

April 2024 Office of Chemical Safety and Pollution Prevention

Draft Risk Evaluation for Asbestos Part 2 – Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos

Systematic Review Supplemental File:

Data Quality Evaluation Information for Environmental Hazard

CASRN: 1332-21-4

This supplemental file contains information regarding the data quality evaluation results relevant to the characterization of environmental hazard for the *Draft Risk Evaluation for Asbestos Part 2: Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos.* For the human health assessment in Asbestos Part 2, EPA focused on epidemiological evidence, therefore studies using human health animal models were considered for the characterization of environmental hazard for terrestrial mammalian wildlife populations.

EPA conducted data quality evaluation based on author-reported descriptions and results; additional analyses (e.g., statistical analyses performed during data integration into the risk evaluation) potentially conducted by EPA are not contained in this supplemental file. EPA used the TSCA systematic review process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* (also referred to as '2021 Draft Systematic Review Protocol'). Any updated steps in the systematic review process since the publication of the 2021 Draft Systematic Review Protocol are described in the *Draft Risk Evaluation for Asbestos Part 2: Supplemental Evaluation Including Legacy Uses and Associated Disposals of Asbestos – Systematic Review Protocol.*

Different data quality evaluation forms were used depending on the organism as described in the PECO statement in Appendix H.5.7 of the 2021 Draft Systematic Review Protocol. Each health outcome was evaluated independently within a given reference, therefore each reference may have more than one overall quality determination (OQD) to more appropriately reflect the quality of each health outcome and the respective hazard endpoints as described by the study authors. Some data evaluation forms have general additional comments presented adjacent to the OQD to add further context. No OQD is determined for each reference as a whole, if it contains data from more than one evidence stream. The table of contents lists references based on chemical, broad habitat (e.g., aquatic, terrestrial), taxa, taxonomic group, exposure duration, and health outcome (e.g., mortality) categories relevant to the endpoint being evaluated.

Table of Contents

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HERO ID	Reference	Page				
Habitat: Aquatic (Habitat: Aquatic (freshwater)					
Taxa: Vertebrates						
Lepomis cyanellus						
3584231	Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and pathological stress. Environmental Research 39(1986):74-85.	7				
Oncorhynchus kisut	ich					
3584231	Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and pathological stress. Environmental Research 39(1986):74-85.	11				
Oryzias latipes						
3585046	Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos exposure. Aquatic Toxicology 17(1990):133-154.	25				
4350438	Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.	33				
3585046	Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos exposure. Aquatic Toxicology 17(1990):133-154.	39				
Pimephales promelo						
4350438	Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.	49				
Poecilia formosa						
3582159	Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment International 9(1983):173-176.	71				
Taxa: Invertebrate	es es					
Corbicula fluminea						
3093856	Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile asbestos. Water Research 20(1986):1243-1250.	81				
Corbicula sp.						

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3093600	Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian Journal of Fisheries and Aquatic Sciences 43(1986):43-52.	93
3584230	Belanger, S. E., Cherry, D. S., Cairns, J., Mcguire, M. J. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies. Journal of the American Water Works Association 79(1987):69-74.	119
Taxa: Plants (Vascu	ılar)	
Lemna gibba		
3080106	Trivedi, A. K., Ahmad, I., Musthapa, M. S., Ansari, F. A., Rahman, Q. (2004). Environmental contamination of chrysotile asbestos and its toxic effects on growth and physiological and biochemical parameters of Lemna gibba. Archives of Environmental Contamination and Toxicology 47(2004):281-289.	121
Habitat: Terrestria	l	
Taxa: Vertebrates		
Cavia porcellus		
1797399	Saxena, K. C., Srivastava, L., Dogra, R. K. (1982). Biochemical and histopathological response to chrysotile ingestion in guinea pigs. Industrial Health 20(1982):19-25.	125
1060372	Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of nickel. Environmental Research 12(1976):139-143.	129
Gallus gallus domest	icus	
3664651	Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.	137
Mesocricetus auratus		
3615254	Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.	152
709665	Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden hamsters. Environmental Health Perspectives 53(1983):11-25.	158
3581049	Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.	176
Mus musculus		
182	Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.	182
758926	Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice. Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.	192

Asbestos	Table of Contents	
182	Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.	200
6867451	Craighead, J. E., Richards, S. A., Calore, J. D., Fan, H., Weaver, D. L. (1993). Genetic factors influence malignant mesothelioma development in mice. European Respiratory Review, vol. 3, review no. 11 nan(1993):118-120.	208
	Rattus norvegicus	
112	Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.	212
3615355	Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.	214
3584909	Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-150.	250
3101157	Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental Contamination and Toxicology 6(1977):507-513.	282
3616802	Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer 45(1980):1073-1084.	288
3619879	Engelbrecht, F. M., Burger, B. F. (1973). Biological effect of asbestos dust on the peritoneal viscera of rats. South African Medical Journal 47(1973):1746-1750.	298
478543	Hasanoglu, H. C., Bayram, E., Hasanoglu, A., Demirag, F. (2008). Orally ingested chrysotile asbestos affects rat lungs and pleura. Archives of Environmental and Occupational Health 63(2008):71-75.	302
3098168	Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.	306
112	Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.	318
709664	Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats. Environmental Health Perspectives 53(1983):27-44.	320
3613439	NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology Program Technical Report Series 280(1988):1-178.	330
758884	NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology Program Technical Report Series 295(1985):1-390.	336
758961	NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).	352
759022	Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 nan(1989):127-133.	360

Asbestos	Table of Contents	
3612470	Will, L. A., Leininger, J. R., Donham, K. J. (1979). Regurgitation and choke in rats. Laboratory Animal Science 29(1979):360-363.	366
Taxa: Invertebrates		
Lumbriculus rubellus		
3583167	Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.	370

HERO ID: 3584231 Table: 1 of 2

Study Citation:	Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and
	nathological stress. Environmental Research 39(1986):74-85

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Lepomis cyanellus; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Desig	on .			
Bomain 2. Test Besig	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 25%
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure	Characterization			
Domain 3. Exposure	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	tion Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	high concentration exposed for a shorter duration, a long duration to not feed the fish
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were adequate to address
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	the purpose of the study
	Metric 12:	resting at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Orga	nism			
	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations about the original source (holding pond)of the test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	replicates were not reported
Domain 5: Outcome			_	
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
		Contin	ued on next pa	nge

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 1 of 2

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Lepomis cyanellus*; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	mortalities were checked twice a day
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Prese	entation and Anal	lysis		
	Metric 21:	Statistical Methods	Low	It was not clear if statistical analysis was performed but raw data was reported
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 2 of 2

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Pauli:

Taxa, Species, Age: Vertebrate; Fish; *Lepomis cyanellus*; Juvenile

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 25%
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Cl	haracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	high concentration exposed for a shorter duration, a long duration to not feed the fish
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were adequate to address
		Spacing of Exposure Levels		the purpose of the study
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organis	sm			
Ç	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations about the original source (holding pond)of the test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	mortalities were checked twice a day
		Cont	tinued on next page	2

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 2 of 2

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Lepomis cyanellus*; Juvenile

Health Outcome:

Behavioral

Chemical: chrysotile

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not shown for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Low	incomplete reporting so unexpected outcomes were not addressed

Overall Quality Determination

Additional Comments: results were not quantified (page 10)

Uninformative

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 1 of 7

Study Citation:	Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Oncorhynchus kisutch; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments	
Domain 1: Test Substan	ice				
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only	
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.	
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.	
Domain 2: Test Design					
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group	
	Metric 5:	Negative Control Response	Low	High control mortality of 13%	
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.	
Domain 3: Exposure Ch	naracterization				
2 cmam 2. 2mpccare cr	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)	
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation	
	Metric 9:	Measurement of Test Substance	Low	measurements were not reported	
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (86 days) to not feed the fish	
	Metric 11:	Number of Exposure Groups/	N/A	only one concentration tested	
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble	
Domain 4: Test Organis	m				
C	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.	
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,	
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported	
		Replicates per Group			
Domain 5: Outcome As	sessment				
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate	
	Metric 17:	Outcome Assessment Methodology	High	mortalities were checked twice a day	
	Continued on next page				

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 1 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	statistical analysis was not reported but raw data was available
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 2 of 7

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Juvenile

Health Outcome: H

Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5) **HERO ID:** 3584231

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design	n			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 13%, behavioral response was not clearly described
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure (Characterization			
Domain of Emposure	Metric 7:	Experimental System/Test Media	Medium	The study provided only limited details on the measures taken to appropriately prepare
		Preparation		test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	tion Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (40 days) to not feed the fish
	Metric 11:	Number of Exposure Groups/	N/A	only one concentration tested
	Wieure II.	Spacing of Exposure Levels	1771	only one concentration assets
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organ	ism			
Domain 1. Test Organ	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported
		Replicates per Group		
Domain 5: Outcome A	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was not clearly reported
	Metric 18:	Consistency of Outcome Assessment	Medium	outcomes were assessed consistently across study groups but few details were provided

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 2 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Juvenile

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
Bomain o. Comounc	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
	Metric 20:	Design and Procedures Outcomes Unrelated to Exposure	Medium	conditions there were no differences among groups but few details were provided
Domain 7: Data Pres	centation and Anal	veic		
Domain 7. Data Fies	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted
		~		Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	Low	incomplete reporting of results
	Metric 23:	Explanation of Unexpected Outcomes	Medium	no unexpected outcomes were reported

Additional Comments: None

Overall Quality Determination

Uninformative

Environmental Hazard Evaluation HERO ID: 3584231 Table: 3 of 7 Asbestos

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Juvenile

Health Outcome: Mechanistic-Cancer/Carcinogenesis-Developmental and juvenile toxicology

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
2, 168, 2, 68, 81	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 13%, assessed response was not thoroughly reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	naracterization			
Domain J. Exposure Ci	Metric 7:	Experimental System/Test Media	Medium	The study provided only limited details on the measures taken to appropriately prepare
	monito /.	Preparation	Micaidill	test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
		tion	C	7 70 1
	Metric 9:	Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (40 days) to not feed the fish
	Metric 11:	Number of Exposure Groups/	N/A	only one concentration tested
	wiettie 11.	Spacing of Exposure Levels	14/11	only one concentration tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
		, , , , , , , , , , , , , , , , , , ,		
Domain 4: Test Organis	sm			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported
		Replicates per Group		
Domain 5: Outcome As	sessment			
Domain 5. Outcome As	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	not all fish were examined
	Metric 18:	Consistency of Outcome	Medium	unclear if outcomes were assessed consistently across study groups
		Assessment		
	Wictie 16.	Assessment	nued on nex	

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 3 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Juvenile

Health Outcome: Mechanistic-Cancer/Carcinogenesis-Developmental and juvenile toxicology

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

	U	Comments
able Control		
ic 19: Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental conditions
\mathcal{E}	Low	there were no differences among groups but few details were provided
nd Analysis		
ic 21: Statistical Methods	N/A	study focused on pathology findings
ic 22: Reporting of Data	Low	Data were only reported for some outcomes
ic 23: Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability
ni ni ni	Design and Procedures Outcomes Unrelated to Exposure and Analysis ric 21: Statistical Methods ric 22: Reporting of Data	ric 19: Confounding Variables in Test Low Design and Procedures ric 20: Outcomes Unrelated to Exposure Low and Analysis ric 21: Statistical Methods N/A ric 22: Reporting of Data Low

Additional Comments: None

Overall Quality Determination

Low

Environmental Hazard Evaluation HERO ID: 3584231 Table: 4 of 7 Asbestos

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Embryo

Health Outcome: Mechanistic-Cancer/Carcinogenesis-Developmental and juvenile toxicology

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

etric 1: etric 2: etric 3: etric 4: etric 5: etric 6: erization etric 7:	Test Substance Identity Test Substance Source Test Substance Purity Negative Controls Negative Control Response Randomized Allocation Experimental System/Test Media Preparation	Low Low High Low Low	Chemical was identified by name only It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text. Purity and/or grade of test substance were not reported. Study authors reported using an appropriate concurrent negative control group High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups. The study provided only limited details on the measures taken to appropriately prepare
etric 2: etric 3: etric 4: etric 5: etric 6: erization etric 7:	Test Substance Source Test Substance Purity Negative Controls Negative Control Response Randomized Allocation Experimental System/Test Media	Low High Low Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text. Purity and/or grade of test substance were not reported. Study authors reported using an appropriate concurrent negative control group High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 3: etric 4: etric 5: etric 6: erization etric 7:	Test Substance Purity Negative Controls Negative Control Response Randomized Allocation Experimental System/Test Media	Low High Low Low	ratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text. Purity and/or grade of test substance were not reported. Study authors reported using an appropriate concurrent negative control group High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 4: etric 5: etric 6: erization etric 7:	Negative Controls Negative Control Response Randomized Allocation Experimental System/Test Media	High Low Low	Study authors reported using an appropriate concurrent negative control group High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 5: etric 6: erization etric 7:	Negative Control Response Randomized Allocation Experimental System/Test Media	Low Low	High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 5: etric 6: erization etric 7:	Negative Control Response Randomized Allocation Experimental System/Test Media	Low Low	High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 6: erization etric 7:	Negative Control Response Randomized Allocation Experimental System/Test Media	Low Low	High control mortality of 19%, assessed response was not clearly reported Researchers did not report how organisms were allocated to study groups.
etric 6: erization etric 7:	Randomized Allocation Experimental System/Test Media	Low	Researchers did not report how organisms were allocated to study groups.
etric 7:		Medium	The study provided only limited details on the measures taken to appropriately propers
etric 7:		Medium	The study provided only limited details on the measures taken to appropriately propers
		1710010111	
	FICUALATION		test concentrations (used sonification)
etric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	tion	8	1
etric 9:	Measurement of Test Substance	Low	measurements were not reported
etric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (86 days) to not feed the fish
			only one concentration tested
uic ii.		IVA	only one concentration tested
etric 12:		N/A	asbestos is considered insoluble
		- "	
etric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
etric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
etric 15:	Conditions Number of Organisms and	Low	replicates were not reported
	Replicates per Group		
nent			
etric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
etric 17:			not all fish were examined
etric 18:			unclear if outcomes were assessed consistently across study groups
	Assessment		
et e	ric 13: ric 14: ric 15: ent ric 16: ric 17:	ric 10: Exposure Duration and Frequency ric 11: Number of Exposure Groups/ Spacing of Exposure Levels ric 12: Testing at or Below Solubility Limit ric 13: Test Organism Characteristics ric 14: Acclimatization and Pretreatment Conditions ric 15: Number of Organisms and Replicates per Group ent ric 16: Adequacy of Test Conditions ric 17: Outcome Assessment Methodology ric 18: Consistency of Outcome Assessment	ric 10: Exposure Duration and Frequency ric 11: Number of Exposure Groups/ Spacing of Exposure Levels ric 12: Testing at or Below Solubility Limit N/A ric 13: Test Organism Characteristics ric 14: Acclimatization and Pretreatment Conditions ric 15: Number of Organisms and Replicates per Group ent ric 16: Adequacy of Test Conditions ric 17: Outcome Assessment Methodology ric 18: Consistency of Outcome Medium

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 4 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Exposure Route,

Additional Comments:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Embryo

Health Outcome: Mechanistic-Cancer/Carcinogenesis-Developmental and juvenile toxicology

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Low	there were no differences among groups but few details were provided
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	study focused on pathology findings
	Metric 22:	Reporting of Data	Low	Data were only reported for some outcomes
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability

Overall Quality Determination

None

Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 5 of 7

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Oncorhynchus kisutch; Embryo

Health Outcome:

Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	e			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 19%
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	aracterization			
2 cmain 2, 2pccare cm	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	tion Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (86 days) to not feed the fish
	Metric 11:	Number of Exposure Groups/	N/A	only one concentration tested
		Spacing of Exposure Levels		•
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organism	n			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported
		Replicates per Group		
Domain 5: Outcome Ass	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	mortalities were checked twice a day
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 5 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
Domain 6: Confoundi	ng / Variable Co	ntrol		
Domain o. Comouna	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	statistical analysis was not reported but raw data was available
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

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Asbestos **Environmental Hazard Evaluation** HERO ID: 3584231 Table: 6 of 7

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days **Exposure Route,**

Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 19%
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	naracterization			
Bonian 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	tion Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (86 days) to not feed the fish
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	only one concentration tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organis	m			
Domain II Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	replicates were not reported
		Treprientes per Group		
Domain 5: Outcome As				
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	response to TMS treatment
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups
		Contin	ued on next pa	age

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Asbestos Environmental Hazard Evaluation HERO ID: 3584231 Table: 6 of 7

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Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oncorhynchus kisutch*; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
_	Metric 20:	Outcomes Unrelated to Exposure	Low	there were no differences among groups but few details were provided
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	statistical analysis was reported but not described adequately
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

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Environmental Hazard Evaluation HERO ID: 3584231 Table: 7 of 7 Asbestos

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Embryo

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substanc	e			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	It was unclear if the test substance identity analytically verified by the performing laboratory. See Stewart and Schurr (1980) for confirmation, otherwise this assessment was based on information provided in the text.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	High control mortality of 19% but behavioral response was suitable
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	racterization			
2 omain of Emposare one	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided only limited details on the measures taken to appropriately prepare test concentrations (used sonification)
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups in a static situation
	Metric 9:	tion Measurement of Test Substance	Low	measurements were not reported
	Metric 10:	Concentration Exposure Duration and Frequency	Low	a long duration (86 days) to not feed the fish
	Metric 11:	Number of Exposure Groups/	N/A	only one concentration tested
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
	Metric 12.	resting at of Below Soldonity Limit	IV/A	aspestos is considered insoluble
Domain 4: Test Organisn	1			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms,
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not reported
		Replicates per Group		
Domain 5: Outcome Ass	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	response to TMS treatment
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

Environmental Hazard Evaluation HERO ID: 3584231 Table: 7 of 7 Asbestos

... continued from previous page

Study Citation: Belanger, S. E., Schurr, K., Allen, D. J., Gohara, A. F. (1986). Effects of chrysotile asbestos on coho salmon and green sunfish: evidence of behavioral and

pathological stress. Environmental Research 39(1986):74-85.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oncorhynchus kisutch; Embryo

Health Outcome:

Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584231

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups but few details were provided
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	statistical analysis was reported but not described adequately
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 3585046 Table: 1 of 4 Asbestos

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Duration:**

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route) **Exposure Route,**

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory, p 139
	Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Domain 2: Test Desig	n			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported and was suitable
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure (Characterization			
•	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra- tion	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured or reported
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were suitable
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organ	nism			
· ·	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
	Metric 15:	Number of Organisms and Replicates per Group	Low	Only 10 organisms with no replicates used
Domain 5: Outcome A	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	ge

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Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 1 of 4

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	mortalities were checked daily
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	sentation and Anal	veic		
Domain 7. Data 110.	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 21:			1 7
		Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 2 of 4

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Vertebrate; Fish; Oryzias latipes; Embryo Taxa, Species, Age:

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Metric 3: Test Substance Purity Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared be milling the fibers through a Fisher Ultrasonic Cleaner. Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Medium The biological response of the negative control groups was reported and was suitable Metric 6: Randomized Allocation Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Medium Some details of exposure administration were reported, exposures were administered consistently across study groups Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported Concentration Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour	HERO ID:	3383040			
Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Source Metric 3: Test Substance Purity Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared be milling the fibers through a Fisher Ultrasonic Cleaner. Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Duration and Frequency Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 13: Test Organism Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Conditions Medium Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated	Domain		Metric	Rating	Comments
Metric 2: Test Substance Source Metric 3: Test Substance Purity Medium Metric 3: Test Substance Purity Medium Medium Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Metric 12: Testing at or Below Solubility Limit Metric 12: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Medium Metric 13: Test Organism Characteristics Medium	Domain 1: Test Substan	ce			
Metric 3: Test Substance Purity Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared be milling the fibers through a Fisher Ultrasonic Cleaner. Domain 2: Test Design Metric 4: Negative Controls High Medium The biological response of the negative control groups was reported and was suitable Metric 6: Randomized Allocation Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Exposure administration were reported, exposures were administered consistently across study groups Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type Metric 11: Number of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics High Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
Domain 2: Test Design Metric 4: Negative Controls High Study authors reported using an appropriate concurrent negative control group Metric 5: Negative Control Response Medium The biological response of the negative control groups was reported and was suitable Metric 6: Randomized Allocation Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Medium The study provided limited details on the measures taken to appropriately prepare tes concentrations Metric 8: Consistency of Exposure Administra- tion Some details of exposure administration were reported, exposures were administered consistently across study groups Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported Concentration Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type Metric 11: Number of Exposure Groups/ High The number of exposure groups and spacing of exposure levels were suitable Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory. p.139
Metric 4: Negative Controls Metric 5: Negative Control Response Medium The biological response of the negative control group was reported and was suitable Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported consistently across study groups Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ High The duration of exposure groups and spacing of exposure levels were suitable Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Metric 4: Negative Controls Metric 5: Negative Control Response Medium The biological response of the negative control group was reported and was suitable Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported consistently across study groups Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ High The duration of exposure groups and spacing of exposure levels were suitable Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated	Domain 2: Test Design				
Metric 5: Negative Control Response Medium Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported and was suitable for the study groups Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type Metric 11: Number of Exposure Levels Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Conditions Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Medium The study provided limited details on the measures taken to appropriately prepare tes concentrations Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported Concentration Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type Metric 11: Number of Exposure Groups/ High The number of exposure groups and spacing of exposure levels were suitable Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 5:	Negative Control Response	_	The biological response of the negative control groups was reported and was suitable
Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Medium Medium Some details of exposure administration were reported, exposures were administered consistently across study groups Low Exposure concentrations were not measured or reported Exposure was reported and suitable for the study type High The number of exposure groups and spacing of exposure levels were suitable N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Medium Medium Some details of exposure administration were reported, exposures were administered consistently across study groups Low Exposure concentrations were not measured or reported Exposure was reported and suitable for the study type High The number of exposure groups and spacing of exposure levels were suitable N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated	Domain 3: Exposure Ch	naracterization			
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Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Conditions Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Concentration Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type High The number of exposure groups and spacing of exposure levels were suitable Spacing of Exposure Levels N/A Asbestos is considered insoluble Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 8:	Consistency of Exposure Administra-	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 14: Number of exposure groups and spacing of exposure levels were suitable N/A Asbestos is considered insoluble The test organisms were adequately described and were obtained from a reliable sour all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 9:		Low	Exposure concentrations were not measured or reported
Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 14: Acclimatization and Pretreatment Conditions Spacing of Exposure Levels N/A Asbestos is considered insoluble High The test organisms were adequately described and were obtained from a reliable sour all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 10:		High	The duration of exposure was reported and suitable for the study type
Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble Domain 4: Test Organism Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated		Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were suitable
Domain 4: Test Organism Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated					
Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a reliable sour Medium Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms although not explicitly stated		Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organisms althoug not explicitly stated	Domain 4: Test Organis	m			
Conditions not explicitly stated		Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Metric 15: Number of Organisms and Low Only 10 organisms with no replicates used		Metric 14:		Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
Replicates per Group		Metric 15:		Low	Only 10 organisms with no replicates used
Domain 5: Outcome Assessment	Domain 5: Outcome As	sessment			
Metric 16: Adequacy of Test Conditions Low Environmental conditions were not sufficiently reported to evaluate if adequate		Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
Metric 17: Outcome Assessment Methodology High The outcome assessment methodology reported the intended outcome of interest		Metric 17:		High	The outcome assessment methodology reported the intended outcome of interest
Metric 18: Consistency of Outcome High mortalities were checked daily Assessment		Metric 18:	Consistency of Outcome	_	
Continued on next page				ued on next no	nge

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 2 of 4

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 3 of 4

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Medium Grammi Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Domain 3: Exposure Characterization	Comments hemical was identified by name only he test substance identity was analytically verified by the performing laboratory, p 179 rade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by tilling the fibers through a Fisher Ultrasonic Cleaner. tudy authors reported using an appropriate concurrent negative control group he biological response of the negative control groups was reported and was suitable esearchers did not report how organisms were allocated to study groups
Metric 2: Test Substance Source High The Metric 3: Test Substance Purity Medium Grand Medium 2: Test Design Metric 4: Negative Controls High Structure Metric 5: Negative Control Response Medium The Metric 6: Randomized Allocation Low Responsion 3: Exposure Characterization	tudy authors reported using an appropriate concurrent negative control group the test substance identity was analytically verified by the performing laboratory, p 179 trade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by tilling the fibers through a Fisher Ultrasonic Cleaner. tudy authors reported using an appropriate concurrent negative control group the biological response of the negative control groups was reported and was suitable
Metric 2: Test Substance Source High The Metric 3: Test Substance Purity Medium Grand Medium 2: Test Design Metric 4: Negative Controls High Structure Structure Metric 5: Negative Control Response Medium The Metric 6: Randomized Allocation Low Responsion 3: Exposure Characterization	tudy authors reported using an appropriate concurrent negative control group the test substance identity was analytically verified by the performing laboratory, p 179 irade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by iilling the fibers through a Fisher Ultrasonic Cleaner. tudy authors reported using an appropriate concurrent negative control group the biological response of the negative control groups was reported and was suitable
Metric 3: Test Substance Purity Medium Grand Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Medium Transport Metric 6: Randomized Allocation Domain 3: Exposure Characterization	tudy authors reported using an appropriate concurrent negative control group he biological response of the negative control groups was reported and was suitable
Domain 2: Test Design Metric 4: Negative Controls High Str Metric 5: Negative Control Response Medium Th Metric 6: Randomized Allocation Low Re	tudy authors reported using an appropriate concurrent negative control group he biological response of the negative control groups was reported and was suitable
Metric 4: Negative Controls High Str. Metric 5: Negative Control Response Medium Th. Metric 6: Randomized Allocation Low Re- Domain 3: Exposure Characterization	he biological response of the negative control groups was reported and was suitable
Metric 4: Negative Controls High Str. Metric 5: Negative Control Response Medium Th. Metric 6: Randomized Allocation Low Re- Domain 3: Exposure Characterization	he biological response of the negative control groups was reported and was suitable
Metric 5: Negative Control Response Medium The Metric 6: Randomized Allocation Low Response Notes and Service Characterization	
Metric 6: Randomized Allocation Low Re- Domain 3: Exposure Characterization	
	he study provided limited details on the measures taken to appropriately prepare test oncentrations
Metric 8: Consistency of Exposure Administra- Medium So	ome details of exposure administration were reported, exposures were administered onsistently across study groups
Metric 9: Measurement of Test Substance Low Ex	xposure concentrations were not measured or reported
	he duration of exposure was reported and suitable for the study type
1 1	he number of exposure groups and spacing of exposure levels were suitable
Spacing of Exposure Levels	
Metric 12: Testing at or Below Solubility Limit N/A As	sbestos is considered insoluble
Domain 4: Test Organism	
Metric 13: Test Organism Characteristics High Th	he test organisms were adequately described and were obtained from a reliable source
	Il pretreatment conditions were the same for control and exposed organisms although of explicitly stated
Metric 15: Number of Organisms and Low 10 Replicates per Group	0 organisms per treatment group
Domain 5: Outcome Assessment	
Metric 16: Adequacy of Test Conditions Low Er	nvironmental conditions were not sufficiently reported to evaluate if adequate
	he outcome assessment methodology reported the intended outcome of interest
Continued on next page	ortalities were checked daily

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 3 of 4

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome:

Mortality

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 4 of 4

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Metric 1: Test Substance Identity Metric 2: Test Substance Source High Metric 3: Test Substance Purity Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and milling the fibers through a Fisher Ultrasonic Cleaner. Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 8: Consistency of Exposure Administration Medium Some details of exposure administration were reported, exposures were acconsistently across study groups	
Metric 2: Test Substance Source Metric 3: Test Substance Purity Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and milling the fibers through a Fisher Ultrasonic Cleaner. Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 8: Consistency of Exposure Administration Medium Medium The test substance identity was analytically verified by the performing lab Medium Grade-5 chrysotile asbestos was obtained from a commercial supplier and milling the fibers through a Fisher Ultrasonic Cleaner. High Study authors reported using an appropriate concurrent negative control groups was reported and variety and the measure of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported and variety of the negative control groups was reported using an appropriate oncurrent negative control groups was reported using an appropriate oncurrent negative control groups was reported using an appropriate oncurrent negative control groups was reported using an appropriate oncurrent negative control groups and propriate oncurrent negative control groups and propriate oncurrent negative control groups and propriate oncurrent negative control groups are propriated was reported using an appropriate oncurrent negative control groups are propriated was reported on the negative control groups are propriated was reported and variety of t	
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Domain 2: Test Design Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 8: Consistency of Exposure Administration Metric 8: Medium Medium The biological response of the negative control groups was reported and was reporte	oratory, p 13
Metric 4: Negative Controls High Study authors reported using an appropriate concurrent negative control groups was reported and we metric 5: Negative Control Response Medium The biological response of the negative control groups was reported and we metric 6: Randomized Allocation Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Medium The study provided limited details on the measures taken to appropriately concentrations Medium Some details of exposure administration were reported, exposures were acconsistently across study groups	prepared by
Metric 4: Negative Controls High Study authors reported using an appropriate concurrent negative control groups was reported and we metric 5: Negative Control Response Medium The biological response of the negative control groups was reported and we metric 6: Randomized Allocation Low Researchers did not report how organisms were allocated to study groups Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Medium The study provided limited details on the measures taken to appropriately concentrations Medium Some details of exposure administration were reported, exposures were acconsistently across study groups	
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Metric 8: Consistency of Exposure Administra- Medium Some details of exposure administration were reported, exposures were acconsistently across study groups	prepare test
Africa Africa (m. co.)	lministered
Metric 9: Measurement of Test Substance Low Exposure concentrations were not measured or reported Concentration	
Metric 10: Exposure Duration and Frequency High The duration of exposure was reported and suitable for the study type	
Metric 11: Number of Exposure Groups/ High The number of exposure groups and spacing of exposure levels were suita	ıble
Spacing of Exposure Levels	
Metric 12: Testing at or Below Solubility Limit N/A Asbestos is considered insoluble	
Domain 4: Test Organism	
Metric 13: Test Organism Characteristics High The test organisms were adequately described and were obtained from a r	eliable source
Metric 14: Acclimatization and Pretreatment Medium all pretreatment conditions were the same for control and exposed organis not explicitly stated	ms although
Metric 15: Number of Organisms and Low Only 10 organisms with no replicates used Replicates per Group	
Domain 5: Outcome Assessment	
Metric 16: Adequacy of Test Conditions Low Environmental conditions were not sufficiently reported to evaluate if ade	quate
Metric 17: Outcome Assessment Methodology High The outcome assessment methodology reported the intended outcome of i	-
Metric 18: Consistency of Outcome High mortalities were checked daily Assessment	
Continued on next page	

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 4 of 4

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Larvae

Health Outcome: Mechanistic-Liver toxicology

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain	Metric	Rating	Comments
Domain 1: Test Substance			
Metric	1: Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric	2: Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
Metric	3: Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design			
Metric	4: Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric	5: Negative Control Response	Low	The biological response of the negative control group was reported and reasonable
Metric	6: Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Characteriza	ution		
Metric		High	The experimental system and methods for preparation of test media were described in adequate detail
Metric	1	- High	exposures were administered consistently across study groups
Metric		Medium	Exposure concentrations were not measured but stock preps were analyzed
Metric	Concentration 10: Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
Metric	11: Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
Metric	1 0 1	N/A	Asbestos is considered insoluble
Domain 4: Test Organism			
Metric	13: Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
Metric	_	High	The F0 generation were acclimatized to lab conditions
Metric	Conditions	Low	number of replicates were unclear, used 15 organisms per treatment
	Replicates per Group		1 F
Domain 5: Outcome Assessment			
Metric	16: Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 1 of 3

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Larvae

Health Outcome: Mechanistic-Liver toxicology

Chamical: Appropriate (correction) (CASPN 12001 20

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presen	itation and Anal	veie		
Domain 7. Data 1 resen	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 21:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected

Overall Quality Determination

Additional Comments: None

High

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 2 of 3

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Larvae

Health Outcome: Mechanistic-Kidney/renal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	Metric	Rating	Comments
ce			
Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:			The biological response of the negative control group was reported and reasonable
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
	Spacing of Exposure Levels		response by study author
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
m			
Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
Metric 14:	Acclimatization and Pretreatment	High	The F0 generation were acclimatized to lab conditions
Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	number of replicates were unclear, used 15 organisms per treatment
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
	Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 13: Metric 14: Metric 15: sessment Metric 16: Metric 17:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group sessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity Low Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response Low Metric 6: Randomized Allocation Low Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ High Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Metric 14: Acclimatization and Pretreatment High Conditions Metric 15: Number of Organisms and Low Replicates per Group Metric 16: Adequacy of Test Conditions High Metric 16: Adequacy of Test Conditions High Metric 17: Outcome Assessment Methodology High

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 2 of 3

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Larvae

Health Outcome: Mechanistic-Kidney/renal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
Damain & Canfayadina	. / Variabla Car	atual		
Domain 6: Confounding	,		TT' 1	
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Present	ation and Anal	veic		
Domain 7. Data Fresent		-	TT' 1	0.221.41.41.41.41
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected
Additional Comments:	None			

Overall Quality Determination

High

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 3

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Larvae

Health Outcome: Mechanistic-Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	Metric	Rating	Comments
ce			
Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:			The biological response of the negative control group was reported and reasonable
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
	Spacing of Exposure Levels		response by study author
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
m			
Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
Metric 14:	Acclimatization and Pretreatment	High	The F0 generation were acclimatized to lab conditions
Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	number of replicates were unclear, used 15 organisms per treatment
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
	Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 13: Metric 14: Metric 15: sessment Metric 16: Metric 17:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group sessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity Low Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response Low Metric 6: Randomized Allocation Low Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ High Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Metric 14: Acclimatization and Pretreatment High Conditions Metric 15: Number of Organisms and Low Replicates per Group Metric 16: Adequacy of Test Conditions High Metric 16: Adequacy of Test Conditions High Metric 17: Outcome Assessment Methodology High

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 3

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Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Oryzias latipes; Larvae

Health Outcome: Mechanistic-Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
Domain 6: Confounding	/ Variable Cor	atral		
Domain 6: Confounding			TT: 1	TTI 1100 d d d d d d d d d d d d d d d d d
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	N (' ' ' ')	O-4	TT' 1	41 11.00
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
D : 5 D : D		1	High	there were no differences among groups
Domain 7: Data Presenta		1	Hign	there were no differences among groups
Domain 7: Data Presenta		1	High	Statistical methods were adequately described
Domain 7: Data Presenta	tion and Anal	ysis		

Additional Comments: intestinal goblet cells

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 1 of 5

Study Citation:	Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Larvae

Health Outcome: ADME (biotransformation)

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported and was suitable
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Cha	aracterization			
r	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were measured, methods used were not clear
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were suitable
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organism	n			
Domain 1. Test Organisi	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
	Metric 15:	Number of Organisms and Replicates per Group	Medium	15 organisms with three replicates used
Domain 5: Outcome Ass	essment			
2 cmain 3. Outcome 1155	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 1 of 5

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Larvae

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	mortalities were checked daily
		Assessment		
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	this part of the study focused on pathology findings, body burden was reported but not analyzed
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 2 of 5

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Larvae

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	Metric	Rating	Comments
e			
Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory.
Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported and was suitable
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
racterization			
Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations
Metric 8:	Consistency of Exposure Administration	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were measured, methods used were not clear
Metric 10:		High	The duration of exposure was reported and suitable for the study type
			The number of exposure groups and spacing of exposure levels were suitable
1.100.10		111811	The number of enposate groups and spacing of enposate to tell write suitable
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
า			
	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Metric 14:	Acclimatization and Pretreatment	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
Metric 15:	Number of Organisms and	Medium	15 organisms with three replicates used
	A.I. CT. (C. IV)	TT' 1	
	1 2		Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric 17:	Consistency of Outcome	High	
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Metric 6: Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group essment Metric 16: Adequacy of Test Conditions	Metric 1: Test Substance Identity Low Metric 2: Test Substance Source High Medium Metric 3: Test Substance Purity Medium Metric 4: Negative Controls Medium Medium Metric 5: Negative Control Response Medium Low Metric 6: Randomized Allocation Low Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ High Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Medium Conditions Metric 15: Number of Organisms and Medium Replicates per Group Metric 16: Adequacy of Test Conditions High

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Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 2 of 5

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Larvae

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain	Metric	Rating	Comments
Domain 6: Confounding / Varia	ble Control		
Metri		High	There were no reported differences among the study groups in environmental conditions
Wietr		High	There were no reported differences among the study groups in environmental conditions
Metri	Design and Procedures c 20: Outcomes Unrelated to Exposure	Hich	4
Metri	c 20: Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentation ar	d Analysis		
Metri	•	High	Statistical methods were adequately described
Metri	c 22: Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
Metri	c 23: Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 3 of 5

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID.	33030 1 0			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported , survival was some what low
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured or reported
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	Medium	Only two exposure groups were used
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
	Metric 15:	Number of Organisms and Replicates per Group	Medium	15 organisms with four replicates used in breeding tanks
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	mortalities were checked daily

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Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 3 of 5

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
	Metric 20:	Design and Procedures Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	entation and Anal	Vicio		
Domain 7. Data 11cs	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 4 of 5

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Juvenile

Health Outcome: Reproductive/Teratogenic

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERO ID.	33030 1 0			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported , survival was some what low
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured or reported
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	Medium	Only two exposure groups were used
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
	Metric 15:	Number of Organisms and Replicates per Group	Medium	15 organisms with four replicates used in breeding tanks
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	mortalities were checked daily

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Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 4 of 5

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Juvenile

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confoundi	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Prese		ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: F1 effects

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 3585046 Table: 5 of 5

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Oryzias latipes; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

3383040			
	Metric	Rating	Comments
ee			
Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory.
Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier and prepared by milling the fibers through a Fisher Ultrasonic Cleaner.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	Medium	The biological response of the negative control groups was reported , survival was some what low
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations
Metric 8:	Consistency of Exposure Administra-	Medium	Some details of exposure administration were reported, exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured or reported
Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
Metric 11:		Medium	Only two exposure groups were used
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
n			
	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Metric 14:	Acclimatization and Pretreatment	Medium	all pretreatment conditions were the same for control and exposed organisms although not explicitly stated
Metric 15:	Number of Organisms and Replicates per Group	Medium	15 organisms with four replicates used in breeding tanks
sessment			
Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric 18:	Consistency of Outcome Assessment	High	mortalities were checked daily
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Metric 12: Metric 13: Metric 14: Metric 15: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Low Metric 2: Test Substance Source High Metric 3: Test Substance Purity Medium Metric 4: Negative Controls High Metric 5: Negative Control Response Medium Metric 6: Randomized Allocation Low Aracterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ Medium Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Medium Conditions Metric 15: Number of Organisms and Replicates per Group Metric 15: Adequacy of Test Conditions Low Metric 16: Adequacy of Test Conditions Low Metric 17: Outcome Assessment Methodology High

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3585046 Table: 5 of 5

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J. (1990). Functional and pathological impairment of japanese medaka (Oryzias latipes) by long-term asbestos

exposure. Aquatic Toxicology 17(1990):133-154.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Oryzias latipes*; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3585046

Domain		Metric	Rating	Comments
Domain 6: Confoundin	g / Variable Coi	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	3.6		TT' 1	.1 1:00
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Damain 7: Data Brasan		1	High	there were no differences among groups
Domain 7: Data Presen	tation and Anal	ysis		
Domain 7: Data Presen	tation and Anal Metric 21:	ysis Statistical Methods	High	Statistical methods were adequately described
Domain 7: Data Presen	tation and Anal	ysis		

Overall Quality Determination

Environmental Hazard Evaluation

HERO ID: 4350438 Table: 1 of 4

Study Citation:	Belanger, S. E. (1985).	Functional and	pathological responses	of selected aquation	c organisms to	chrysotile asbestos.
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Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

ADME (biotransformation) **Health Outcome:**

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported, other than mention that there was no acute effects
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	.a.a.atamizatian			
Domain 5. Exposure Ci	Metric 7:	Experimental System/Test Media	High	The experimental system and methods for preparation of test media were described in
	Metric 7.	Preparation	High	adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
		tion	_	. 1
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
		Spacing of Exposure Levels		response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
Domain 1. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	acclimatized to lab conditions was not reported
	Metric 15:	Conditions Number of Organisms and	Low	two replicates and 10 organisms per replicate
	Wiedle 13.	Replicates per Group	Eon.	two replicates and to organisms per replicate
D 5. Ot A				
Domain 5: Outcome As		A degree of Test Conditions	High	
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
		Contin	ued on next pa	ege

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 1 of 4

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Prese	entation and Anal	vsis		
Domain 7. Data 11000	Metric 21:	Statistical Methods	Low	Statistical analysis are not typically used
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were not presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were not satisfactorily explained

Additional Comments: accumulation

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 2 of 4

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	4350438			
Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported, other than mention that there was no acute effects
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Cl	haracterization			
Domain 3. Exposure Of	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	em			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	acclimatized to lab conditions was not reported
	Metric 15:	Conditions Number of Organisms and	Low	two replicates and 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 2 of 4

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path: Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preser	atation and Anal	lyeie		
Domain 7. Data Fleser		5	-	
	Metric 21:	Statistical Methods	Low	Statistical analysis reported, +/- SE
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not presented for each treatment and control group, results only reported as no acute effects, page 134
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability

Additional Comments: Mortality

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 4

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route) **Media, Path:**

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	4550458			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Ü	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported, other than mention that there was no acute effects
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	naracterization			
Domain 3. Exposure of	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	em.			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	acclimatized to lab conditions was not reported
	Metric 15:	Conditions Number of Organisms and	Low	two replicates and 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	nge

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 4

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration:

Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Pimephales promelas; Juvenile

Health Outcome:

Mortality

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundir	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preser	ntation and Anal	veic		
Domain 7. Data Fresci	Metric 21:	Statistical Methods	Low	Statistical analysis consisted of mean +/- SE
		Statistical Methods	LOW	Statistical analysis consisted of mean +/- SE
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not presented for each treatment and control group, results only reported as no acute effects, page 134
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability

Additional Comments: Mortality

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 4 of 4

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route) **Media, Path:**

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	4350438			
Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported, other than mention that there was no acute effects
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Cl	haracterization			
Domain 3. Exposure Of	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	em			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	acclimatized to lab conditions was not reported
	Metric 15:	Conditions Number of Organisms and	Low	two replicates and 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 4 of 4

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Present	tation and Anal	vsis		
	Metric 21:	Statistical Methods	Low	Statistical analysis are not typically used
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were not presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	no accumulation was reported

Additional Comments: accumulation

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 1 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:
Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	4350438			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported, high control mortality noted
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	paracterization			
Boniani 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
20am 1. 100t Organio	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Metric 15:	Conditions Number of Organisms and	Low	two replicates with 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
			High	The outcome assessment methodology reported the intended outcome of interest

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 1 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundi	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Prese	ntation and Anal	veis		
Domain 7. Data 11ese	Metric 21:	Statistical Methods	N/A	Statistical analysis typically not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in the growth table
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 4350438 Table: 2 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Behavioral

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERO ID:	4350438			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported, high control mortality noted
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Evenouse Ch	orooterization			
Domain 3: Exposure Ch	Metric 7:	Experimental System/Test Media	High	The experimental system and methods for preparation of test media were described in
	wictiic /.	Preparation	High	adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	M	tion	- ·	
	Metric 9:	Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
		Spacing of Exposure Levels	37/1	response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
C	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Metric 15:	Conditions Number of Organisms and	Low	two replicates with 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 2 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Adult

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presen	itation and Anal	vsis		
Bollain 7. Bata Fresch	Metric 21:	Statistical Methods	High	Statistical analysis was conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in the growth table
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected

Additional Comments: swimming performance

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	4330436			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported,
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
		Spacing of Exposure Levels		response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	two replicates with 10 organisms per replicate
Domain 5: Outcome Ass	racemant			
Domain 3. Outcome Ass	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 3 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Additional Comments:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
Domain 6: Confounding	/ Variable Cor	ntrol		
Domain o. Comounting	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures	8	, 6
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentat	tion and Analy	ysis		
Domain 7: Data Presentat	tion and Analy Metric 21:	ysis Statistical Methods	High	Statistical analysis was conducted.
Domain 7: Data Presental			High High	Statistical analysis was conducted. Data for exposure-related findings were presented for each treatment and control group in the growth table

Overall Quality Determination

None

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 4 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported,
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
z omam et znpesare en	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
		Spacing of Exposure Levels		response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	two replicates with 10 organisms per replicate
		Replicates per Group		
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 4 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Wandia, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Juvenile

Health Outcome: Development/Growth
Chemical: Chemical: Development/Growth

HERO ID: 4350438

Additional Comments:

Domain	Metric	Rating	Comments
Daniel (Canfanalia - / Variabl	Control		
Domain 6: Confounding / Variable			
Metric 1	9: Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
	Design and Procedures		
Metric 2	0: Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentation and	Analysis		
Metric 2	•	High	Statistical analysis was conducted.
	1: Statistical Methods	High High	Statistical analysis was conducted. Data for exposure-related findings were presented for each treatment and control group in the growth table

Overall Quality Determination

None

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 5 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (fresh **Media, Path:**

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Adult

Health Outcome: ADME (biotransformation)
Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HFRO ID: 4350438

4350438			
	Metric	Rating	Comments
e			
Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported, high control mortality noted
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
n			
	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
		_	The fish were acclimatized to lab conditions
	Conditions	C	two replicates with 10 organisms per replicate
	Replicates per Group		
accoment			
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Contin	nued on nex	at page
	Metric 1: Metric 2: Metric 3: Metric 3: Metric 4: Metric 5: Metric 6: Aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Metric 12: Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response Medium Metric 6: Randomized Allocation Low Metric 8: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ High Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Metric 14: Acclimatization and Pretreatment High Conditions Metric 15: Number of Organisms and Low Replicates per Group

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 5 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome:

ADME (biotransformation)

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Damain 7. Data Brasan	tation and Anal	viai a		
Domain 7: Data Presen		-	37/1	
	Metric 21:	Statistical Methods	N/A	Statistical analysis typically not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
				in the growth table
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 6 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Pimephales promelas*; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
2. 100. 2009.	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported,
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	araatarization			
Domain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organism	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Metric 15:	Conditions Number of Organisms and	Low	two replicates with 15 organisms per replicate
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups
		Con	tinued on next page	•••

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Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 6 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Additional Comments:

Vertebrate; Fish; Pimephales promelas; Juvenile

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
D				
Domain 7: Data Prese		•		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in the growth table
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected

Overall Quality Determination

None

Uninformative

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 4350438 Table: 7 of 7

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Pimephales promelas; Adult **Health Outcome:**

Mortality

chrysotile (serpentine) (CASRN 12001-29-5) Chemical: **HERO ID:** 4350438

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported, high mortality
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	naracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were justified for a dose
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	response by study author Asbestos is considered insoluble
Domain 4: Test Organis	m Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 13:	Acclimatization and Pretreatment	High	The fish were acclimatized to lab conditions
	Wictile 14.	Conditions	High	The fish were accommutated to lab conditions
	Metric 15:	Number of Organisms and	Low	two replicates with 15 organisms per replicate
		Replicates per Group		· · · · · · · · · · · · · · · · · · ·
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 4350438 Table: 7 of 7

... continued from previous page

Study Citation: Belanger, S. E. (1985). Functional and pathological responses of selected aquatic organisms to chrysotile asbestos.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Ac Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Additional Comments:

Vertebrate; Fish; Pimephales promelas; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 4350438

Domain		Metric	Rating	Comments
Domain 6: Confounding	y / Variable Co	ntrol		
Domain o. Comounting				
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures	_	
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Present		•		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in the growth table
	Metric 23:	Explanation of Unexpected Outcomes	Medium	reasonable response, nothing unexpected except for high control mortality

Overall Quality Determination

None

Uninformative

HERO ID: 3582159 Table: 1 of 5

Study Citation:	Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment
	International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cardiovascular

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Б .				
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	Chemical was identified by name; type - Johns Manville No. 7RF02
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	Number of lesions were noted but mortalities were not
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	paracterization			
Bollium 3. Exposure Ch	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured
	Metric 10:	Exposure Duration and Frequency	Medium	Long test duration with a closed system resulted in a downgrade
	Metric 11:	Number of Exposure Groups/	Medium	only three exposure levels resulted in a downgrade
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	insoluble chemical
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	Low	The source of the test animals was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms replicates was only two
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology partially addressed the intended outcomes but few details were provided

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 1 of 5

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Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cardiovascular

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3582159

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment were lim-
		Assessment		ited,
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not conducted but raw data were provided, study focused on pathology findings
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

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Environmental Hazard Evaluation HERO ID: 3582159 Table: 2 of 5 Asbestos

Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported Taxa, Species, Age:

Health Outcome:

Musculoskeletal

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3582159			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	Chemical was identified by name; type - Johns Manville No. 7RF02
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	Number of lesions were noted but mortalities were not
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured
	Metric 10:	Exposure Duration and Frequency	Medium	Long test duration with a closed system resulted in a downgrade
	Metric 11:	Number of Exposure Groups/	Medium	only three exposure levels resulted in a downgrade
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	insoluble chemical
Domain 4: Test Organis	m			
zomani ii rest organis	Metric 13:	Test Organism Characteristics	Low	The source of the test animals was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms replicates was only two
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology partially addressed the intended outcomes but few details were provided
	Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for outcome assessment were limited.

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 2 of 5

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Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Musculoskeletal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3582159

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not conducted, study focused on pathology findings
	Metric 22:	Reporting of Data	Medium	results were described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 3 of 5

Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Poecilia formosa*; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Hepatic/Liver

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3362139			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	Chemical was identified by name; type - Johns Manville No. 7RF02
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	Number of lesions were noted but mortalities were not
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	paracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured
	Metric 10:	Exposure Duration and Frequency	Medium	Long test duration with a closed system resulted in a downgrade
	Metric 11:	Number of Exposure Groups/	Medium	only three exposure levels resulted in a downgrade
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	insoluble chemical
Domain 4: Test Organis	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Low	The source of the test animals was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms replicates was only two
Domain 5, Outage - A	aaaamant			
Domain 5: Outcome As		Adaguagy of Test Conditions	Low	Environmental conditions were not sufficiently remorted to avaluate 'f - dt-
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology partially addressed the intended outcomes but few details were provided
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment were lim-

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 3 of 5

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Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Poecilia formosa*; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Hepatic/Liver

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3582159

Domain		Metric	Rating	Comments
Domain 6: Confound	ng / Variable Coi	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not conducted, study focused on pathology findings
	Metric 22:	Reporting of Data	Medium	results were described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 4 of 5

Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Renal/Kidney

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

3382139			
	Metric	Rating	Comments
ice			
Metric 1:	Test Substance Identity	Medium	Chemical was identified by name; type - 7RF02
Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	Medium	Number of lesions were noted but mortalities were not
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
naracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
Metric 10:	Exposure Duration and Frequency	Medium	Long test duration with a closed system resulted in a downgrade
Metric 11:	Number of Exposure Groups/	Medium	only three exposure levels resulted in a downgrade
Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	insoluble chemical
sm			
Metric 13:	Test Organism Characteristics	Low	The source of the test animals was not reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms replicates was only two
ssessment			
Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology partially addressed the intended outcomes but few details were provided
Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for outcome assessment were limited.
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Maracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Sm Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit sm Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group ssessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source Low Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response Medium Metric 6: Randomized Allocation Low Maracterization Metric 7: Experimental System/Test Media High Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Concentration Metric 10: Exposure Duration and Frequency Medium Metric 11: Number of Exposure Groups/ Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Low Metric 14: Acclimatization and Pretreatment Low Conditions Metric 15: Number of Organisms and Low Replicates per Group Ssessment Metric 16: Adequacy of Test Conditions Low Medium Test 17: Outcome Assessment Methodology Medium Medium Low Medium Low Medium Low Metric 16: Adequacy of Test Conditions Low Medium Low Metric 16: Adequacy of Test Conditions Low Medium Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 4 of 5

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Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Fish; *Poecilia formosa*; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Renal/Kidney

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3582159

Domain		Metric	Rating	Comments
Domain 6: Confounding	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presenta	Metric 21:	Statistical Methods	Low	Statistical analysis was not conducted but raw data were provided, study focused on pathology findings
	Metric 22: Metric 23:	Reporting of Data Explanation of Unexpected Outcomes	High High	Data for exposure-related findings were presented for each treatment and control group unexpected outcomes were satisfactorily explained.
Additional Comments:	None			

Overall Quality Determination

Low

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Environmental Hazard Evaluation HERO ID: 3582159 Table: 5 of 5 Asbestos

Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age:

Vertebrate; Fish; Poecilia formosa; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Skin and Connective Tissue

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

3382139			
	Metric	Rating	Comments
ice			
Metric 1:	Test Substance Identity	Medium	Chemical was identified by name; type - 7RF02
Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	Medium	Number of lesions were noted but mortalities were not
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
naracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
Metric 10:	Exposure Duration and Frequency	Medium	Long test duration with a closed system resulted in a downgrade
Metric 11:	Number of Exposure Groups/	Medium	only three exposure levels resulted in a downgrade
Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	insoluble chemical
sm			
Metric 13:	Test Organism Characteristics	Low	The source of the test animals was not reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms replicates was only two
ssessment			
Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology partially addressed the intended outcomes but few details were provided
Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for outcome assessment were limited.
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Maracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Sm Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit sm Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group ssessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source Low Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response Medium Metric 6: Randomized Allocation Low Maracterization Metric 7: Experimental System/Test Media High Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Concentration Metric 10: Exposure Duration and Frequency Medium Metric 11: Number of Exposure Groups/ Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Low Metric 14: Acclimatization and Pretreatment Low Conditions Metric 15: Number of Organisms and Low Replicates per Group Ssessment Metric 16: Adequacy of Test Conditions Low Medium Test 17: Outcome Assessment Methodology Medium Medium Low Medium Low Medium Low Metric 16: Adequacy of Test Conditions Low Medium Low Metric 16: Adequacy of Test Conditions Low Medium Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3582159 Table: 5 of 5

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Study Citation: Woodhead, A. D., Setlow, R. B., Pond, V. (1983). The effects of chronic exposure to asbestos fibers in the Amazon molly Poecilia formosa. Environment

International 9(1983):173-176.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age:

vertebrate; Fish; *Poecilia formosa*; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Skin and Connective Tissue

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3582159

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not conducted, study focused on pathology findings
	Metric 22:	Reporting of Data	Medium	data was reported as "No effects were noted upon the skin"
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 1 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source was reported in Acknowledgements section.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Figure 2 and in text.
	Metric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure Ch	naracterization			
Bomain 3. Exposure Ci	Metric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
	1.100110 /.	Preparation	1/10/01/01/11	The same with server sype was used for assessor field steeler.
	Metric 8:	Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently.
	Metric 9:	tion Measurement of Test Substance	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
		Concentration		
	Metric 10:	Exposure Duration and Frequency	High	30 day exposure, appropriate for determining daily siphoning activity.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Five concentrations covering six orders of magnitude and a control group were included in the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	e m			
Domain 4. 10st Organis	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
	Moure 14.	Conditions	111511	The test organisms were accommunized to test conditions for 7 days.
	Metric 15:	Number of Organisms and Replicates per Group	Low	10 clams per group, no replicates reported. In Results section, it was reported that 120 and 60 clams were utilized for 10(8) fiber group for summer and winter-collected, respectively.

Domain 5: Outcome Assessment

Continued on next page ...

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Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 1 of 6

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Toyo Species Ago

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome:

Behavioral

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.
Metric 17:	Outcome Assessment Methodology	High	"Two hours after feeding (10 am), the number of clams in each chamber with valves parted were counted as an indication of siphoning activity"
Metric 18:	Consistency of Outcome Assessment	High	Siphoning activity determined two hours after feeding.
Domain 6: Confounding / Variable Co	ontrol		
Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions.
Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Presentation and Ana	llysis		
Metric 21:	Statistical Methods	High	Statistical methods were well-described.
Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented in Figure 2 for each treatment and control group.
Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes.

Additional Comments:

siphoning activity, this form applies to summer and winter-collected clams.

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 2 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula fluminea*; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source stated in the Acknowledgements section.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Figure 3.
	Metric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure Ch	aracterization			
1	Metric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
	Metric 8:	Preparation Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently.
	Metric 9:	tion Measurement of Test Substance	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
	Metric 10:	Concentration Exposure Duration and Frequency	High	30 day exposure adequate for endpoint (shell growth).
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Five concentrations covering six orders of magnitude and a control group were include in the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	m			
Domain i. rest Organis.	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
	Metric 15:	Conditions Number of Organisms and	Low	Authors did not report how many clams were included in Figure 3. Stated in methods
		Replicates per Group		that clams were grouped by 10 without mention of replicates.
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.

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Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 2 of 6

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula fluminea*; Juvenile

Health Outcome:

Development/Growth

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Medium	Outcome methodology for determining shell growth adequately described. Change in length presented rather than initial and final lengths for all treatment groups.
	Metric 18:	Consistency of Outcome	Medium	Unclear how often measurements were taken.
-		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions.
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Figure 3.
	Metric 23:	Explanation of Unexpected Outcomes	High	No unexpected outcomes. Variability of the data presented.

Additional Comments: Shell growth. This form applies to winter-collected and summer-collected clams.

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 3 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome:

Respiratory

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance				
Meta	ric 1:	Test Substance Identity	Low	No CASRN provided.
Meta	ric 2:	Test Substance Source	High	Source was stated in the Acknowledgements.
Met	ric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
ē	ric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
Meta	ric 5:	Negative Control Response	High	Control response reported in the text.
Meta	ric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure Character	rization			
-	ric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
Wich	110 7.	Preparation	Wicdiani	Not stated what solvent type was used for aspestos liber stocks.
Met	ric 8:	Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently across groups.
1,120		tion	111811	2. postates appeared to be daministrated consistently decrease groups.
Meta	ric 9:	Measurement of Test Substance	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
Met	ric 10:	Concentration Exposure Duration and Frequency	High	30 day exposure appropriate for endpoint (size and surface area of locules in the gill lamellae).
Met	ric 11:	Number of Exposure Groups/	High	Five concentrations covering six orders of magnitude and a control group were included
		Spacing of Exposure Levels	8	in the study.
Meta	ric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organism				
_	ric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	ric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
1,120		Conditions	111811	The lost organisms were accumulated to test conditions for y days.
Meta	ric 15:	Number of Organisms and	Low	Unclear how many clams were analyzed by ultrastructural analysis. Methods generally
		Replicates per Group		states clams were grouped by 10 and does not state replicates.
Domain 5: Outcome Assessme	ent			
	ric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism
Med	10.	Transport for conditions	111511	health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093856 Table: 3 of 6

Media, Path: Taxa, Species, Age:

Age: Invertebrate; Mollusks; *Corbicula fluminea*; Juvenile

Health Outcome:

Respiratory

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	Outcome assessment methodology for ultrastructural analysis stated.
	Metric 18:	Consistency of Outcome Assessment	High	Outcome assessed at conclusion of exposure.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Pres	sentation and Anal	lysis		
	Metric 21:	Statistical Methods	High	Planimetric analysis of gill tissue described in text. P-values stated in Results for significance.
	Metric 22:	Reporting of Data	High	Results were described in the text. Control and high exposure group sampled for this analysis. Representative illustration shown in Figure 4.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes and variability of the data described in the text.

Additional Comments: gill locules. This form applies to both summer-collected and winter-collected clams.

Overall Quality Determination

Medium

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 4 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Pauli:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula fluminea*; Juvenile

Health Outcome:

Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ance			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source stated in Acknowledgements section.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design	n			
	Metric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
	Metric 5:	Negative Control Response	High	No mortality was observed in the control group for summer-collected or winter-collected clams.
	Metric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure (Characterization			
Domain D. Enposure	Metric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
		Preparation		
	Metric 8:	Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently.
	Metric 9:	tion Measurement of Test Substance	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
	Metric 10:	Concentration Exposure Duration and Frequency	High	30 day exposure appropriate for endpoint (mortality).
	Metric 11:	Number of Exposure Groups/	High	Five concentrations covering six orders of magnitude and a control group were included
		Spacing of Exposure Levels	8	in the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organ	ism			
Č	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	10 clams per group, no replicates reported. In Results section, it was reported that 120 and 60 clams were utilized for 10(8) fiber group for summer and winter-collected, respectively.

Domain 5: Outcome Assessment

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093856 Table: 4 of 6

Media, Path: Taxa, Species, Age:

cies, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome:

Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.
	Metric 17:	Outcome Assessment Methodology	Medium	Unclear how often clams were monitored for mortality (or how mortality was determined).
	Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for outcome assessment were confusing, limited, or not reported.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Negative findings across all groups except a few mortalities in the high exposure group.
	Metric 22:	Reporting of Data	Medium	Results were described in the text. Timing of mortalities in high exposure group not reported.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes.
Additional Comments:	This form ap	oplies to both summer-collected and winter-c	collected clams.	

Overall Quality Determination

Medium

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 5 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

ge: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3093630			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	No CASRN was provided.
	Metric 2:	Test Substance Source	High	Source was stated in the Acknowledgements section.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
	Metric 5:	Negative Control Response	High	The biological response of the control group was reported in Table 2 and in the text as below detection limit.
	Metric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure Ch	aracterization			
C C C C C C	Metric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
	Metric 8:	Preparation Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently across groups.
	Metric 9:	tion Measurement of Test Substance Concentration	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
	Metric 10:	Exposure Duration and Frequency	High	30 day exposure appropriate for endpoint (fiber burdens).
	Metric 11:	Number of Exposure Groups/	High	Five concentrations covering six orders of magnitude and a control group were included
		Spacing of Exposure Levels		in the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	m			
Ü	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
	Metric 15:	Conditions Number of Organisms and	Low	N reported in Table 2 as 2-4 and three clams were utilized for Table 3 data.
		Replicates per Group		
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.

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Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 5 of 6

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome: ADME

ADME (biotransformation)

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	Asbestos fiber analysis in tissue adequately described.
	Metric 18:	Consistency of Outcome Assessment	High	Outcome was determined at conclusion of study.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Pres		-		
	Metric 21:	Statistical Methods	High	Statistical method for fiber size distribution described.
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were described for control and two treatment groups in Table 2 and high treatment group only in Table 3.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Authors state that fibers in the visceral tissue may not have been embedded in the tissue but present only in the gastointestinal lumen.

Additional Comments: gills and viscera. This form applies to both summer-collected and winter-collected clams.

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 6 of 6

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

HERO ID:	3093630			
Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source stated in the Acknowledgements section.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Low	A control group was included in the study. Not reported what solvent was utilized for preparing the asbestos exposure and whether the control group also received the same solvent.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Figure 3 (weight gain) and Table 1 (wet weight, dry weight, and tissue water content).
	Metric 6:	Randomized Allocation	Low	Randomized allocation not stated.
Domain 3: Exposure Cl	haracterization			
	Metric 7:	Experimental System/Test Media	Medium	Not stated what solvent type was used for asbestos fiber stocks.
	Metric 8:	Preparation Consistency of Exposure Administra-	High	Exposures appeared to be administered consistently.
	Metric 9:	tion Measurement of Test Substance Concentration	High	Asbestos concentrations in water measured at day 0 and day 30 via the TEM method.
	Metric 10:	Exposure Duration and Frequency	High	30 day exposure adequate for endpoint (weight change, water tissue content).
	Metric 11:	Number of Exposure Groups/	High	Five concentrations covering six orders of magnitude and a control group were included in the study.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	em			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 7 days.
	Metric 15:	Conditions Number of Organisms and Parlicates per Group	Low	Authors did not report how many clams were included in Figure 3 and n for Table 1 is
	Wietric 13.	Replicates per Group	Low	15 and 10 for summer-collected and winter-collected clams, respectively.
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health. Measurements of pH, ammonia, alkalinity, hardness, and nutrient content analyzed on days 0 and 30 of the experiment. Temperature was measured.

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Asbestos Environmental Hazard Evaluation HERO ID: 3093856 Table: 6 of 6

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Seasonal behavioral and growth changes of juvenile Corbicula-fluminea exposed to chrysotile

asbestos. Water Research 20(1986):1243-1250.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age:

: Invertebrate; Mollusks; Corbicula fluminea; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093856

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Medium	Outcome methodology for determining weight and tissue water content adequately described.
	Metric 18:	Consistency of Outcome Assessment	Medium	Unclear how often measurements were taken.
Domain 6: Confounding	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported for all doses and control. 2/120 and 3/60 clams died at highest level exposure for summer collected and winter collected, respectively.
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Figure 3 and Table 1.
_	Metric 23:	Explanation of Unexpected Outcomes	High	No unexpected outcomes. Variability of the data presented.

Additional Comments:

weights and tissue water. This form applies to winter-collected and summer-collected clams.

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 1 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian
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Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch				
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis		T. (O.). Cl. ().	3.6 11	
	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	no biological replicates and only 10 organisms per treatment

Domain 5: Outcome Assessment

Continued on next page ...

HERO ID: 3093600 Table: 1 of 13

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J,, J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain	Metric	Rating	Comments
Metrio	e 16: Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric	217: Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric	2 18: Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups
Domain 6: Confounding / Varial	ole Control		
Metrio	2 19: Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions
Metric		High	there were no differences among groups
Domain 7: Data Presentation an	d Analysis		
Metric	21: Statistical Methods	High	Statistical methods were adequately described
Metric	22: Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
Metric	23: Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: siphoning activity

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3093600 Table: 2 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

neko id:	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
.	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
Domain 4. 10st Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	no biological replicates and only 10 organisms per treatment
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 2 of 13

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding /	Variable Con	itrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentati	ion and Analy	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: siphoning activity

Overall Quality Determination

April 2024

Environmental Hazard Evaluation

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 3 of 13

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3073000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	:			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Char	roctarization			
-	Metric 7:	Experimental System/Test Media	High	The experimental system and methods for preparation of test media were described in
	ivicule /.	Preparation	mgn	adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
		tion		
	Metric 9:	Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Damain 4. Tark Organism				
Domain 4: Test Organism	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	1,100110 14.	Conditions	High	The test organisms were accumulated to test conditions for 14 days
	Metric 15:	Number of Organisms and	Low	no biological replicates were reported
		Replicates per Group		
Domain 5: Outcome Asses	ssment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		G	nued on nex	4

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Asbestos Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 3 of 13

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Statistical methods are typically not used for accumulation assessments
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not presented for each treatment, just two high concs and control
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: gills and viscera

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 4 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
.	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
Domain 1. 10st Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	no biological replicates were reported
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

HERO ID: 3093600 Table: 4 of 13

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: M

Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preser	ntation and Anal	vsis		
	Metric 21:	Statistical Methods	N/A	no statistical analysis performed due to no mortality was reported in text
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not shown for each treatment and control group, but results were described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: fed and not fed

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3093600 Table: 5 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID.	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
105t O15um5	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	no biological replicates were reported
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism
				health

HERO ID: 3093600 Table: 5 of 13

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain	Metric	Rating	Comments
Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
	Assessment		
Domain 6: Confounding / Variable Co	ontrol		
Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
	Design and Procedures		
Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentation and Ana	ılysis		
Metric 21:	Statistical Methods	N/A	Statistical methods are typically not used for accumulation assessments
Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not presented for each treatment, just two high concs and control
Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: gills and viscera

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3093600 Table: 6 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Mollusks; Corbicula sp.; Adult

Health Outcome: Reproduction Chemical: Chrysotile

Reproductive/Teratogenic chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
8	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	orostorization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
2 cmain ii rost Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and	Low	no biological replicates were reported
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

HERO ID: 3093600 Table: 6 of 13

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Exposure Route, Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome:

Reproductive/Teratogenic

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately, (page 54)
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were shown for each treatment and control group, and results were described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes

Additional Comments: larval release and mortality

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 7 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
.	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
Domain 1. 10st Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	no biological replicates were reported
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

April 2024

Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Duration: Exposure Route,

Aquatic (freshwater); Water, Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 7 of 13

Media, Path:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula sp.; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
Me	etric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding / Va	ariable Con	itrol		
Me	etric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
Me	etric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presentation	n and Analy	ysis		
Me	etric 21:	Statistical Methods	N/A	no statistical analysis performed due to no mortality was reported in text
Me	etric 22:	Reporting of Data	Low	Data for exposure-related findings were not shown for each treatment and control group, but results were described in the text.
Me	etric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

April 2024

Environmental Hazard Evaluation

HERO ID: 3093600 Table: 8 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Overall Duration: > 21 days: Exposure Duration: > 21 days:

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

: Invertebrate; Mollusks; Corbicula sp.; Adult

Taxa, Species, Age: Health Outcome:

Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3093600			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
8	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	orostarization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organism	m			
Domain 1. 10st Organish	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and	Medium	no biological replicates were reported but experiment was repeated 5 times
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 8 of 13

Media, Path:

Duration:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome:

Additional Comments:

Behavioral

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

siphoning behavior

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundin	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
_	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 9 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Overall Duration: > 21 days **Exposure Route,** Aquatic (freshwater); Water;

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Skin and Connective Tissue

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cit	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisı	m			
2 cinami ii 10st Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	no biological replicates were reported but experiment was repeated 5 times
Domain 5: Outcome Ass	sessment			
Domain 3. Outcome Ass	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Environmental Hazard Evaluation

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

HERO ID: 3093600 Table: 9 of 13

Media, Path:

Duration:

Asbestos

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Skin and Connective Tissue

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	sentation and Anal	vsis		
201111111 // 24141 110	Metric 21:	Statistical Methods	N/A	Statistical methods are typically not used for accumulation assessments
	Metric 22:	Reporting of Data	Low	Weight gain was reported as tissue water.
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

High

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Environmental Hazard Evaluation HERO ID: 3093600 Table: 10 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Asbestos

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

: Invertebrate; Mollusks; Corbicula sp.; Adult

Health Outcome:

Respiratory

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERU ID:	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organis	m			
Domain 1. 10st Organis.	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	no biological replicates were reported but experiment was repeated 5 times
Domain 5: Outcome Ass	sessment			
Domain J. Outcome Ass	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism
		Adequacy of Test Conditions	mgn	health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 10 of 13

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; Corbicula sp.; Adult

Health Outcome:

Respiratory

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoundir	ng / Variable Con	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presei	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Statistical analysis was performed and adequately described
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not shown for each treatment and control group, but results were described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: locule area and composition

Overall Quality Determination

High

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 11 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Overall Duration: > 21 days; Exposure Duration: > 2 Exposure Route, Aquatic (freshwater); Water; Not determined by study

Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Toyo Chooles Age

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cit	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisı	m			
2 cinami ii 10st Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	no biological replicates were reported but experiment was repeated 5 times
Domain 5: Outcome Ass	sessment			
Domain 3. Outcome Ass	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 11 of 13

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Duration:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Presenta	ation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Statistical methods are typically not used for accumulation assessments
	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not presented for each treatment, just two high concs and control
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Overall Quality Determination

High

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 12 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Skin and Connective Tissue

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3093600			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	oroctarization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
rost organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and	Medium	no biological replicates were reported but experiment was repeated 5 times
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 12 of 13

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Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Duration:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Skin and Connective Tissue

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
N	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confounding / V	Variable Con	itrol		
N	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
N	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
D				
Domain 7: Data Presentation	-			
N	Metric 21:	Statistical Methods	N/A	adult mortality was reported as not significant in text
N	Metric 22:	Reporting of Data	Low	Data for exposure-related findings were not shown for each treatment and control group, but results were described in the text.
N	Aetric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Overall Quality Determination

None

Additional Comments:

High

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 13 of 13

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J., J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Toyo Species Age

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

	3093000			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
	Metric 2:	Test Substance Source	High	The test substance identity was analytically characterized and verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Ü	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported and reasonable for reported outcomes, survival outcomes were not reported
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cit	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Medium	Exposure concentrations were not measured but stock preps were analyzed
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The number of exposure groups and spacing of exposure levels were justified for a dose response by study author
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble
Domain 4: Test Organisi	m			
2 cmmii ii rest Organisi	Metric 13:	Test Organism Characteristics	Medium	There are minor reservations source (wild caught) of test organisms
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions for 14 days
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	no biological replicates were reported but experiment was repeated 5 times
		represes per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 3093600 Table: 13 of 13

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns J, , J. R. (1986). Uptake of chrysotile asbestos fibers alters growth and reproduction of Asiatic clams. Canadian

Journal of Fisheries and Aquatic Sciences 43(1986):43-52. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Mollusks; *Corbicula sp.*; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3093600

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoun	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pre	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained.

Additional Comments: shell size and tissue water

Overall Quality Determination

High

April 2024

Environmental Hazard Evaluation

HERO ID: 3584230 Table: 1 of 1

Study Citation:	Belanger, S. E., Cherry, D. S., Cairns, J., Mcguire, M. J. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies.
	Journal of the American Water Works Association 79(1987):69-74.
Duration:	Overall Duration: > 21 days; Exposure Duration: > 21 days
Exposure Route,	Aquatic (freshwater); Water: Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Asbestos

require (resirvator), water, two determined by study authors (i.e., elerinear of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Mollusks; Corbicula sp.; species was not specified in this paper; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: AD

ADME (biotransformation)

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	Medium	Grade-5 chrysotile asbestos was obtained from a commercial supplier.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
Zeman et Zinpesare en	Metric 7:	Experimental System/Test Media Preparation	Low	Few details were provided on the experimental system, but the exposure concentrations were measured.
	Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration
	Metric 9:	tion Measurement of Test Substance Concentration	High	Exposure concentrations were measured using appropriate analytical technologies and methods
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/	Medium	There were only 2 exposure groups in the laboratory setting.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Asbestos exposure with possible dietary exposure.
Domain 4: Test Organism	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Low	Just the genus and not the species was given. Laboratory test organisms were field collected from the New River, VA
	Metric 14:	Acclimatization and Pretreatment Conditions	High	The test organisms were acclimatized to test conditions and all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The numbers of test organisms and replicates were reported and sufficient to characterize toxicological effects
Domain 5: Outcome Ass	sessment			
Domain J. Outcome Ass	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	ge

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Asbestos Environmental Hazard Evaluation HERO ID: 3584230 Table: 1 of 1

... continued from previous page

Study Citation: Belanger, S. E., Cherry, D. S., Cairns, J., Mcguire, M. J. (1987). Using Asiatic clams as a biomonitor for chrysotile asbestos in public water supplies.

Journal of the American Water Works Association 79(1987):69-74.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Aquatic (freshwater); Water; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age:

Invertebrate; Mollusks; Corbicula sp.; species was not specified in this paper; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

ADME (biotransformation)

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584230

Domain	Metric	Rating	Comments
Metric 18	Consistency of Outcome	High	Details of the outcome assessment protocol were reported, and outcomes were assessed
	Assessment		consistently across study groups
Domain 6: Confounding / Variable 0	Control		
Metric 19	Confounding Variables in Test Design and Procedures	Low	he study did not provide enough information to allow a comparison of environmental conditions or other non-treatment-related factors across study groups. Little detail on environmental conditions was reported at all.
Metric 20	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentation and A	nalysis		
Metric 21	Statistical Methods	High	Statistical methods were adequately described
Metric 22	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest
Metric 23	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Asbestos	Environmental Hazard Evaluation	HERO ID: 3080106 Table: 1 of 2

Study Citation: Trivedi, A. K., Ahmad, I., Musthapa, M. S., Ansari, F. A., Rahman, Q. (2004). Environmental contamination of chrysotile asbestos and its toxic effects on

growth and physiological and biochemical parameters of Lemna gibba. Archives of Environmental Contamination and Toxicology 47(2004):281-289. Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Aquatic (freshwater); Water; Dermal (topical application), Not determined by study authors (i.e., chemical of interest in exposure water, but unable to

Media, Path: determine exact uptake route)

Vegetation; Vascular Plants; Lemna gibba; Not Applicable (e.g., fungi or algae studies) or Not Reported Taxa, Species, Age:

Development/Growth **Health Outcome:**

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3080106

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
D				
Domain 3: Exposure Ch	Metric 7:	Experimental System/Test Media	Lliah	The experimental system and methods for preparation of test media were described in
	Metric 7.	Preparation	High	adequate detail
	Metric 8:	Consistency of Exposure Administra- tion	Medium	Details of exposure administration were reported and exposures were administered consistently across study groups although it wasn't clear if the control fronds had clean water applied to the fronds
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured or measurements were not reported.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	Medium	only two concentrations were tested
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	an insoluble chemical was tested
Domain 4: Test Organis	m			
Zemain ii rest Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a third generation field population.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	20 plants and three replicates seemed adequate

Domain 5: Outcome Assessment

Continued on next page ...

Environmental Hazard Evaluation HERO ID: 3080106 Table: 1 of 2 Asbestos

... continued from previous page

Study Citation: Trivedi, A. K., Ahmad, I., Musthapa, M. S., Ansari, F. A., Rahman, Q. (2004). Environmental contamination of chrysotile asbestos and its toxic effects on growth and physiological and biochemical parameters of Lemna gibba. Archives of Environmental Contamination and Toxicology 47(2004):281-289.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Aquatic (freshwater); Water; Dermal (topical application), Not determined by study authors (i.e., chemical of interest in exposure water, but unable to **Exposure Route,**

Media, Path: determine exact uptake route)

Taxa, Species, Age: Vegetation; Vascular Plants; Lemna gibba; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3080106

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology cited methods for determining attributes
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment were lim-
		Assessment		ited.
Domain 6: Confoundin	ng / Variable Con	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition
Domain 7: Data Presen	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes

Additional Comments: None

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3080106 Table: 2 of 2

Study Citation:				2004). Environmental contamination of chrysotile asbestos and its toxic effects on Archives of Environmental Contamination and Toxicology 47(2004):281-289.
Duration:		ation: > 21 days; Exposure Duration: > 21 d		Archives of Environmental Contamination and Toxicology 47(2004).281-289.
Exposure Route,				ned by study authors (i.e., chemical of interest in exposure water, but unable to
Media, Path:		xact uptake route)	ii), i tot deteiiii	med by study dutilots (no., electrical of interest in exposure water, but dilucte to
Taxa, Species, Age:		Vascular Plants; <i>Lemna gibba</i> ; Not Applicabl	e (e.g. fungio	r algae studies) or Not Reported
Health Outcome:		-Biomarkers (exposure and effect)-Oxidative		
Chemical:		erpentine) (CASRN 12001-29-5)	stress (meradii	ig redox biology)-1 notosynthesis
HERO ID:	3080106	erpendine) (Crisidi 12001 25 3)		
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
D : 2 T (D :				
Domain 2: Test Design	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for
			8	assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	naracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra- tion	Medium	Details of exposure administration were reported and exposures were administered consistently across study groups although it wasn't clear if the control fronds had clean water applied to the fronds
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured or measurements were not reported.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	Medium	only two concentrations were tested
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	an insoluble chemical was tested
Domain 4: Test Organis	m			
a.i rest organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a third generation field population.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and	Medium	20 plants and three replicates seemed adequate
		Replicates per Group		
Damain F. C.				
Domain 5: Outcome As	sessment Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evolve to the description
	Metric 10:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate

Medium The Continued on next page ...

The outcome assessment methodology cited methods for determining attributes

Outcome Assessment Methodology

Metric 17:

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Asbestos Environmental Hazard Evaluation HERO ID: 3080106 Table: 2 of 2

... continued from previous page

Study Citation: Trivedi, A. K., Ahmad, I., Musthapa, M. S., Ansari, F. A., Rahman, Q. (2004). Environmental contamination of chrysotile asbestos and its toxic effects on

growth and physiological and biochemical parameters of Lemna gibba. Archives of Environmental Contamination and Toxicology 47(2004):281-289.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Aquatic (freshwater); Water; Dermal (topical application), Not determined by study authors (i.e., chemical of interest in exposure water, but unable to

Media, Path: determine exact uptake route)

Taxa, Species, Age: Vegetation; Vascular Plants; *Lemna gibba*; Not Applicable (e.g., fungi or algae studies) or Not Reported **Health Outcome:** Mechanistic-Biomarkers (exposure and effect)-Oxidative stress (including redox biology)-Photosynthesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3080106

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment were lim-
		Assessment		ited.
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes

Additional Comments: None

Overall Quality Determination

Study Citation: Saxena, K. C., Srivastava, L., Dogra, R. K. (1982). Biochemical and histopathological response to chrysotile ingestion in guinea pigs. Industrial Health

20(1982):19-25.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Adult

Health Outcome: Mechanistic-Biomarkers (exposure and effect)-Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	chemical identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control grou
	Metric 5:	Negative Control Response	Medium	The biological responses of the negative control group were reported, but no comment on control condition other than specific responses
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cl	naracterization			
Zemani J. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	exposure duration was suitable for these endpoints
	Metric 11:	Number of Exposure Groups/	N/A	only one exposure group, a timed dose response was the goal
	Metric 11.	Spacing of Exposure Levels	14/11	only one exposure group, a timed dose response was the godi
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organis	em			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described although scientific name was not provided and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment Conditions	High	The test organisms were acclimatized to test conditions and all pretreatment conditions were the same for control and exposed organism
	Metric 15:	Number of Organisms and Replicates per Group	Low	60 animals per treatment but no replicates used
D 1.50				
Domain 5: Outcome As		A L CT + C L''	.	
	Metric 16:	Adequacy of Test Conditions	Low	environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcomes of interest
		Contin	ued on next pa	nge

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 1797399 Table: 1 of 2

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Study Citation: Saxena, K. C., Srivastava, L., Dogra, R. K. (1982). Biochemical and histopathological response to chrysotile ingestion in guinea pigs. Industrial Health

20(1982):19-25.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Adult

Health Outcome: Mechanistic-Biomarkers (exposure and effect)-Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 1797399

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Preso	entation and Anal	lysis		
	Metric 21:	Statistical Methods	High	Statistical analysis was performed and described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 1797399 Table: 2 of 2

Study Citation: Saxena, K. C., Srivastava, L., Dogra, R. K. (1982). Biochemical and histopathological response to chrysotile ingestion in guinea pigs. Industrial Health

20(1982):19-25.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Adult

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID.	1171377			
Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	chemical identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control grou
	Metric 5:	Negative Control Response	Medium	The biological responses of the negative control group were reported, but no comment on control condition other than specific responses
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
r	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	High	exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	exposure duration was suitable for these endpoints
	Metric 11:	Number of Exposure Groups/	N/A	only one exposure group, a timed dose response was the goal
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organ	niem			
Domain 4. Test Organ	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described although scientific name was not provided and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment Conditions	High	The test organisms were acclimatized to test conditions and all pretreatment conditions were the same for control and exposed organism
	Metric 15:	Number of Organisms and Replicates per Group	Low	60 animals per treatment but no replicates used
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcomes of interest
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		

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Asbestos Environmental Hazard Evaluation HERO ID: 1797399 Table: 2 of 2

... continued from previous page

Study Citation: Saxena, K. C., Srivastava, L., Dogra, R. K. (1982). Biochemical and histopathological response to chrysotile ingestion in guinea pigs. Industrial Health

20(1982):19-25.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Adult

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 1797399

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	there were no differences among groups
Domain 7: Data Pres	entation and Anal	lysis		
	Metric 21:	Statistical Methods	High	Statistical analysis was performed and described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 1 of 4

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The source was not reported.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cl	haracterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure were reported and suitablee for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
		Spacing of Exposure Levels		·
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via gavage
Domain 4: Test Organis	sm			
Č	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but the ITRC source wasn't defined
	Metric 14:	Acclimatization and Pretreatment	Medium	The study did not report whether test organisms were acclimatized but they were fasted
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms (20) was reported and sufficient for the purpose of this
		Replicates per Group		study
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	oge

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Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 1 of 4

... continued from previous page

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Additional Comments:

ge: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 1060372

Domain	Metric	Rating	Comments
Metri	c 18: Consistency of Outcome	High	outcomes were assessed consistently across study groups
	Assessment		
Domain 6: Confounding / Varia	ble Control		
Metri	c 19: Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
	Design and Procedures		conditions
Metri	c 20: Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presentation ar	d Analysis		
Metri	c 21: Statistical Methods	High	Statistical methods were adequately described
Metri	22: Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
Metri	e 23: Explanation of Unexpected Outcomes	High	There were no unexpected outcomes

Overall Quality Determination Medium

Gastric juice characteristics post exposure

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Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 2 of 4

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

tremolite (CASRN 14567-73-8)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The source was not reported.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Desig	n			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure were reported and suitablee for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
		Spacing of Exposure Levels		•
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via gavage
Domain 4: Test Organ	nism			
	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but the ITRC source wasn't defined
	Metric 14:	Acclimatization and Pretreatment	Medium	The study did not report whether test organisms were acclimatized but they were faste
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms (20) was reported and sufficient for the purpose of this
		Replicates per Group		study
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 2 of 4

... continued from previous page

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: tremolite (CASRN 14567-73-8)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	entation and Anal Metric 21:	ysis Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes
Additional Comments	s: Gastric juice	characteristics post exposure		

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 3 of 4

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical: anthophyllite (CASRN 17068-78-9)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The source was not reported.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Desig	gn			
•	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
Boniam 3. Exposure	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure were reported and suitablee for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
		Spacing of Exposure Levels		•
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via gavage
Domain 4: Test Orga	niem			
Domain 1. Test Orga	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but the ITRC source wasn't defined
	Metric 14:	Acclimatization and Pretreatment	Medium	The study did not report whether test organisms were acclimatized but they were fasted
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms (20) was reported and sufficient for the purpose of this
		Replicates per Group		study
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment	-6	

Continued on next page ...

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Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 3 of 4

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Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: anthophyllite (CASRN 17068-78-9)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presen	tation and Anal Metric 21:	ysis Statistical Methods	High	Statistical methods were adequately described
	Metric 21:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes
Additional Comments:	Costria inica	characteristics post exposure		

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 4 of 4

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The source was not reported.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Design	1			
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	haracterization			
Bonian 3. Exposure C	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure were reported and suitablee for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
	1,10,1110 111	Spacing of Exposure Levels	1,711	omy one concentration esseu
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via gavage
Domain 4: Test Organi	em			
Domain 1. Test Organi	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but the ITRC source wasn't defined
	Metric 14:	Acclimatization and Pretreatment	Medium	The study did not report whether test organisms were acclimatized but they were fasted
		Conditions		
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The numbers of test organisms (20) was reported and sufficient for the purpose of this study
Domain 5: Outcome A	ssassmant			
Domain 5: Outcome A	Metric 16:	Adaguagy of Tost Conditions	Low	Environmental conditions were not sufficiently reported to avaluate if a description
	Metric 16:	Adequacy of Test Conditions Outcome Assessment Methodology		Environmental conditions were not sufficiently reported to evaluate if adequate
			High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 1060372 Table: 4 of 4

... continued from previous page

Study Citation: Zaidi, S. H., Gupta, G. S., Rahman, Q., Kaw, J. L., Shanker, R. (1976). Early response of gastric mucosa to ingested asbestos dust and the dissolution of

nickel. Environmental Research 12(1976):139-143.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Cavia porcellus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 1060372

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese		•	IIi ab	Contration of the decrease of contrals described
Domain 7: Data Preso	Metric 21:	Statistical Methods	High High	Statistical methods were adequately described Data for exposure related findings were presented for each treatment and control group.
Domain 7: Data Preso		•	High High High	Statistical methods were adequately described Data for exposure-related findings were presented for each treatment and control group There were no unexpected outcomes

Overall Quality Determination

Study Citation:

Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

HERO ID: 3664651 Table: 1 of 5

Duration:

Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome:

Cancer/Carcinogenesis

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only. The study authors reported "0.5 ml. "asbestos" (of unknown origin) suspension in tributyrin"
	Metric 2:	Test Substance Source	Low	The source of the asbestos was not reported. It was also not reported whether the asbestos was analytically verfied.
	Metric 3:	Test Substance Purity	Low	The size and distribution of the asbestos was not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	Low	It was not reported that a concurrent negative control was used for the study. However, the study authors reported that all other fowl grown in their line-bred fowl could be used as negative controls.
	Metric 5:	Negative Control Response	Low	It was reported that all line-bred white leghorn fowl grown by the researchers had never experienced spontaneous lung tumors. This was reported in the text and was suggested to be the negative control.
	Metric 6:	Randomized Allocation	Low	The researchers did not report how the fowl were allocated into study groups.
D : 3 E G	,			
Domain 3: Exposure Ch		English and all Contains / Total Mark	T	
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided limited details on the preparation of the test substance and on the test system. Finley ground asbestos powders were suspended in tributyrin.
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All birds were injected with asbestos/tributyrin suspension in the right axillary air sac.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the exposure concentrations were measured or if analysis had been done on the asbestos fibers' concentration, size, and distribution.
	Metric 10:	Exposure Duration and Frequency	High	This appears to be a lifelong study that is ongoing at the point that this paper was written. Exposure was via the one injection
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The purpose of the study was not to have a dose response, but to observe the pathological effects of asbestos injected into the air sacs of white leghorn fowl.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
D				
Domain 4: Test Organis		Test Ousenisms Chamastanistics	Low	
	Metric 13:	Test Organism Characteristics	Low	The scientific name of the test organisms was not given. It was not reported what the fowl were fed or how often they were fed. The source was not reported, but it was implied they were obtained from the laboratory performing the study.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the fowl were acclimatized to test conditions.

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 1 of 5

... continued from previous page

Study Citation:

Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration:

Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Taxa, Species, Age: Health Outcome:

Cancer/Carcinogenesis

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and Replicates per Group	Low	In the first test, 6 birds were injected with asbestos. In the second test, 12 birds were injected with amosite and 12 birds were injected with crocidolite. This is a low quantity of organisms for a study.
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	The housing and environmental conditions were not sufficiently reported to evaluate if they were adequate. The study did not report the feeding and watering regimen of the fowl either.
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy.
	Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for the outcome assessment were limited or not reported at all. There was not information provided as to when a fowl was euthanized for necropsy or how often fowl were observed for health/behavioral issues.
Domain 6: Confounding	y / Variable Co	ntrol		
Domain of Companding	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported whether the fowl were acclimatized to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Present	ation and Anal	vsis		
2 0.1.41.11 / 1 2 41.41 2 1 2 0 2 1 1 0	Metric 21:	Statistical Methods	N/A	This study focused on pathological findings and thus statistical analysis was not performed.
	Metric 22:	Reporting of Data	Medium	Results were described in the text for most of the treatments. There was not a description of a concurrent negative control. This paper appears to have been written as the study was ongoing, and thus there may have been more results reported after this paper was written.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	There were minor uncertainties regarding how the study characterized unexpected outcomes. Little information on methods used and methods assessment prevents characterization of unexpected outcomes.
Additional Comments:	axillary air s this is the rea	ac. This study appears to be ongoing at the ason for the lack of detail in this paper.It is	e time this pa unclear how	fibers, amosite and crocidolite on white leghorn fowl after being injected into the right aper was written, so there may have been more results reported later. It is also possible this paper can be used qualitatively given that the purpose of the study was to observe ls to asbestos." This is a descriptive toxicity study. No dose/response information was

Continued on next page ...

provided. Animals were sacrificed at different time points and observations regarding the response to asbestos were made.

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 1 of 5

... continued from previous page

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain	Metric	Rating	Comments	
Overall Quality Det	ermination	Low		

Asbestos **Environmental Hazard Evaluation** HERO ID: 3664651 Table: 2 of 5

Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503. **Study Citation:**

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only. The study authors reported "0.5 ml. "asbestos" (of unknown origin) suspension in tributyrin"
	Metric 2:	Test Substance Source	Low	The source of the asbestos was not reported. It was also not reported whether the as- bestos was analytically verfied.
	Metric 3:	Test Substance Purity	Low	The size and distribution of the asbestos was not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	Low	It was not reported that a concurrent negative control was used for the study. However, the study authors reported that all other fowl grown in their line-bred fowl could be used as negative controls.
	Metric 5:	Negative Control Response	Low	It was reported that all line-bred white leghorn fowl grown by the researchers had never experienced spontaneous lung tumors. This was reported in the text and was suggested to be the negative control.
	Metric 6:	Randomized Allocation	Low	The researchers did not report how the fowl were allocated into study groups.
Domain 3: Exposure Ch			_	
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided limited details on the preparation of the test substance and on the test system. Finley ground asbestos powders were suspended in tributyrin.
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All birds were injected with asbestos/tributyrin suspension in the right axillary air sac.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the exposure concentrations were measured or if analysis had been done on the asbestos fibers' concentration, size, and distribution.
	Metric 10:	Exposure Duration and Frequency	High	This appears to be a lifelong study that is ongoing at the point that this paper was written. Exposure was via the one injection
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The purpose of the study was not to have a dose response, but to observe the pathological effects of asbestos injected into the air sacs of white leghorn fowl.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4: Test Organis	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Low	The scientific name of the test organisms was not given. It was not conserted what the
	MEUIC 15:	rest Organism Characteristics	LUW	The scientific name of the test organisms was not given. It was not reported what the fowl were fed or how often they were fed. The source was not reported, but it was implied they were obtained from the laboratory performing the study.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the fowl were acclimatized to test conditions.

HERO ID: 3664651 Table: 2 of 5

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Environmental Hazard Evaluation

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Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path: Taxa, Species, Age:

Asbestos

: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome:

Mortality

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain		Metric	Rating	Comments
1	Metric 15:	Number of Organisms and Replicates per Group	Low	In the first test, 6 birds were injected with asbestos. In the second test, 12 birds were injected with amosite and 12 birds were injected with crocidolite. This is a low quantity of organisms for a study.
Domain 5: Outcome Asses	ssment			
1	Metric 16:	Adequacy of Test Conditions	Low	The housing and environmental conditions were not sufficiently reported to evaluate if they were adequate. The study did not report the feeding and watering regimen of the fowl either.
I	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy.
]	Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for the outcome assessment were limited or not reported at all. There was not information provided as to when a fowl was euthanized for necropsy or how often fowl were observed for health/behavioral issues.
Domain 6: Confounding /	Variable Cor	atral		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
•	wiedle 15.	Design and Procedures	Low	conditions—it was not reported whether the fowl were acclimatized to test conditions.
1	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentati	on and Anal	vsis		
	Metric 21:	Statistical Methods	N/A	This study focused on pathological findings and thus statistical analysis was not performed.
1	Metric 22:	Reporting of Data	Medium	Results were described in the text for most of the treatments. There was not a description of a concurrent negative control. This paper appears to have been written as the study was ongoing, and thus there may have been more results reported after this paper was written.
1	Metric 23:	Explanation of Unexpected Outcomes	Medium	There were minor uncertainties regarding how the study characterized unexpected outcomes. Little information on methods used and methods assessment prevents characterization of unexpected outcomes.

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 2 of 5

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Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age:

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain

Additional Comments:

Amosite; lifestage Pullet, 3 Month(s); exposure duration 4 years; study duration 48 months; 1ml doseThis paper was on the effects of undetermined asbestos fibers, amosite and crocidolite on white leghorn fowl after being injected into the right axillary air sac. This study appears to be ongoing at the time this paper was written, so there may have been more results reported later. It is also possible this is the reason for the lack of detail in this paper. It is unclear how this paper can be used qualitatively given that the purpose of the study was to observe the reaction of "mesothelial and pulmonary epithelial tissues of fowls to asbestos." This is a descriptive toxicity study. No dose/response information was provided. Animals were sacrificed at different time points and observations regarding the response to asbestos were made.

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 3 of 5

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain Domain 1: Test Substance		Metric	D .:	_
Domain 1: Test Substance		17100110	Rating	Comments
	e			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only. The study authors reported "0.5 ml. "asbestos" (of unknown origin) suspension in tributyrin"
	Metric 2:	Test Substance Source	Low	The source of the asbestos was not reported. It was also not reported whether the asbestos was analytically verfied.
	Metric 3:	Test Substance Purity	Low	The size and distribution of the asbestos was not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	Low	It was not reported that a concurrent negative control was used for the study. However, the study authors reported that all other fowl grown in their line-bred fowl could be used as negative controls.
	Metric 5:	Negative Control Response	Low	It was reported that all line-bred white leghorn fowl grown by the researchers had never experienced spontaneous lung tumors. This was reported in the text and was suggested to be the negative control.
	Metric 6:	Randomized Allocation	Low	The researchers did not report how the fowl were allocated into study groups.
Domain 3: Exposure Cha	racterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided limited details on the preparation of the test substance and on the test system. Finley ground asbestos powders were suspended in tributyrin.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All birds were injected with asbestos/tributyrin suspension in the right axillary air sac.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the exposure concentrations were measured or if analysis had been done on the asbestos fibers' concentration, size, and distribution.
	Metric 10:	Exposure Duration and Frequency	High	This appears to be a lifelong study that is ongoing at the point that this paper was written. Exposure was via the one injection
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The purpose of the study was not to have a dose response, but to observe the pathological effects of asbestos injected into the air sacs of white leghorn fowl.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4. Test On	_			
Domain 4: Test Organism	Metric 13:	Test Organism Characteristics	Low	The scientific name of the test organisms was not given. It was not reported what the fowl were fed or how often they were fed. The source was not reported, but it was implied they were obtained from the laboratory performing the study.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the fowl were acclimatized to test conditions.

Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 3 of 5

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Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age:

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain	Metric	Rating	Comments
Metric 1	5: Number of Organisms and Replicates per Group	Low	In the first test, 6 birds were injected with asbestos. In the second test, 12 birds were injected with amosite and 12 birds were injected with crocidolite. This is a low quantity of organisms for a study.
Domain 5: Outcome Assessment			
Metric 1	6: Adequacy of Test Conditions	Low	The housing and environmental conditions were not sufficiently reported to evaluate if they were adequate. The study did not report the feeding and watering regimen of the fowl either.
Metric 1	7: Outcome Assessment Methodology	Low	The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy.
Metric 1	8: Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for the outcome assessment were limited or not reported at all. There was not information provided as to when a fowl was euthanized for necropsy or how often fowl were observed for health/behavioral issues.
Domain 6: Confounding / Variable	Control		
Metric 1		Low	The study did not provide enough information to allow a comparison of environmental
Metric 1	Design and Procedures	Low	conditions—it was not reported whether the fowl were acclimatized to test conditions.
Metric 2	2	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentation and	polygic		
Domain 7: Data Presentation and A Metric 2	<u> </u>	N/A	This study focused on pathological findings and thus statistical analysis was not per-
Metric 2	1. Statistical Methods	1 W /A	formed.
Metric 2	2: Reporting of Data	Medium	Results were described in the text for most of the treatments. There was not a description of a concurrent negative control. This paper appears to have been written as the study was ongoing, and thus there may have been more results reported after this paper was written.
Metric 2	3: Explanation of Unexpected Outcomes	Medium	There were minor uncertainties regarding how the study characterized unexpected outcomes. Little information on methods used and methods assessment prevents characterized

Continued on next page ...

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 3 of 5

... continued from previous page

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h) **Exposure Route,** Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; *Gallus gallus domesticus*; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain

Additional Comments:

Crocidolite; lifestage Pullet, 3 Month(s); exposure and study duration 48 months; 1ml doseThis paper was on the effects of undetermined asbestos fibers, amosite and crocidolite on white leghorn fowl after being injected into the right axillary air sac. This study appears to be ongoing at the time this paper was written, so there may have been more results reported later. It is also possible this is the reason for the lack of detail in this paper. It is unclear how this paper can be used qualitatively given that the purpose of the study was to observe the reaction of "mesothelial and pulmonary epithelial tissues of fowls to asbestos." This is a descriptive toxicity study. No dose/response information was provided. Animals were sacrificed at different time points and observations regarding the response to asbestos were made.

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 4 of 5

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age: Vertebrate; Avian

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only. The study authors reported "0.5 ml. "asbestos" (of unknown origin) suspension in tributyrin"
	Metric 2:	Test Substance Source	Low	The source of the asbestos was not reported. It was also not reported whether the as- bestos was analytically verfied.
	Metric 3:	Test Substance Purity	Low	The size and distribution of the asbestos was not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	Low	It was not reported that a concurrent negative control was used for the study. However, the study authors reported that all other fowl grown in their line-bred fowl could be used as negative controls.
	Metric 5:	Negative Control Response	Low	It was reported that all line-bred white leghorn fowl grown by the researchers had never experienced spontaneous lung tumors. This was reported in the text and was suggested to be the negative control.
	Metric 6:	Randomized Allocation	Low	The researchers did not report how the fowl were allocated into study groups.
Domain 3: Exposure Ch			_	
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided limited details on the preparation of the test substance and on the test system. Finley ground asbestos powders were suspended in tributyrin.
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All birds were injected with asbestos/tributyrin suspension in the right axillary air sac.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the exposure concentrations were measured or if analysis had been done on the asbestos fibers' concentration, size, and distribution.
	Metric 10:	Exposure Duration and Frequency	High	This appears to be a lifelong study that is ongoing at the point that this paper was written. Exposure was via the one injection
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The purpose of the study was not to have a dose response, but to observe the pathological effects of asbestos injected into the air sacs of white leghorn fowl.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4: Test Organis	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Low	The scientific name of the test organisms was not given. It was not conserted what the
	MEUIC 15:	rest Organism Characteristics	LUW	The scientific name of the test organisms was not given. It was not reported what the fowl were fed or how often they were fed. The source was not reported, but it was implied they were obtained from the laboratory performing the study.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the fowl were acclimatized to test conditions.

Asbestos Environmental Hazard Evaluation

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Study Citation:

Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

HERO ID: 3664651 Table: 4 of 5

Duration:

Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path: Taxa, Species, Age:

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome:

Cancer/Carcinogenesis

Chemical:

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Number of Organisms and Replicates per Group Adequacy of Test Conditions Outcome Assessment Methodology Consistency of Outcome Assessment	Low Low Low	In the first test, 6 birds were injected with asbestos. In the second test, 12 birds were injected with amosite and 12 birds were injected with crocidolite. This is a low quantity of organisms for a study. The housing and environmental conditions were not sufficiently reported to evaluate if they were adequate. The study did not report the feeding and watering regimen of the fowl either. The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy. Details regarding the execution of the study protocol for the outcome assessment were
Outcome Assessment Methodology Consistency of Outcome	Low	they were adequate. The study did not report the feeding and watering regimen of the fowl either. The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy. Details regarding the execution of the study protocol for the outcome assessment were
Outcome Assessment Methodology Consistency of Outcome	Low	they were adequate. The study did not report the feeding and watering regimen of the fowl either. The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy. Details regarding the execution of the study protocol for the outcome assessment were
Consistency of Outcome		mation on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy. Details regarding the execution of the study protocol for the outcome assessment were
	Low	
		limited or not reported at all. There was not information provided as to when a fowl was euthanized for necropsy or how often fowl were observed for health/behavioral issues.
ntrol		
Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported whether the fowl were acclimatized to test conditions.
Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
vsis		
Statistical Methods	N/A	This study focused on pathological findings and thus statistical analysis was not performed.
Reporting of Data	Medium	Results were described in the text for most of the treatments. There was not a description of a concurrent negative control. This paper appears to have been written as the study was ongoing, and thus there may have been more results reported after this paper was written.
Explanation of Unexpected Outcomes	Medium	There were minor uncertainties regarding how the study characterized unexpected outcomes. Little information on methods used and methods assessment prevents characterization of unexpected outcomes.
	Design and Procedures Outcomes Unrelated to Exposure ysis Statistical Methods Reporting of Data Explanation of Unexpected Outcomes s paper was on the effects of undetermined ac. This study appears to be ongoing at the	Design and Procedures Outcomes Unrelated to Exposure Medium ysis Statistical Methods N/A Reporting of Data Medium

Continued on next page ...

provided. Animals were sacrificed at different time points and observations regarding the response to asbestos were made.

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 4 of 5

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Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

Domain	Metric	Rating	Comments	
Overall Quality Det	ermination	Low		

Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 5 of 5

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age: Verte

Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain Domain 1: Test Substance		Metric	D .:	_
Domain 1: Test Substance		17100110	Rating	Comments
	e			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only. The study authors reported "0.5 ml. "asbestos" (of unknown origin) suspension in tributyrin"
	Metric 2:	Test Substance Source	Low	The source of the asbestos was not reported. It was also not reported whether the asbestos was analytically verfied.
	Metric 3:	Test Substance Purity	Low	The size and distribution of the asbestos was not reported.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	Low	It was not reported that a concurrent negative control was used for the study. However, the study authors reported that all other fowl grown in their line-bred fowl could be used as negative controls.
	Metric 5:	Negative Control Response	Low	It was reported that all line-bred white leghorn fowl grown by the researchers had never experienced spontaneous lung tumors. This was reported in the text and was suggested to be the negative control.
	Metric 6:	Randomized Allocation	Low	The researchers did not report how the fowl were allocated into study groups.
Domain 3: Exposure Cha	racterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided limited details on the preparation of the test substance and on the test system. Finley ground asbestos powders were suspended in tributyrin.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All birds were injected with asbestos/tributyrin suspension in the right axillary air sac.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the exposure concentrations were measured or if analysis had been done on the asbestos fibers' concentration, size, and distribution.
	Metric 10:	Exposure Duration and Frequency	High	This appears to be a lifelong study that is ongoing at the point that this paper was written. Exposure was via the one injection
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The purpose of the study was not to have a dose response, but to observe the pathological effects of asbestos injected into the air sacs of white leghorn fowl.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4. Test On	_			
Domain 4: Test Organism	Metric 13:	Test Organism Characteristics	Low	The scientific name of the test organisms was not given. It was not reported what the fowl were fed or how often they were fed. The source was not reported, but it was implied they were obtained from the laboratory performing the study.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the fowl were acclimatized to test conditions.

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 5 of 5

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Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age:

ties, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: Mortant asbestos

asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and Replicates per Group	Low	In the first test, 6 birds were injected with asbestos. In the second test, 12 birds were injected with amosite and 12 birds were injected with crocidolite. This is a low quantity of organisms for a study.
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	The housing and environmental conditions were not sufficiently reported to evaluate if they were adequate. The study did not report the feeding and watering regimen of the fowl either.
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was not clearly reported. There was no information on how often the health of the fowl was observed or when a bird may have been euthanized for examination/necropsy.
	Metric 18:	Consistency of Outcome Assessment	Low	Details regarding the execution of the study protocol for the outcome assessment were limited or not reported at all. There was not information provided as to when a fowl was euthanized for necropsy or how often fowl were observed for health/behavioral issues.
D : (C . 1		. 1		
Domain 6: Confound	C		-	
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported whether the fowl were acclimatized to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Prese	entation and Anal	vsis		
20	Metric 21:	Statistical Methods	N/A	This study focused on pathological findings and thus statistical analysis was not performed.
	Metric 22:	Reporting of Data	Medium	Results were described in the text for most of the treatments. There was not a description of a concurrent negative control. This paper appears to have been written as the study was ongoing, and thus there may have been more results reported after this paper was written.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	There were minor uncertainties regarding how the study characterized unexpected outcomes. Little information on methods used and methods assessment prevents characteri-

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Asbestos Environmental Hazard Evaluation HERO ID: 3664651 Table: 5 of 5

... continued from previous page

Study Citation: Peacock, P. R., Peacock, A. (1965). Asbestos-induced tumors in white leghorn fowls. Annals of the New York Academy of Sciences 132(1965):501-503.

Duration: Overall Duration: > 21 days; Exposure Duration: 0 - 4 days (0-96h) **Exposure Route,** Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Avian; Gallus gallus domesticus; White leghorn fowl; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3664651

Domain	Metric	Rating	Comments
Additional Comments:	Asbestos; lifestage 2-6 years; exposure and st	udy duration 1 year; 0.5 ml dose	This paper was on the effects of undetermined asbestos fibers, amosite and
	crocidolite on white leghorn fowl after being i	njected into the right axillary air	sac. This study appears to be ongoing at the time this paper was written, so
	there may have been more results reported lat	er. It is also possible this is the re	eason for the lack of detail in this paper.It is unclear how this paper can be
	used qualitatively given that the purpose of the	study was to observe the reaction	of "mesothelial and pulmonary epithelial tissues of fowls to asbestos." This
	is a descriptive toxicity study. No dose/respons	se information was provided. Ani	imals were sacrificed at different time points and observations regarding the
	response to asbestos were made.		

Overall Quality Determination

Low

HERO ID: 3615254 Table: 1 of 3

Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,** Terrestrial; N/A (e.g., injection); Dermal (topical application)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the asbestos fibers was not reported by the study authors.
	Metric 3:	Test Substance Purity	Medium	All 5 types of asbestos fibers used were UICC standardized.
Domain 2: Test Design	1			
· ·	Metric 4:	Negative Controls	Uninformative	The study did not report the use of a negative control.
	Metric 5:	Negative Control Response	Low	A biological response for a negative control was not reported in this study.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Domain 3: Exposure C	Characterization			
•	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system was described adequately as the hamster cheek pouch where the asbestos fibers were implanted.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Sanders and Shubik (1964) and Greenblatt et all (1969) were cited for the exposure administration using the transparent cheek method.
	Metric 9:	Measurement of Test Substance Concentration	Low	The exposures were not reported to be analyzed by the performing laboratory. Only one exposure level for each fiber was used in the study.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was appropriate for the study type and outcome of interesting, which was vascularization of the cheek after asbestos implantation. The exposure was for as long as the cheek pouch chamber's quality permitted examination. This was typically for 8-12d.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe changes in the cheek pouch with different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble.
Domain 4: Test Organ	ism			
5 6	Metric 13:	Test Organism Characteristics	Low	Female Syrian hamsters 20-24wks in age were used. The source of the animals was not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported if the hamsters were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	There were 5 experimental groups with 10 animals in each group.

Environmental Hazard Evaluation HERO ID: 3615254 Table: 1 of 3 Asbestos

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Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,**

Media, Path:

Terrestrial; N/A (e.g., injection); Dermal (topical application)

Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

HERO ID: 3615254

Domain	Metric	Rating	Comments
Domain 5: Outcome Assessment			
Metric 16	Adequacy of Test Conditions	Medium	The hamsters were housed with one individual per plastic cage and fed a pellet diet with water continuously available. No information was reported on temperature or size of cages though.
Metric 17	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest. Hamsters were examined daily under a microscope for vascularization of the cheek at the site of the asbestos implantation.
Metric 18	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups—daily assessments were reported until the condition of the transparent cheek chamber had deteriorated.
Domain 6: Confounding / Variable 0	Control		
Metric 19	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the hamsters were acclimated to the test conditions.
Metric 20		Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentation and A	nalysis		
Metric 21	•	N/A	This study focused on the pathological findings in the cheek tissue after asbestos fibers were implanted in the cheek pouch.
Metric 22	Reporting of Data	Medium	Data for exposure-related findings were reported for most, but not all, outcomes by treatment and control group—no findings for a control group were reported.
Metric 23	Explanation of Unexpected Outcomes	High	The study did not report any unexpected outcomes. Variability was not reported be the results were pathological findings and statistics were not performed on these.

daily for changes in vascularization. The gastrointestinal outcome was selected because this study was conducted in the mouth of the hamster and exposure affects were assessed in the mouth. No control was reported and thus the rating was unacceptable.

Overall Quality Determination

Uninformative

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Asbestos Environmental Hazard Evaluation HERO ID: 3615254 Table: 2 of 3

Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,** Terrestrial; N/A (e.g., injection); Dermal (topical application)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mesocricetus auratus*; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

HERO ID: 3615254

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the asbestos fibers was not reported by the study authors.
	Metric 3:	Test Substance Purity	Medium	All 5 types of asbestos fibers used were UICC standardized.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Uninformative	The study did not report the use of a negative control.
	Metric 5:	Negative Control Response	Low	A biological response for a negative control was not reported in this study.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Domain 3: Exposure Ch	naracterization			
•	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system was described adequately as the hamster cheek pouch where the asbestos fibers were implanted.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Sanders and Shubik (1964) and Greenblatt et all (1969) were cited for the exposure administration using the transparent cheek method.
	Metric 9:	Measurement of Test Substance Concentration	Low	The exposures were not reported to be analyzed by the performing laboratory. Only one exposure level for each fiber was used in the study.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was appropriate for the study type and outcome of interesting, which was vascularization of the cheek after asbestos implantation. The exposure was for as long as the cheek pouch chamber's quality permitted examination. This was typically for 8-12d.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe changes in the cheek pouch with different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble.
Domain 4: Test Organis	m			
Domain 1. 1000 Organis	Metric 13:	Test Organism Characteristics	Low	Female Syrian hamsters 20-24wks in age were used. The source of the animals was not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported if the hamsters were acclimated to test conditions.
	Metric 15:	Number of Organisms and	Medium	There were 5 experimental groups with 10 animals in each group.
		Replicates per Group		

Domain 5: Outcome Assessment

Continued on next page ...

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Asbestos Environmental Hazard Evaluation HERO ID: 3615254 Table: 2 of 3

... continued from previous page

Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,** Terrestrial; N/A (e.g., injection); Dermal (topical application)

Media, Path:

Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

HERO ID: 3615254

Domain		Metric	Rating	Comments
N	Metric 16:	Adequacy of Test Conditions	Medium	The hamsters were housed with one individual per plastic cage and fed a pellet diet with water continuously available. No information was reported on temperature or size of cages though.
N	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest. Hamsters were examined daily under a microscope for vascularization of the cheek at the site of the asbestos implantation.
<u> </u>	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups—daily assessments were reported until the condition of the transparent cheek chamber had deteriorated.
Domain 6: Confounding / V	Variable Con	trol		
Ν	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the hamsters were acclimated to the test conditions.
N	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentation	on and Analy	/sis		
Ν	Metric 21:	Statistical Methods	N/A	This study focused on the pathological findings in the cheek tissue after asbestos fibers were implanted in the cheek pouch.
Ν	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were reported for most, but not all, outcomes by treatment and control group—no findings for a control group were reported.
N	Metric 23:	Explanation of Unexpected Outcomes	High	The study did not report any unexpected outcomes. Variability was not reported be the results were pathological findings and statistics were not performed on these.

Additional Comments:

This form is for CrocidoliteThis study was performed on Syrian hamsters. 5 different asbestos fibers were implanted into the cheek pouch, which was examined daily for changes in vascularization. The gastrointestinal outcome was selected because this study was conducted in the mouth of the hamster and exposure affects were assessed in the mouth. No control was reported and thus the rating was unacceptable.

Overall Quality Determination

Uninformative

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3615254 Table: 3 of 3

Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,** Terrestrial; N/A (e.g., injection); Dermal (topical application)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

HERO ID: 3615254

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the asbestos fibers was not reported by the study authors.
	Metric 3:	Test Substance Purity	Medium	All 5 types of asbestos fibers used were UICC standardized.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Uninformative	The study did not report the use of a negative control.
	Metric 5:	Negative Control Response	Low	A biological response for a negative control was not reported in this study.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Domain 3: Exposure Ch	naracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system was described adequately as the hamster cheek pouch where the asbestos fibers were implanted.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Sanders and Shubik (1964) and Greenblatt et all (1969) were cited for the exposure administration using the transparent cheek method.
	Metric 9:	Measurement of Test Substance Concentration	Low	The exposures were not reported to be analyzed by the performing laboratory. Only one exposure level for each fiber was used in the study.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was appropriate for the study type and outcome of interesting, which was vascularization of the cheek after asbestos implantation. The exposure was for as long as the cheek pouch chamber's quality permitted examination. This was typically for 8-12d.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe changes in the cheek pouch with different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble.
Domain 4: Test Organis	m			
Domain 1. 10st Organis	Metric 13:	Test Organism Characteristics	Low	Female Syrian hamsters 20-24wks in age were used. The source of the animals was not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported if the hamsters were acclimated to test conditions.
	Metric 15:	Number of Organisms and	Medium	There were 5 experimental groups with 10 animals in each group.
		Replicates per Group		

Domain 5: Outcome Assessment

Continued on next page ...

Environmental Hazard Evaluation HERO ID: 3615254 Table: 3 of 3 Asbestos

... continued from previous page

Study Citation: Pelfrene, A. F. (1977). Early vascular modifications induced by asbestos fibers in the hamster cheek pouch. Microvascular Research 13(1977):261-266.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Exposure Route,**

Media, Path:

Terrestrial; N/A (e.g., injection); Dermal (topical application)

Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)-anthophyllite

(CASRN 17068-78-9)

HERO ID: 3615254

Domain	Metric	Rating	Comments
Metric	16: Adequacy of Test Conditions	Medium	The hamsters were housed with one individual per plastic cage and fed a pellet diet with water continuously available. No information was reported on temperature or size of cages though.
Metric	17: Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest. Hamsters were examined daily under a microscope for vascularization of the cheek at the site of the asbestos implantation.
Metric	18: Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups—daily assessments were reported until the condition of the transparent cheek chamber had deteriorated.
Domain 6: Confounding / Variable	e Control		
Metric		Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the hamsters were acclimated to the test conditions.
Metric 2		Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Presentation and	Analysis		
Metric 2	21: Statistical Methods	N/A	This study focused on the pathological findings in the cheek tissue after asbestos fibers were implanted in the cheek pouch.
Metric 2	22: Reporting of Data	Medium	Data for exposure-related findings were reported for most, but not all, outcomes by treatment and control group—no findings for a control group were reported.
Metric 2	23: Explanation of Unexpected Outcomes	High	The study did not report any unexpected outcomes. Variability was not reported be the results were pathological findings and statistics were not performed on these.

Additional Comments:

This form is for chrysotileThis study was performed on Syrian hamsters. 5 different asbestos fibers were implanted into the cheek pouch, which was examined daily for changes in vascularization. The gastrointestinal outcome was selected because this study was conducted in the mouth of the hamster and exposure affects were assessed in the mouth. No control was reported and thus the rating was unacceptable.

Overall Quality Determination

Uninformative

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organis				
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		Replicates per Group		thetis
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
		Conti	nued on nex	et page

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 1 of 9

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Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Pres	sentation and Analy	vsis		
Domain 7. Data Free	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	Low	results were described in the text
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: body weight

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 2 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	;			
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Char	racterization			
•	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organism				
•	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		replicates per Group		
Domain 5: Outcome Asse	ssment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 2 of 9

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Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
Domain o. Comound	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures	-6	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Pros	ontation and Anal	 NO10		
Domain 7: Data Pres		-	Uiah	Statistical methods were adequately described
Domain 7: Data Pres	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
Domain 7: Data Pres		-	High High	Statistical methods were adequately described Data for exposure-related findings were presented for each treatment and control group

Additional Comments: tumors

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 709665 Table: 3 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

> hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Vertebrate; Mammalian; Mesocricetus auratus; Adult Taxa, Species, Age:

Cancer/Carcinogenesis **Health Outcome:**

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Desig	n			
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure	Characterization			
1	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organ	niam.			
Domain 4. Test Organ	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 3 of 9

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Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Damain & Canfaundin	y / Variabla Car	atual		
Domain 6: Confounding	-		TT' 1	
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Present	ation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained
Additional Comments:	tumore			· · · · · · · · · · · · · · · · · · ·
Additional Comments:	tumors			

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 4 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	;			
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Char	acterization			
•	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organism				
•	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		replicates per Group		
Domain 5: Outcome Asse	ssment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 4 of 9

... continued from previous page

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Coi	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
	Metric 20:	Design and Procedures Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Prese	entation and Anal	vsis		
Domain 7: Data Preso	entation and Anal Metric 21:	ysis Statistical Methods	High	Statistical methods were adequately described
Domain 7: Data Prese		-	High High	Statistical methods were adequately described Data for exposure-related findings were presented for each treatment and control group

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 709665 Table: 5 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Vertebrate; Mammalian; Mesocricetus auratus; Adult Taxa, Species, Age:

Health Outcome:

Mortality

amosite (grunerite) (CASRN 12172-73-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince		8	
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
		·		
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure C	Characterization			
1	Metric 7:	Experimental System/Test Media	Medium	The experimental system was described in adequate detail, methods for preparation of
		Preparation		test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	M 0	tion		
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for
	metric 10.	Exposure Burdion and Frequency	mgm	the study type
	Metric 11:	Number of Exposure Groups/	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure
		Spacing of Exposure Levels		concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
ъ				
Domain 4: Test Organi		T (O ' Cl ' ' '	TT' 1	
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological
	1.100110 10.	Replicates per Group		effects
		represents per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 5 of 9

... continued from previous page

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Mortality

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confounding / Va	ariable Con	trol		
_	letric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
M.	Ietric 20:	Outcomes Unrelated to Exposure	Medium	41 1:65
ME	ieu ic 20.	Outcomes Officiated to Exposure	Medium	there were no differences among groups
		•	Medium	there were no differences among groups
Domain 7: Data Presentation	n and Analy	vsis		
Domain 7: Data Presentation		•	High	Statistical methods were adequately described
Domain 7: Data Presentation	n and Analy	vsis		

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 709665 Table: 6 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

> hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Vertebrate; Mammalian; Mesocricetus auratus; Adult Taxa, Species, Age:

Health Outcome: Mortality

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince		8	
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
		·		
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure C	Characterization			
1	Metric 7:	Experimental System/Test Media	Medium	The experimental system was described in adequate detail, methods for preparation of
		Preparation		test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	M 0	tion		
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for
	metric 10.	Exposure Burdion and Frequency	mgm	the study type
	Metric 11:	Number of Exposure Groups/	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure
		Spacing of Exposure Levels		concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
ъ				
Domain 4: Test Organi		T (O ' Cl ' ' '	TT' 1	
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological
	1.100110 10.	Replicates per Group		effects
		represents per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome	High	outcomes were assessed consistently across study groups

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 6 of 9

... continued from previous page

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confounding	r / Variable Cor	atral		
Domain o. Comounting	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures	8	
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
D 15D D				
Domain 7: Data Present	ation and Anal	ysis —		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained
Additional Comments:	lifespan			

Overall Quality Determination

April 2024

Asbestos **Environmental Hazard Evaluation** HERO ID: 709665 Table: 7 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

> hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Vertebrate; Mammalian; Mesocricetus auratus; Adult Taxa, Species, Age:

Health Outcome: Mortality

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substan				
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Ch	aracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
D : 4 T : 0 :				
Domain 4: Test Organis	m Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
		Acclimatization and Pretreatment	_	1 .
	Metric 14:		High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		. p		
Domain 5: Outcome As				
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 7 of 9

... continued from previous page

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Chemical:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome:

Mortality

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental condition
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: lifespan

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 8 of 9

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Age: Vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan				
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
8	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cit	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
D : 1 T : 0				
Domain 4: Test Organism		Tt O Chti-ti	TT: _L	
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		Replicates per Group		CHOCO .
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups
			nued on nex	rt nage

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 8 of 9

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Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Duration:

vertebrate; Mammalian; Mesocricetus auratus; Adult

Health Outcome: Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confoundi	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
D ' 7 D . D				
Domain 7: Data Prese	ntation and Analy	ysis —		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
			T	
	Metric 22:	Reporting of Data	Low	results were described in the text

Additional Comments: body weight

Overall Quality Determination

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

> hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Vertebrate; Mammalian; Mesocricetus auratus; Adult Taxa, Species, Age:

Development/Growth **Health Outcome:**

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	the CAS number was not provided
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	High	fiber characteristics and impurities were well documented
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and suitable.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure C	haracterization			
•	Metric 7:	Experimental System/Test Media Preparation	Medium	The experimental system was described in adequate detail, methods for preparation of test media were minimal
	Metric 8:	Consistency of Exposure Administra-	Medium	Reporting omissions are unlikely to have a substantial impact on results.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	the study goal was not to have a dose-dependent effect and there is only one exposure concentration
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Di- 4. T+ 0i				
Domain 4: Test Organia	sm Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 13:	Acclimatization and Pretreatment	High	all pretreatment conditions were the same for control and exposed organisms
	MICHIC 14.	Conditions	High	an predeatment conditions were the same for control and exposed organisms
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported and sufficient to characterize toxicological effects
		replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	the assessment methodology was sensitive and appropriate for the outcomes of interest.
	Metric 18:	Consistency of Outcome Assessment	High	outcomes were assessed consistently across study groups

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Asbestos Environmental Hazard Evaluation HERO ID: 709665 Table: 9 of 9

... continued from previous page

Study Citation: Mcconnell, E. E., Shefner, A. M., Rust, J. H., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite and chrysotile asbestos in Syrian golden

hamsters. Environmental Health Perspectives 5311-25. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; *Mesocricetus auratus*; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 709665

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	Medium	there were no differences among groups
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	Low	results were described in the text
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: body weight

Overall Quality Determination

HERO ID: 3581049 Table: 1 of 3

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:** Terrestrial; Food/Diet; Dietary **Exposure Route,**

Media, Path:

Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile Taxa, Species, Age:

Health Outcome: Development/Growth

amosite (grunerite) (CASRN 12172-73-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The source of the amosite was from the Pneumoconiosis Research Unit, Council for Scientific and Industrial Research in Johannesburg, South Africa. The taconite tailings were from Reserve Mining Company in Silver Bay, MN. The beach rocks were collected from the Baptism and Beaver river mouths near Silver Bay. All test substances were analyzed for fiber size and distribution.
	Metric 3:	Test Substance Purity	Medium	Fiber size and distribution were analyzed for each test substance.
Domain 2: Test Design				
Domain 2. Test Design	Metric 4:	Negative Controls	High	The study authors reported that Groups 9 and 10 were used as untreated controls.
	Metric 5:	Negative Control Response	High	The negative control response was adequate and can be found in Tables 5, 6a, and 6b.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Domain 3: Exposure C	haracterization			
Domain 3. Exposure C	Metric 7:	Experimental System/Test Media Preparation	High	Stock solutions of the minerals were diluted to get the proper test concentrations. The test concentrations were examined under optical and electron microscopes for determination of fiber size and distribution.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Exposures were administered via drinking water across all study groups.
	Metric 9:	Measurement of Test Substance Concentration	High	Optical and electron microscopy were used to determine fiber concentration and distribution of each concentration of fibers used in this study. This can be found in Tables 1 and 2.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was for the lifetime of the hamsters.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	There were 3 treatment levels each for the amosite and tailings groups, 2 treatment levels for the beach rocks group, and 2 negative control groups. This was adequate to see a response.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain A: Test Organi	em			
Domain 4: Test Organi	Metric 13:	Test Organism Characteristics	High	The species of the golden variety were used for this study. Organisms were obtained from Charles River Breeding Laboratories Lakeview Hamster Colony in New Jersey. Feeding was described in the "Materials and Methods" section.
		Contin	nued on nex	at page

Asbestos Environmental Hazard Evaluation HERO ID: 3581049 Table: 1 of 3

... continued from previous page

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile

Health Outcome:

Development/Growth

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3581049

Domain		Metric	Rating	Comments
	Metric 14:	Acclimatization and Pretreatment	Low	It was not reported if the organism were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	It was reported that there were 60 hamsters in each group of the study.
		Replicates per Group		
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	It was reported that there were 10 animals per cage which were provided the correct type of drinking water. Animals fed pelleted food daily that was supplemented with fresh produce.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-weight/growth.
	Metric 18:	Consistency of Outcome Assessment	High	The hamsters were assessed if they died within the course of the experiment or if they were moribund. All hamsters were necropsied by December 1975 if they had not died before then. Body weights were taken at various intervals throughout the study.
Domain 6: Confounding	-			
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the animals were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	High	ANOVA was used to test the differences in weights in each group.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest. Weight data can be seen in Tables 5, 6a, and 6b.
	Metric 23:	Explanation of Unexpected Outcomes	High	The study authors did not report any unexpected outcomes.
Additional Comments:	exposed to g		ere used as	osed to asbestos and taconite tailings via drinking water. There were two groups als control that were given filtered Lake Superior water. This evaluation was done or

Overall Quality Determination

HERO ID: 3581049 Table: 2 of 3

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile

Health Outcome: Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

iieko ib.	33010 1 9			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The source of the amosite was from the Pneumoconiosis Research Unit, Council for Scientific and Industrial Research in Johannesburg, South Africa. The taconite tailings were from Reserve Mining Company in Silver Bay, MN. The beach rocks were collected from the Baptism and Beaver river mouths near Silver Bay. All test substances were analyzed for fiber size and distribution.
	Metric 3:	Test Substance Purity	Medium	Fiber size and distribution were analyzed for each test substance.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	The study authors reported that Groups 9 and 10 were used as untreated controls.
	Metric 5:	Negative Control Response	High	The negative control response was adequate and can be found in Tables 7 and 8.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Domain 3: Evnosura Ch	ornotarization			
Domain 3: Exposure Ch	Metric 7:	Experimental System/Test Media Preparation	High	Stock solutions of the minerals were diluted to get the proper test concentrations. The test concentrations were examined under optical and electron microscopes for determination of fiber size and distribution.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Exposures were administered via drinking water across all study groups.
	Metric 9:	Measurement of Test Substance Concentration	High	Optical and electron microscopy were used to determine fiber concentration and distribution of each concentration of fibers used in this study. This can be found in Tables 1 and 2.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was for the lifetime of the hamsters.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	There were 3 treatment levels each for the amosite and tailings groups, 2 treatment levels for the beach rocks group, and 2 negative control groups. This was adequate to see a response.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4: Test Organis	m			
Zomani ii You Organis	Metric 13:	Test Organism Characteristics	High	The species of the golden variety were used for this study. Organisms were obtained from Charles River Breeding Laboratories Lakeview Hamster Colony in New Jersey. Feeding was described in the "Materials and Methods" section.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported if the organism were acclimated to test conditions.
		Contin	nued on nex	at page

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Asbestos Environmental Hazard Evaluation HERO ID: 3581049 Table: 2 of 3

... continued from previous page

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3581049

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and Replicates per Group	Medium	It was reported that there were 60 hamsters in each group of the study.
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	It was reported that there were 10 animals per cage which were provided the correct type of drinking water. Animals fed pelleted food daily that was supplemented with fresh produce.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–cancer formation.
	Metric 18:	Consistency of Outcome Assessment	High	The hamsters were assessed if they died within the course of the experiment or if they were moribund. All hamsters were necropsied by December 1975 if they had not died before then. Body weights were taken at various intervals throughout the study.
Domain 6: Confounding	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the animals were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Present	ation and Anal	vsis		
	Metric 21:	Statistical Methods	N/A	This portion of the study focused on pathology, and thus statistics were not performed.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest. Weight data can be seen in Tables 7 and 8.
	Metric 23:	Explanation of Unexpected Outcomes	High	The study authors did not report any unexpected outcomes.
Additional Comments:	exposed to g	ž ,		osed to asbestos and taconite tailings via drinking water. There were two groups all control that were given filtered Lake Superior water. This evaluation was done on the

Overall Quality Determination

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile

Health Outcome: Mortality

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID.	33010 1 9			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The source of the amosite was from the Pneumoconiosis Research Unit, Council for Scientific and Industrial Research in Johannesburg, South Africa. The taconite tailings were from Reserve Mining Company in Silver Bay, MN. The beach rocks were collected from the Baptism and Beaver river mouths near Silver Bay. All test substances were analyzed for fiber size and distribution.
	Metric 3:	Test Substance Purity	Medium	Fiber size and distribution were analyzed for each test substance.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	The study authors reported that Groups 9 and 10 were used as untreated controls.
	Metric 5:	Negative Control Response	High	Survivorship of the controls was adequate and can be seen in Tables 3, 4, and 5.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the hamsters were allocated into study groups.
Damain 2. Evmanum Ch	omo otomization			
Domain 3: Exposure Ch	Metric 7:	Experimental System/Test Media	High	Stock solutions of the minerals were diluted to get the proper test concentrations. The
	Wietrie 7.	Preparation	High	test concentrations were examined under optical and electron microscopes for determination of fiber size and distribution.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. Exposures were administered via drinking water across all study groups.
	Metric 9:	Measurement of Test Substance Concentration	High	Optical and electron microscopy were used to determine fiber concentration and distribution of each concentration of fibers used in this study. This can be found in Tables 1 and 2.
	Metric 10:	Exposure Duration and Frequency	High	The exposure duration was for the lifetime of the hamsters.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	There were 3 treatment levels each for the amosite and tailings groups, 2 treatment levels for the beach rocks group, and 2 negative control groups. This was adequate to see a response.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble chemical.
Domain 4: Test Organis	m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	High	The species of the golden variety were used for this study. Organisms were obtained from Charles River Breeding Laboratories Lakeview Hamster Colony in New Jersey. Feeding was described in the "Materials and Methods" section.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported if the organism were acclimated to test conditions.
		Contin	nued on nex	xt page
		Conti	u on nex	- Labrer

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Asbestos Environmental Hazard Evaluation HERO ID: 3581049 Table: 3 of 3

... continued from previous page

Study Citation: Smith, W. E., Hubert, D. D., Sobel, H. J., Peters, E. T., Doerfler, T. E. (1980). Health of experimental animals drinking water with and without amosite

asbestos and other mineral particles. Journal of Environmental Pathology and Toxicology 3(1980):277-300.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Mesocricetus auratus; Lak:LVG; Juvenile

Health Outcome:

Mortality

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3581049

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and Replicates per Group	Medium	It was reported that there were 60 hamsters in each group of the study.
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	It was reported that there were 10 animals per cage which were provided the correct type of drinking water. Animals fed pelleted food daily that was supplemented with fresh produce.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–survival.
	Metric 18:	Consistency of Outcome Assessment	High	The hamsters were assessed if they died within the course of the experiment or if they were moribund. All hamsters were necropsied by December 1975 if they had not died before then.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the animals were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Present	ation and Anal	vsis		
	Metric 21:	Statistical Methods	Low	The study reported confidence limits for survival (Table 4), but statistics were not described.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest. Survival data was reported for all groups in Table 3. Confidence limits were reported in Table 4.
	Metric 23:	Explanation of Unexpected Outcomes	High	The study authors did not report any unexpected outcomes.
Additional Comments:	exposed to g	•		osed to asbestos and taconite tailings via drinking water. There were two groups als rol that were given filtered Lake Superior water. This evaluation was done on mortality

Overall Quality Determination

High

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 1 of 5

Study Citation:	Schneider, V., Maurer, R. R. (1977). Asbesto	s and embryonic development.	Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design	gn			
	Metric 4:	Negative Controls	High	A BMOC-3 medium control group was included.
	Metric 5:	Negative Control Response	High	Biological response of control group shown in Table 2 and appears reasonable.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure	Characterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations in BMOC-3 medium.
	Metric 8:	Consistency of Exposure Administra-	High	Exposure to Day 4 blastocysts occurred for 4 hours in BMOC-3 medium and appears consistent among treatment groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not analytically quantified.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and based on previous study (Elliot et al 1974).
	Metric 11:	Number of Exposure Groups/	High	Study included a control and three asbestos concentrations (1, 10, and 100 micro-g per
		Spacing of Exposure Levels		mL BMOC-3).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Orga	nism			
	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
	Metric 15:	Conditions Number of Organisms and	Low	Replicates not well described. 10 blastocysts per well.
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Medium	Culture methods referenced and described. Some housing details provided for surrogate females; diet, size of cages and type of bedding not described.
	Metric 17:	Outcome Assessment Methodology	High	Sex ratio of fetuses determined and number of implantation sites in each uterine horn.
	Metric 18:	Consistency of Outcome	High	Outcome methodology took place on day 18 of gestation.
		Assessment		

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 1 of 5

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 2) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical analysis was performed and described in footnote of Table 2.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 2.
	Metric 23:	Explanation of Unexpected Outcomes	High	Data presented with standard error and unexpected outcomes (apparent lack of difference in outcomes in treatments vs control group) explained by authors in the discussion section.

Additional Comments: Number pregnant, number of implants, fetal sex ratio, number of fetuses

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 182 Table: 2 of 5 Asbestos

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Media, Path:

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; CD-1; Embryo **Health Outcome:** ADME (biotransformation)

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Desi	gn			
	Metric 4:	Negative Controls	High	A BMOC-3 medium control group was included.
	Metric 5:	Negative Control Response	Low	No response reported for the control group.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure	Characterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations in BMOC-3 medium.
	Metric 8:	Consistency of Exposure Administration	High	Exposure to Day 4 blastocysts occurred for 4 hours in BMOC-3 medium and appears consistent among treatment groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not analytically quantified.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and based on previous study (Elliot et al 1974).
	Metric 11:	Number of Exposure Groups/	N/A	Control group and one treatment group (100 microgram asbestos per mL)
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Orga	nism			
· ·	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
	Metric 15:	Conditions Number of Organisms and	Low	Number of replicates not well described. 10 blastocysts per well.
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Culture methods referenced and described.
	Metric 17:	Outcome Assessment Methodology	High	Asbestos fiber presence was described in methods.
	Metric 18:	Consistency of Outcome	High	Outcome methodology took place after 4 hour exposure.
		Assessment		

Domain 6: Confounding / Variable Control

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 2 of 5

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 0 - 4 days (0-96h); Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, To

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
	Metric 19:	Confounding Variables in Test	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Design and Procedures Outcomes Unrelated to Exposure	Medium	No information suggesting differences in blastocyst survival during the four hours.
Domain 7: Data Preser		•		
Domain 7: Data Preser	ntation and Anal Metric 21:	ysis Statistical Methods	N/A	Study focused on qualitative analysis of asbestos fibers (location and presence).
Domain 7: Data Preser		•	N/A Low	Study focused on qualitative analysis of asbestos fibers (location and presence). Representative figures shown in text of 100 microgram per mL treatment but not of the control group. Results described in text for treated group but not control group.

Overall Quality Determination

Low

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 3 of 5

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

HERO ID:	162			
Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	A BMOC-3 medium control was included.
	Metric 5:	Negative Control Response	High	Response of control group reported in Table 2 and appears reasonable.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure C	haracterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations in BMOC-3 medium.
	Metric 8:	Consistency of Exposure Administra- tion	High	Exposure to Day 4 blastocysts occurred for 4 hours in BMOC-3 medium and appears consistent among treatment groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not analytically quantified.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and based on previous study (Elliot et al 1974).
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1, 10, and 100 micro-g per mL BMOC-3).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organi	sm			
	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
	Metric 15:	Number of Organisms and Replicates per Group	Low	Number of replicates not well described. 10 blastocysts per well.
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Medium	Culture methods referenced and described. Some housing details provided for surrogate females; diet, size of cages and type of bedding not described.
	Metric 17:	Outcome Assessment Methodology	Medium	Live fetuses were weighed; methodology does not describe criteria for stunted vs norma fetus.
	Metric 18:	Consistency of Outcome Assessment	High	Fetuses were weighed on day 18 of gestation.

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 3 of 5

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confoun	nding / Variable Con	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 2) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Pre	esentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis not adequately described.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 2.
	Metric 23:	Explanation of Unexpected Outcomes	High	Lack of significance from control group was discussed by the authors in the Discussion. Data was presented with standard error.
Additional Commer	nts: Fetal weight	and % stunted.		

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 4 of 5

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

пекоть:	162			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	A BMOC-3 medium control group was included.
	Metric 5:	Negative Control Response	Medium	High percentage of reabsorptions/dead observed in control group, likely due to nature o experimental set-up.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure C	naracterization			
r	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations in BMOC-3 medium.
	Metric 8:	Consistency of Exposure Administra-	High	Exposure to Day 4 blastocysts occurred for 4 hours in BMOC-3 medium and appears consistent among treatment groups.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not analytically quantified.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and based on previous study (Elliot et al 1974).
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1, 10, and 100 micro-g per mL BMOC-3).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	e m			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	Number of replicates not well described. 10 blastocysts per well.
Domain 5: Outcome As	gaaamant			
Domain 5. Outcome As	Metric 16:	Adequacy of Test Conditions	Medium	Cultura mathods referenced and described. Some housing details arounded for surrecess
		1 2		Culture methods referenced and described. Some housing details provided for surrogate females; diet, size of cages and type of bedding not described.
	Metric 17:	Outcome Assessment Methodology	Medium	Was not described how fetuses were determined as alive.
	Metric 18:	Consistency of Outcome Assessment	High	Outcome methodology took place on day 18 of gestation.

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 4 of 5

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 2) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Prese		•		
	Metric 21:	Statistical Methods	High	Statistical analysis was described adequately in the text and footnote of Table 2.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 2.
	Metric 23:	Explanation of Unexpected Outcomes	High	Data presented with standard error and there were no unexpected outcomes.
Additional Comments	s: Percent reso	rptions and number of dead fetuses		

Overall Quality Determination

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Asbestos **Environmental Hazard Evaluation** HERO ID: 182 Table: 5 of 5

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route, Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERO ID:	182			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
8	Metric 4:	Negative Controls	High	A BMOC-3 medium control group was included.
	Metric 5:	Negative Control Response	Medium	Biological response of control group shown in Table 2. Some malformations noted in control group for day 4 recipients.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure Ch	aracterization			
Domain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations in BMOC-3 medium.
	Metric 8:	Consistency of Exposure Administra-	High	Exposure to Day 4 blastocysts occurred for 4 hours in BMOC-3 medium and appears consistent among treatment groups.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not analytically quantified.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and based on previous study (Elliot et al 1974).
	Metric 11:	Number of Exposure Groups/	High	Study included a control and three asbestos concentrations (1, 10, and 100 micro-g per
		Spacing of Exposure Levels		mL BMOC-3).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organism	m			
	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The study did not report whether blastocysts were acclimatized prior to treatment.
Domain 5: Outcome Ass			3.6 "	
	Metric 16:	Adequacy of Test Conditions	Medium	Culture methods referenced and described. Some housing details provided for surrogate females; diet, size of cages and type of bedding not described.
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was cited to other publications but few details provided.
	Metric 18:	Consistency of Outcome	High	Outcome methodology was conducted on day 18 of gestation.

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 5 of 5

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 0 - 4 days (0-96h)

Exposure Route,

Terrestrial; Cell Culture Media; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confoun	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	No apparent differences in environmental conditions between the study groups.
		Design and Procedures	υ	
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 2) and no non-treatment differences between study groups
				that would influence the outcome assessment.
Domain 7: Data Pre	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
				in Table 2.
	Metric 23:	Explanation of Unexpected Outcomes	High	Authors reported number of malformations for each group, data appeared more consis-
	Wictife 23.	1		

Additional Comments: % malformed fetuses.

Overall Quality Determination

Low

HERO ID: 758926 Table: 1 of 4

Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study contained a control group (saline gavage).
	Metric 5:	Negative Control Response	Medium	Biological response of control stated in text as total number, unclear if the deaths oc- curred in single litter vs multiple
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	A suspension was used but few details were provided.
	Metric 8:	Consistency of Exposure Administration	Medium	Two doses administered days 2 and 4 after acclimation. Two days after day 4, mice were mated and upon confirmed pregnancy, mice were dosed on gestational days 7 and 12. Authors did not report the number of days between the first females becoming pregnant and the last females becoming pregnant (presumably gestational days 7 and 12 differed female to female).
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	Exposure occurred twice before pregnancy and then on days 7 and 12 of pregnancy. Total exposure time would slightly differ among female mice depending on when pregnancy occurred.
	Metric 11:	Number of Exposure Groups/	N/A	One concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (gavage).
Domain 4: Test Organis	m			
Domain 7. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were described as female ICR mice and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment Conditions	High	The test organisms were acclimatized to test conditions.
		Conti	nued on nex	et page

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Asbestos Environmental Hazard Evaluation HERO ID: 758926 Table: 1 of 4

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Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and	Medium	6 female mice were treated and 6 were control. Litters were obtained from each mouse.
		Replicates per Group		
Domain 5: Outcome A	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	High	Non-sacrifice death of pups was recorded.
	Metric 18:	Consistency of Outcome	Medium	Unclear if counts were made daily.
		Assessment		
Domain 6: Confoundi	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	entation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described.
	Metric 22:	Reporting of Data	Low	Total number of dead pups presented for control and treatment. Unclear as to when they died or from how many litters.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Variability not necessarily applicable for reporting total number of dead pups.

Additional Comments: None

Overall Quality Determination

Low

Environmental Hazard Evaluation HERO ID: 758926 Table: 2 of 4 Asbestos

Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31. Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Duration:

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical identified by name only.
	Metric 2:	Test Substance Source	High	Source was reported.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study contained a control group (saline gavage).
	Metric 5:	Negative Control Response	High	Mean weight gain of pups shown in Figure 2 and described in text.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch				
	Metric 7:	Experimental System/Test Media Preparation	Medium	A suspension was used but few details were provided.
	Metric 8:	Consistency of Exposure Administration	Medium	Two doses administered days 2 and 4 after acclimation. Two days after day 4, mice were mated and upon confirmed pregnancy, mice were dosed on gestational days 7 and 12. Authors did not report the number of days between the first females becoming pregnant and the last females becoming pregnant (presumably gestational days 7 and 12 differed female to female).
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	Exposure occurred twice before pregnancy and then on days 7 and 12 of pregnancy. Total exposure time would slightly differ among female mice depending on when pregnancy occurred.
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration.
		Spacing of Exposure Levels		·
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (gavage).
Domain 4: Test Organis	m			
C	Metric 13:	Test Organism Characteristics	High	The test organisms were described as female ICR mice and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment Conditions	High	The test organisms were acclimatized to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	6 female mice were treated and 6 were control. Litters were obtained from each mouse.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 758926 Table: 2 of 4

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Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Medium	Weight gain was determined from subtracting birth weight from weight at time of sacrifice. Actual weights not reported.
	Metric 18:	Consistency of Outcome Assessment	Medium	Pups from both treated and control litters were weighed on days 8, 11, 19, and 20 after birth (some differences between control and treated in the number of litters sacrificed on a given day).
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	The test utilized was described but alpha not stated.
	Metric 22:	Reporting of Data	High	Mean weight gain were presented for each treatment and control group in Figure 2.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals) and/or insufficient information was provided to determine if excessive variability or unexpected outcomes occurred.

Additional Comments: None

Overall Quality Determination

Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study contained a control group (saline gavage).
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes, no fibers were found in controls pups.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
D 2. E Ch				
Domain 3: Exposure Ch	Metric 7:	Experimental System/Test Media	Medium	A suspension was used but few details were provided.
	Metric 8:	Preparation Consistency of Exposure Administra- tion	Medium	Two doses administered days 2 and 4 after acclimation. Two days after day 4, mice were mated and upon confirmed pregnancy, mice were dosed on gestational days 7 and 12. Authors did not report the number of days between the first females becoming pregnant and the last females becoming pregnant (presumably gestational days 7 and 12 differed female to female).
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	Exposure occurred twice before pregnancy and then on days 7 and 12 of pregnancy. Total exposure time would slightly differ among female mice depending on when pregnancy occurred.
	Metric 11:	Number of Exposure Groups/	N/A	One concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (gavage).
D : 4 T + 0 :				
Domain 4: Test Organis	m Metric 13:	Test Organism Characteristics	High	The test organisms were described as female ICR mice and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	6 female mice were treated and 6 were control. Litters were obtained from each mouse.
		replicates per Group		

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Asbestos Environmental Hazard Evaluation HERO ID: 758926 Table: 3 of 4

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Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	High	The methodology for electron microscopy well described.
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups.
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical methods for treated pups described but no alpha stated.
	Metric 22:	Reporting of Data	High	Mean fiber count in lung and liver of treated pups shown in Figure 1 and stated in text and discussed in text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Study reported variability among litters but not within litters.

Additional Comments: None

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 758926 Table: 4 of 4

Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; ICR; Adult

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	Low	Chemical identified by name only.
	Metric 2:	Test Substance Source	High	Source was reported.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design	I			
Č	Metric 4:	Negative Controls	High	Study contained a control group (saline gavage).
	Metric 5:	Negative Control Response	Medium	Average litter size reported in text for control group. No variance reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
D : 4 E G	1			
Domain 3: Exposure C			3.6.12	
	Metric 7:	Experimental System/Test Media	Medium	A suspension was used but few details were provided.
	Metric 8:	Preparation Consistency of Exposure Administration	Medium	Two doses administered days 2 and 4 after acclimation. Two days after day 4, mice were mated and upon confirmed pregnancy, mice were dosed on gestational days 7 and 12. Authors did not report the number of days between the first females becoming pregnant and the last females becoming pregnant (presumably gestational days 7 and 12 differed female to female).
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	Exposure occurred twice before pregnancy and then on days 7 and 12 of pregnancy. Total exposure time would slightly differ among female mice depending on when pregnancy occurred.
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration.
		Spacing of Exposure Levels		·
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (gavage).
Domain 4: Test Organia	sm			
	Metric 13:	Test Organism Characteristics	High	The test organisms were described as female ICR mice and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	6 female mice were treated and 6 were control. Litters were obtained from each mouse.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 758926 Table: 4 of 4

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Study Citation: Haque, A. K., Ali, I., Vrazel, D. M., Uchida, T. (2001). Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice.

Journal of Toxicology and Environmental Health, Part A: Current Issues 62(2001):23-31.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Dietary

Media, Path:

Chemical:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; ICR; Adult

Health Outcome: Reproductive/Teratogenic

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758926

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	High	Litter size determined per female and averaged within treatment groups.
	Metric 18:	Consistency of Outcome	Medium	Litter size presumably determined at time of birth.
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Medium	Average litter size for treated and control stated in text.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals) and/or insufficient information was provided to determine if excessive variability or unexpected outcomes occurred.

Additional Comments: None

Overall Quality Determination

Uninformative

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HERO ID: 182 Table: 1 of 4 Asbestos **Environmental Hazard Evaluation**

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days **Duration:**

Exposure Route,

Terrestrial; Water; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Reproductive/Teratogenic **Health Outcome:**

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	182			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	A water-only control was included.
	Metric 5:	Negative Control Response	Medium	Response of control group shown in Table 1; higher number of malformations shown in control group than other treatment groups but there were also more live fetuses in control group than other treatment groups.
	Metric 6:	Randomized Allocation	Medium	The female mice were randomly allocated.
Domain 3: Exposure Ch	paracterization			
Boniani 3. Exposure en	Metric 7:	Experimental System/Test Media Preparation	Medium	Preparation of stock solution described and water solution renewed daily. Unclear if treatment concentrations were prepared straight from stock solution or were serially diluted.
	Metric 8:	Consistency of Exposure Administra- tion	Medium	Treatments were administered daily in the drinking water and concluded on day 15 of pregnancy; however, it is unclear when dosing commenced (on day 1 vs prior to day 1).
	Metric 9:	Measurement of Test Substance Concentration	Medium	Asbestos was weighed and water consumption was measured but no analytical quantitation was described.
	Metric 10:	Exposure Duration and Frequency	High	Unclear if exposure commenced prior to pregnancy; if on Day 1 of pregnancy, exposure would be 15 days and seems appropriate.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1.43, 14.3, and 143 micro-g per L water).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	m			
Domain 4. 10st Organis	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of female mice per group (10-12) and replicate groups per treatment (three
	wicuic 13.	Replicates per Group	Micuiuiii	replicate groups) were reported and sufficient to characterize toxicological effects.
Domain 5: Outcome As	ceccment			
Domain 3. Outcome As	Metric 16:	Adequacy of Test Conditions	Medium	Some housing details provided; diet, size of cages and type of bedding not described.
		Conti	nued on nex	of page
		Contra		

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 1 of 4

... continued from previous page

Study Citation:

Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration:

Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome:

Reproductive/Teratogenic

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology was cited to other publications but few details provided.
	Metric 18:	Consistency of Outcome Assessment	High	Outcome methodology conducted on Day 18 of gestation.
Domain 6: Confoundi	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 1) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was not described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Authors did not discuss why higher number of malformations were observed in control group vs chrysotile treatments.

Additional Comments: Percent malformed.

Overall Quality Determination

Low

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 2 of 4

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Water; Dietary

Taxa, Species, Age: Vertebrate; I

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

182			
	Metric	Rating	Comments
ce			
Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
Metric 2:	Test Substance Source	High	Source was identified.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	A water-only group was included.
Metric 5:	Negative Control Response	High	Response of control group shown in Table 1 and appears reasonable.
Metric 6:	Randomized Allocation	Medium	Female mice were randomly distributed.
aracterization			
Metric 7:	Experimental System/Test Media Preparation	Medium	Preparation of stock solution described and water solution renewed daily. Unclear if treatment concentrations were prepared straight from stock solution or were serially diluted.
Metric 8:	Consistency of Exposure Administra- tion	Medium	Treatments were administered daily in the drinking water and concluded on day 15 of pregnancy; however, it is unclear when dosing commenced (on day 1 vs prior to day 1).
Metric 9:	Measurement of Test Substance Concentration	Medium	Asbestos was weighed and water consumption was measured but no analytical quantitation was described.
Metric 10:	Exposure Duration and Frequency	Medium	Unclear if exposure commenced prior to pregnancy; if on Day 1 of pregnancy, exposure would be 15 days and seems appropriate.
Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1.43, 14.3, and 143 micro-g per L water).
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
m			
	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
Metric 15:	Conditions Number of Organisms and	Medium	The numbers of female mice per group (10-12) and replicate groups per treatment (three replicate groups) were reported and sufficient to characterize toxicological effects.
	Replicates per Group		replicate groups) were reported and sufficient to characterize toxicological effects.
Metric 16:	* *		Some housing details provided; diet, size of cages and type of bedding not described.
Metric 17:	Outcome Assessment Methodology	Medium	Live fetuses were weighed; methodology does not describe criteria for stunted vs norma fetus.
Metric 18:	Consistency of Outcome	High	Fetuses were weighed on day 18 of gestation.
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 13: Metric 14: Metric 15: sessment Metric 16: Metric 17:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Sessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response High Metric 6: Randomized Allocation Medium Aracterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency Medium Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Medium Metric 13: Test Organism Characteristics Medium Metric 14: Acclimatization and Pretreatment Low Conditions Metric 15: Number of Organisms and Replicates per Group Sessment Metric 16: Adequacy of Test Conditions Medium Metric 17: Outcome Assessment Methodology Medium

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 2 of 4

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confounding	g / Variable Co	ntrol		
_	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 1) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Presenta	ation and Anal	ysis		
Domain 7: Data Presenta	ation and Anal Metric 21:	ysis Statistical Methods	Low	Statistical analysis was not described adequately.
Domain 7: Data Presenta		•	Low High	Statistical analysis was not described adequately. Data for exposure-related findings were presented for each treatment and control group in Table 1.

Overall Quality Determination

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Asbestos **Environmental Hazard Evaluation** HERO ID: 182 Table: 3 of 4

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Mortality

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERO ID:	182			
Domain		Metric	Rating	Comments
Domain 1: Test Substar	ice			
	Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was described as No. 7RFO2.
	Metric 2:	Test Substance Source	High	Source was identified.
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	A water-only control was included.
	Metric 5:	Negative Control Response	High	Response of control group reported in Table 1 and appears reasonable.
	Metric 6:	Randomized Allocation	Medium	Female mice were randomly distributed.
Domain 3: Exposure Cl	naracterization			
	Metric 7:	Experimental System/Test Media Preparation	Medium	Preparation of stock solution described and water solution renewed daily. Unclear if treatment concentrations were prepared straight from stock solution or were serially diluted.
	Metric 8:	Consistency of Exposure Administra- tion	Medium	Treatments were administered daily in the drinking water and concluded on day 15 of pregnancy; however, it is unclear when dosing commenced (on day 1 vs prior to day 1).
	Metric 9:	Measurement of Test Substance Concentration	Medium	Asbestos was weighed and water consumption was measured but no analytical quantita tion was described.
	Metric 10:	Exposure Duration and Frequency	Medium	Unclear if exposure commenced prior to pregnancy; if on Day 1 of pregnancy, exposure would be 15 days and seems appropriate.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1.43, 14.3, and 143 micro-per L water).
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
Domain 4: Test Organis	sm			
	Metric 13:	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of female mice per group (10-12) and replicate groups per treatment (three
		Replicates per Group		replicate groups) were reported and sufficient to characterize toxicological effects.
Domain 5: Outcome As				
	Metric 16:	Adequacy of Test Conditions	Medium	Some housing details provided; diet, size of cages and type of bedding not described.
	Metric 17:	Outcome Assessment Methodology	Medium	Was not described how fetuses were determined as alive.
	Metric 18:	Consistency of Outcome Assessment	High	Outcome methodology took place on Day 18 of gestation.
		Contin	ued on next pa	nge

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 3 of 4

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Water; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confoundi	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported (Table 1) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	High	Data presented with standard error and unexpected outcomes (apparent lack of mortality

Additional Comments: This form applies to percent resorptions and number of dead fetuses.

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 4 of 4

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path: Taxa, Species, Age:

e: Vertebrate; Mammalian; *Mus musculus*; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

182			
	Metric	Rating	Comments
ce			
Metric 1:	Test Substance Identity	Medium	CASRN was not provided but the chrysotile was referred to as No. 7RFO2.
Metric 2:	Test Substance Source	High	Source was identified.
Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Metric 4:	Negative Controls	High	A water-only control was included.
Metric 5:	Negative Control Response	High	Response of control group shown in Table 1 and appears reasonable.
Metric 6:	Randomized Allocation	Medium	Female mice were randomly distributed.
aracterization			
Metric 7:	Experimental System/Test Media Preparation	Medium	Preparation of stock solution described and water solution renewed daily. Unclear if treatment concentrations were prepared straight from stock solution or were serially diluted.
Metric 8:	Consistency of Exposure Administra- tion	Medium	Treatments were administered daily in the drinking water and concluded on day 15 of pregnancy; however, it is unclear when dosing commenced (on day 1 vs prior to day 1).
Metric 9:	Measurement of Test Substance Concentration	Medium	Asbestos was weighed and water consumption was measured but no analytical quantitation was described.
Metric 10:	Exposure Duration and Frequency	Medium	Unclear if exposure commenced prior to pregnancy; if on Day 1 of pregnancy, exposure would be 15 days and seems appropriate.
Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Study included a control and three asbestos concentrations (1.43, 14.3, and 143 micro-g per L water).
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is considered insoluble.
m			
	Test Organism Characteristics	Medium	The test organisms were adequately described but original source was not reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of female mice per group (10-12) and replicate groups per treatment (three replicate groups) were reported and sufficient to characterize toxicological effects.
sessment			
Metric 16:	Adequacy of Test Conditions	Medium	Some housing details provided; diet, size of cages and type of bedding not described.
	1 2		Sex ratio of fetuses determined and number of implantation sites in each uterine horn.
Metric 18:	Consistency of Outcome Assessment	High	Outcome methodology conducted on Day 18 of gestation.
	Metric 1: Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Maracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 12: m Metric 13: Metric 14: Metric 15: sessment Metric 16: Metric 17:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit m Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group sessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity Low Metric 4: Negative Controls High Metric 5: Negative Control Response High Metric 6: Randomized Allocation Medium Preparation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency Medium Metric 11: Number of Exposure Groups/Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A m Metric 13: Test Organism Characteristics Medium Metric 14: Acclimatization and Pretreatment Low Conditions Number of Organisms and Replicates per Group sessment Metric 16: Adequacy of Test Conditions Medium Metric 17: Outcome Assessment Methodology High Metric 18: Consistency of Outcome High

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Asbestos Environmental Hazard Evaluation HERO ID: 182 Table: 4 of 4

... continued from previous page

Study Citation: Schneider, V., Maurer, R. R. (1977). Asbestos and embryonic development. Teratology 15(1977):273-279.

Duration: Overall Duration: 11 - 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Mus musculus; CD-1; Embryo

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 182

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	No apparent differences in environmental conditions between the study groups.
	Metric 20:	Design and Procedures Outcomes Unrelated to Exposure	High	Attrition was reported (Table 1) and no non-treatment differences between study groups that would influence the outcome assessment.
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical analysis was performed (described in footnote of Table 1)
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	High	Data presented with standard error and unexpected outcomes (apparent lack of difference in outcomes in treatments vs control group) explained by authors in the discussion section.
Additional Comments	s: Number pre	gnant, number of implants, number of fetuses	s, fetus sex ratio)

Overall Quality Determination

HERO ID: 6867451 Table: 1 of 2

Study Citation: Craighead, J. E., Richards, S. A., Calore, J. D., Fan, H., Weaver, D. L. (1993). Genetic factors influence malignant mesothelioma development in mice.

European Respiratory Review, vol. 3, review no. 11 118-120.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; C3H(He), DBA/2, Balb/c Bailey, Balb/c Cumberland; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Cancer/Carcinogenesis

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the crocidolite was not reported.
	Metric 3:	Test Substance Purity	Medium	The crocidolite was described as UICC, so it was held to a certain standard.
Domain 2: Test Desig	2n			
	Metric 4:	Negative Controls	Uninformative	The study authors did not report the use of a negative control. A positive control using 3-methycholanthrene was reported.
	Metric 5:	Negative Control Response	Low	There was no negative control, and thus a negative control response was not reported.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the mice were allocated into study groups.
Domain 3: Exposure	Characterization			
r	Metric 7:	Experimental System/Test Media Preparation	Medium	The crocidolite was prepared in Hank's solution (not described), and 10mg was injected intraperitoneally into each mouse. Amount injected not described.
	Metric 8:	Consistency of Exposure Administra-	Low	Exposures were administered via injection into the peritoneal cavity. 10mg of crocidolite was administered to each mouse. The volume injected was not described.
	Metric 9:	Measurement of Test Substance	Low	It was not reported if the crocidolite was measured.
	Metric 10:	Concentration Exposure Duration and Frequency	High	Exposure was for the lifetime of the mouse or until the mouse developed illness or ascites.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of this study was not to have a dose dependent response, but to observe responses of genetically different mice to exposure to crocidolite.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Crocidolite is an insoluble chemical.
Domain 4: Test Orga	nism			
Domain 4. Test Olga	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source. The mice used were all young females. The C3H and the DBA/2 strains came from Jackson Laboratories in Bar Harbor, ME, and the Balb/c Bailey and the Balb/c Cumberland were from the University of Vermont.
	Metric 14:	Acclimatization and Pretreatment	Low	It was not reported if the mice were acclimated to testing conditions.
	Metric 15:	Conditions Number of Organisms and Population per Group	Low	The number of test organisms in each treatment was not reported.
		Replicates per Group		

Asbestos Environmental Hazard Evaluation HERO ID: 6867451 Table: 1 of 2

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Study Citation: Craighead, J. E., Richards, S. A., Calore, J. D., Fan, H., Weaver, D. L. (1993). Genetic factors influence malignant mesothelioma development in mice.

European Respiratory Review, vol. 3, review no. 11 118-120.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path: Taxa, Species, Age:

ecies, Age: Vertebrate; Mammalian; Mus musculus; C3H(He), DBA/2, Balb/c Bailey, Balb/c Cumberland; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 6867451

Domain		Metric	Rating	Comments
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	The test conditions and environment were not sufficiently reported to evaluate if they were adequate. It was not reported what the mice were fed for the duration of the study.
	Metric 17:	Outcome Assessment Methodology	Medium	Minimal detail provided on the methodology for using of monoclonal antibodies to identify cytokeratin's as a marker for malignant mesothelioma (reagents, materials, and instrumentation not described). Minimal description of methodology for use of other markers for determining epithelial tumors (reagents, materials, and instrumentation not described).
	Metric 18:	Consistency of Outcome Assessment	Medium	All mice were assessed twice weekly for illness and ascites. If either of those conditions were observed, the mouse was euthanized and examined for tumors. Cytokeratin in fibroblastoid cells was used as the criterion for identifying malignant mesothelioma.
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental condition—it was not reported if the mice were acclimated to study conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presen	ntation and Anal	lysis		
	Metric 21:	Statistical Methods	N/A	This portion of the study focused on pathological findings and thus statistical analysis was not conducted.
	Metric 22:	Reporting of Data	Medium	There was not data for negative control survival, but there was no reported negative control. Data for malignant mesothelioma can be found in Table 2 and Table 4, which also contains positive control data.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability not reported.
Additional Comments:	developmen	t, but also reported mortality. This evaluation verse of a negative control, thus the unacceptal	was done on the devel	t of malignant mesothelioma in mice. The study primarily looked at cancer opment of malignant mesothelioma data presented. The study authors did aluation was done on the tumor induction through cultured tumors portion

Overall Quality Determination

Uninformative

Asbestos Environmental Hazard Evaluation HERO ID: 6867451 Table: 2 of 2

Study Citation: Craighead, J. E., Richards, S. A., Calore, J. D., Fan, H., Weaver, D. L. (1993). Genetic factors influence malignant mesothelioma development in mice.

European Respiratory Review, vol. 3, review no. 11 118-120. Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Chemical:

Duration:

Taxa, Species, Age: Vertebrate; Mammalian; *Mus musculus*; C3H(He), DBA/2, Balb/c Bailey, Balb/c Cumberland; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mor

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 6867451

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the crocidolite was not reported.
	Metric 3:	Test Substance Purity	Medium	The crocidolite was described as UICC, so it was held to a certain standard.
Domain 2: Test Desi	gn			
20 100 2 00 C	Metric 4:	Negative Controls	Uninformative	The study authors did not report the use of a negative control. A positive control using 3-methycholanthrene was reported.
	Metric 5:	Negative Control Response	Low	There was no negative control, and thus a negative control response was not reported.
	Metric 6:	Randomized Allocation	Low	The study authors did not report how the mice were allocated into study groups.
Domain 3: Exposure	Characterization			
1	Metric 7:	Experimental System/Test Media Preparation	Medium	The crocidolite was prepared in Hank's solution, and 10mg was injected intraperitoneally into each mouse.
	Metric 8:	Consistency of Exposure Administra-	Low	Exposures were administered via injection into the peritoneal cavity. 10mg of crocido- lite was administered to each mouse. Unclear how much solution was injected.
	Metric 9:	Measurement of Test Substance	Low	It was not reported if the crocidolite was measured.
	Metric 10:	Concentration Exposure Duration and Frequency	High	Exposure was for the lifetime of the mouse or until the mouse developed illness or ascites.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of this study was not to have a dose dependent response, but to observe responses of genetically different mice to exposure to crocidolite.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Crocidolite is an insoluble chemical.
Domain 4: Tast Orga	niam			
Domain 4: Test Orga	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source. The mice used were all young females. The C3H and the DBA/2 strains came from Jackson Laboratories in Bar Harbor, ME, and the Balb/c Bailey and the Balb/c Cumberland were from the University of Vermont.
	Metric 14:	Acclimatization and Pretreatment	Low	It was not reported if the mice were acclimated to testing conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	The number of test organisms in each treatment was not reported.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 6867451 Table: 2 of 2

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Study Citation: Craighead, J. E., Richards, S. A., Calore, J. D., Fan, H., Weaver, D. L. (1993). Genetic factors influence malignant mesothelioma development in mice.

European Respiratory Review, vol. 3, review no. 11 118-120. Overall Duration: > 21 days; Exposure Duration: > 21 days

Duration: Overall Duration **Exposure Route,** Terrestrial; N/A

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Mus musculus; C3H(He), DBA/2, Balb/c Bailey, Balb/c Cumberland; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Morta

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 6867451

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Low	The test conditions and environment were not sufficiently reported to evaluate if they were adequate. It was not reported what the mice were fed for the duration of the study
	Metric 17:	Outcome Assessment Methodology	Low	The outcome assessment methodology unclear on mortality observations or if dead mic were removed from the cage. Mice were observed twice weekly illness or ascites. If illness or ascites was observed, mice were removed and examined for tumors.
	Metric 18:	Consistency of Outcome Assessment	Low	Unclear how often mice were monitored for mortality. Mice were monitored twice weekly for illness or ascites.
Domain 6: Confounding	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental condition—it was not reported if the mice were acclimated to study conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	It did not appear that statistical analysis was conducted on mortality.
	Metric 22:	Reporting of Data	Medium	There was not data for negative control survival, but there was no reported negative control. All other mortality data was presented.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.

Overall Quality Determination

Uninformative

HERO ID: 112 Table: 1 of 1

Study Citation: Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and

short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.

Overall Duration: 4 - 10 days; Exposure Duration: 4 - 10 days **Duration:**

Terrestrial; Food/Diet; Dietary **Exposure Route,**

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; MRC Hooded; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	naracterization			
Domain 3. Exposure Of	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	Details of exposure administration were not elaborated on
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	Low	The duration of exposure was shorter than common dietary rat exposures
	Metric 11:	Number of Exposure Groups/	Medium	only two exposure levels tested
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	exposure was via diet
Domain 4: Test Organis	ım			
Domain 4. Test Organis	Metric 13:	Test Organism Characteristics	Low	few details such as initial weight were reported
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	The number of test organisms and/or replicates was not reported
		Replicates per Group		
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology addressed the intended outcomes of interest although sample size was not reported

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Asbestos Environmental Hazard Evaluation HERO ID: 112 Table: 1 of 1

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Study Citation: Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and

short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.

Duration: Overall Duration: 4 - 10 days; Exposure Duration: 4 - 10 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; MRC Hooded; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 112

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	There were minor uncertainties in the outcome assessment study group size
		Assessment		
Domain 6: Confoundi	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	study focused on pathology findings
	Metric 22:	Reporting of Data	Low	Data were only reported for some outcomes
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 1 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organ	nism			
	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

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Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

Asbestos

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

HERO ID: 3615355 Table: 1 of 18

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 5: Outcome	e Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confour	nding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Pre	esentation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Crocidolite; Exposure duration 1- 8 Week(s); Study Duration 2 Month(s)Accumulation (Accumulation-Residue, Response Site: Feces,Gut)

Overall Quality Determination

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 2 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organ	niem			
Domain 1. 1est Organ	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

HERO ID: 3615355 Table: 2 of 18

April 2024

Environmental Hazard Evaluation

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Exposure Route,

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days Terrestrial; Food/Diet; Dietary

Exposure Route Media, Path:

a Dath.

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable C	ontrol		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and An	alysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments:

Amosite; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Cellular (Cell(s)-Cell changes, Organelle changes, Response Site: Gastrointestinal tract,Lymph node,Small intestine)

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3615355 Table: 3 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

e, Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

Asbestos

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
•	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	niem			
Domain 4. Test Orga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

April 2024

Environmental Hazard Evaluation

... continued from previous page

Study Citation:

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

HERO ID: 3615355 Table: 3 of 18

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

ne: Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 120-28-4)-amosite (grunerite) (GASRN 120-28-4)-amosite (grune

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
N	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Ν	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
N	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / V	Variable Cor	ntrol		
N	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
N	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation	on and Anal	ysis		
N	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
N	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
N	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments:

Amosite; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Cellular (Histology-Histological changes, general, Response Site: Gastrointestinal

tract)

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3615355 Table: 4 of 18

Study Citation:

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Taxa, Species, Age: Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 4 of 18

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
M	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
N.	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-changes in the gastrointestinal tract due to asbestos fibers.
M	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
5 1 6 5 6 11 17				
Domain 6: Confounding / V		ntrol		
M	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
M	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentatio	on and Analy	ysis		
N	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
N	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,
Additional Comments: C	Chrysotile; E	Exposure duration 2-52 Week(s); Study Dur	ation 1 Year(s)C	Cellular (Histology-Histological changes, general, Response Site: Gastrointestinal

Overall Quality Determination

tract)

Environmental Hazard Evaluation HERO ID: 3615355 Table: 5 of 18

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128. **Study Citation:**

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days Terrestrial; Food/Diet; Dietary

Exposure Route,

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Taxa, Species, Age: **Health Outcome:**

Chemical:

Asbestos

Gastrointestinal asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

April 2024

Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 12001-28-4)-amosite (grunerite) (grunerite) (grunerite) (grunerite) (grunerite) (grunerite) (grunerite) (grunerite) (grunerite) (gruner

HERO ID: 3615355 Table: 5 of 18

12172-73-5)

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 16	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
Metric 18	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable C	Control		
Metric 19	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and Ar	alysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments:

Chrysotile; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Cellular (Cell(s)-Cell changes, Organelle changes, Response Site: Gastrointestinal tract,Lymph node,Small intestine)

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 3615355 Table: 6 of 18 Asbestos

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128. **Study Citation:**

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administration	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
D 4. T+ O				
Domain 4: Test Orga		T+ O	M - 4:	The Color of Table M. I. ODE II
	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

April 2024

Environmental Hazard Evaluation

Asbestos

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrys

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3615355 Table: 6 of 18

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presenta	tion and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Chrysotile; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Accumulation (Accumulation-Residue, Response Site: Feces,Gut)

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3615355 Table: 7 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

Asbestos

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

HERO ID: 3615355 Table: 7 of 18

April 2024

Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Asbestos

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 1	6: Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 1	7: Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
Metric 1	8: Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable	Control		
Metric 1	9: Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 2		Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and A	Analysis		
Metric 2	1: Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 2	2: Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 2	3: Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Chrysotile; Exposure duration 13 Month(s); Study Duration 13 Month(s)Accumulation (Accumulation-Residue, Response Site: Feces,Gut)

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3615355 Table: 8 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Development/Growth

Chemical:

Asbestos

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subs	stance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desi	ign			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	aniem			
Domain 1. Test Orge	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

HERO ID: 3615355 Table: 8 of 18

Duration:

Chemical:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Development/Growth

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding /	Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentati	ion and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Amosite; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Growth (Development-Abnormal, Deformation, Response Site: Not reported)

Overall Quality Determination

April 2024

Environmental Hazard Evaluation HERO ID: 3615355 Table: 9 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

Asbestos

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subs	stance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desi	ign			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	aniem			
Domain 1. Test Orge	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 9 of 18

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Chemical:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Taxa, Species, Age: Health Outcome:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

Gastrointestinal

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-changes in the gastrointestinal tract due to asbestos fibers.
Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable Con	ntrol		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and Anal	ysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

raditional comments

Crocidolite; growth/development; exposure duration 2-52 weeks; study duration 1 yearCellular (Histology-Histological changes, general, Response Site: Gastrointestinal tract)Exposure duration 2-52 weeks; Cellular (Histology-Histological changes, general, Response Site: Gastrointestinal tract); This study observed the long term effects of 3 asbestos fibers, chrysotile, crocidolite, and amosite, on the gastrointestinal tract of male SPF Han rats. Three experiments were performed and all were to observe the gastrointestinal tract.

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 10 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Development/Growth

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 10 of 18

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: asbestos (CAS

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 120-28-4)-amosite (grunerite) (GASRN 120-2

HERO ID: 12172-73-5) 3615355

Domain	Metric	Rating	Comments
Metric	16: Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric	17: Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
Metric	18: Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variabl	e Control		
Metric	19: Confounding Variables in TestDesign and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric	20: Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and	Analysis		
Metric	21: Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric	22: Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric	23: Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments:

Crocidolite; exposure duration 2-52 weeks; study duration 1 yearGrowth (Development-Abnormal,Deformation, Response Site: Not reported)Exposure duration 2-52 weeks; Cellular (Cell(s)-Cell changes,Organelle changes, Response Site: Gastrointestinal tract,Lymph node,Small intestine); This study observed the long term effects of 3 asbestos fibers, chrysotile, crocidolite, and amosite, on the gastrointestinal tract of male SPF Han rats. Three experiments were performed and all were to observe the gastrointestinal tract.

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 11 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administration	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
D 4. T+ O				
Domain 4: Test Orga		T+ O	M - 4:	The Color of Table M. I. ODE II
	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 11 of 18

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Amosite; Exposure duration 1- 8 Week(s); Study Duration 2 Month(s)Accumulation (Accumulation-Residue, Response Site: Feces,Gut)

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 12 of 18

Study Citation:

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Taxa, Species, Age: Health Outcome:

Development/Growth

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure C	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organi	ism			
organi	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Development/Growth

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

HERO ID: 3615355 Table: 12 of 18

12172-73-5)

HERO ID:

3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Chrysotile; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Growth (Development-Abnormal, Deformation, Response Site: Not reported)

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 13 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path: Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Environmental Hazard Evaluation

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Study Citation:

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

HERO ID: 3615355 Table: 13 of 18

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 12001-28-4)-amosite (gruneri

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presenta	tion and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Chrysotile; Exposure duration 1- 8 Week(s); Study Duration 2 Month(s)Accumulation (Accumulation-Residue, Response Site: Feces,Gut)

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 14 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

HERO ID: 3615355 Table: 14 of 18

April 2024

Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Asbestos

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 12001-28-4)-amosite (grunerite)

12172-73-5)

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable C	ontrol		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:	2	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and Ar	alysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Amosite; Exposure duration 2-52 Week(s); Study Duration 1 Year(s)Accumulation (Accumulation-Residue, Response Site: Gut)

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 15 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure C	Characterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organi	in.			
Domain 4: Test Organi	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

HERO ID: 3615355 Table: 15 of 18

April 2024

Environmental Hazard Evaluation

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Asbestos

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 12001-28-4)-amosite (grunerite)

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confoundi	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: Amosite; Exposure duration 13 Month(s); Study Duration 13 Month(s)Accumulation (Accumulation-Residue, Response Site: Gut)

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 16 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path: Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Orga	nism			
Domain 1. 10st Olga	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

Asbestos Environmental Hazard Evaluation

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Study Citation:

Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

HERO ID: 3615355 Table: 16 of 18

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (GASRN 12001-28-4)-amosite (gruneri

12172-73-5)

HERO ID:

3615355

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–changes in the gastrointestinal tract due to asbestos fibers.
Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable C	ontrol		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and An	alysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments:

Crocidolite; growth/development; exposure duration 2-52 weeks; study duration 1 yearCellular (Cell(s)-Cell changes, Organelle changes, Response Site: Gastrointestinal tract, Lymph node, Small intestine) Exposure duration 2-52 weeks; Cellular (Histology-Histological changes, general, Response Site: Gastrointestinal tract); This study observed the long term effects of 3 asbestos fibers, chrysotile, crocidolite, and amosite, on the gastrointestinal tract of male SPF Han rats. Three experiments were performed and all were to observe the gastrointestinal tract.

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 17 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path: Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Chemical:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure C	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organi	ism			
organi	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Environmental Hazard Evaluation

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Bioaccumulation; 2-52 Week(s) exposure duration

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

HERO ID: 3615355 Table: 17 of 18

12172-73-5)

HERO ID: 3615355

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding / Variable C	Control		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
Metric 20:		Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presentation and Ar	alysis		
Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Overall Quality Determination

Additional Comments:

Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 18 of 18

Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Other (please specify below) (Bioaccumulation)

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance		-	
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile, crocidolite, and amosite was not reported, nor were they analytically verified.
	Metric 3:	Test Substance Purity	Medium	The chrysotile, crocidolite, and amosite were all reported as UICC standard references, and thus they met some standards.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Negative controls were reported in to be used in each portion of the study.
	Metric 5:	Negative Control Response	High	The response of the negative controls was reported in the text under the "results" section.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were divided into study groups.
Domain 3: Exposure	Characterization			
·	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail—the three different asbestos fiber were mixed in margarine at 5mg asbestos per 1g of margarine, so each rat was getting approximately 250-300mg asbestos per rat.
	Metric 8:	Consistency of Exposure Administra- tion	High	Rats were fed margarine dosed with a particular asbestos fiber at a dose of approximately 250-300mg of asbestos per rat. Rats were given the margarine ad libitum along with a pelleted diet. Exposures were administered consistently across study groups.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the asbestos concentrations were measured.
	Metric 10:	Exposure Duration and Frequency	High	The duration for each experiment was 1 year or less of exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the pathological response of the gastrointestinal tract to 3 different asbestos fibers.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble fiber and the exposure was via diet.
Domain 4: Test Organ	niem			
Domain 4. Test Olgan	Metric 13:	Test Organism Characteristics	Medium	The source of the rats was not reported. The rats were Male SPF Han rats that were reported to be 10wks of age at the start of the test.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	In the first and third experiments there were 4 rats for each asbestos fiber and 2 controls. In the second experiment there were 2 rats per fiber type and a control.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 3615355 Table: 18 of 18

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Study Citation: Bolton, R. E., Davis, J. M. (1976). The short-term effects of chronic asbestos ingestion in rats. Annals of Occupational Hygiene 19(1976):121-128.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path: Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; SPF Han; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Bioaccumulation)

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-crocidolite (riebeckite) (CASRN 12001-28-4)-amosite (grunerite) (CASRN

12172-73-5)

HERO ID: 3615355

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate. Rats were housed with two rats per cage. They were fed a standard laboratory rat pellet diet with the addition of asbestos dosed margarine.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—changes in the gastrointestinal tract due to asbestos fibers.
	Metric 18:	Consistency of Outcome Assessment	Medium	All groups were assessed the same for each experiment except for chrysotile in the ashing analysis. This was due to acid susceptibility of chrysotile.
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—the study did not report if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure.
Domain 7: Data Presenta	tion and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Poisson distribution was assumed in order to conduct comparisons between fibers.
	Metric 22:	Reporting of Data	Low	Data for exposure related findings was described in the text.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Statistics were reported to be performed, but there were nor measures of variability reported. However, the study was primarily on pathological effects of asbestos on the gastrointestinal tract,

Additional Comments: 13 month exposure duration

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 1 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150. Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Mortality

crocidolite (riebeckite) (CASRN 12001-28-4) **Chemical:**

HERO ID: 3584909

Domain		Metric	Rating	Comments
Domain 1: Test Substanc	e			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism	n			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Asse	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 1 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Mortality

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Low	Unclear how many rats were killed by subsampling or from being moribund vs allowed to live the remainder of their life span.
	Metric 18:	Consistency of Outcome Assessment	Low	Data not reported on when rats were killed.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	lysis		
	Metric 21:	Statistical Methods	Low	Authors state lack of statistical significance in text of results but test not described.
	Metric 22:	Reporting of Data	Uninformative	Mention in text of no significant difference between treatment and control average survival time but no numbers presented/described.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Additional Comments: None

Overall Quality Determination

Uninformative

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 2 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

amosite (grunerite) (CASRN 12172-73-5) **Chemical:**

3584909 **HERO ID:**

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design	gn			
•	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
Bolliani 3. Exposure	Metric 7:	Experimental System/Test Media	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Preparation Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. No explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Orga	nism			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	Unclear how many rats were killed by subsampling or from being moribund vs allowed to live the remainder of their life span.
		Cont	tinued on next page	
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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 2 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Mortality

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Data not reported on when rats were killed.
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Authors state lack of statistical significance in text of results but test not described.
	Metric 22:	Reporting of Data	Uninformative	Mention in text of no significant difference between treatment and control average sur-
				vival time but no numbers presented/described.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Additional Comments: None

Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 3 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
· ·	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	haracterization			
Z cilium et Zilpesure e	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. No explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organi	sm			
Domain 1. Test Organi	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	Autopsy and histology procedures not well described. Determination of tumors not well described.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 3 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical:

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied after death.
		Assessment		
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistics were performed but statistical test not described.
	Metric 22:	Reporting of Data	High	Data presented in tables and some description in text.
	Metric 23:	Explanation of Unexpected Outcomes	High	Any unexpected outcomes satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Medium

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 4 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Mechanistic-Biomarkers (exposure and effect)-Genotox (including DNA repair)-Cancer/Carcinogenesis

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

	Metric 1:	Metric Test Substance Identity	Rating	Comments
	Metric 1:	Test Substance Identity		
		Test Substance Identity		
	Metric 2:		Low	Chemical was identified by name only.
		Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Char	acterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. No explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism				
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	Study utilized eight and six rats for this analysis from treatment and control, respectively.
		replicates per Group		4.009.
Domain 5: Outcome Asse	ssment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	High	Methodology well described.
	Metric 18:	Consistency of Outcome Assessment	High	Rats in this analysis were sampled at 25 months exposure.
			ued on next pa	0.000

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 4 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Mechanistic-Biomarkers (exposure and effect)-Genotox (including DNA repair)-Cancer/Carcinogenesis

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistics were performed as t-test and significance stated.
	Metric 22:	Reporting of Data	High	Data presented in tables and some description in text.
	Metric 23:	Explanation of Unexpected Outcomes	High	Any unexpected outcomes satisfactorily explained.

Additional Comments: amosite treatment only

Overall Quality Determination

Medium

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 5 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile Taxa, Species, Age:

Health Outcome: ADME (biotransformation)

Chemical: amosite (grunerite) (CASRN 12172-73-5)

3304707			
	Metric	Rating	Comments
ce			
Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
Metric 5:	Negative Control Response	_	The biological response of the negative control groups were reported.
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
aracterization			
Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. No explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
m			
Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
	Replicates per Group		
sessment			
Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
Metric 17:	Outcome Assessment Methodology	Uninformative	Results reported as fiber type per sample; however it was not stated how much sample was obtained from each rat or whether this was standardized across rats.
	Metric 1: Metric 2: Metric 3: Metric 3: Metric 4: Metric 5: Metric 6: aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group	Metric 1: Test Substance Identity Low Metric 2: Test Substance Source High Metric 3: Test Substance Purity High Metric 3: Test Substance Purity High Metric 4: Negative Controls High Metric 5: Negative Control Response High Metric 6: Randomized Allocation Low aracterization Metric 7: Experimental System/Test Media Low Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Low Concentration Metric 10: Exposure Duration and Frequency Medium Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Metric 14: Acclimatization and Pretreatment Low Conditions Metric 15: Number of Organisms and Low Replicates per Group sessment Metric 16: Adequacy of Test Conditions Low

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 5 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

ADME (biotransformation)

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied for fiber analysis after death.
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	vsis		
Domain 7. Data 110	Metric 21:	Statistical Methods	N/A	Study focused on presence of fiber type.
	Metric 22:	Reporting of Data	Low	Results presented in table; however, sample size (weight, area) from each rat not described nor how many rats were sampled for the fiber analysis.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Unclear how much sample was analyzed therefore unable to determine if excessive variability was present.

Additional Comments: None

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 6 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

111110 121	220.707			
Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design	1			
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	Characterization			
Domain of Enposure C	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured.
	Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organ	ism			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	Autopsy and histology procedures not well described. Determination of tumors not well described.
		Contin	ued on next pa	age

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 6 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical:

amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied after death.
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmenta
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistics were performed but statistical test not described.
	Metric 22:	Reporting of Data	High	Data presented in tables and some description in text.
	Metric 23:	Explanation of Unexpected Outcomes	High	Any unexpected outcomes satisfactorily explained.

Overall Quality Determination

Additional Comments: None

Medium

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 7 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	;			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Char	acterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg as- bestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism				
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Asse	ssment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Uninformative	Results reported as fiber type per sample; however it was not stated how much sample was obtained from each rat or whether this was standardized across rats.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 7 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

ADME (biotransformation)

Chemical:

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied for fiber analysis after death.
		Assessment		
Domain 6: Confoun	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pre	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Study focused on presence of fiber type.
	Metric 22:	Reporting of Data	Low	Results presented in table; however, sample size (weight, area) from each rat not described nor how many rats were sampled for the fiber analysis.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Unclear how much sample was analyzed therefore unable to determine if excessive variability was present.

Additional Comments: None

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 8 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; HAN spf Wistar; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain	Metric	Rating	Comments
Domain 1: Test Substance			
Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design			
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Characterization	1		
Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured.
Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. No explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism			
Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
	Replicates per Group		
Domain 5: Outcome Assessment			
Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
Metric 17:	Outcome Assessment Methodology	Uninformative	Results reported as fiber type per sample; however it was not stated how much sample was obtained from each rat or whether this was standardized across rats.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 8 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

: Vertebrate; Mammalian; *Rattus norvegicus*; HAN spf Wistar; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied for fiber analysis after death.
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Preso	entation and Anal	vsis		
	Metric 21:	Statistical Methods	N/A	Study focused on presence of fiber type.
	Metric 22:	Reporting of Data	Low	Results presented in table; however, sample size (weight, area) from each rat not described nor how many rats were sampled for the fiber analysis.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Unclear how much sample was analyzed therefore unable to determine if excessive variability was present.

Additional Comments: None

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 9 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile Taxa, Species, Age:

Health Outcome:

Cancer/Carcinogenesis

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	ice			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups were reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cl	naracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organis	sm			
Č	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	Autopsy and histology procedures not well described. Determination of tumors not well described.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 9 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Cancer/Carcinogenesis

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Rats were autopsied after death.
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Statistics were performed but statistical test not described.
	Metric 22:	Reporting of Data	High	Data presented in tables and some description in text.
	Metric 23:	Explanation of Unexpected Outcomes	High	Any unexpected outcomes satisfactorily explained.

Overall Quality Determination

Medium

Asbestos **Environmental Hazard Evaluation** HERO ID: 3584909 Table: 10 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile Taxa, Species, Age:

Health Outcome:

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	Unclear how many rats were killed by subsampling or from being moribund vs allowed to live the remainder of their life span.

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 10 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Data not reported on when rats were killed.
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	lysis		
	Metric 21:	Statistical Methods	Low	Authors state lack of statistical significance in text of results but test not described.
	Metric 22:	Reporting of Data	Uninformative	Mention in text of no significant difference between treatment and control average survival time but no numbers presented/described.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Additional Comments: None

Environmental Hazard Evaluation HERO ID: 3584909 Table: 11 of 16 Asbestos

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Behavioral

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured.
	Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4. Test Organis				
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided on food consumption/fecal collection protocol.
	Metric 18:	Consistency of Outcome Assessment	Low	Data not reported on timing of endpoint assessment.
			ntinued on next page	

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 11 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Chemical:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: B

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
Domain 6: Confoun	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
D				
Domain 7: Data Pre	sentation and Anal	ysis —		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in food consumption and fecal production between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Behavioral

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance				
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Char	racterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured.
	Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism	1			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Asse	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided on food consumption/fecal collection protocol.
	Metric 18:	Consistency of Outcome Assessment	Low	Data not reported on timing of endpoint assessment.
			tinued on next page	•••

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 12 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; HAN spf Wistar; Juvenile

Health Outcome:

Behavioral

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Presen		•		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in food consumption and fecal production between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 3584909 Table: 13 of 16 Asbestos

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Development/Growth

crocidolite (riebeckite) (CASRN 12001-28-4) **Chemical:**

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design	1			
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	haracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra-	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organi	sm			
Domain I. Test organi	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided of weighing regime.
	Metric 18:	Consistency of Outcome	Low	Data not reported on when rats were weighed.
		Assessment		
		Con	tinued on next page.	••

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 13 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Media, Pain:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Development/Growth

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in weight between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
Ü	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	aracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration.
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism	n			
	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided of weighing regime.
	Metric 18:	Consistency of Outcome	Low	Data not reported on when rats were weighed.
		Assessment		
		Con	ntinued on next page	••

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 14 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome:

Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in weight between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

HERO ID: 3584909 Table: 15 of 16

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Development/Growth

chrysotile (serpentine) (CASRN 12001-29-5) **Chemical:**

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Desig	n			
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organ	nism			
Domain II Test organ	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	Study utilized between 22-24 rats per group without replicate.
Domain 5: Outcome	A academant			
Domain 5: Outcome I	Assessment Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided of weighing regime.
	Metric 17:	Consistency of Outcome	Low	Data not reported on when rats were weighed.
	wienie 16.	Assessment Assessment	LUW	Data not reported on when rats were weighted.
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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 15 of 16

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Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584909

Additional Comments: None

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in weight between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 3584909 Table: 16 of 16 Asbestos

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile Taxa, Species, Age:

Health Outcome:

Behavioral

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substance	e			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Samples were UICC reference samples, referenced to Rendall 1980.
	Metric 3:	Test Substance Purity	High	Characterization of UICC reference samples described in Rendall 1980.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control group was not reported.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	aracterization			
•	Metric 7:	Experimental System/Test Media Preparation	Low	Author cited methodology; however cited methodology does not adequately describe preparation of test substrate/experimental design.
	Metric 8:	Consistency of Exposure Administra- tion	Low	Authors report approximate loading of 250 mg asbestos per week per rat and 5 mg asbestos/margarine but do not describe details of feeding such as timing.
	Metric 9:	Measurement of Test Substance Concentration	Low	Exposure concentrations were not measured.
	Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported as 25 months and suitable for the study type. Not explicitly stated if feeding of treatment with margarine was daily and, if so, how many times a day.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet (margarine).
Domain 4: Test Organism	n			
Domain 1. Test Organisi	Metric 13:	Test Organism Characteristics	High	Strain, age, and sex of rats reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	Study utilized between 22-24 rats per group without replicate.
		Replicates per Group		
Domain 5: Outcome Ass	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate.
	Metric 17:	Outcome Assessment Methodology	Low	No details provided on food consumption/fecal collection protocol.
	Metric 18:	Consistency of Outcome Assessment	Low	Data not reported on timing of endpoint assessment.
			tinued on next page	

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Asbestos Environmental Hazard Evaluation HERO ID: 3584909 Table: 16 of 16

... continued from previous page

Study Citation: Bolton, R. E., Davis, J. M. G., Lamb, D. (1982). The pathological effects of prolonged asbestos ingestion in rats. Environmental Research 29(1982):134-

150.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; HAN spf Wistar; Juvenile

Health Outcome: Behavi

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3584909

Domain		Metric	Rating	Comments
Domain 6: Confoun	nding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pre	esentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Chemical-specific data not reported. Authors describe approximate difference in food consumption and fecal production between untreated and vehicle-control rats.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No measures of variability reported.

Overall Quality Determination

Additional Comments: None

HERO ID: 3101157 Table: 1 of 3

Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	Source of asbestos reported as, Johns-Manville Company, Asbestos, Quebec, Grade No. 7RF02.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Design	1			
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	haracterization			
Z omani er Emposare e	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided few details on exposure media preparation
	Metric 8:	Consistency of Exposure Administra-	Medium	ad libitum feeding always has some uncertainty regarding consistancy
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration was used
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure was via diet
Domain 4: Test Organi	sm			
Č	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	Downgraded due to using only 10 organisms without the use of replicates
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
		Contin	ued on next pa	nge

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Asbestos Environmental Hazard Evaluation HERO ID: 3101157 Table: 1 of 3

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Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3101157

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	entation and Anal	vsis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained.

Additional Comments:

Overall Quality Determination

experiment 1

Medium

Asbestos Environmental Hazard Evaluation HERO ID: 3101157 Table: 2 of 3

Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3101137			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	Source of asbestos reported as, Johns-Manville Company, Asbestos, Quebec, Grade No. 7RF02.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using 2 concurrent negative control groups, molasses and corn oil, later combined values
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported, downgraded because all organs contained asbestos
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C	haracterization			
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided few details on exposure media preparation
	Metric 8:	Consistency of Exposure Administra-	Medium	ad libitum feeding always has some uncertainty regarding consistancy
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration was used
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
Domain 4: Test Organis	sm			
Domain ii Test organi	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
		Conditions		
	Metric 15:	Number of Organisms and	Low	Downgraded due to using only 10 organisms without the use of replicates
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	nge

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Asbestos Environmental Hazard Evaluation HERO ID: 3101157 Table: 2 of 3

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Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3101157

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Authors did not address the asbestos levels found in control organs

Additional Comments: experiment 3

Overall Quality Determination

Medium

HERO ID: 3101157 Table: 3 of 3

Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3101157			
Domain		Metric	Rating	Comments
Domain 1: Test Subs				
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	Source of asbestos reported as, Johns-Manville Company, Asbestos, Quebec, Grade No. 7RF02.
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance were not reported.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure	Characterization			
r	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided few details on exposure media preparation
	Metric 8:	Consistency of Exposure Administra-	Medium	ad libitum feeding always has some uncertainty regarding consistancy
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	Only one concentration was used
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
Domain 4: Test Orga	nism			
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	Downgraded due to using only 10 organisms without the use of replicates
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
		Contin	ued on next pa	ige

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 3101157 Table: 3 of 3

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Study Citation: Cunningham, H. M., Moodie, C. A., Lawrence, G. A., Pontefract, R. D. (1977). Chronic effects of ingested asbestos in rats. Archives of Environmental

Contamination and Toxicology 6(1977):507-513.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3101157

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confoun	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Pres	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained.

Additional Comments: experiment 2

Overall Quality Determination

Medium

Asbestos **Environmental Hazard Evaluation** HERO ID: 3616802 Table: 1 of 5

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Fisher 344, SPF stock; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Cited references provided characterization of the asbestos.
Domain 2: Test Design				
Ü	Metric 4:	Negative Controls	High	Two control groups were included in the study.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Figure 1 and reasonable for assessed outcomes.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha	aracterization			
Z omani ev Znposare em	Metric 7:	Experimental System/Test Media Preparation	High	Details were provided on how asbestos was incorporated into the feed.
	Metric 8:	Consistency of Exposure Administra-	Low	Details of how much feed was provided (vs free-feeding), how often feed was provided/ changed were lacking.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	High	Exposure duration was 6 weeks.
	Metric 11:	Number of Exposure Groups/	High	Five doses were tested (1-20% asbestos in diet).
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Exposure via diet.
Domain 4: Test Organism	n			
Domain 1. Test Organisi	Metric 13:	Test Organism Characteristics	High	Common name, strain, source, and age stated.
	Metric 14:	Acclimatization and Pretreatment	High	Rats were acclimated for 1 week before conducting experiments.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	10 rats per treatment group, 10 rats per cellulose control group, and 20 standard diet control rats were utilized in the experiment.
		Replicates per Group		control tale more difficult in the experiment.
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Medium	Conditions adequately explained, amount of diet not described.
	Metric 17:	Outcome Assessment Methodology	Medium	Weight gain was determined at 6 weeks with initial weight presumably taken at start of study (this was not stated). Total weight not stated.

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 1 of 5

... continued from previous page

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Not explicitly stated when the rats were weighed. Figure 1 legend indicates weight gain
		Assessment		determined at 6 weeks of exposure.
		_		
Domain 6: Confounding	g/Variable Con	trol		
	Metric 19:	Confounding Variables in Test	Medium	Treated rats kept in a different room than control rats (presumably to limit asbestos ex-
		Design and Procedures		posure to control rats). However, both rooms seemed to contain the same environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Presenta	ation and Analy	/sis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Medium	Sex-specific average weight gain per treatment group presented in Figure 1. Total body weights not reported at beginning and start of study. Minimal discussion in text of the results (discussion found in methods section).
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals).

Additional Comments: None

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 2 of 5

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Fisher 344, SPF stock; Juvenile

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Cited references provided characterization of the asbestos.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Two control groups (cellulose diet and standard laboratory diet).
	Metric 5:	Negative Control Response	Medium	Biological responses of controls shown in Figure 1 and with positive tumor results described in Table 1 and lesion results shown in Table 2. Number of tumors in standard laboratory diet control equaled that of the asbestos treatment.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure C				
	Metric 7:	Experimental System/Test Media Preparation	High	Details were provided on how asbestos was incorporated into the feed.
	Metric 8:	Consistency of Exposure Administra-	Low	Details of how much feed was provided (vs free-feeding), how often feed was provided changed were lacking.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentration was not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported (6 months-32 months) and suitable for the study type (chronic).
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration was tested (10% asbestos in feed).
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via diet.
Domain 4: Test Organia	sm			
	Metric 13:	Test Organism Characteristics	High	Common name, strain, source, and age stated.
	Metric 14:	Acclimatization and Pretreatment	High	Rats were acclimated for 1 week before conducting experiments.
	Metric 15:	Conditions Number of Organisms and	Medium	Asbestos treatment contained 240 rats, fiber control group contained 242 rats, and stan-
		Replicates per Group		dard laboratory diet group contained 121 rats.
D		-		
Domain 5: Outcome A		A do To Co didi	M - J:	
	Metric 16:	Adequacy of Test Conditions	Medium	Conditions adequately explained, amount of diet not described.
	Metric 17:	Outcome Assessment Methodology	High	Outcome methodology well described.

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 2 of 5

... continued from previous page

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

This form also applies to the preliminary IP experiment.

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain	Metric	Rating	Comments
Metric	8: Consistency of Outcome Assessment	High	Observations were made at 6, 7, and 8 months of exposure with routine sampling. From then-on to the end of the study (32 months exposure), sacrifice was made only for the rats that were noticeably ill/dying with the remaining rats sacrificed at 32 months.
Domain 6: Confounding / Variabl	e Control		
Metric	9: Confounding Variables in Test Design and Procedures	Medium	Treated rats kept in a different room than control rats (presumably to limit asbestos exposure to control rats). However, both rooms seemed to contain the same environmental conditions.
Metric 2	20: Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Presentation and	Analysis		
Metric 2	21: Statistical Methods	High	Statistical methods were adequately explained.
Metric 2	22: Reporting of Data	High	Data for exposure-related findings were presented for asbestos-treated and control groups in Figure 2, Table 1, and Table 2.
Metric 2	23: Explanation of Unexpected Outcomes	High	Unexpected outcome (high incidence of colon tumors in one of the control groups) satisfactorily explained by the authors.

Overall Quality Determination

Additional Comments:

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 3 of 5

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: Not-reported; Exposure Duration: > 21 days

Exposure Route,

Taxa, Species, Age:

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; Fisher 344, SPF stock; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3616802			
Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Cited references provided characterization of the asbestos.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Two control groups were included in the study.
	Metric 5:	Negative Control Response	Medium	Several of the control rats had fibers in tissues of the colon. Also not clear as to fiber load per section of tissue as this was not reported by the authors.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Evnosura Ch	oroctarization			
Domain 3: Exposure Cha	Metric 7:	Experimental System/Test Media	High	Details were provided on how asbestos was incorporated into the feed.
	wichie /.	Preparation	mgn	Details were provided on now aspestos was incorporated into the reed.
	Metric 8:	Consistency of Exposure Administra-	Low	Details of how much feed was provided (vs free-feeding), how often feed was provided/
		tion		changed were lacking.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentration was not measured.
		Concentration		
	Metric 10:	Exposure Duration and Frequency	Medium	The duration of exposure was reported (24 months) and suitable for the study type. Not explicitly stated when study was ended.
	Metric 11:	Number of Exposure Groups/	N/A	Only one concentration was tested.
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via diet.
Domain 4: Test Organism	n			
	Metric 13:	Test Organism Characteristics	High	Common name, strain, source, and age stated.
	Metric 14:	Acclimatization and Pretreatment	High	Rats were acclimated for 1 week prior to conducting experiments.
	Metric 15:	Conditions Number of Organisms and	Low	
	Menic 13:		LOW	10 rats in both the asbestos and cellulose control group were included in the study. 6 rats were included in the standard laboratory diet control group.
		Replicates per Group		were meraded in the standard mooratory diet control group.
Domain 5: Outcome Ass				
Domain 5. Outcome 7155	35	Adequacy of Test Conditions	Medium	Conditions adequately explained, amount of diet not described.
Boniam 3. Outcome 71se	Metric 16: Metric 17:	Outcome Assessment Methodology	High	Outcome methodology adequately described.

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 3 of 5

... continued from previous page

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: Not-reported; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Fisher 344, SPF stock; Juvenile

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome Assessment	Low	Unclear when study was terminated or rats were sacrificed (it was stated that rats were switched to a normal diet at least 30 days before their death or the termination of the study).
Domain 6: Confoundin	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	Unclear how long rats in the asbestos and cellulose groups were on the standard diet prior to sacrifice/death.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	Study focused on pathology findings.
	Metric 22:	Reporting of Data	Low	Data was presented as absence or presence of fibers in colon tissue; fiber load not presented.
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcome (presence of fibers in colon of control rats) were satisfactorily explained as contamination with different type of material since fiber length did not match UICC chrysotile.

Additional Comments: lesions

Overall Quality Determination

Low

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 4 of 5

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: Not-reported; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

Health Outcome:Mechanistic-Cell signaling/function-Kidney/renalChemical:chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Cited references provided characterization of the asbestos.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Two control groups included in the study.
	Metric 5:	Negative Control Response	Medium	The biological response of control groups is shown in Figures 4 (cAMP) and 5 (cGMP) and appears reasonable for cAMP. No explanation provided for why standard laboratory diet control response was equal to that of asbestos group for cGMP whereas the cellulose control group had an order of magnitude greater level of cGMP.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch		T	*** 1	
	Metric 7:	Experimental System/Test Media	High	Details were provided on how asbestos was incorporated into the feed.
	Metric 8:	Preparation Consistency of Exposure Administration	Low	Details of how much feed was provided (vs free-feeding), how often feed was provided/changed were lacking.
	Metric 9:	Measurement of Test Substance	Low	Exposure concentration was not measured.
		Concentration		1
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported (24 months) and suitable for the study type. Study was terminated when rats were 33 months of age.
	Metric 11:	Number of Exposure Groups/	N/A	One concentration was tested.
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via diet.
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	Common name, strain, source, and age stated.
	Metric 14:	Acclimatization and Pretreatment	High	Rats were acclimated for 1 week before conducting experiments.
		Conditions		
	Metric 15:	Number of Organisms and Replicates per Group	Low	Although 36 and 30 rats used in asbestos and cellulose control groups, respectively, only 6 rats were included in the standard laboratory diet control group for analysis of cAMP. Similarly, 7, 30, and 4 rats were included in asbestos, cellulose, and standard laboratory diet control groups for analysis of cGMP.

Domain 5: Outcome Assessment

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 4 of 5

... continued from previous page

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: Not-reported; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

Health Outcome:Mechanistic-Cell signaling/function-Kidney/renalChemical:chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Medium	Conditions adequately explained, amount of diet not described.
	Metric 17:	Outcome Assessment Methodology	Medium	The radioimmunoassay technique was lacking in detail past the vendor.
	Metric 18:	Consistency of Outcome	Medium	Rats were terminated at 33 months of age. Presumably, the weanlings were 1 month of age when study commenced but this was not explicitly stated.
		Assessment		age when study commenced but this was not explicitly stated.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Medium	Treated rats kept in a different room than control rats (presumably to limit asbestos exposure to control rats). However, both rooms seemed to contain the same environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	It does not appear that statistics were conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Figures 4 and 5.
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Variability of the data shown in Figures 4 and 5 but no explanation provided by authors of why cGMP levels were equal between asbestos and one of the control groups but far

Additional Comments: cAMP

Overall Quality Determination

Medium

higher in the other control group.

Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 5 of 5

Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	3010602			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Cited references provided characterization of the asbestos.
Domain 2: Test Design				
_	Metric 4:	Negative Controls	High	Control rats were either gavaged or injected with DI water.
	Metric 5:	Negative Control Response	Medium	Authors stated no lesions found in the control rats. Unclear if this included observation of mesothelioma.
	Metric 6:	Randomized Allocation	Low	Random allocation not stated.
Domain 3: Exposure Ch	aracterization			
r	Metric 7:	Experimental System/Test Media Preparation	Low	Minimal details on preparation of asbestos slurry in water.
	Metric 8:	Consistency of Exposure Administra-	Low	Presumably all rats gavaged or injected on the same day but not explicitly stated.
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured.
	Metric 10:	Concentration Exposure Duration and Frequency	Medium	Animals presumably gavaged or IP injected a single time and observations noted 4-8 months after exposure but this was not explicitly stated.
	Metric 11:	Number of Exposure Groups/	High	Three asbestos doses used: 5.9 mg, 17.1 mg, and 29.4 mg.
		Spacing of Exposure Levels	_	
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via gavage and IP injection.
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	High	Common name, strain, source, and age stated.
	Metric 14:	Acclimatization and Pretreatment	High	Rats were acclimated for 1 week before conducting experiments.
		Conditions	C	
	Metric 15:	Number of Organisms and Replicates per Group	Low	26 rats gavaged with asbestos (authors stated divided into three equal groups, one group per dose), 18 rats injected with asbestos (authors stated divided into three equal groups one group per dose), 3 control rats gavage with DI water, 2 control rats injected with D water. Number of rats per treatment group in the asbestos gavage is confusing. Number of control rats is lower than that used in the treatment groups.
Domain 5: Outcome As	sessment			
Zamani J. Gateonie 115	Metric 16:	Adequacy of Test Conditions	Medium	Conditions adequately explained, amount of diet not described.
		Con	tinued on next page	

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Asbestos Environmental Hazard Evaluation HERO ID: 3616802 Table: 5 of 5

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Study Citation: Donham, K. J., Berg, J. W., Will, L. A., Leininger, J. R. (1980). The effects of long-term ingestion of asbestos on the colon of F344 rats. Cancer

45(1980):1073-1084.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Additional Comments:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fisher 344, SPF stock; Juvenile

This form also applies to the preliminary IP experiment.

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3616802

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Low	No details provided as to how the authors determined mesotheliomas or gastric lesions.
	Metric 18:	Consistency of Outcome	Low	Not explicitly stated when the experiment ended. Observations found between 4-8
		Assessment		months post-treatment.
Domain 6: Confoun	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Medium	Treated rats kept in a different room than control rats (presumably to limit asbestos ex-
		Design and Procedures		posure to control rats). However, both rooms seemed to contain the same environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups.
Domain 7: Data Pre	sentation and Anal	lysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics not performed.
	Metric 22:	Reporting of Data	Uninformative	Dose-specific effects not stated. Instead, results in text were presented as asbestos- treated vs control.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals).

Overall Quality Determination

Uninformative

HERO ID: 3619879 Table: 1 of 2

Study Citation: Engelbrecht, F. M., Burger, B. F. (1973). Biological effect of asbestos dust on the peritoneal viscera of rats. South African Medical Journal 47(1973):1746-

1750. Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Cancer/Carcinogenesis **Health Outcome:**

crocidolite (riebeckite) (CASRN 12001-28-4) **Chemical:**

HERO ID: 3619879

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile and the crocidolite was not reported.
	Metric 3:	Test Substance Purity	Medium	Both the chrysotile and the crocidolite were reported as UICC standard reference as- bestos samples, so they were held to a standard.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	Uninformative	The study did not report the use of negative controls.
	Metric 5:	Negative Control Response	Low	The study did not report the use of a negative control, and therefore did not report a negative control response.
	Metric 6:	Randomized Allocation	Medium	The rats were reported to be randomly divided into two study groups.
Domain 3: Exposure	Characterization			
,	Metric 7:	Experimental System/Test Media Preparation	High	The chrysotile and crocidolite particles were suspended in saline solution at 50mg/mL and injected into the abdominal cavity of the rats.
	Metric 8:	Consistency of Exposure Administration	Medium	Details of exposure administration were reported in some detail—All rats were injected with 1mL of the 50mg/mL suspension of asbestos along with 1mL of air. The timing of when the animals received the injection was not reported.
	Metric 9:	Measurement of Test Substance	Low	The study authors did not report if the test substances were measured.
	Metric 10:	Concentration Exposure Duration and Frequency	High	This study was described as a survival experiment and went for the duration of the rats' lives.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the response of the rats to either chrysotile or crocidolite injected into the abdominal cavity.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Chrysotile and crocidolite are insoluble chemicals.
Domain 4: Test Orgai	nism			
Zemani ii Test Olgai	Metric 13:	Test Organism Characteristics	Low	The rats were female albinos, but the source of the rats and the age of the rats were not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	It was not reported whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	There were 10 animals per treatment. This is lower than numbers typically used in these tests.

Asbestos Environmental Hazard Evaluation HERO ID: 3619879 Table: 1 of 2

... continued from previous page

Study Citation: Engelbrecht, F. M., Burger, B. F. (1973). Biological effect of asbestos dust on the peritoneal viscera of rats. South African Medical Journal 47(1973):1746-

1750.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: C

Cancer/Carcinogenesis

Chemical: cr

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3619879

Domain		Metric	Rating	Comments
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions and food and water conditions were not sufficiently reported to evaluate if they were adequate. Housing was not described either.
	Metric 17:	Outcome Assessment Methodology	Low	Minimal description on histological examination for tumors.
	Metric 18:	Consistency of Outcome Assessment	High	Animals were assessed daily for signs and symptoms of abdominal tumors. Once ascites developed, the rat was killed and the abdominal organs were inspected. Tissue was taken for histological examination.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Pres	sentation and Anal	lysis		
	Metric 21:	Statistical Methods	N/A	This study focused on pathological findings and therefore no statistics were performed.
	Metric 22:	Reporting of Data	Medium	Pathological results for each asbestos fiber were reported in the text and in Figures 1-7 for treatment only. No control group was reported and no results for control shown.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comment	-	was on the effect of intraperitoneal injection of na. This study received an unacceptable ranking		dolite in rats. Rats were then observed for the development of malignant did not report the use of a negative control.

Overall Quality Determination

Uninformative

HERO ID: 3619879 Table: 2 of 2

Study Citation: Engelbrecht, F. M., Burger, B. F. (1973). Biological effect of asbestos dust on the peritoneal viscera of rats. South African Medical Journal 47(1973):1746-

1750.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; N/A (e.g., injection); Injection

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3619879

Domain		Metric	Rating	Comments
Domain 1: Test Subst	tance			
	Metric 1:	Test Substance Identity	Low	The test substances were identified by name only.
	Metric 2:	Test Substance Source	Low	The source of the chrysotile and the crocidolite was not reported.
	Metric 3:	Test Substance Purity	Medium	Both the chrysotile and the crocidolite were reported as UICC standard reference as- bestos samples, so they were held to a standard.
Domain 2: Test Desig	gn			
	Metric 4:	Negative Controls	Uninformative	The study did not report the use of negative controls.
	Metric 5:	Negative Control Response	Low	The study did not report the use of a negative control, and therefore did not report a negative control response.
	Metric 6:	Randomized Allocation	Medium	The rats were reported to be randomly divided into two study groups.
Domain 3: Exposure	Characterization			
Domain 3. Exposure	Metric 7:	Experimental System/Test Media Preparation	High	The chrysotile and crocidolite particles were suspended in saline solution at 50mg/mL and injected into the abdominal cavity of the rats.
	Metric 8:	Consistency of Exposure Administration	Medium	Details of exposure administration were reported in some detail—All rats were injected with 1mL of the 50mg/mL suspension of asbestos along with 1mL of air. The timing of when the animals received the injection was not reported.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report if the test substances were measured.
	Metric 10:	Exposure Duration and Frequency	High	This study was described as a survival experiment and went for the duration of the rats' lives.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent response, but to observe the response of the rats to either chrysotile or crocidolite injected into the abdominal cavity.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Chrysotile and crocidolite are insoluble chemicals.
Domain 4: Test Organ	nism			
Domain 1. Test Organ	Metric 13:	Test Organism Characteristics	Low	The rats were female albinos, but the source of the rats and the age of the rats were not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	It was not reported whether the rats were acclimated to test conditions.
	Metric 15:	Number of Organisms and	Low	There were 10 animals per treatment. This is lower than numbers typically used in these
		Replicates per Group		tests.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 3619879 Table: 2 of 2

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Study Citation: Engelbrecht, F. M., Burger, B. F. (1973). Biological effect of asbestos dust on the peritoneal viscera of rats. South African Medical Journal 47(1973):1746-

1750.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; N/A (e.g., injection); Injection

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3619879

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions and food and water conditions were not sufficiently reported to evaluate if they were adequate. Housing was not described either.
	Metric 17:	Outcome Assessment Methodology	Low	Minimal description on histological examination for tumors.
	Metric 18:	Consistency of Outcome Assessment	High	Animals were assessed daily for signs and symptoms of abdominal tumors. Once ascites developed, the rat was killed and the abdominal organs were inspected. Tissue was taken for histological examination.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimated to test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure
Domain 7: Data Present	tation and Anal	vsis		
	Metric 21:	Statistical Methods	N/A	This study focused on pathological findings and therefore no statistics were performed.
	Metric 22:	Reporting of Data	Medium	Pathological results for each asbestos fiber were reported in the text and in Figures 1-7 for treatment only. No control group was reported and no results for control shown.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comments:	-	vas on the effect of intraperitoneal injection of na. This study received an unacceptable ranking		dolite in rats. Rats were then observed for the development of malignant did not report the use of a negative control.

Overall Quality Determination

Uninformative

HERO ID: 478543 Table: 1 of 2

Study Citation: Hasanoglu, H. C., Bayram, E., Hasanoglu, A., Demirag, F. (2008). Orally ingested chrysotile asbestos affects rat lungs and pleura. Archives of Environ-

mental and Occupational Health 63(2008):71-75.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path: Terrestrial; Water; Dietary

Taxa, Species, Age:

, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Wistar; Adult

Health Outcome:

Respiratory

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cl	haracterization			
Domain 3. Exposure Of	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra-	Medium	exposures were administered consistently across study groups although quantity consumed per rat was not reported
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	The duration of exposure was reported and suitable for the study type
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organis	zm			
Domain 1. Test Organis	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not used
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology reported the intended outcome of interest but fedetails were reported
		Contin	ued on next pa	ge

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Asbestos Environmental Hazard Evaluation HERO ID: 478543 Table: 1 of 2

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Study Citation: Hasanoglu, H. C., Bayram, E., Hasanoglu, A., Demirag, F. (2008). Orally ingested chrysotile asbestos affects rat lungs and pleura. Archives of Environ-

mental and Occupational Health 63(2008):71-75.

multiple histopathological results reported for lung and pleura

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Additional Comments:

Terrestrial; Water; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Adult

Health Outcome: Respiratory

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 478543

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome Assessment	Medium	there was incomplete reporting of minor details of outcome assessment protocol execution
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presenta	ation and Anal	ysis Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 478543 Table: 2 of 2

Study Citation: Hasanoglu, H. C., Bayram, E., Hasanoglu, A., Demirag, F. (2008). Orally ingested chrysotile asbestos affects rat lungs and pleura. Archives of Environ-

mental and Occupational Health 63(2008):71-75.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Adult

Health Outcome: ADME (biotransformation)

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	High	The test substance identity was analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administra- tion	Medium	exposures were administered consistently across study groups although quantity consumed per rat was not reported
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration	High	
		Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	Metric 11:	Number of Exposure Groups/	High	The duration of exposure was reported and suitable for the study type
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
	Wietife 12.	resting at of Below Soldonity Ellint	IVA	asocstos is constacted insoluble
Domain 4: Test Organisa	m			
_	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	replicates were not used
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology reported the intended outcome of interest but fedetails were reported
	Metric 18:	Consistency of Outcome	Medium	there was incomplete reporting of minor details of outcome assessment protocol execu-

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Asbestos Environmental Hazard Evaluation HERO ID: 478543 Table: 2 of 2

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Study Citation: Hasanoglu, H. C., Bayram, E., Hasanoglu, A., Demirag, F. (2008). Orally ingested chrysotile asbestos affects rat lungs and pleura. Archives of Environ-

mental and Occupational Health 63(2008):71-75.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Water; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar; Adult

Health Outcome: ADME (biotransformation)

Overall Quality Determination

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 478543

Domain 6: Confounding / Variable Conf Metric 19:			
Metric 19:			
	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presentation and Analy			
Metric 21:	Statistical Methods	N/A	Statistical analysis is not typically applied to accumulation
Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

HERO ID: 3098168 Table: 1 of 6

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:** Terrestrial; Food/Diet; Dietary **Exposure Route,**

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Gastrointestinal **Health Outcome:**

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substan				
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.G. Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
2 oman 2 1000 2 000gm	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Ch	aracterization			
2 Similar S. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to test- ing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Domain 4: Test Organis	m			
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was not reported.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the rats were acclimated to test conditions.
		Contin	ued on next pa	nge

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 1 of 6

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Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome:

Gastrointestinal

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.
		Replicates per Group		Methods section.
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
Di (- Cfli	- / Manialala Car	-A1		
Domain 6: Confounding	•		T	
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Present	ation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency table described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comments:		• •	os fibers. Expos	ure was either through drinking water or through food. The researchers examined
	the rats for t	umors after the lifetime exposure.		

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 2 of 6

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome:

Endocrine

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.G. Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
Bomain 2. Test Besign	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Cl	haracterization			
Bomain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to test- ing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Domain 4. Test O				
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.
		Contin	ued on next pa	and a

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 2 of 6

... continued from previous page

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome:

Endocrine

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest—tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
Domain 6: Confounding	/ Variable Co	ntrol		
zoman er comouname	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Present	ation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency ta- ble described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comments:		ietary exposure to various sources of asbesto	os fibers. Expos	ure was either through drinking water or through food. The researchers examined

Overall Quality Determination

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome:

Immune/Hematological

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.G. Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
Bomain 2. Test Besign	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Cl	haracterization			
Bomain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to test- ing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Domain 4. Test O				
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.
		Contin	ued on next pa	and a

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 3 of 6

... continued from previous page

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Chemical:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome: Imm

Immune/Hematological

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 5: Outcome Asso	essment			
	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
D : (C f 1:	/W : 11 C	. 1		
Domain 6: Confounding				
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Presenta	tion and Anal	vsis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency table described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.

Overall Quality Determination

HERO ID: 3098168 Table: 4 of 6

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome: Skin and Connective Tissue

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.C Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
Joinam 2. Test Design	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Ch	naracterization			
1	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to test- ing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was no reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 4 of 6

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Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome: Skin and Connective Tissue

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 5: Outcome As	sessment			
Bomain 3. Gateome 115	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency ta- ble described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comments:		ietary exposure to various sources of asbesto amors after the lifetime exposure.	os fibers. Expos	ure was either through drinking water or through food. The researchers examined

Overall Quality Determination

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome:

Respiratory

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.G. Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
20 mani 21 1200 2 200g.	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Ch	aracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to test- ing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Domain 4: Test Organism	m			
Domain 4. Test Organisi	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.
			ued on next pa	σε

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 5 of 6

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Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Health Outcome: Respira

Chemical: asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 5: Outcome Ass	essment			
	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Presenta	tion and Anal	vsis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency ta- ble described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
		1 0	Low	The study did not report any measures of variability.

Overall Quality Determination

HERO ID: 3098168 Table: 6 of 6

Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile Taxa, Species, Age:

Health Outcome:

Reproductive/Teratogenic

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was identified by name only.
	Metric 2:	Test Substance Source	High	The amosite asbestos was UICC Standard Reference Amosite Asbestos from the R.E.G. Rendall Pneumoconiosis Research Unit in Johannesburg, South Africa. The chrysotile was from Johns Manville Co. in Denver, CO.
	Metric 3:	Test Substance Purity	Low	The purity/contents of the asbestos was not reported.
Domain 2: Test Design				
2011an 27 1000 2 001gn	Metric 4:	Negative Controls	High	The study reported using 28 rats that were given fiber free well water for the first 9 months and then filtered Duluth municipal water thereafter.
	Metric 5:	Negative Control Response	High	The control response can be seen in Table 1 and are adequate.
	Metric 6:	Randomized Allocation	Low	It was not reported how the rats were allocated into study groups.
Domain 3: Exposure Ch	naracterization			
2 Samuel C. Exposure C.	Metric 7:	Experimental System/Test Media Preparation	High	The test system was described adequately-there were five rats per cage and the number of rats per treatment were reported. Preparation for each exposure was also described adequately.
	Metric 8:	Consistency of Exposure Administration	Medium	The low dose asbestos treatment reported using chrysotile for the first 7 months due to the unavailability of the amosite fibers. At month 8, the rats were switched to a diet containing amosite fibers as they became available.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether they analyzed the asbestos fibers prior to testing or during testing.
	Metric 10:	Exposure Duration and Frequency	High	The study duration was for the lifetime of the rats and was appropriate for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal of the study was not to have a dose dependent effect. The goal was to observe the pathological response of rats to exposure from asbestos like fibers from different sources.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is an insoluble substances and the exposure was via diet.
Damain 4. Tast Organia				
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	Low	The rats were described as weanling Sprague-Dawly rats. The source of the rats was not reported.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the rats were acclimated to test conditions.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The number of test organisms for each treatment was reported in the "Materials and Methods" section.

Asbestos Environmental Hazard Evaluation HERO ID: 3098168 Table: 6 of 6

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Study Citation: Hilding, A. C., Hilding, D. A., Larson, D. M., Aufderheide, A. C. (1981). Biological effects of ingested amosite asbestos, taconite tailings, diatomaceous

earth and Lake Superior water in rats. Archives of Environmental Health 36(1981):298-303.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; Sprague-Dawly; Juvenile

Taxa, Species, Age: Health Outcome:

Reproductive/Teratogenic

Chemical:

asbestos (CASRN 1332-21-4)-chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 3098168

Domain		Metric	Rating	Comments
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Medium	The diet of the rats for each treatment was reported, but other environmental conditions were not reported by the study authors.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–tumor formation in different tissues of the rat.
	Metric 18:	Consistency of Outcome Assessment	Low	Little detail on the outcome assessment was described other than to say detailed autopsies were performed.
Domain 6: Confounding	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported if the rats were acclimatized to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure were reported. It was reported that 3 rats were cannibalized before they could be examined.
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Analysis of the test groups compared to the controls was done by 2 x k contingency ta- ble described by Armitage and was performed by the University of Minnesota Division of Biometry, School of Public Health.
	Metric 22:	Reporting of Data	High	Data for each exposure was adequate and reported in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability.
Additional Comments:		lietary exposure to various sources of asbestouries after the lifetime exposure.	os fibers. Expos	ure was either through drinking water or through food. The researchers examined

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 112 Table: 1 of 1 Asbestos

Study Citation: Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and

short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; MRC Hooded; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ice			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The test substance identity was not analytically verified by the performing laboratory
	Metric 3:	Test Substance Purity	Low	Purity and/or grade of test substance were not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cl	naracterization			
Domain 3. Exposure Ci	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	Details of exposure administration were not elaborated on
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was adequate for a dietary rat exposure
	Metric 11:	Number of Exposure Groups/	Medium	only two exposure levels tested
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	exposure was via diet
Domain 4: Test Organis	e m			
Domain 1. Test Organic	Metric 13:	Test Organism Characteristics	Low	few details such as initial weight were reported
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Low	The number of test organisms and/or replicates was not reported
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	Medium	The outcome assessment methodology addressed the intended outcomes of interest although sample size was not reported
		Conti	nued on nex	at nage

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Asbestos Environmental Hazard Evaluation HERO ID: 112 Table: 1 of 1

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Study Citation: Jacobs, R., Humphrys, J., Dodgson, K. S., Richards, R. J. (1978). Light and electron microscope studies of the rat digestive tract following prolonged and

short-term ingestion of chrysotile asbestos. International Journal of Experimental Pathology 59(1978):443-453.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; MRC Hooded; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Gastrointestinal

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 112

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	There were minor uncertainties in the outcome assessment study group size
		Assessment		
Domain 6: Confoundin	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups
Domain 7: Data Presen	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	N/A	study focused on pathology findings
	Metric 22:	Reporting of Data	Low	Data were only reported for some outcomes
	Metric 23:	Explanation of Unexpected Outcomes	Medium	unexpected outcomes were satisfactorily explained.

Additional Comments: None

Overall Quality Determination

Low

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Adult

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Medium	No CAS number was given, but mineral and fiber characteristics were reported in Tables 1-5.
	Metric 2:	Test Substance Source	High	Source was reported.
	Metric 3:	Test Substance Purity	High	The chemicals were analytically verified by the performing laboratory and mineral and fiber characteristics were reported.
Domain 2: Test Desig	n			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group reported in the text as an average.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups.
Domain 3: Exposure	Characterization			
1	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail.
	Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration.
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Each lot of the blended pellet feed was analyzed for amosite and tremolite (results not reported), but no measurement was done on the PWG treatments, though this was likely not to have significant impacts on results.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration per fiber type (1% in diet) and a dose dependent effect was not the goal of the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure is asbestos via diet and/or gavage.
Domain 4: Test Organ	nism			
- 8	Metric 13:	Test Organism Characteristics	High	Test organisms were adequately described.
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	The study did not report whether test organisms were acclimatized. Unclear whether gavage group had a counterpart control (gavage with sterile water only).
	Metric 15:	Number of Organisms and Replicates per Group	Low	The number of test organisms and/or replicates was not reported.

Domain 5: Outcome Assessment

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Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 1 of 5

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Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Adult

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate
	Metric 17:	Outcome Assessment Methodology	High	Live fetuses counted at birth.
	Metric 18:	Consistency of Outcome	High	Litter size assessed at birth.
		Assessment		
Domain 6: Confound	ding / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental condition or other factors that could influence the outcome assessment.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure (e.g., infection) that could influence the outcome assessment.
Domain 7: Data Pres	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	Uninformative	No statistics conducted for significant difference on litter size.
	Metric 22:	Reporting of Data	Low	Data reported as average litter size without variance.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals) and/or insufficient information was provided to determine if excessive variability or unexpected outcomes occurred.

Additional Comments

This was a lifetime rat study. FO rats were put on an amosite or tremolite diet. The study was done on the offspring which were put on the appropriate diet post weaning. PWG with chrysotile (used mistakenly instead of amosite) was also used in one study group that went on to receive the amosite diet. Differences in weight between treatment groups and controls were reported and thus the growth/development outcome was selected.

Overall Quality Determination

Uninformative

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 2 of 5

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; Fischer 344; Embryo

Taxa, Species, Age: Health Outcome:

Cancer/Carcinogenesis

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID.				
Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Medium	No CAS number was given, but mineral and fiber characteristics were reported in Tables 1-5.
	Metric 2:	Test Substance Source	High	Sources were reported.
	Metric 3:	Test Substance Purity	High	The chemicals were analytically verified by the performing laboratory and mineral and fiber characteristics were reported.
Domain 2: Test Design	ı			
Ü	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Tables 8-17 and appear adequate.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups.
Domain 3: Exposure C	haracterization			
Domain 3. Exposure C	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail.
	Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration.
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Each lot of the blended pellet feed was analyzed for amosite and tremolite (results not shown), but no measurement was done on the PWG treatments, though this was likely not to have significant impacts on results.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type (chronic).
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration per fiber type (1% in diet) and a dose dependent effect was not the goal of the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via diet and/or gavage.
Domain 4: Test Organi	sm			
Č	Metric 13:	Test Organism Characteristics	High	Test organisms were adequately described.
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	The study did not report whether test organisms were acclimatized. Unclear whether gavage group had a counterpart control (gavage with sterile water only).
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The number of test organisms was sufficient to characterize toxicological effects and are reported in the tables in Results.
Domain 5: Outcome A	ssessment			
Domain J. Outcome A	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate.

Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 2 of 5

... continued from previous page

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Embryo

Health Outcome:

Cancer/Carcinogenesis

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology (pathology) reported the intended outcome of interest.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups.
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment.
	Metric 20:	Outcomes Unrelated to Exposure	High	Male amosite treated rats had a higher rate of C-Cell carcinoma, and male amosite and amosite + PWG had a higher rate of mononuclear cell leukemia. These were not thought to be treatment related.
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were well-described.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Tables 8-17 and discussed in text.
_	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained.

Additional Comments:

This was a lifetime rat study. FO rats were put on an amosite or tremolite diet. The study was done on the offspring which were put on the appropriate diet post weaning. PWG with chrysotile was also inadvertently used (instead of gavage with 1% amosite) in one study group that went on to receive the amosite diet.

Overall Quality Determination

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Environmental Hazard Evaluation HERO ID: 709664 Table: 3 of 5 Asbestos

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Chemical:

Vertebrate; Mammalian; Rattus norvegicus; Fischer 344; Embryo Taxa, Species, Age:

Health Outcome:

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ce			
	Metric 1:	Test Substance Identity	Medium	No CAS number was given, but mineral and fiber characteristics were reported in Tables 1-5.
	Metric 2:	Test Substance Source	High	Source was reported.
	Metric 3:	Test Substance Purity	High	The chemicals were analytically verified by the performing laboratory and mineral and fiber characteristics were reported.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	Low	The biological response of the negative control groups was not reported.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups.
Domain 3: Exposure Cha	aracterization			
•	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail.
	Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration.
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Each lot of the blended pellet feed was analyzed for amosite and tremolite (results not reported), but no measurement was done on the PWG treatments, though this was likely not to have significant impacts on results.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration per fiber type (1% in diet) and a dose dependent effect was not the goal of the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure is asbestos via diet and/or gavage.
Domain 4: Test Organism	n			
	Metric 13:	Test Organism Characteristics	High	Test organisms were adequately described.
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	The study did not report whether test organisms were acclimatized. Unclear whether gavage group had a counterpart control (gavage with sterile water only).
	Metric 15:	Number of Organisms and Replicates per Group	Low	The number of test organisms and/or replicates was not reported.
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate

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Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 3 of 5

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Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Chemical:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Embryo

Health Outcome: B

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome Assessment	High	Food consumption was measured weekly per cage.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment.
	Metric 20:	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal attrition or health outcomes unrelated to exposure (e.g., infection) that could influence the outcome assessment.
Domain 7: Data Pres	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	Uninformative	It does not appear that statistical analysis was performed on food consumption of treated groups relative to the control.
	Metric 22:	Reporting of Data	Low	Data reported as percentages compared to control groups in text but no table or figure presented. No food amounts presented.
	Metric 23:	Explanation of Unexpected Outcomes	Low	The study did not report any measures of variability (e.g., SE, SD, confidence intervals) and/or insufficient information was provided to determine if excessive variability or

Additional Comments:

This was a lifetime rat study. FO rats were put on an amosite or tremolite diet. The study was done on the offspring which were put on the appropriate diet post weaning. PWG with chrysotile (used mistakenly instead of amosite) was also used in one study group that went on to receive the amosite diet. Differences in weight between treatment groups and controls were reported and thus the growth/development outcome was selected.

Overall Quality Determination

Uninformative

Asbestos **Environmental Hazard Evaluation** HERO ID: 709664 Table: 4 of 5

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Fischer 344; Embryo

Health Outcome:

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Medium	No CAS number was given, but mineral and fiber characteristics were reported in Tables 1-5.
	Metric 2:	Test Substance Source	High	Sources were reported.
	Metric 3:	Test Substance Purity	High	The chemicals were analytically verified by the performing laboratory and mineral and fiber characteristics were reported.
Domain 2: Test Design	l			
S	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Tables 7 and appear adequate.
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups.
Domain 3: Exposure C	haracterization			
Domain 3. Exposure C	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail.
	Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration.
	Metric 9:	tion Measurement of Test Substance Concentration	Medium	Each lot of the blended pellet feed was analyzed for amosite and tremolite (results not shown), but no measurement was done on the PWG treatments, though this was likely not to have significant impacts on results.
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type (chronic).
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration per fiber type (1% in diet) and a dose dependent effect was not the goal of the study.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure via diet and/or gavage.
Domain 4: Test Organi	sm			
Č	Metric 13:	Test Organism Characteristics	High	Test organisms were adequately described.
	Metric 14:	Acclimatization and Pretreatment Conditions	Medium	The study did not report whether test organisms were acclimatized. Unclear whether gavage group had a counterpart control (gavage with sterile water only).
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The number of test organisms was sufficient to characterize toxicological effects and are reported in Table 7 in Results.
Domain 5: Outcome A	cceccment			
Domain 3. Outcome A	Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate.

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Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 4 of 5

... continued from previous page

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Fischer 344; Embryo

Health Outcome:

Mortality

Chemical: who tall chrysot

chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	Mortality was assessed.
	Metric 18:	Consistency of Outcome Assessment	High	Mortality assessed twice daily.
Domain 6: Confoundir	ng / Variable Con	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment.
	Metric 20:	Outcomes Unrelated to Exposure	High	Details regarding test organism attrition and outcomes unrelated to exposure (e.g., infection) were reported for each study group and there were no differences among groups that could influence the outcome assessment.
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods for survival were described in Methods.
	Metric 22:	Reporting of Data	High	Data for survival shown in Table 7.
	Metric 23:	Explanation of Unexpected Outcomes	High	The study did not report any measures of variability (e.g., SE, SD, confidence intervals) and/or insufficient information was provided to determine if excessive variability or unexpected outcomes occurred.

Additional Comments:

This was a lifetime rat study. FO rats were put on an amosite or tremolite diet. The study was done on the offspring which were put on the appropriate diet post weaning. PWG with chrysotile was also inadvertently used (instead of gavage with 1% amosite) in one study group that went on to receive the amosite diet.

Overall Quality Determination

Medium

April 2024

Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 5 of 5

Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

	Metric	Rating	Comments
Metric 1:	Test Substance Identity	Medium	No CAS number was given, but mineral and fiber characteristics were reported in Tables 1-5.
Metric 2:	Test Substance Source	High	Source was reported.
Metric 3:	Test Substance Purity	High	The chemicals were analytically verified by the performing laboratory and mineral and fiber characteristics were reported.
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group.
Metric 5:	Negative Control Response	Low	The biological response of the negative control groups was not reported.
Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups.
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail.
Metric 8:	Consistency of Exposure Administra-	High	No mention of irregularities in exposure administration.
Metric 9:	tion Measurement of Test Substance Concentration	Medium	Each lot of the blended pellet feed was analyzed for amosite and tremolite (results not reported), but no measurement was done on the PWG treatments, though this was likely not to have significant impacts on results.
Metric 10:	Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type.
Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration per fiber type (1% in diet) and a dose dependent effect was not the goal of the study.
Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure is asbestos via diet and/or gavage.
n			
Metric 13:	Test Organism Characteristics	High	Test organisms were adequately described.
Metric 14:	Acclimatization and Pretreatment Conditions	Medium	The study did not report whether test organisms were acclimatized. Unclear whether gavage group had a counterpart control (gavage with sterile water only).
Metric 15:	Number of Organisms and Replicates per Group	Low	The number of test organisms and/or replicates was not reported.
sessment			
Metric 16:	Adequacy of Test Conditions	High	Organism housing, environmental conditions, food, water, and nutrients were conducive to maintenance of health and biomass loading was appropriate
	Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: aracterization Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: m Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity High Metric 3: Test Substance Purity High Metric 4: Negative Controls High Metric 5: Negative Control Response Low Metric 6: Randomized Allocation Medium Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ Spacing of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Metric 13: Test Organism Characteristics High Metric 14: Acclimatization and Pretreatment Medium Conditions Metric 15: Number of Organisms and Replicates per Group

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Asbestos Environmental Hazard Evaluation HERO ID: 709664 Table: 5 of 5

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Study Citation: Mcconnell, E. E., Rutter, H. A., Ulland, B. M., Moore, J. A. (1983). Chronic effects of dietary exposure to amosite asbestos and tremolite in F344 rats.

Environmental Health Perspectives 5327-44.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet, N/A (e.g., injection); Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; Fischer 344; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)-amosite (grunerite) (CASRN 12172-73-5)-tremolite (CASRN 14567-73-8)

HERO ID: 709664

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome Assessment	High	"Mean body weights analyzed selected were at intervals: birth, 3, 8, 11, 15, 24, 33, and 60 weeks for the males, and birth, 3, 8, 11, 16, 27, 48 and 60 weeks for the females by the method of Rao (9)."
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment.
	M	Outcomes Unrelated to Exposure	Medium	There was no information in the study to suggest differences among groups in animal
	Metric 20:	Outcomes Officiated to Exposure	Wedium	attrition or health outcomes unrelated to exposure (e.g., infection) that could influence the outcome assessment.
Domain 7: Data Prese		•	Medium	attrition or health outcomes unrelated to exposure (e.g., infection) that could influence
Domain 7: Data Prese		•	Uninformative	attrition or health outcomes unrelated to exposure (e.g., infection) that could influence
Domain 7: Data Prese	entation and Anal	ysis		attrition or health outcomes unrelated to exposure (e.g., infection) that could influence the outcome assessment.

Overall Quality Determination

Uninformative

diet.Differences in weight between treatment groups and controls were reported and thus the growth/development outcome was selected.

Asbestos Environmental Hazard Evaluation HERO ID: 3613439 Table: 1 of 3

Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, To

Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mo

Mortality

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substance				
Mei	ric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Me	ric 2:	Test Substance Source	High	The source of the test substance was reported, as a manufacturer or the production process was specifically identified.
Me	ric 3:	Test Substance Purity	High	Chemical purity reported as 99%
Domain 2: Test Design				
_	ric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Med	ric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for reported outcomes
Met	ric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Characte	rization			
•	ric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Me	ric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
Me	ric 9:	tion Measurement of Test Substance	Medium	Each lot was analyzed
Me	ric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
	ric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
		Spacing of Exposure Levels		•
Me	ric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
Domain 4: Test Organism				
•	ric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Met	ric 14:	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms,
Me	ric 15:	Conditions Number of Organisms and	Medium	Adequate number of animals, individuals used as replicates
		Replicates per Group		
Domain 5: Outcome Assessm	ent			
	ric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 3613439 Table: 1 of 3

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Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Mortality

Chemical: Morta crocid

crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3613439

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups that could influence the outcome assessment
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Environmental Hazard Evaluation HERO ID: 3613439 Table: 2 of 3 Asbestos

Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

crocidolite (riebeckite) (CASRN 12001-28-4) Chemical:

	Metric	Rating	Comments
e			
Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric 2:	Test Substance Source	High	The source of the test substance was reported, as a manufacturer or the production process was specifically identified.
Metric 3:	Test Substance Purity	High	Chemical purity reported as 99%
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for reported outcomes
Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
Metric 9:	Measurement of Test Substance	Medium	Each lot was analyzed
Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
	Spacing of Exposure Levels		
Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
n			
Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Metric 14:	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms,
Metric 15:	Conditions Number of Organisms and	Medium	Adequate number of animals, individuals used as replicates
	Replicates per Group		
essment			
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Matric 6: Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Metric 12: Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity High Metric 4: Negative Controls High Metric 5: Negative Control Response High Metric 6: Randomized Allocation Medium Metric 7: Experimental System/Test Media High Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics High Conditions Metric 15: Number of Organisms and Medium Replicates per Group

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Asbestos Environmental Hazard Evaluation HERO ID: 3613439 Table: 2 of 3

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Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3613439

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups that could influence the outcome assessment
Domain 7: Data Preso	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Asbestos Environmental Hazard Evaluation HERO ID: 3613439 Table: 3 of 3

Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

	Metric	Rating	Comments
e			
Metric 1:	Test Substance Identity	Medium	The test substance was identified and the specific form was characterized
Metric 2:	Test Substance Source	High	The source of the test substance was reported, as a manufacturer or the production process was specifically identified.
Metric 3:	Test Substance Purity	High	Chemical purity reported as 99%
Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for reported outcomes
Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
aracterization			
Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
Metric 9:	Measurement of Test Substance	Medium	Each lot was analyzed
Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure was reported and suitable for the study type
Metric 11:	Number of Exposure Groups/	N/A	Only one concentration tested
	Spacing of Exposure Levels		
Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
n			
Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
Metric 14:	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms,
Metric 15:	Conditions Number of Organisms and	Medium	Adequate number of animals, individuals used as replicates
	Replicates per Group		
essment			
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 2: Metric 3: Metric 4: Metric 5: Metric 6: Matric 6: Metric 7: Metric 8: Metric 9: Metric 10: Metric 11: Metric 12: Metric 12: Metric 13: Metric 14: Metric 15:	Metric 1: Test Substance Identity Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group	Metric 1: Test Substance Identity Medium Metric 2: Test Substance Source High Metric 3: Test Substance Purity High Metric 4: Negative Controls High Metric 5: Negative Control Response High Metric 6: Randomized Allocation Medium Metric 7: Experimental System/Test Media High Preparation Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Medium Concentration Metric 10: Exposure Duration and Frequency High Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Characteristics High Conditions Metric 15: Number of Organisms and Medium Replicates per Group

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Asbestos Environmental Hazard Evaluation HERO ID: 3613439 Table: 3 of 3

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Study Citation: NTP, (1988). Toxicology and carcinogenesis studies of crocidolite asbestos (Cas no. 12001-28-4) in F344/n rats (Feed studies). National Toxicology

Program Technical Report Series 2801-178.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; F344/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: crocidolite (riebeckite) (CASRN 12001-28-4)

HERO ID: 3613439

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups that could influence the outcome assessment
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 758884 Table: 1 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo Taxa, Species, Age:

Health Outcome: Development/Growth

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substance	e			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Control rats received regular feed without asbestos.
	Metric 5:	Negative Control Response	High	Weights for control rats shown in Tables 4 and 5 and Figures 2-3 and described in the text and appear reasonable.
	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups
Domain 3: Exposure Cha	aracterization			
	Metric 7:	Experimental System/Test Media	High	Preparation of asbestos in feed adequately described.
		Preparation		
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance Concentration	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%. Data was reported for 130-141 weeks post-birth in Tables 4 and 5.
	Metric 11:	Number of Exposure Groups/	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organism	n			
Č	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
		Replicates per Group		
Domain 5: Outcome Ass	essment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
		Con	tinued on next page	

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 1 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Development/Growth Chemical: chrysotile (serpentine

chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest. Mean body weights were provided throughout the study for each treatment and the control.
	Metric 18:	Consistency of Outcome Assessment	High	Rats were weighed weekly throughout the study.
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics were not performed.
	Metric 22:	Reporting of Data	High	Data for control and treatment are presented in Tables 4-5 and Figures 2-3 and Appendix H.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability of the data not reported.

Additional Comments:

This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Overall Quality Determination

Uninformative

Asbestos **Environmental Hazard Evaluation** HERO ID: 758884 Table: 2 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo Taxa, Species, Age:

Development/Growth **Health Outcome:**

chrysotile (serpentine) (CASRN 12001-29-5) **Chemical:**

Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Control litters from mothers not fed asbestos.
	Metric 5:	Negative Control Response	Medium	The biological response of the negative control group was reported in the text without variability.
	Metric 6:	Randomized Allocation	Medium	Adults were assigned to a treatment according to a table of random numbers.
Domain 3: Exposure C	haracterization			
2 omani et 2. specure e	Metric 7:	Experimental System/Test Media Preparation	High	Preparation of asbestos in feed adequately described.
	Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance Concentration	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysi for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Mothers were fed asbestos four weeks prior to birthing pups.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organia	sm			
Domain 1. Test Organi	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
		Replicates per Group		
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
	Metric 17:	Outcome Assessment Methodology	High	Fetal weights obtained by dividing weight of litter by number of live pups.
	Metric 18:	Consistency of Outcome Assessment	Medium	Fetal weights determined presumably at birth.

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 2 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	No statistics performed.
	Metric 22:	Reporting of Data	Medium	Results presented in the text as averages, no tables or figures provided.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No variability reported.

Overall Quality Determination

Uninformative

Additional Comments: This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Asbestos **Environmental Hazard Evaluation** HERO ID: 758884 Table: 3 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo Taxa, Species, Age:

Health Outcome: Mortality

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

HERU ID:	130004			
Domain		Metric	Rating	Comments
Domain 1: Test Substa	ince			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	Control rats received feed without asbestos.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Tables 4-8 and Table 10 and reasonable for assessed outcomes.
	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups.
D : 2 E . C	71			
Domain 3: Exposure C	Metric 7:	Expanimental System/Test Mc 4:-	High	Decreasing of advance in find advanced decreasing
	Metric /:	Experimental System/Test Media	High	Preparation of asbestos in feed adequately described.
	Metric 8:	Preparation Consistency of Exposure Administra-	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and
	wiethe 6.	tion	mgn	were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis
		Concentration	8	for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%. Data was
			C	reported for 130-141 weeks post-birth in Tables 4 and 5.
	Metric 11:	Number of Exposure Groups/	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only
		Spacing of Exposure Levels		one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organi	ism			
	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
		Conditions	6	5
	Metric 15:	Number of Organisms and	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
	Metric 17:	Outcome Assessment Methodology	Medium	Animals were observed for mortality, any moribund rats were killed according to criteria
				described by the authors.
		Conti	nued on nex	t nogo

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 3 of 8

... continued from previous page

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Mort

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Animals observed twice daily for mortality.
		Assessment		
Domain 6: Confoundin	g / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	High	There were no reported differences among the study groups in environmental conditions or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Presen	tation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical analysis for mortality adequately described in methods and p-values presented in Tables.
	Metric 22:	Reporting of Data	High	Data presented for control and treatment in Tables 4-8 and Table 10 and described in text.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes.

Additional Comments: This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Overall Quality Determination

Asbestos **Environmental Hazard Evaluation** HERO ID: 758884 Table: 4 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo Taxa, Species, Age:

Health Outcome: Behavioral

chrysotile (serpentine) (CASRN 12001-29-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substance				
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
I	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Control rats received regular feed without asbestos.
1	Metric 5:	Negative Control Response	High	Food consumption for control rats shown in Appendix H and appear reasonable.
I	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups
Domain 3: Exposure Chara	acterization			
-	Metric 7:	Experimental System/Test Media Preparation	High	Preparation of asbestos in feed adequately described.
1	Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H.
I	Metric 9:	Measurement of Test Substance Concentration	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G.
I	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%. Data was reported for 130-141 weeks post-birth in Tables 4 and 5.
I	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile.
]	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organism				
_	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
]	Metric 15:	Conditions Number of Organisms and	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
		Replicates per Group		
Domain 5: Outcome Asses	ssment			
]	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
I	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest. Food consumption reported weekly throughout the study for each treatment and the control.
		Con	tinued on next page	•••

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 4 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Behar

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Food consumed reported as per day on a weekly basis.
		Assessment		
Domain 6: Confoundin	ng / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent
		•		non-treatment differences that would affect the outcome.
Domain 7: Data Preser	ntation and Anal	veic		
Domain 7. Data Fresci		-	II . C	
	Metric 21:	Statistical Methods	Uninformative	Statistics were not performed.
	Metric 22:	Reporting of Data	High	Data for control and treatment are presented in Appendix H and briefly mentioned in text of results.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability of the data not reported.

Overall Quality Determination

Additional Comments:

Uninformative

This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 5 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Adult

Health Outcome: Re

Reproductive/Teratogenic

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Metric 15: Number of Granisms and Metric 16: Adequacy of Test Conditions Metric 15: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Metric 19: Assessment Metric 19: Adequacy of Test Conditions Metric 19: Outcome Assessment Metric 19: Adequacy of Test Conditions Metric 19: Outcome Assessment Methodology Medium Litter size determined presumably prior to culling. Assessment	Domain		Metric	Rating	Comments
Metric 2: Test Substance Source Metric 3: Test Substance Purity Metric 4: Negative Controls Metric 5: Negative Controls Metric 5: Negative Control Response Metric 6: Randomized Allocation Metric 6: Randomized Allocation Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administra- tion Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Metric 12: Testing at or Below Solubility Limit Metric 12: Testing at or Below Solubility Limit Metric 13: Metric 13: Metric 14: Acclimatization and Pretreatment Metric 15: Metric 15: Number of Organisms and Replicates per Group Metric 16: Acclimatization and Pretreatment Metric 16: Acclimatization and Pretreatment Metric 16: Acclimatization and Pretreatment Metric 17: Testing at or Below Solubility Limit Metric 18: Consistency of Test Organisms and Replicates per Group Metric 16: Acclimatization and Pretreatment Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Metric 19: Liter size from each treatment was determined. Metric 19: Testing at or Below Solubility Limit Metric 19: Testing at or Below Solubility Limit Metric 10: Testing at or Below Solubility Limit Metric 10: Testing at or Below Solubility Limit Metric 10: Testing at Organisms and Replicates per Group Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Acclimatization and Pretreatment Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Metric 19: Outcome Assessment Metric 19: Outcome A	Domain 1: Test Substa	nce			
Metric 3: Test Substance Purity		Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
Domain 2: Test Design Metric 4: Negative Control Response Medium The biological response of the negative control group was reported in the text without variability. Metric 6: Randomized Allocation Medium Adults were assigned to a treatment according to a table of random numbers. Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation of asbestos in feed adequately described. Preparation Onsistency of Exposure Administration Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance High Each tool feed was measured for asbestos concentration varies of measurement of Test Substance High Each tool feed was measured for asbestos concentration varies of the substance		Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
Metric 4: Negative Controls High Control litters from mothers not fed asbestos. Metric 5: Negative Control Response Medium The biological response of the negative control group was reported in the text without variability. Metric 6: Randomized Allocation Medium Adults were assigned to a treatment according to a table of random numbers. Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media High Preparation of asbestos in feed adequately described. Preparation Metric 8: Consistency of Exposure Administration Tion Metric 9: Measurement of Test Substance High Each lot of feed was measured for asbestos concentration via atomic absorption analysis of magnesium. Doses described in Appendix H. Metric 10: Exposure Duration and Frequency High Mothers were fed asbestos four weeks prior to birthing pups. Metric 11: Number of Exposure Groups/Spacing of Exposure Levels Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Adequacy of Test Conditions Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Medium Litter size from each treatment was determined. Medium Litter size form each treatment was determined. Medium Litter size form each treatment was determined. Medium Litter size form each treatment was determined. Metric 18: Consistency of Outcome Assessment Medium Litter size form each treatment was determined. Medium Litter size form each treatment was determined. Medium Litter size form each treatment was determined.		Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Metric 5: Negative Control Response Medium The biological response of the negative control group was reported in the text without variability. Metric 6: Randomized Allocation Medium Adults were assigned to a treatment according to a table of random numbers. Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media Preparation Metric 8: Consistency of Exposure Administration Metric 8: Consistency of Exposure Administration Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Founds Metric 12: Testing at or Below Solubility Limit Metric 12: Testing at or Below Solubility Limit Metric 13: Test Organism Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Medium Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Assessment Metric 18: Consistency of Outcome Medium Litter size forem and treatment was a determined. Medium Litter size forem and treatment was determined. Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Assessment Metric 18: Consistency of Outcome Medium Litter size forem and treatment was determined. Medium Litter size determined presumably prior to culling.	Domain 2: Test Design	1			
Metric 6: Randomized Allocation Medium Adults were assigned to a treatment according to a table of random numbers. Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media High Preparation of asbestos in feed adequately described. Preparation Metric 8: Consistency of Exposure Administration were consistent. Amount of feed consumed is reported in Appendix H. Metric 9: Measurement of Test Substance High Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G. Metric 10: Exposure Duration and Frequency High Mothers were fed asbestos four weeks prior to birthing pups. Metric 11: Number of Exposure Croups/ N/A The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile. Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Medium The numbers of test organisms were reported in Table 2 and were appropriate. Polimain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions High Environmental conditions of test system were conducive and described in Table 3. Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Assessment Methodology High Litter size determined presumably prior to culling.	Č	Metric 4:	Negative Controls	High	Control litters from mothers not fed asbestos.
Domain 3: Exposure Characterization Metric 7: Experimental System/Test Media High Preparation of asbestos in feed adequately described. Preparation Metric 8: Consistency of Exposure Administration tion Metric 9: Measurement of Test Substance Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 15: Number of Organisms and Metric 16: Acclimatization and Pretreatment Metric 17: Outcome Assessment Metric 18: Adequacy of Test Conditions Metric 19: Adequacy of Test Conditions Metric 19: Adequacy of Test Conditions Metric 18: Consistency of Outcome Medium Medium Litter size determined, presumably prior to culling. Assessment		Metric 5:	Negative Control Response	Medium	
Metric 7: Experimental System/Test Media Preparation of asbestos in feed adequately described. Preparation of Exposure Administration were consistent. Amount of feed consumed is reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H. Metric 9: Measurement of Test Substance High Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Dosse described in Appendix H. Metric 10: Exposure Duration and Frequency High Mothers were fed asbestos four weeks prior to birthing pups. Metric 11: Number of Exposure Groups/ N/A The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile. Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Strain, sex, and source of animals stated. Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment		Metric 6:	Randomized Allocation	Medium	Adults were assigned to a treatment according to a table of random numbers.
Metric 7: Experimental System/Test Media Preparation of asbestos in feed adequately described. Preparation of Exposure Administration were consistent. Amount of feed consumed is reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H. Metric 9: Measurement of Test Substance High Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Dosse described in Appendix H. Metric 10: Exposure Duration and Frequency High Mothers were fed asbestos four weeks prior to birthing pups. Metric 11: Number of Exposure Groups/ N/A The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile. Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Strain, sex, and source of animals stated. Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment	Domain 3: Exposure C	haracterization			
Metric 8: Consistency of Exposure Administration were reported in Figure 1, Table 3, and the text and toon Metric 9: Measurement of Test Substance High Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix H. Metric 10: Exposure Duration and Frequency High Mothers were fed asbestos four weeks prior to birthing pups. Metric 11: Number of Exposure Groups/ N/A The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile. Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Strain, sex, and source of animals stated. Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment			1	High	Preparation of asbestos in feed adequately described.
Concentration Metric 10: Exposure Duration and Frequency Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Forganisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Metric 18: Consistency of Outcome Medium Assessment Medium Litter size determined presumably prior to culling. Medium Litter size determined presumably prior to culling. Medium Litter size determined presumably prior to culling.		Metric 8:	Consistency of Exposure Administra-	High	
Metric 11: Number of Exposure Groups/ Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions High Adult rats of F0 generation acclimated and described in Table 3. Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Assessment Metric 18: Consistency of Outcome Assessment Metric 18: Consistency of Outcome Assessment Medium Litter size determined presumably prior to culling. Litter size determined presumably prior to culling.		Metric 9:		High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G.
Spacing of Exposure Levels Metric 12: Testing at or Below Solubility Limit Domain 4: Test Organism Metric 13: Test Organism Characteristics Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Assessment Medium Litter size determined presumably prior to culling. Assessment		Metric 10:	Exposure Duration and Frequency	High	Mothers were fed asbestos four weeks prior to birthing pups.
Metric 12: Testing at or Below Solubility Limit N/A Asbestos exposure via diet. Domain 4: Test Organism Metric 13: Test Organism Characteristics High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Assessment Medium Litter size determined presumably prior to culling. Litter size determined presumably prior to culling. Medium Litter size determined presumably prior to culling.		Metric 11:		N/A	
Metric 13: Test Organism Characteristics High Strain, sex, and source of animals stated. Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Assessment Medium Environmental conditions of test system were conducive and described in Table 3. Metric 18: Consistency of Outcome Medium Litter size from each treatment was determined. Medium Litter size determined presumably prior to culling. Assessment		Metric 12:		N/A	
Metric 13: Test Organism Characteristics High Strain, sex, and source of animals stated. Metric 14: Acclimatization and Pretreatment High Adult rats of F0 generation acclimated 4-5 weeks prior to testing. Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Assessment Medium Environmental conditions of test system were conducive and described in Table 3. Metric 18: Consistency of Outcome Medium Litter size from each treatment was determined. Medium Litter size determined presumably prior to culling. Assessment	Domain 4: Test Organi	ism			
Metric 14: Acclimatization and Pretreatment Conditions Metric 15: Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Medium Metric 18: Consistency of Outcome Medium Medium Litter size determined presumably prior to culling. Assessment			Test Organism Characteristics	High	Strain, sex, and source of animals stated.
Conditions Number of Organisms and Replicates per Group Domain 5: Outcome Assessment Metric 16: Adequacy of Test Conditions Metric 17: Outcome Assessment Methodology Metric 18: Consistency of Outcome Metric 18: Consistency of Outcome Assessment Litter size determined presumably prior to culling. Assessment The numbers of test organisms were reported in Table 2 and were appropriate. Environmental conditions of test system were conducive and described in Table 3. Litter size from each treatment was determined. Litter size determined presumably prior to culling. Assessment		Metric 14:		•	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
Metric 16: Adequacy of Test Conditions High Environmental conditions of test system were conducive and described in Table 3. Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment		Metric 15:	Number of Organisms and		
Metric 16: Adequacy of Test Conditions High Environmental conditions of test system were conducive and described in Table 3. Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment	D : 5 O : 4		-		
Metric 17: Outcome Assessment Methodology High Litter size from each treatment was determined. Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment	Domain 5: Outcome A		A da	111.1	
Metric 18: Consistency of Outcome Medium Litter size determined presumably prior to culling. Assessment				e e	•
Assessment					
		Metric 18:	•	Medium	Litter size determined presumably prior to culling.
				ntinued on next page	

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 5 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; F344/N; Adult

Health Outcome: Reproductive/Teratogenic

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	No statistics performed.
	Metric 22:	Reporting of Data	Medium	Results presented in the text as averages, no tables or figures provided.
	Metric 23:	Explanation of Unexpected Outcomes	Low	No variability reported.

Overall Quality Determination

Uninformative

Additional Comments: This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 6 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2. Test Design				
Domain 2: Test Design	Metric 4:	Negative Controls	High	Controls rats received feed without asbestos.
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported in Tables 11-16 and in the text of the results.
	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups
Domain 3: Exposure Ch	nornatarization			
Domain 5. Exposure Ci	Metric 7:	Experimental System/Test Media	High	Preparation of asbestos in feed adequately described.
	MEUIC /.	Preparation	High	reparation of aspestos in reed adequately described.
	Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and
	mente o.	tion	111511	were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis
		Concentration	Č	for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%.
	Metric 11:	Number of Exposure Groups/	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only
		Spacing of Exposure Levels		one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organis	m			
Domain 4. 16st Organis	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
	1.10010 11.	Conditions	111511	Transfer to generation accumulated 1.5 meets prior to tooling.
	Metric 15:	Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
Domain 5: Outcome As	sessment			
Domain J. Outcome As	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of
	Medic 17.	Outcome Assessment Methodology	mgn	interest and is described in the Methods and Table 3. Lesion examination described well especially for the gastrointestinal tract.

Environmental Hazard Evaluation HERO ID: 758884 Table: 6 of 8 Asbestos

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Overall Duration: > 21 days; Exposure Duration: > 21 days **Duration:**

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Vertebrate; Mammalian; Rattus norvegicus; F344/N; Embryo Taxa, Species, Age:

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	High	Animals observed twice daily for moribund conditions and terminated if moribund.
		Assessment		Necropsy and histological examinations performed on those animals and on any remain-
				ing animals at the conclusion of the study.
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
	1			
Domain 7: Data Pres		-		
	Metric 21:	Statistical Methods	High	3 different methods of statistical analysis for lesion/cancer occurrence were described.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented in text of Results and Tables 11-16 and in the Appendices.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes.

Additional Comments: This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 7 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Immune/Hematological

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Control rats received regular feed without asbestos.
	Metric 5:	Negative Control Response	High	Pathological burden shown in Appendices and described in Table D.
	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups
Domain 3: Exposure Ch	naracterization			
	Metric 7:	Experimental System/Test Media Preparation	High	Preparation of asbestos in feed adequately described.
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance Concentration	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%. Data was reported for 130-141 weeks post-birth in Tables 4 and 5.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Organis	m			
C	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
		represents per Group		
Domain 5: Outcome Ass				
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive and described in Table 3.
	Metric 17:	Outcome Assessment Methodology	Low	Few details provided on methodology for identifying parasites/infections.
		Con	tinued on next page	···

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 7 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Embryo

Health Outcome: Immune/Hematological

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment (e.g.,
		Assessment		timing of assessment across groups) were confusing, limited, or not reported.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Pre	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics were not performed.
	Metric 22:	Reporting of Data	High	Data for randomly sampled rats are presented in Appendices and as percentages in Table D.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability of the data not reported.

Overall Quality Determination

Additional Comments:

Uninformative

This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 8 of 8

Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Adult

Health Outcome: Immune/Hematological

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Subs	tance			
	Metric 1:	Test Substance Identity	High	Chemical was identified by name and CAS number.
	Metric 2:	Test Substance Source	High	Source was stated and chrysotile analytically verified (Table 1).
	Metric 3:	Test Substance Purity	High	SR and IR chrysotile were both detected at greater than 96% by volume.
Domain 2: Test Desig	gn			
•	Metric 4:	Negative Controls	High	Control rats received regular feed without asbestos.
	Metric 5:	Negative Control Response	High	Pathological burden shown in Appendices and described in Table D.
	Metric 6:	Randomized Allocation	Medium	Allocation was performed with an unbiased method with a nonrandom component to ensure distribution across groups
Domain 3: Exposure	Characterization			
Z omam er Emposare	Metric 7:	Experimental System/Test Media Preparation	High	Preparation of asbestos in feed adequately described.
	Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported in Figure 1, Table 3, and the text and were consistent. Amount of feed consumed is reported in Appendix H.
	Metric 9:	Measurement of Test Substance Concentration	High	Each lot of feed was measured for asbestos concentration via atomic absorption analysis for magnesium. Doses described in Appendix G.
	Metric 10:	Exposure Duration and Frequency	High	Study was terminated for a treatment group when survival reached 10%. Data was reported for 130-141 weeks post-birth in Tables 4 and 5.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	The goal was not to have a dose-dependent effect. This was a lifetime study with only one exposure concentration for both SR and IR chrysotile.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos exposure via diet.
Domain 4: Test Orga	nism			
C	Metric 13:	Test Organism Characteristics	High	Strain, sex, and source of animals stated.
	Metric 14:	Acclimatization and Pretreatment	High	Adult rats of F0 generation acclimated 4-5 weeks prior to testing.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	The numbers of test organisms were reported in Table 2 and were appropriate.
Damain 5: Out-	A a a a a a a m = +			
Domain 5: Outcome		Adaguagy of Tost Conditions	Uiah	Environmental conditions of test system years conducing and decards dis Table 2
	Metric 16: Metric 17:	Adequacy of Test Conditions Outcome Assessment Methodology	High Low	Environmental conditions of test system were conducive and described in Table 3. Few details provided on methodology for identifying parasites/infections.
	Medic 17:			1 0 1 01
		Con	tinued on next page	?

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Asbestos Environmental Hazard Evaluation HERO ID: 758884 Table: 8 of 8

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Study Citation: NTP, (1985). NTP toxicology and carcinogenesis studies of chrysotile asbestos (CAS no. 12001-29-5) in F344/N rats (feed studies). National Toxicology

Program Technical Report Series 2951-390.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; *Rattus norvegicus*; F344/N; Adult

Health Outcome: Immune/Hematological

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 758884

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Details regarding the execution of the study protocol for outcome assessment (e.g.,
		Assessment		timing of assessment across groups) were confusing, limited, or not reported.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		or other factors that could influence the outcome assessment. Controls were housed in a separate room, but conditions were the same as the treated conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition in each group was reported in Tables 4-8 and 10 and there were no apparent non-treatment differences that would affect the outcome.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistics were not performed.
	Metric 22:	Reporting of Data	High	Data for randomly sampled rats are presented in Appendices and as percentages in Table D.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability of the data not reported.

Overall Quality Determination

Additional Comments:

Uninformative

This form applies to both short-range and intermediate-range chrysotile treatments in feed as well as the preweaning gavage/feed treatment group.

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Behavioral

Chemical: amosite (grunerite) (CASRN 12172-73-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance				
	Metric 1:	Test Substance Identity	High	The test substance was identified definitively by nomenclature and the specific form and composition
	Metric 2:	Test Substance Source	High	The source of the test substance was reported as a manufacturer, type and region of origin was specifically identified
	Metric 3:	Test Substance Purity	High	The test substance purity and composition were identified such that any observed effects were highly likely to be due to the nominal test substance itself
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 2. Erraguer Char	o otomizatie			
Domain 3: Exposure Char	Metric 7:	Experimental System/Test Media	Uigh	The experimental system and methods for preparation of test media were described in
	Metric 7:	Preparation	High	adequate detail
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	High	Exposure concentrations were measured using appropriate analytical technologies and methods
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	N/A	There is only one asbestos only concentration tested
		Spacing of Exposure Levels	27/1	
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet and/or gavage
Domain 4: Test Organism				
9	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	Adequate number of organisms, individuals used as replicates

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 1 of 4

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Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

 $\textbf{Duration:} \hspace{1.5cm} \textbf{Overall Duration:} > 21 \ \text{days; Exposure Duration:} > 21 \ \text{days}$

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Behavioral

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 758961

Domain	Metric	Rating	Comments
Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
Metric 18:	Consistency of Outcome Assessment	High	Outcomes were assessed consistently across study groups
Domain 6: Confounding / Variable Co	ontrol		
Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
	Design and Procedures		
Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups
Domain 7: Data Presentation and Ana	lysis		
Metric 21:	Statistical Methods	High	Statistical methods were adequately described
Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: food consumption, see appendix H

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 2 of 4

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID.	730901			
Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	High	The test substance was identified definitively by nomenclature and the specific form and composition
	Metric 2:	Test Substance Source	High	The source of the test substance was reported as a manufacturer, type and region of origin was specifically identified
	Metric 3:	Test Substance Purity	High	The test substance purity and composition were identified such that any observed effects were highly likely to be due to the nominal test substance itself
Domain 2: Test Design	ı.			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure C	haracterization			
1	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	High	Exposure concentrations were measured using appropriate analytical technologies and methods
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There is only one asbestos only concentration tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet and/or gavage
Domain 4: Test Organi	sm			
8	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment Conditions	High	All pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Number of Organisms and Replicates per Group	Medium	Adequate number of organisms, individuals used as replicates
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 2 of 4

... continued from previous page

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 758961

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

April 2024

HERO ID: 758961 Table: 3 of 4 Asbestos **Environmental Hazard Evaluation**

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mortality

amosite (grunerite) (CASRN 12172-73-5) Chemical:

Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	High	The test substance was identified definitively by nomenclature and the specific form and composition
	Metric 2:	Test Substance Source	High	The source of the test substance was reported as a manufacturer, type and region of origin was specifically identified
	Metric 3:	Test Substance Purity	High	The test substance purity and composition were identified such that any observed effects were highly likely to be due to the nominal test substance itself
Domain 2: Test Design	1			
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure C	Characterization			
1	Metric 7:	Experimental System/Test Media Preparation	High	The experimental system and methods for preparation of test media were described in adequate detail
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	High	Exposure concentrations were measured using appropriate analytical technologies and methods
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There is only one asbestos only concentration tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet and/or gavage
Domain 4: Test Organi	sm			
- 6	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 14:	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Medium	Adequate number of organisms, individuals used as replicates
		replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 3 of 4

... continued from previous page

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mortality

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 758961

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Additional Comments: None

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 4 of 4

Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID:	738901			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	High	The test substance was identified definitively by nomenclature and the specific form and composition
	Metric 2:	Test Substance Source	High	The source of the test substance was reported as a manufacturer, type and region of origin was specifically identified
	Metric 3:	Test Substance Purity	High	The test substance purity and composition were identified such that any observed effects were highly likely to be due to the nominal test substance itself
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using an appropriate concurrent negative control group
	Metric 5:	Negative Control Response	High	The biological response of the negative control group was reported and reasonable for assessed outcomes
	Metric 6:	Randomized Allocation	Medium	The study reported that organisms were randomly allocated into study groups
Domain 3: Exposure Ch	naracterization			
Domain 3. Exposure Ci	Metric 7:	Evnerimental System/Test Media	High	The experimental system and methods for preparation of test media were described in
		Experimental System/Test Media Preparation	High	adequate detail
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups
	Metric 9:	Measurement of Test Substance Concentration	High	Exposure concentrations were measured using appropriate analytical technologies and methods
	Metric 10:	Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There is only one asbestos only concentration tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet and/or gavage
D				
Domain 4: Test Organis	m Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.
	Metric 13.	Acclimatization and Pretreatment	High	All pretreatment conditions were the same for control and exposed organisms
	ivicuit 14.	Conditions	High	An preneament conditions were the same for control and exposed organisms
	Metric 15:	Number of Organisms and Replicates per Group	Medium	Adequate number of organisms, individuals used as replicates
		*		
Domain 5: Outcome As				
	Metric 16:	Adequacy of Test Conditions	High	Environmental conditions of test system were conducive to maintenance of organism health

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Asbestos Environmental Hazard Evaluation HERO ID: 758961 Table: 4 of 4

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Study Citation: NTP, (1990). Toxicology and carcinogenesis studies of amosite asbestos (CAS no. 12172-73-5) in F344/N rats (feed studies).

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age: Vertebrate

Vertebrate; Mammalian; Rattus norvegicus; F300/N; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: amosite (grunerite) (CASRN 12172-73-5)

HERO ID: 758961

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment		
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	High	There were no reported differences among the study groups in environmental conditions
		Design and Procedures		
	Metric 20:	Outcomes Unrelated to Exposure	High	There were no differences among groups
Domain 7: Data Pres	sentation and Anal	vsis		
	Metric 21:	Statistical Methods	High	Statistical methods were adequately described
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	unexpected outcomes were satisfactorily explained

Overall Quality Determination

Additional Comments: various neoplasms, lesions and other pathologies

Study Citation:

Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path:

Taxa, Species, Age: Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome:

Development/Growth

Chemical:

chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Subst	ance			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Chrysotile was UICC granulometry.
Domain 2: Test Desig	n			
	Metric 4:	Negative Controls	High	Control groups included palm-oil without asbestos and no palm-oil.
	Metric 5:	Negative Control Response	Medium	Weights of the control groups shown in Table 1. Control rats with palm-oil were heavier than no palm-oil controls during the dosing period.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups only that they were distributed.
Domain 3: Exposure (Characterization			
20mm or 2mposure	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations.
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
	Metric 9:	tion Measurement of Test Substance	Medium	Amount ingested was measured but not the actual asbestos content.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for a chronic study.
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were suitable
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organ	nism			
· ·	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized 1 week prior to testing.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	Each treatment group consisted of 140 rats (70 male, 70 female).
		represents per Group		
Domain 5: Outcome A				
	Metric 16:	Adequacy of Test Conditions	Low	Study was conducted according to OECD 451. However, these details were not specified in the study.
		Con	tinued on next page	·

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Asbestos Environmental Hazard Evaluation HERO ID: 759022 Table: 1 of 3

... continued from previous page

Study Citation: Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

This form applies to both the chrysotile-only and chrysotile+crocidolite mixture treatments.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Development/Growth

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 759022

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	Medium	Study was conducted according to OECD 451. However, details of weighing aside from time-points not specified in the study.
	Metric 18:	Consistency of Outcome Assessment	High	Weights obtained at 12, 24, and 30 months.
Domain 6: Confound	ding / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition was reported in Table 1, no differences that could influence the outcome assessment.
Domain 7: Data Pres	sentation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis between the palm oil control and asbestos-treated groups (vehicle was palm oil) was not performed.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Variability not reported.

Overall Quality Determination

Additional Comments:

Uninformative

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Asbestos Environmental Hazard Evaluation HERO ID: 759022 Table: 2 of 3

Study Citation: Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID:	139022			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source was stated.
	Metric 3:	Test Substance Purity	Medium	Chrysotile was UICC granulometry.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Control groups included palm-oil without asbestos and no palm-oil.
	Metric 5:	Negative Control Response	High	Control survival reported in text and Table 1 and appear reasonable.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups only that they were distributed.
Domain 3: Exposure Ch	aracterization			
•	Metric 7:	Experimental System/Test Media Preparation	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations.
	Metric 8:	Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
	Metric 9:	tion Measurement of Test Substance	Medium	Amount ingested was measured but not the actual asbestos content.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for a chronic study.
	Metric 11:	Number of Exposure Groups/	High	The number of exposure groups and spacing of exposure levels were suitable
	Metric 12:	Spacing of Exposure Levels Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organism	m			
Domain ii Test Organisi	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized 1 week prior to testing.
	Metric 15:	Conditions Number of Organisms and	Low	Each treatment group consisted of 140 rats (70 male, 70 female).
		Replicates per Group		
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Low	Study was conducted according to OECD 451. However, these details were not specified in the study.
	Metric 17:	Outcome Assessment Methodology	Medium	Study conducted according to OECD 451; however no details of mortality observations aside from time points provided in Table 1.

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Asbestos Environmental Hazard Evaluation HERO ID: 759022 Table: 2 of 3

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Study Citation: Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

This form applies to both the chrysotile-only and chrysotile+crocidolite mixture treatments.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Additional Comments:

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Mortality

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 759022

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Medium	Not reported how often animals were assessed for mortality. Cumulative survival was
		Assessment		reported at 24 and 30 months.
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition reported for each treatment group (Table 1 and text).
Domain 7: Data Pres	entation and Anal	lysis		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not performed.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group in Table 1.
	Metric 23:	Explanation of Unexpected Outcomes	High	No unexpected outcomes.

Overall Quality Determination

Uninformative

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Asbestos Environmental Hazard Evaluation HERO ID: 759022 Table: 3 of 3

Study Citation: Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 759022

HERO ID:	139022			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	nce			
	Metric 1:	Test Substance Identity	Low	No CASRN provided.
	Metric 2:	Test Substance Source	High	Source of chemical was stated.
	Metric 3:	Test Substance Purity	Medium	Chrysotile was UICC granulometry.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Control groups included palm-oil without asbestos and no palm-oil.
	Metric 5:	Negative Control Response	Medium	Tumor results for control groups shown in Table 2. Authors noted that the proportion of animals with tumors is high but consistent with previous literature.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups only that they were distributed.
Domain 3: Exposure C	haracterization			
Zomani si Ziiposare e	Metric 7:	Experimental System/Test Media	Medium	The study provided some details on the measures taken to appropriately prepare test concentrations.
	Metric 8:	Preparation Consistency of Exposure Administra-	High	Exposures were administered consistently across study groups.
	Metric 9:	tion Measurement of Test Substance	Medium	Amount ingested was measured but not the actual asbestos content.
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for a chronic exposure.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	High	Three doses of chrysotile only or chrysotile+crocidolite were utilized (10, 60, and 360 mg/day).
	Metric 12:	Testing at or Below Solubility Limit	N/A	asbestos is considered insoluble
Domain 4: Test Organi	sm			
Bomain i. rest organi	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	High	The test organisms were acclimatized 1 week prior to testing.
	Metric 15:	Conditions Number of Organisms and	Low	Each treatment group consisted of 140 rats (70 male, 70 female).
		Replicates per Group		
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	Low	Study was conducted according to OECD 451. However, these details were not specified in the study.
	Metric 17:	Outcome Assessment Methodology	Low	Study was conducted according to OECD 451. However, no details of how tumor types were determined were provided.

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Asbestos Environmental Hazard Evaluation HERO ID: 759022 Table: 3 of 3

... continued from previous page

Study Citation: Truhaut, R., Chouroulinkov, I. (1989). Effect of long-term ingestion of asbestos fibres in rats. IARC Scientific Publication no. 90 127-133.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; Wistar Han SPF; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Cancer/Carcinogenesis

Chemical: chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 759022

Domain		Metric	Rating	Comments
	Metric 18:	Consistency of Outcome	Low	Study conducted according to OECD 451; however, no details of timing of assessment
		Assessment		provided in this study.
Domain 6: Confound	ling / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	Attrition reported for each study group and no differences among groups that could
				influence the outcome assessment.
Domain 7: Data Pres	entation and Anal	veis		
Domain 7. Data 1105	Metric 21:	Statistical Methods	Low	Statistical analysis was performed but not described adequately.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	wietite 22.	Reporting of Data	mgn	in Table 2.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes.

Additional Comments: This form applies to both the chrysotile-only and chrysotile+crocidolite mixture treatments.

Overall Quality Determination

Medium

HERO ID: 3612470 Table: 1 of 2

Asbestos Environmental Hazard Evaluation

Study Citation:		Vill, L. A., Leininger, J. R., Donham, K. J. (1979). Regurgitation and choke in rats. Laboratory Animal Science 29(1979):360-363.							
Duration:		Overall Duration: > 21 days; Exposure Duration: > 21 days							
Exposure Route,	Terrestrial; I	Terrestrial; Food/Diet; Dietary							
Media, Path:									
Taxa, Species, Age:		Mammalian; <i>Rattus norvegicus</i> ; F344 female;	Not Applicable (e.g., fu	ingi or algae studies) or Not Reported					
Health Outcome:		e specify below) (Choking)							
Chemical:	•	erpentine) (CASRN 12001-29-5)							
HERO ID:	3612470								
Domain		Metric	Rating	Comments					
Domain 1: Test Substanc		m and the state							
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only					
	Metric 2:	Test Substance Source	Low	The source was not reported					
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance was not reported.					
Domain 2: Test Design									
Bollani 2. Test Besign	Metric 4:	Negative Controls	Uninformative	The study was conducted with three different types of feed - a cellulose diet, asbestos diet, and standard diet. Each type of feed had different percentages of dry matter, nitrogen, crude protein, ether extract, ash, and energy (for cellulose and asbestos). The study was designed to evaluate regurgitation and choking in rats but the study authors did not attempt to normalize or explain why three distinct types of feed were used. It is not possible to make conclusions without taking the feed differences into consideration. Additionally, the study authors observed differences between male and female rats regardless of the type of feed. It is unclear what role asbestos played in this study, if any.					
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and reasonable.					
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.					
Damain 2. Evmasura Cha									
Domain 3: Exposure Cha	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations					
	Metric 8:	Consistency of Exposure Administra-	Medium	consistency is questionable with ad libitum offering of food					
	Metric 9:	Measurement of Test Substance	Low	Exposure concentrations were not measured					
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type					
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	Only one treatment level used.					
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet					
Domain 4: Test Organism	n								
	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source.					
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study did not report whether test organisms were acclimatized					

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Asbestos Environmental Hazard Evaluation HERO ID: 3612470 Table: 1 of 2

... continued from previous page

Study Citation: Will, L. A., Leininger, J. R., Donham, K. J. (1979). Regurgitation and choke in rats. Laboratory Animal Science 29(1979):360-363.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Food/Diet; Dietary

Taxa, Species, Age:

Vertebrate; Mammalian; Rattus norvegicus; F344 female; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Chemical: Other (please specify below) (Choking) chrysotile (serpentine) (CASRN 12001-29-5)

outcomes, if at all. Results of a mixture were also reported.

HERO ID: 3612470

Domain		Metric	Rating	Comments
	Metric 15:	Number of Organisms and	Medium	suitable number, individuals could serve as replicates
		Replicates per Group		
Domain 5: Outcome Asse	essment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome	High	Outcomes were assessed consistently across study groups
		Assessment	-	
Domain 6: Confounding	/ Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Low	There were reported differences between male and female rats with no explanation as t why that might have occurred, regardless of what the feed contained.
Domain 7: Data Presenta	tion and Anal	veic		
Domain 7. Data i resenta	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	Medium	Unexpected outcomes were satisfactorily explained, aside from the differences between male and female rats.

Overall Quality Determination

Uninformative

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Asbestos Environmental Hazard Evaluation HERO ID: 3612470 Table: 2 of 2

Study Citation: Will, L. A., Leininger, J. R., Donham, K. J. (1979). Regurgitation and choke in rats. Laboratory Animal Science 29(1979):360-363.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

ver: Vertebrate; Mammalian; Rattus norvegicus; F344 male; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Other (please specify below) (Choking) **Chemical:** chrysotile (serpentine) (CASRN 12001-29-5)

Domain		Metric	Rating	Comments
Domain 1: Test Substance	ee			
	Metric 1:	Test Substance Identity	Low	Chemical was identified by name only
	Metric 2:	Test Substance Source	Low	The source was not reported
	Metric 3:	Test Substance Purity	Low	Purity or grade of test substance was not reported.
Domain 2: Test Design				
	Metric 4:	Negative Controls	Uninformative	The study was conducted with three different types of feed - a cellulose diet, asbestos diet, and standard diet. Each type of feed had different percentages of dry matter, nitrogen, crude protein, ether extract, ash, and energy (for cellulose and asbestos). The study was designed to evaluate regurgitation and choking in rats but the study authors did not attempt to normalize or explain why three distinct types of feed were used. It is not possible to make conclusions without taking the feed differences into consideration. Additionally, the study authors observed differences between male and female rats regardless of the type of feed. It is unclear what role asbestos played in this study, if any
	Metric 5:	Negative Control Response	High	The biological response of the negative control groups was reported and reasonable.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how organisms were allocated to study groups.
Domain 3: Exposure Cha				
	Metric 7:	Experimental System/Test Media Preparation	Low	The study provided only limited details on the measures taken to appropriately prepare test concentrations
	Metric 8:	Consistency of Exposure Administra-	Medium	consistency is questionable with ad libitum offering of food
	Metric 9:	tion Measurement of Test Substance	Low	Exposure concentrations were not measured
	Metric 10:	Concentration Exposure Duration and Frequency	High	The duration of exposure and/or exposure frequency were reported and appropriate for the study type
	Metric 11:	Number of Exposure Groups/	N/A	Only one treatment level used.
		Spacing of Exposure Levels		
	Metric 12:	Testing at or Below Solubility Limit	N/A	Exposure was via diet
Domain 4: Test Organism	n			
C	Metric 13:	Test Organism Characteristics	High	The test organisms were adequately described and were obtained from a reliable source
	Metric 14:	Acclimatization and Pretreatment	Low	The study did not report whether test organisms were acclimatized
	Metric 15:	Conditions Number of Organisms and	Medium	suitable number, individuals could serve as replicates

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Asbestos Environmental Hazard Evaluation HERO ID: 3612470 Table: 2 of 2

... continued from previous page

Study Citation: Will, L. A., Leininger, J. R., Donham, K. J. (1979). Regurgitation and choke in rats. Laboratory Animal Science 29(1979):360-363.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Food/Diet; Dietary

Media, Path: Taxa, Species, Age:

vertebrate; Mammalian; *Rattus norvegicus*; F344 male; Not Applicable (e.g., fungi or algae studies) or Not Reported

Health Outcome: Chemical:

Other (please specify below) (Choking) chrysotile (serpentine) (CASRN 12001-29-5)

HERO ID: 3612470

Domain		Metric	Rating	Comments
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Low	Environmental conditions were not sufficiently reported to evaluate if adequate
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology reported the intended outcome of interest
	Metric 18:	Consistency of Outcome Assessment	High	Outcomes were assessed consistently across study groups
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test	Low	The study did not provide enough information to allow a comparison of environmental
		Design and Procedures		conditions
	Metric 20:	Outcomes Unrelated to Exposure	Low	There were reported differences between male and female rats with no explanation as to why that might have occurred, regardless of what the feed contained.
Domain 7: Data Preso	entation and Anal	ysis		
	Metric 21:	Statistical Methods	Uninformative	Statistical analysis was not conducted.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group
	Metric 23:	Explanation of Unexpected Outcomes	High	Unexpected outcomes were satisfactorily explained
Additional Comment		existed in the types of feed used as well as magain at all. Results of a mixture were also reported		inclear the extent asbestos contributed to the choking played in the study

Overall Quality Determination

Uninformative

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Cl	haracterization			
r r	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 21 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 21 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organis	sm			
C	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.

Domain 5: Outcome Assessment

HERO ID: 3583167 Table: 1 of 13

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Environmental Hazard Evaluation

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not det **Media, Path:**

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation)
Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Asbestos

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Domain		Metric	Rating	Comments
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 21 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Pres	entation and Anal	vsis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 1 of 13

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Study Citation: Duration: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path: Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain Metric Rating Comments Additional Comments: Exposure and study duration 21 days; Biochemical (Biochemistry-Calcium to magnesium ratio, Response Site: Not reported) This portion of the evaluation was done on the accumulation of metals in the worms for the 21 day exposure. Worms were exposed to asbestos fibers for 21 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. This portion of the evaluation was done on the mortality of the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination

Environmental Hazard Evaluation

HERO ID: 3583167 Table: 2 of 13 Asbestos

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome:

Mortality

Chemical:

asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
C	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in the text under "Results: Earthworm Survival." Results are also reported in figure 1. All earthworms survived in the negative control.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Ch				
	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with H2SO4, but it was not stated how this was done. The test system was described adequately.
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 21 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	It was reported that no earthworms in the 21 and 30 day tests died in the unaltered as- bestos soil treatment. Perhaps the exposure duration could have been longer to see an effect at this level.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organis				
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 2 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain	Metric	Rating	Comments
Domain 5: Outcome Assessment			
Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-mortality
Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 21 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically.
Domain 6: Confounding / Variable C	Control		
Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions. The authors indicated there may be an additional consequence with the additional of citric acid and food. The study authors reported, "Survival in the sediments acidified with organic acids varied greatly. No worms survived in the sediments altered with acetic acid and (NH4)2SO4. In contrast, 81% survived in the sediments neutralized with citric acid. This was 10% higher than the survival in the unaltered asbestos sediments and suggests that the addition of citric acid might have improved the conditions by adding additional food components."
Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Presentation and Ar	alvsis		
Metric 21:	•	Low	Only percent survival was reported for this section without a description of any statistical analysis performed.
Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest–mortality. Figure 1 contains data for all exposure related findings.
Metric 23:	Explanation of Unexpected Outcomes	Low	Any variability in survival between replicates was not reported.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 2 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestr Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain	Metric	Rating	Comments
Additional Comments:	This portion of the evaluation was done on th	e mortality of the worms for the	21 day exposure. Worms were exposed to asbestos fibers for 21 days with
	a 5 day period of non-exposure following that	at to give worms time to empty t	heir guts prior to chemical analysis. The purpose of the study was to test
	exposure of works to asbestos fibers in soil. Co	ontrol worms were exposed to soil	with a pH of 5.7. There were no asbestos-containing treatment groups that
	were exposed to a soil of pH 5.7. Control sed	liments were that of Westham Isla	and while sediments were acidified with H2SO4 to a pH of 6. This creates
	uncertainty regarding the effect of the asbesto	os on the worms, if it was due to	the asbestos, the pH soil, or both. Its clear pH alone has an effect on the
	worms that may or may not be due to asbestos	s. The overall study score was rar	ked 'low' as a result. Although these results are for 21 days, the effects of
	soil pH cannot be ignored in the subsequent 3	0 day tests (both laboratory and fi	eld trials).

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 3 of 13

Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation)
Chemical: asbestos (CASRN 1332-21-4)

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Domain		Metric	Rating	Comments
Domain 1: Test Substa	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure C	haracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 21 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 21 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organi	sm			
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome A	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.

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Study Citation: Duration: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 3 of 13

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 21 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

Exposure and study duration 21 days; Biochemical (Biochemistry-Nickel content, Response Site: Not reported)This portion of the evaluation was done on the accumulation of metals in the worms for the 21 day exposure. Worms were exposed to asbestos fibers for 21 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. This portion of the evaluation was done on the mortality of the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 3 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

Domain	Metric	Rating	Comments
Overall Quality Det	termination	Low	

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Environmental Hazard Evaluation HERO ID: 3583167 Table: 4 of 13

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical: ADME (biotransformation) asbestos (CASRN 1332-21-4)

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Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure C	haracterization			
1 " "	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 21 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 21 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organi	sm			
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome A	ssessment			
Domain 3. Outcome A.	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.

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Study Citation: Duration: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 4 of 13

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 21 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confoundi	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

Exposure and study duration 21 days; Biochemical (Biochemistry-Nickel content, Response Site: Not reported) This portion of the evaluation was done on the accumulation of metals in the worms for the 21 day exposure. Worms were exposed to asbestos fibers for 21 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. This portion of the evaluation was done on the mortality of the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 4 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

Domain	Metric	Rating	Comments
Overall Quality Det	termination	Low	

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Environmental Hazard Evaluation HERO ID: 3583167 Table: 5 of 13

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical: ADME (biotransformation) asbestos (CASRN 1332-21-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	nce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
· ·	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure C	haracterization			
1	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 21 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 21 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organi	sm			
10 00 01guin	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome A	ssessment			
Domain 3. Outcome A	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
		G	nued on nex	A

Environmental Hazard Evaluation Asbestos

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Study Citation: Duration:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 5 of 13

Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) Chemical: asbestos (CASRN 1332-21-4) **HERO ID:**

3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 21 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confoundi	ng / Variable Coi	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest—accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

Exposure and study duration 21 days; Biochemical (Biochemistry-Chromium content, Response Site: Not reported) This portion of the evaluation was done on the accumulation of metals in the worms for the 21 day exposure. Worms were exposed to asbestos fibers for 21 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. This portion of the evaluation was done on the mortality of the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 5 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: 11 - 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

Domain	Metric	Rating	Comments	
Overall Quality Det	ermination	Low		

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Environmental Hazard Evaluation HERO ID: 3583167 Table: 6 of 13

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical: Reproductive/Teratogenic asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	Low	The negative control response was reported in the text under "Results: Earthworm Survival." It was reported that only 15% of the control worms went on to reproduce.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Ch	aracterization			
2 smain 3. Exposure Cir	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with H2SO4, but it was not stated how this was done. The test system was described adequately.
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 297 days in 25L plastic containers that were watered 3 times during dry periods. This portion of the test is referred to as the "field study" by the study authors.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	It was reported that earthworms in both asbestos exposures died before the end of the 297 day study. Perhaps a shorter exposure duration would have been suitable to obtain more data on survival and reproduction.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Damain 4. Tark Oncorio				
Domain 4: Test Organis	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	There were 20 earthworms per test chamber and two replicates per treatment. More
		Replicates per Group		replicates or more worms may have provided a more insightful data set.

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Environmental Hazard Evaluation

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Study Citation: Duration:

Asbestos

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 6 of 13

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

Reproductive/Teratogenic asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 5: Outcome Ass	sessment			
	Metric 16:	Adequacy of Test Conditions	Medium	This portion of the study was conducted outdoors, and environmental conditions were not reported. Worms were fed clover straw during the study and loading rate seemed appropriate.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–reproduction.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 297 days, the worms were assessed for survival and reproduction.
Domain 6: Confounding	g / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Present	ation and Anal	ysis		
	Metric 21:	Statistical Methods	Low	Only percent reproduction was reported for this section without a description of any statistical analysis performed.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for each treatment and control group. Reproduction could not be assessed for the asbestos treatments because all the worms in those treatments died before the end of the 297 day study.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Any variability in survival between replicates was not reported.
Additional Comments:	after which tworms were study. This c	they were assessed for survival and reprodexposed to soil with a pH of 5. There were	uction. The no asbestos	worms for the 297 day exposure. Worms were exposed to asbestos fibers for 297 days purpose of the study was to test exposure of works to asbestos fibers in soil. Control-containing treatment groups that were exposed to a soil of pH 5 over the course of the n the worms, if it was due to the asbestos, the pH soil, or both. The overall study score

Overall Quality Determination

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Environmental Hazard Evaluation HERO ID: 3583167 Table: 7 of 13

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substar	ice			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
Č	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Cl	naracterization			
r	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 30 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organis	sm			
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
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Environmental Hazard Evaluation Asbestos

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Study Citation: Duration:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 7 of 13

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation)

asbestos (CASRN 1332-21-4) **HERO ID:** 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confound	ing / Variable Co	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Preso	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest-accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

Exposure duration 30 days. Biochemical (Biochemistry-Nickel content, Response Site: Not reported) This portion of the evaluation was done on the accumulation of metals in the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 8 of 13

Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route) **Media, Path:**

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

Domain	Metric	Rating	Comments
Domain 1: Test Substance			
Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design			
Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
Metric 5:	Negative Control Response	Low	The negative control response was reported in the text under "Results: Earthworm Survival." Results are also reported in figure 1. Only 15% of the control worms survived the 297 day study.
Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Characterization			
Metric 7:	Experimental System/Test Media	Low	Test media was said to have been altered to adjust the pH with H2SO4, but it was not
Wiethe 7.	Preparation	LOW	stated how this was done. The test system was described adequately.
Metric 8:	Consistency of Exposure Administra-	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 297 days in 25L plastic containers that were watered 3 times during dry periods. This portion of the test is referred to as the "field study" by the study authors.
Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
Metric 10:	Exposure Duration and Frequency	Medium	It was reported that earthworms in both asbestos exposures died before the end of the 297 day study. Perhaps a shorter exposure duration would have been suitable to obtain more data on survival and reproduction.
Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested
Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Daniela A. Tart Organiana			
Domain 4: Test Organism	Test Organism Characteristics	Madium	The service of the least the service of the service
Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
Metric 15:	Conditions Number of Organisms and Replicates per Group	Low	There were 20 earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 8 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not of **Media, Path:**

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	Medium	This portion of the study was conducted outdoors, and environmental conditions were not reported. Worms were fed clover straw during the study and loading rate seemed appropriate.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-mortality
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 297 days, the worms were assessed for survival and reproduction.
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported whether the earthworms were acclimated to the test conditions. The authors indicated there may be an additional consequence with the additional of citric acid and food. The study authors reported, "Survival in the sediments acidified with organic acids varied greatly. No worms survived in the sediments altered with acetic acid and (NH4)2SO4. In contrast, 81% survived in the sediments neutralized with citric acid. This was 10% higher than the survival in the unaltered asbestos sediments and suggests that the addition of citric acid might have improved the conditions by adding additional food components."
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Pres	entation and Anal	veis		
Domain 7. Data 1105	Metric 21:	Statistical Methods	Low	Only percent survival was reported for this section without a description of any statistical analysis performed.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest–mortality. Figure 1 contains data for all exposure related findings.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Any variability in survival between replicates was not reported.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 8 of 13

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain	Metric	Rating	Comments
Additional Comments:	This portion of the evaluation was done on the	ne mortality of the worms for the 297	7 day exposure. Worms were exposed to asbestos fibers for 297 days after
	which they were assessed for survival and re-	eproduction. This portion of the eval	uation was done on the mortality of the worms for the 30 day exposure.
	Worms were exposed to asbestos fibers for 3	30 days with a 5 day period of non-	exposure following that to give worms time to empty their guts prior to
	chemical analysis. The purpose of the study v	was to test exposure of works to asbo	estos fibers in soil. Control worms were exposed to soil with a pH of 5.7.
	There were no asbestos-containing treatment	groups that were exposed to a soil	of pH This creates uncertainty regarding the effect of the asbestos on the
	worms, if it was due to the asbestos, the pH	soil, or both. It is clear pH alone h	has an effect on the worms that may or may not be due to asbestos. The
	overall study score was ranked 'low' as a res	ult.	

Overall Quality Determination

HERO ID: 3583167 Table: 9 of 13

Environmental Hazard Evaluation

Asbestos

Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

asbestos (CASRN 1332-21-4) Chemical:

HERO ID: 3583167

etric 1: letric 2: letric 3:	Test Substance Identity Test Substance Source Test Substance Purity	Low Low	The test substance was simply identified as asbestos from serpentinitic rock and soil. The test substance was from a 1975 flood deposit in in Whatcom Country, Washington.
etric 2:	Test Substance Source	Low	1.
			The test substance was from a 1975 flood deposit in in Whatcom Country, Washington.
etric 3:	Test Substance Purity	T	The study authors did not report if it was analytically verified.
		Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
etric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
etric 5:	Negative Control Response	High	The negative control response was reported in the text under "Results: Earthworm Survival." Results are also reported in figure 1. All earthworms survived in the negative control.
letric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
eterization letric 7:	Experimental System/Test Media	Low	Test media was said to have been altered to adjust the pH with various acids, but it was
	Preparation		not stated how this was done. The test system was described adequately.
etric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
etric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
etric 10:	Exposure Duration and Frequency	Medium	It was reported that no earthworms in the 21 and 30 day tests died in the unaltered as- bestos soil treatment. Perhaps the exposure duration could have been longer to see an effect at this level.
etric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration of the asbestos. What changed was the chemical used to adjust the pH of the soil being tested.
etric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
12	T (O : O : (: (: (: (: (: (: (: (3.6 11	
etric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
etric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
etric 15:	Number of Organisms and	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
	etric 5: etric 6: terization etric 7: etric 8: etric 9: etric 10: etric 11: etric 12: etric 12:	etric 5: Negative Control Response etric 6: Randomized Allocation terization etric 7: Experimental System/Test Media Preparation Consistency of Exposure Administration etric 9: Measurement of Test Substance Concentration etric 10: Exposure Duration and Frequency etric 11: Number of Exposure Groups/ Spacing of Exposure Levels etric 12: Testing at or Below Solubility Limit etric 13: Test Organism Characteristics etric 14: Acclimatization and Pretreatment Conditions	etric 5: Negative Control Response High etric 6: Randomized Allocation Low terization etric 7: Experimental System/Test Media Preparation etric 8: Consistency of Exposure Administration etric 9: Measurement of Test Substance Low Concentration etric 10: Exposure Duration and Frequency Medium etric 11: Number of Exposure Groups/Spacing of Exposure Levels etric 12: Testing at or Below Solubility Limit N/A etric 13: Test Organism Characteristics Medium etric 14: Acclimatization and Pretreatment Low Conditions Number of Organisms and Low

HERO ID: 3583167 Table: 9 of 13

Asbestos Environmental Hazard Evaluation

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Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-mortality
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically.
Domain 6: Confound	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions—it was not reported whether the earthworms were acclimated to the test conditions. The authors indicated there may be an additional consequence with the additional of citric acid and food. The study authors reported, "Survival in the sediments acidified with organic acids varied greatly. No worms survived in the sediments altered with acetic acid and (NH4)2SO4. In contrast, 81% survived in the sediments neutralized with citric acid. This was 10% higher than the survival in the unaltered asbestos sediments and suggests that the addition of citric acid might have improved the conditions by adding additional food components."
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Pres	entation and Anal	vsis		
. Data 1100	Metric 21:	Statistical Methods	Low	Only percent survival was reported for this section without a description of any statistical analysis performed.
	Metric 22:	Reporting of Data	High	Data for exposure-related findings were presented for each treatment and control group and were adequate to determine values for the endpoint of interest–mortality. Figure 1 contains data for all exposure related findings.
	Metric 23:	Explanation of Unexpected Outcomes	Low	Any variability in survival between replicates was not reported.

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 9 of 13

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Study Citation: Duration: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

ration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Taxa, Species, Age:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Mortality

Chemical: asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Additional Comments:

This portion of the evaluation was done on the mortality of the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidifiedasbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortalityrate in the first experiment."

Overall Quality Determination

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Environmental Hazard Evaluation HERO ID: 3583167 Table: 10 of 13

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration:

Asbestos

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

Domain		Metric	Rating	Comments
Domain 1: Test Substa	ance			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design	n			
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure (haracterization			
Domain 3. Exposure C	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 30 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organ	ism			
100t O1guii	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome A	Assassment			
Domain 5; Outcome F	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.

Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 10 of 13

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Study Citation:
Duration:
Expression Posts

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confoundi	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Prese	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest—accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

297 day duration. Biochemical (Biochemistry-Calcium content, Chromium content, Magnesium (Mg) content, Nickel content, Response Site: Feces) This portion of the evaluation was done on the accumulation of metals in the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination

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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 11 of 13

Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: ADME (biotransformation) **Chemical:** asbestos (CASRN 1332-21-4)

HERO ID:	3383107			
Domain		Metric	Rating	Comments
Domain 1: Test Subs	stance			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the as- bestos was made of in terms of metals.
Domain 2: Test Desi	gn			
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure	Characterization			
- ·	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administra- tion	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 30 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Orga	ınism			
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and Replicates per Group	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment. More replicates or more worms may have provided a more insightful data set.
		Replicates per Group		
Domain 5: Outcome	Assessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
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		Collu	nucu on nez	vi haže · · ·

Asbestos Environmental Hazard Evaluation

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Study Citation: Duration: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 11 of 13

Overall Duration: > 21 days; Exposure Duration: > 21 days

asbestos (CASRN 1332-21-4)

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Health Outcome:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Chemical: HERO ID: ADME (biotransformation)

D: 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confoundi	ing / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Prese	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

30 day duration. Biochemical (Biochemistry-Chromium content, Response Site: Not reported) This portion of the evaluation was done on the accumulation of metals in the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination

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Asbestos **Environmental Hazard Evaluation** HERO ID: 3583167 Table: 12 of 13

Study Citation: Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Duration: Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

ADME (biotransformation) **Health Outcome:** Chemical: asbestos (CASRN 1332-21-4)

HERO ID:	3583167			
Domain		Metric	Rating	Comments
Domain 1: Test Substar	ice			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the asbestos was made of in terms of metals.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Cl	naracterization			
1	Metric 7:	Experimental System/Test Media	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it
		Preparation		was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-
	Metric 9:	Measurement of Test Substance	Low	exposure period for worms to empty their guts. Exposures were in the dark at 10C. The study authors did not report whether the asbestos was measured during the test or
	Metric 9.	Concentration	Low	before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 30 days was appropriate for the outcomes of interest. Re-
				searchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/	N/A	There was only one exposure concentration of the asbestos. What changed was the pH
		Spacing of Exposure Levels		of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organis	sm			
C	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Conditions Number of Organisms and	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment.
	Micure 13.	Replicates per Group	LOW	More replicates or more worms may have provided a more insightful data set.
		represent the order		1
Domain 5: Outcome As	ssessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.

Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 12 of 13

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Study Citation:
Duration:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical: HERO ID: ADME (biotransformation) asbestos (CASRN 1332-21-4)

3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest-accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confoundin	ng / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Preser	ntation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

30 day duration. Biochemical (Biochemistry-Calcium to magnesium ratio, Response Site: Not reported)This portion of the evaluation was done on the accumulation of metals in the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination

Study Citation:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

HERO ID: 3583167 Table: 13 of 13

Duration:

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route,

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Media, Path:

Taxa, Species, Age: Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Health Outcome: Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

HERO ID:

3583167

пекотр:	3383107			
Domain		Metric	Rating	Comments
Domain 1: Test Substan	ce			
	Metric 1:	Test Substance Identity	Low	The test substance was simply identified as asbestos from serpentinitic rock and soil.
	Metric 2:	Test Substance Source	Low	The test substance was from a 1975 flood deposit in in Whatcom Country, Washington. The study authors did not report if it was analytically verified.
	Metric 3:	Test Substance Purity	Low	The purity of the test substance was not reported. There was not report of what the as- bestos was made of in terms of metals.
Domain 2: Test Design				
	Metric 4:	Negative Controls	High	Study authors reported using Westham Island soil as a negative control.
	Metric 5:	Negative Control Response	High	The negative control response was reported in Table 1 and in Figure 2 and was adequate.
	Metric 6:	Randomized Allocation	Low	Researchers did not report how the earthworms were divided into study groups.
Domain 3: Exposure Ch	naracterization			
r	Metric 7:	Experimental System/Test Media Preparation	Low	Test media was said to have been altered to adjust the pH with various chemicals, but it was not stated how this was done. The test system was described adequately
	Metric 8:	Consistency of Exposure Administration	High	Details of exposure administration were reported and exposures were administered consistently across study groups. All exposures were for 30 days with a 5 day non-exposure period for worms to empty their guts. Exposures were in the dark at 10C.
	Metric 9:	Measurement of Test Substance Concentration	Low	The study authors did not report whether the asbestos was measured during the test or before the test.
	Metric 10:	Exposure Duration and Frequency	Medium	The exposure duration of 30 days was appropriate for the outcomes of interest. Researchers were able to see an increase in accumulation of Ni and Mg components.
	Metric 11:	Number of Exposure Groups/ Spacing of Exposure Levels	N/A	There was only one exposure concentration of the asbestos. What changed was the pH of the soil being tested.
	Metric 12:	Testing at or Below Solubility Limit	N/A	Asbestos is insoluble and the exposure was via soil.
Domain 4: Test Organis	m			
	Metric 13:	Test Organism Characteristics	Medium	The organisms were reported to be collected from a clover field near Vancouver. This creates questions regarding organism health.
	Metric 14:	Acclimatization and Pretreatment Conditions	Low	The study authors did not report whether the organisms were acclimatized.
	Metric 15:	Number of Organisms and	Low	There were 4 weighed earthworms per test chamber and two replicates per treatment.
		Replicates per Group		More replicates or more worms may have provided a more insightful data set.
Domain 5: Outcome As	sessment			
	Metric 16:	Adequacy of Test Conditions	High	Earthworms were kept in the dark at 10C for the duration of the test. Worms were fed clover straw during the study.
		Conti	nued on nex	kt page
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Asbestos Environmental Hazard Evaluation HERO ID: 3583167 Table: 13 of 13

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Study Citation:
Duration:

Schreier, H., Timmenga, H. J. (1986). Earthworm response to asbestos rich serpentinitic sediments. Soil Biology and Biochemistry 18(1986):85-89.

Overall Duration: > 21 days; Exposure Duration: > 21 days

Exposure Route, Media, Path:

Terrestrial; Soil; Not determined by study authors (i.e., chemical of interest in exposure water, but unable to determine exact uptake route)

Taxa, Species, Age: Health Outcome:

Invertebrate; Worms (e.g., Annelids, Nematodes); Lumbriculus rubellus; Adult

Chemical:

ADME (biotransformation) asbestos (CASRN 1332-21-4)

HERO ID: 3583167

Domain		Metric	Rating	Comments
	Metric 17:	Outcome Assessment Methodology	High	The outcome assessment methodology addressed or reported the intended outcome of interest–accumulation of metals due to asbestos exposure.
	Metric 18:	Consistency of Outcome Assessment	High	Details of the outcome assessment protocol were reported, and outcomes were assessed consistently across study groups. After 30 days, the worms were removed from the test substance and placed in petri dishes with wet filter paper for 5 days to empty their guts. They were then analyzed chemically for metal accumulation.
Domain 6: Confound	ling / Variable Cor	ntrol		
	Metric 19:	Confounding Variables in Test Design and Procedures	Low	The study did not provide enough information to allow a comparison of environmental conditions –it was not reported whether the earthworms were acclimated to the test conditions.
	Metric 20:	Outcomes Unrelated to Exposure	High	The study authors reported "Acidification of asbestos decreased survival rate substantially, but this is dependent on the acidused."
Domain 7: Data Pres	entation and Anal	ysis		
	Metric 21:	Statistical Methods	High	A Mann-Whitney nonparametric significance test was used to determine differences in metal content between treatments and the control.
	Metric 22:	Reporting of Data	Medium	Data for exposure-related findings were presented for most treatments and the control group and were adequate to determine values for the endpoint of interest–accumulation of metals. The study did not report results for all the asbestos treatments and their pHs.
	Metric 23:	Explanation of Unexpected Outcomes	High	There were no unexpected outcomes, or unexpected outcomes were satisfactorily explained. Variability was reported in Table 1 and in Figure 2.

Additional Comments:

30 day duration. Biochemical (Biochemistry-Magnesium (Mg) content, Response Site: Not reported)This portion of the evaluation was done on the accumulation of metals in the worms for the 30 day exposure. Worms were exposed to asbestos fibers for 30 days with a 5 day period of non-exposure following that to give worms time to empty their guts prior to chemical analysis. The purpose of the study was to test exposure of works to asbestos fibers in soil. Control worms were exposed to soil with a pH of 5.0 and 5.7. There were no asbestos-containing treatment groups that were exposed to a soil of pH 5.7 but citric acid was used to bring soil to a pH of 5.0. Control sediments were that of Westham Island while sediments were acidified with citric acid to 7.5. This creates uncertainty regarding the effect of the asbestos on the worms, if it was due to the asbestos, the pH soil, or both. It is clear pH alone has an effect on the worms that may or may not be due to asbestos. The overall study score was ranked 'low' as a result. The study authors indicated "Survival rates dropped dramatically in the acidified asbestos-rich sediments and mortality was particularly high in asbestos sediments acidified with H2SO4." "As shown by Piearce (1979, 1982) most earthworms avoid salinity levels of 1.4% (total dissolved salts) and 2.9% are considered lethal. Tests after incubation showed that soil salinity ranged from 0.02% in the unacidified sediments to 1.2, 2.1 and 2.2% in soils adjusted to pH 8.3, 7.1 and 5.3 respectively. It is thus evident that salinity might have contributed to the high mortality rate in the first experiment."

Overall Quality Determination