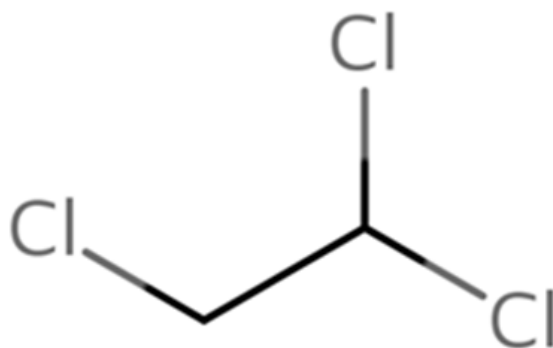

**Draft Data Quality Evaluation Information for
Human Health Hazard Epidemiology for
1,1,2-Trichloroethane**

Systematic Review Support Document for the Draft Risk Evaluation

CASRN: 79-00-5



May 2026

This supplemental file contains the data quality evaluation results for epidemiology data sources that met the PECO screening criteria for the *Draft Human Health and Environmental Hazard Assessment for 1,1,2-Trichloroethane*. 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* (referred to hereafter as the '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 Systematic Review Protocol for 1,1,2-Trichloroethane*.

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HERO ID	Reference	Page
Observational Epidemiology Studies		
1,1,2-Trichloroethane		
Cancer/Carcinogenesis		
4697224	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.	8
194820	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.	11
Endocrine		
194820	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.	13
Neurological/Behavioral		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	15
Lung/Respiratory		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	19
Cardiovascular		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	23
Gastrointestinal		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	27
Ocular & Sensory		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	31
Renal/Kidney		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	35
4697224	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.	39
Reproductive/Developmental		
2799700	Brender, J. D., Shinde, M. U., Zhan, F. B., Gong, X., Langlois, P. H. (2014). Maternal residential proximity to chlorinated solvent emissions and birth defects in offspring: A case-control study. Environmental Health 13(1):96.	42

1,1,2-Trichloroethane

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200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	44
Immune/Hematological		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	48
Skin and Connective Tissue		
200292	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.	52
Isomer: 1,1,1-Trichloroethane		
Mortality		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	56
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	59
Cancer/Carcinogenesis		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	61
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	64
1069372	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.	80
Lung/Respiratory		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	82
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	85
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	87
Gastrointestinal		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	126
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	129
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	131

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1069372	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.	143
Renal/Kidney		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	145
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	148
Hepatic/Liver		
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	150
Neurological/Behavioral		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	152
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	155
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	157
677146	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.	247
Skin and Connective Tissue		
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	249
Cardiovascular		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	251
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	254
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	256
Immune/Hematological		
5452779	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.	262
702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	265
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	267
Nutrition & Metabolic		

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702055	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.	270
Musculoskeletal		
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	272
Irritation		
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	275
Other (Finger nails, dry mouth)		
1576	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.	281
Reproductive/Developmental		
200239	Bove, F. J. (1996). Public drinking water contamination and birthweight, prematurity, fetal deaths, and birth defects. Toxicology and Industrial Health 12(2):255-266.	287
194932	Bove, F. J., Fulcomer, M. C., Klotz, J. B., Esmart, J., Dufficy, E. M., Savrin, J. E. (1995). Public drinking water contamination and birth outcomes. American Journal of Epidemiology 141(9):850-862.	291
671475	Sallmen, M., Lindbohm, M. L., Anttila, A., Kyyronen, P., Taskinen, H., Nykyri, E., Hemminki, K. (1998). Time to pregnancy among the wives of men exposed to organic solvents. Occupational and Environmental Medicine 55(1):24-30.	295
5414	Taskinen, H., Anttila, A., Lindbohm, M. L., Sallmén, M., Hemminki, K. (1989). Spontaneous abortions and congenital malformations among the wives of men occupationally exposed to organic solvents. Scandinavian Journal of Work, Environment and Health 15(5):345-352.	297
708475	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.	299
Other (Sleep apnea or nocturnal arterial oxygen desaturation)		
677146	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.	305
Other (sick building syndrome)		
1938385	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.	307

Isomer: Methyl chloroform**Renal/Kidney**

4697224	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.	312

Cancer/Carcinogenesis

4697224	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.	314

Isomer: Trichloroethane

Cancer/Carcinogenesis		
32901	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.	316
Intentional Dosing Studies		
1,1,2-Trichloroethane		
Irritation		
5469150	Wahlberg, J. E. (1984). Edema-inducing effects of solvents following topical administration. Dermatosen in Beruf und Umwelt 32(3):91-94.	324

Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	renal cell carcinoma		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	4697224		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	The details of the study design were reported elsewhere (Chow et al. 1994, HERO ID 701514). Brief details about the setting, date, number of eligible participants, and control matching were reported. Reasons for exclusions/non-participation were described with details by Chow et al. (1994).
Metric 2:	Attrition	High	For the details of the study design and attrition of study subjects, the study authors referred to another publication by Chow et al., 1994. Chow et al. (1994) mentioned that at the end of the personal interview, the respondents were given a self-administered food-frequency questionnaire. Of the subjects interviewed for the study, 632 patients (79% of 796 eligible patients) and 653 control subjects (79% of 707 eligible control subjects) returned the diet questionnaire. A number of subjects, whose responses were considered unreliable, were excluded from the analysis, including 48 patients and three control subjects who had seven or more skipped food items or had questionable data and 50 patients whose next-of-kin respondent was not a spouse. Also excluded were two patients with unknown smoking status, since smoking is a risk factor.
Metric 3:	Comparison Group	Medium	The cases were pulled from the Minnesota Cancer Surveillance System. Controls were selected from the general population of Minnesota; controls age 20-64 years were selected through random digital dialing and controls age 65-85 years were collected from files through the Health Care Financing Administration. Controls were age- and gender-stratified and were of the same race. Characteristics of cases and controls were not provided in the text or a table.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	High	Occupational histories including the most recent and usual occupation and industry, job activities, started-year and ended-year, and part-time/full-time status were collected. Occupations and industries were coded according to the standard occupational classification (SOC) and standard industrial classification (SIC) schemes. The National Cancer Institute developed job exposure matrices (JEM) for nine individual chlorinated aliphatic hydrocarbons (CAHCs), all CAHCs-combined, and all organic solvents-combined. These JEMs were merged with assigned SOC and SIC to determine the exposure status to these chemicals for each study subject. Application of the JEM was described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154).
Metric 5:	Exposure Levels	Medium	Details of the application of the JEM were described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154). Dosemeci et al. (1994) described more details about that this study assigned three levels of probability (low, medium, high) to industries and occupations for chemical exposure levels.

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	renal cell carcinoma			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	4697224			
Domain		Metric	Rating	Comments
	Metric 6:	Temporality	Medium	Occupational questionnaires identified prior exposures based on reported recent and usual occupations as well as duration of employment. Outcome status was determined from registry data. The authors note that some occupational history was incomplete which may result in some uncertainty in regard to temporality.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Cases were identified as newly diagnosed and histologically confirmed renal cell carcinoma through the Minnesota Cancer Surveillance System and information about each participant was collected using a questionnaire. Validation was not specified.
	Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and ORs were stratified by sex. Effect estimates are reported with a confidence interval. One table showed the total numbers of men and women respectively for each chemical, but numbers of cases/controls were not reported.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made in the final analysis, including age, gender, smoking, hypertension and the use of diuretics and/or anti-hypertension drugs, and BMI. Results were stratified by sex.
	Metric 10:	Covariate Characterization	Medium	Information about participants was collected using a questionnaire, and it includes potential confounders, e.g., smoking habits. Validation was not specified.
	Metric 11:	Co-exposure Counfounding	Medium	Co-exposures were identified through the job exposure matrices. Chemicals were evaluated individually and as a group.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen (case-control) was appropriate for the research question (renal cell carcinoma risk from occupational organic solvent exposure). Logistic regression models were used to estimate the relative risk and 95% CI.
	Metric 13:	Statistical Power	Low	Statistical power calculations were not provided. No significant effects were observed with 1,1,2-trichloroethane. The number of participated women to calculate odds ratio was inadequate to detect an effect in the participants for other chemicals or the combined risk, because it was very low.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis was brief, but is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15:	Statistical Analysis	High	Model assumptions for logistic regression were met. The odds ratios were adjusted for age, smoking, hypertension status and/or use of diuretic and/or anti-hypertension drugs, and body mass index for men and women separately.

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.
Health Outcome(s) Assessed:	Cancer/Carcinogenesis
Reported Health Effect(s):	renal cell carcinoma
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	4697224

Domain	Metric	Rating	Comments
Additional Comments:	A group of 438 cases (273 men and 165 women) were selected from the Minnesota Cancer Surveillance System that had been newly diagnosed with renal cell carcinoma. Controls included 687 participants (462 men and 225 women) age- and gender- stratified that were selected from either the general population of Minnesota (age 20-64 years) or from the Health Care Financing Administration files (age 65-85). No significant increase in the risk of renal cell carcinoma was observed with exposure to 1,1,2-trichloroethane among men or women separately, or for all participants exposed.		

Overall Quality Determination

Medium

Study Citation:	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Death from pancreatic cancer		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	194820		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	The National Cancer Institute, National Institute of Occupational Safety and Health, and the National Center for Health Statistics reviewed death certificates from 24 states to select cases from those that had died from pancreatic cancer and matched controls. Controls with cause of death related to the outcome of interest (i.e. pancreatic diseases) were excluded from the study. All key elements of the study design were reported.
Metric 2:	Attrition	Medium	There was no direct evidence of subject loss or exclusion of subgroups from analyses. The authors provide the total number of cases and controls in the analysis. Case and control data were taken from a registry. It can be assumed that the data are complete for each subject.
Metric 3:	Comparison Group	High	Controls were selected from the same pool of death certificates from 24 states that cases were selected from. Controls with cause of death related to the outcome of interest were eliminated. Differences in baseline characteristics were controlled for via matching, stratification, and adjustment.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Exposure was assessed via occupation and industry data on death certificates. A job matrix was further applied to assess the likely levels of exposure. Probability and intensity of exposure were estimated across four levels for each occupation. Only employment captured on the death certificate could be considered. The exposure assessment needs exposure information before the job listed on the death certificates.
Metric 5:	Exposure Levels	Medium	The study offers 4 levels of estimated probability and intensity of exposure (referent, low, medium, high).
Metric 6:	Temporality	Medium	Exposure was determined by occupational and industry codes on death certificates and indicate that exposure would precede disease, however, the timing and latency period is less clear.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Causes of mortality were determined from death certificates for both cases and controls. Death certificates were drawn from death registries of participating states (n=24). Causes of death were coded using ICD-9 codes, and pancreatic cancer was identified as ICD 157.
Metric 8:	Reporting Bias	Medium	Measured outcomes, effect estimates and confidence intervals are reported. Number of exposed cases is reported for each analysis, however the number of controls (exposed and unexposed) are not reported for analyses.

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Study Citation:	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Death from pancreatic cancer		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	194820		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	Medium	Potential confounders were accounted for in the following ways: matching (five year age group, state, race, and gender); adjustment in models (age, marital status, metropolitan, and residential status); and stratification (race and gender). Smoking was not included as a confounder.
	Metric 10: Covariate Characterization	Medium	Data used to assess potential confounders was derived from death certificates, an adequate measure. However, no information about cigarette smoking and other lifestyle factors were available for adjustment in the analysis.
	Metric 11: Co-exposure Counfounding	Medium	The variety of industries considered in the analysis diminishes concerns about co-exposures.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	The case-control study design and statistical analysis methods were appropriate to assess the exposures/outcome of interest.
	Metric 13: Statistical Power	Medium	This study had an adequate sample size to detect an effect (n for cases = 63,097; n for controls = 252,386).
	Metric 14: Reproducibility of Analyses	Medium	The description of analysis was sufficient and would be reproducible.
	Metric 15: Statistical Analysis	High	The model to calculate risk estimates was transparent.
Additional Comments:	This case-control study examined the risk of death from pancreatic cancer in different occupational settings. Exposure was solely assessed using occupation/industry at time of death (reported on death certificate) and the application of a job matrix assessing likely levels of exposure for different positions. This means of estimating exposure may not fully represent a participant's exposure history. Additionally, the number of impacted participants (exposed cases) was inadequate to perform quality analyses for some exposure levels.		

Overall Quality Determination

High

Study Citation:	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.		
Health Outcome(s) Assessed:	Endocrine		
Reported Health Effect(s):	Death from pancreatic cancer		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	194820		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	The National Cancer Institute, National Institute of Occupational Safety and Health, and the National Center for Health Statistics reviewed death certificates from 24 states to select cases from those that had died from pancreatic cancer and matched controls. Controls with cause of death related to the outcome of interest (i.e. pancreatic diseases) were excluded from the study. All key elements of the study design were reported.
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Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Exposure was assessed via occupation and industry data on death certificates. A job matrix was further applied to assess the likely levels of exposure. Probability and intensity of exposure were estimated across four levels for each occupation. Only employment captured on the death certificate could be considered. The exposure assessment needs exposure information before the job listed on the death certificates.
Metric 5:	Exposure Levels	Medium	The study offers 4 levels of estimated probability and intensity of exposure (referent, low, medium, high).
Metric 6:	Temporality	Medium	Exposure was determined by occupational and industry codes on death certificates and indicate that exposure would precede disease, however, the timing and latency period is less clear.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Causes of mortality were determined from death certificates for both cases and controls. Death certificates were drawn from death registries of participating states (n=24). Causes of death were coded using ICD-9 codes, and pancreatic cancer was identified as ICD 157.
Metric 8:	Reporting Bias	Medium	Measured outcomes, effect estimates and confidence intervals are reported. Number of exposed cases is reported for each analysis, however the number of controls (exposed and unexposed) are not reported for analyses.

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Study Citation:	Kernan, G. J., Ji, B. T., Dosemeci, M., Silverman, D. T., Balbus, J., Zahm, S. H. (1999). Occupational risk factors for pancreatic cancer: A case-control study based on death certificates from 24 U.S. states. American Journal of Industrial Medicine 36(2):260-270.		
Health Outcome(s) Assessed:	Endocrine		
Reported Health Effect(s):	Death from pancreatic cancer		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	194820		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	Medium	Potential confounders were accounted for in the following ways: matching (five year age group, state, race, and gender); adjustment in models (age, marital status, metropolitan, and residential status); and stratification (race and gender). Smoking was not included as a confounder.
	Metric 10: Covariate Characterization	Medium	Data used to assess potential confounders was derived from death certificates, an adequate measure. However, no information about cigarette smoking and other lifestyle factors were available for adjustment in the analysis.
	Metric 11: Co-exposure Counfounding	Medium	The variety of industries considered in the analysis diminishes concerns about co-exposures.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	The case-control study design and statistical analysis methods were appropriate to assess the exposures/outcome of interest.
	Metric 13: Statistical Power	Medium	This study had an adequate sample size to detect an effect (n for cases = 63,097; n for controls = 252,386).
	Metric 14: Reproducibility of Analyses	Medium	The description of analysis was sufficient and would be reproducible.
	Metric 15: Statistical Analysis	High	The model to calculate risk estimates was transparent.
Additional Comments:	This case-control study examined the risk of death from pancreatic cancer in different occupational settings. Exposure was solely assessed using occupation/industry at time of death (reported on death certificate) and the application of a job matrix assessing likely levels of exposure for different positions. This means of estimating exposure may not fully represent a participant's exposure history. Additionally, the number of impacted participants (exposed cases) was inadequate to perform quality analyses for some exposure levels.		

Overall Quality Determination

High

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Convulsions, dizziness/blackouts, frequent headaches, learning difficulties, nervousness, numbness in fingers/toes, sleeping difficulties, tremors, unusual fatigue, decreased sense of smell, peculiar odor/taste		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Convulsions, dizziness/blackouts, frequent headaches, learning difficulties, nervousness, numbness in fingers/toes, sleeping difficulties, tremors, unusual fatigue, decreased sense of smell, peculiar odor/taste			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Convulsions, dizziness/blackouts, frequent headaches, learning difficulties, nervousness, numbness in fingers/toes, sleeping difficulties, tremors, unusual fatigue, decreased sense of smell, peculiar odor/taste			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.	
	Metric 10: Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.	
	Metric 11: Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.	
	Metric 13: Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.	
	Metric 14: Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.	
	Metric 15: Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Convulsions, dizziness/blackouts, frequent headaches, learning difficulties, nervousness, numbness in fingers/toes, sleeping difficulties, tremors, unusual fatigue, decreased sense of smell, peculiar odor/taste
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Frequent allergies, breathing difficulty, persistent cough, irritated nose, lung irritation, frequent sinus ailments, sore throat/trouble swallowing			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.	
Metric 2:	Attrition	Medium		
Metric 3:	Comparison Group	Medium		
Domain 2: Exposure Characterization				
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Frequent allergies, breathing difficulty, persistent cough, irritated nose, lung irritation, frequent sinus ailments, sore throat/trouble swallowing			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Frequent allergies, breathing difficulty, persistent cough, irritated nose, lung irritation, frequent sinus ailments, sore throat/trouble swallowing			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain		Metric	Rating	Comments
	Metric 8:	Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.
	Metric 10:	Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.
	Metric 13:	Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.
	Metric 14:	Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.
	Metric 15:	Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maier, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Frequent allergies, breathing difficulty, persistent cough, irritated nose, lung irritation, frequent sinus ailments, sore throat/trouble swallowing
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Cardiovascular		
Reported Health Effect(s):	Chest pains, irregular heartbeat		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Chest pains, irregular heartbeat			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Chest pains, irregular heartbeat			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.	
	Metric 10: Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.	
	Metric 11: Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.	
	Metric 13: Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.	
	Metric 14: Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.	
	Metric 15: Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Cardiovascular
Reported Health Effect(s):	Chest pains, irregular heartbeat
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Gastrointestinal		
Reported Health Effect(s):	Diarrhea/stomach cramps, gastritis, nausea/vomiting		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Diarrhea/stomach cramps, gastritis, nausea/vomiting			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Diarrhea/stomach cramps, gastritis, nausea/vomiting			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.	
	Metric 10: Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.	
	Metric 11: Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.	
	Metric 13: Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.	
	Metric 14: Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.	
	Metric 15: Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maier, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Gastrointestinal
Reported Health Effect(s):	Diarrhea/stomach cramps, gastritis, nausea/vomiting
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Ocular & Sensory		
Reported Health Effect(s):	Irritated eyes		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups. Characteristics of the two comparison groups are not reported. However, the race of all participants is reported to be Black and all participants were drawn from the same small community during the same time frame, providing indirect evidence that the comparison groups may be similar. There are no adjustments for potential differences between the two groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Ocular & Sensory			
Reported Health Effect(s):	Irritated eyes			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Ocular & Sensory			
Reported Health Effect(s):	Irritated eyes			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain		Metric	Rating	Comments
	Metric 8:	Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.
	Metric 10:	Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.
	Metric 13:	Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.
	Metric 14:	Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.
	Metric 15:	Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Ocular & Sensory
Reported Health Effect(s):	Irritated eyes
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Renal/Kidney		
Reported Health Effect(s):	Unusual color urine		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	Unusual color urine			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	Unusual color urine			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.	
	Metric 10: Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.	
	Metric 11: Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.	
	Metric 13: Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.	
	Metric 14: Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.	
	Metric 15: Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection	

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1,1,2-Trichloroethane

Human Health Hazard Epidemiology Evaluation

HERO ID: 200292 Table: 1 of 1

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Renal/Kidney
Reported Health Effect(s):	Unusual color urine
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	renal cell carcinoma			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	4697224			
Domain	Metric		Rating	Comments
Domain 1: Study Participation				
	Metric 1:	Participant Selection	Medium	The details of the study design were reported elsewhere (Chow et al. 1994, HERO ID 701514). Brief details about the setting, date, number of eligible participants, and control matching were reported. Reasons for exclusions/non-participation were described with details by Chow et al. (1994).
	Metric 2:	Attrition	Medium	For the details of the study design and attrition of study subjects, the study authors referred to another publication by Chow et al., 1994. Chow et al. (1994) mentioned that at the end of the personal interview, the respondents were given a self-administered food-frequency questionnaire. Of the subjects interviewed for the study, 632 patients (79% of 796 eligible patients) and 653 control subjects (79% of 707 eligible control subjects) returned the diet questionnaire. A number of subjects, whose responses were considered unreliable, were excluded from the analysis, including 48 patients and three control subjects who had seven or more skipped food items or had questionable data and 50 patients whose next-of-kin respondent was not a spouse. Also excluded were two patients with unknown smoking status, since smoking is a risk factor.
	Metric 3:	Comparison Group	Medium	The cases were pulled from the Minnesota Cancer Surveillance System. Controls were selected from the general population of Minnesota; controls age 20-64 years were selected through random digital dialing and controls age 65-85 years were collected from files through the Health Care Financing Administration. Controls were age- and gender-stratified and were of the same race. Characteristics of cases and controls were not provided in the text or a table.
Domain 2: Exposure Characterization				
	Metric 4:	Measurement of Exposure	High	Occupational histories including the most recent and usual occupation and industry, job activities, started-year and ended-year, and part-time/full-time status were collected. Occupations and industries were coded according to the standard occupational classification (SOC) and standard industrial classification (SIC) schemes. The National Cancer Institute developed job exposure matrices (JEM) for nine individual chlorinated aliphatic hydrocarbons (CAHCs), all CAHCs-combined, and all organic solvents-combined. These JEMs were merged with assigned SOC and SIC to determine the exposure status to these chemicals for each study subject. Application of the JEM was described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154).
	Metric 5:	Exposure Levels	Medium	Details of the application of the JEM were described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154). Dosemeci et al. (1994) described more details about that this study assigned three levels of probability (low, medium, high) to industries and occupations for chemical exposure levels.

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	renal cell carcinoma			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	4697224			
Domain		Metric	Rating	Comments
	Metric 6:	Temporality	Medium	Occupational questionnaires identified prior exposures based on reported recent and usual occupations as well as duration of employment. Outcome status was determined from registry data. The authors note that some occupational history was incomplete which may result in some uncertainty in regard to temporality.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Cases were identified as newly diagnosed and histologically confirmed renal cell carcinoma through the Minnesota Cancer Surveillance System and information about each participant was collected using a questionnaire. Validation was not specified.
	Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and ORs were stratified by sex. Effect estimates are reported with a confidence interval. One table showed the total numbers of men and women respectively for each chemical, but numbers of cases/controls were not reported.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made in the final analysis, including age, gender, smoking, hypertension and the use of diuretics and/or anti-hypertension drugs, and BMI. Results were stratified by sex.
	Metric 10:	Covariate Characterization	Medium	Information about participants was collected using a questionnaire, and it includes potential confounders, e.g., smoking habits. Validation was not specified.
	Metric 11:	Co-exposure Counfounding	Medium	Co-exposures were identified through the job exposure matrices. Chemicals were evaluated individually and as a group.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen (case-control) was appropriate for the research question (renal cell carcinoma risk from occupational organic solvent exposure). Logistic regression models were used to estimate the relative risk and 95% CI.
	Metric 13:	Statistical Power	Low	Statistical power calculations were not provided. No significant effects were observed with 1,1,2-trichloroethane. The number of participated women to calculate odds ratio was inadequate to detect an effect in the participants for other chemicals or the combined risk, because it was very low.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis was brief, but is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15:	Statistical Analysis	High	Model assumptions for logistic regression were met. The odds ratios were adjusted for age, smoking, hypertension status and/or use of diuretic and/or anti-hypertension drugs, and body mass index for men and women separately.

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.
Health Outcome(s) Assessed:	Renal/Kidney
Reported Health Effect(s):	renal cell carcinoma
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	4697224

Domain	Metric	Rating	Comments
Additional Comments:	A group of 438 cases (273 men and 165 women) were selected from the Minnesota Cancer Surveillance System that had been newly diagnosed with renal cell carcinoma. Controls included 687 participants (462 men and 225 women) age- and gender- stratified that were selected from either the general population of Minnesota (age 20-64 years) or from the Health Care Financing Administration files (age 65-85). No significant increase in the risk of renal cell carcinoma was observed with exposure to 1,1,2-trichloroethane among men or women separately, or for all participants exposed.		

Overall Quality Determination

Medium

Study Citation:	Brender, J. D., Shinde, M. U., Zhan, F. B., Gong, X., Langlois, P. H. (2014). Maternal residential proximity to chlorinated solvent emissions and birth defects in offspring: A case-control study. Environmental Health 13(1):96.		
Health Outcome(s) Assessed:	Reproductive/Developmental		
Reported Health Effect(s):	birth defects (neural tube defects, limbs deficiencies, oral cleft defects, heart defects, spina bifida, anencephaly)		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	2799700		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	Participants were drawn from the Texas Birth Defects Registry (TBDR) for years 1996-2008. Controls were frequency matched from the same registry. Study authors state that neural tube cases were more likely to not be successfully geocoded which may introduce selection bias, however, the authors note that both cases and controls with addresses that could not be geocoded were similar. In spite of that, the inclusion criteria, methods of participant selection, and frequency match were reported.
Metric 2:	Attrition	Medium	13.3% case mother addresses and 12.8% control mother addresses were unable to be geocoded, however this most likely only lowered the precision of the study and most likely does not vary based on exposure level.
Metric 3:	Comparison Group	Medium	Controls were matched to cases and pulled from the same eligible population by year of delivery and public health service region. Other demographic factors, e.g., race was not matched in population selection. However, statistical analyses were adjusted for year of delivery, maternal age, race/ethnicity, education, and public health region of residence.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Used Emission Weighted Proximity Model to estimate exposure at a given address based on proximity to emission sources and the specific amount or type of pollutant emitted. There may be some exposure misclassification due to mothers moving away from geocoded addresses. Previous studies indicate ~67% of mothers do not move between conception and delivery.
Metric 5:	Exposure Levels	Medium	Reports exposure as "exposure risk value" and groups the risk values into quartiles, with exposure risk values < 0 being the referent group
Metric 6:	Temporality	Medium	The study authors estimated exposure based on residence during pregnancy and evaluated birth outcomes. Temporality is established. Previous studies indicate ~67% mothers don't move between trimester and delivery.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcomes determined by Texas Birth Defect Registry, checking for birth defect diagnosis. Birth certificates came from Center for Health Statistics at Texas Department of State Health Services
Metric 8:	Reporting Bias	High	Outcome data measured and reported clearly, stratified by specific type of birth defect
Domain 4: Potential Confounding / Variability Control			
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Study Citation:	Brender, J. D., Shinde, M. U., Zhan, F. B., Gong, X., Langlois, P. H. (2014). Maternal residential proximity to chlorinated solvent emissions and birth defects in offspring: A case-control study. Environmental Health 13(1):96.
Health Outcome(s) Assessed:	Reproductive/Developmental
Reported Health Effect(s):	birth defects (neural tube defects, limbs deficiencies, oral cleft defects, heart defects, spina bifida, anencephaly)
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	2799700

Domain	Metric	Rating	Comments
	Metric 9: Covariate Adjustment	High	Cases were frequency matched by year of delivery and public health service region. Final models were adjusted for year of delivery, public health region, maternal age (<20, 20-24, 25-29, 30-34, 35-39, >39 years), education (<12 years, 12 years, >12 years), and race/ethnicity (Whit non-Hispanic, Black non-Hispanic, Hispanic, other non-Hispanic).
	Metric 10: Covariate Characterization	High	Used birth and death certificates for demographic information
	Metric 11: Co-exposure Confounding	Medium	other co-exposures were not described
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	study used logistic regression to measure association between exposure and birth defects
	Metric 13: Statistical Power	Medium	Overall adequate number of cases and controls - some effects have low cell counts, but at least one health effect has sufficient statistical power.
	Metric 14: Reproducibility of Analyses	Medium	Methods sufficiently detailed for reproducibility
	Metric 15: Statistical Analysis	High	No logistic regression model assumption violations were identified.

Additional Comments: This study examined the association between proximity to several point sources of chlorinated solvents and birth defects. Exposure was assessed using EPA's Toxic Release Inventory, and birth defects were assessed using Texas birth registries. The geocoded address of mothers on day of delivery and the amount of solvent was plugged into the Emission Weighted Probability model to assign each mother an exposure risk value. Limitations include limited evidence of temporality. Additionally, elective terminations lacked a vital record, which meant only 69% of mothers with neural tube defects were geocoded. Mothers highly exposed to 1,1,2-trichloroethane were 1.40 times more likely to have the spina bifida birth defect than mothers who were not significantly exposed.

Overall Quality Determination

High

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Reproductive/Developmental		
Reported Health Effect(s):	Menstrual disorder		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Menstrual disorder			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Menstrual disorder			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain		Metric	Rating	Comments
	Metric 8:	Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.
	Metric 10:	Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.
	Metric 13:	Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.
	Metric 14:	Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.
	Metric 15:	Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Reproductive/Developmental
Reported Health Effect(s):	Menstrual disorder
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Immune/Hematological		
Reported Health Effect(s):	Swollen glands		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	Swollen glands			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	Swollen glands			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain		Metric	Rating	Comments
	Metric 8:	Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.
	Metric 10:	Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.
	Metric 13:	Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.
	Metric 14:	Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.
	Metric 15:	Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maier, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Immune/Hematological
Reported Health Effect(s):	Swollen glands
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.		
Health Outcome(s) Assessed:	Skin and Connective Tissue		
Reported Health Effect(s):	Skin rashes, bruising		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	200292		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective study surveyed residents of Barrett Station, Texas, a community located near two Superfund sites between December 1989 and April 1990. Inclusion and exclusion criteria are not well defined, but it appears that all residents in the community were targeted for recruitment. Questionnaires were mailed to 6,209 residents and there were 4,950 responses with complete residence data (response rate = 80%). Survey respondents 30 years or older had a cumulative exposure measure calculated based on location and length of residence, and the top 10% (high exposure group) and bottom 30% (low exposure group) of the distribution were then selected as the final analysis population. It is unclear how these thresholds were chosen. It is difficult to evaluate selection bias without additional information on the characteristics of the eligible population and the participants. There is potential for response bias if residents who were more highly exposed or had more outcomes were more likely to respond to the survey. Complete data were available for 321 out of 372 individuals in the high exposure group (86%) and 351 out of 433 individuals in the low exposure group (81%). Characteristics of subjects with missing outcome data are not reported. Only individuals with complete data were included in analysis, and the rate of missing data was similar across the two comparison groups.
Metric 2:	Attrition	Medium	
Metric 3:	Comparison Group	Medium	
Domain 2: Exposure Characterization			
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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Skin and Connective Tissue			
Reported Health Effect(s):	Skin rashes, bruising			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Uninformative	Exposure was defined based on residence history, with each participant assigned a cumulative exposure score based on the distance of each of their residences to each of two Superfund sites and the number of months in each residence. Participants in the top 10% of the distribution of this exposure score were designated as high exposure, and participants in the bottom 30% of the distribution were designated as low/minimal exposure. While this measure could serve as a reasonable proxy for overall exposure to the Superfund site in some circumstances, it is not specific to the chemicals of interest. 1,2-dichloroethane and 1,1,2-trichloroethane are both listed as present at one of the two Superfund sites, but are among a list of 20+ chemicals present across the two sites. Environmental concentrations are not reported for any of the chemicals, making the exposure measure imprecise. This is especially concerning considering that the exposure metric is based on two Superfund sites, but the chemicals of interest are only present at one of the sites. Additionally, the reason for selecting the top 10% and bottom 30% to define high vs. low exposure (as opposed to dichotomizing at the median, categorizing by quartiles/tertiles, or other more common methods) is not explained. Given this, there is substantial potential for exposure misclassification for the two chemicals of interest.	
	Metric 5: Exposure Levels	Low	No description is provided for the levels or range of exposure. As described previously, high vs. low exposure was determined using the distribution of a cumulative exposure score. However, the values of the "scores" are not reported, so it is unclear what the true exposure levels were for the top 10% and bottom 30% of the distribution.	
	Metric 6: Temporality	High	Exposure was determined using a 28-year residence history based on lease and deed data, establishing a clear temporality of exposure preceding outcome assessment (symptom prevalence).	
Domain 3: Outcome Assessment	Metric 7: Outcome Measurement or Characterization	Low	All outcome data were self-reported by participants via questionnaire, which may introduce recall bias. The questionnaire asked about presence or absence of a list of 29 symptoms across neurological, respiratory, cardiovascular and gastrointestinal organ systems as well as several "miscellaneous" symptoms. Validation of the questionnaire is not described. The time period covered by the questionnaire is also not reported, and symptom definitions are not provided. It is noted that the survey also asked about frequency of symptoms and treatment by a doctor, but that those data were not analyzed because of very incomplete responses. Given the reliance on self-report and the insensitive nature of the questionnaire, outcome misclassification is a concern. The study does not provide a copy of the survey, so the wording of each question cannot be validated.	

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maierson, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.			
Health Outcome(s) Assessed:	Skin and Connective Tissue			
Reported Health Effect(s):	Skin rashes, bruising			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	200292			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Medium	All of the primary outcomes described in the methods (symptom presence/absence data) were reported in the results. However, data on symptom frequency and medical treatment are not reported due to incomplete data. Precise p-values are not reported for statistical tests, but significance is categorized at the levels of p <0.05, p<0.01, or p<0.001.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	The analyses do not adjust for any covariates or confounders and there is no comparison of characteristics between the high vs. low exposure groups. It is reported that "the usual demographic confounders (i.e., age, race, and gender) have been addressed by virtue of the design and because the population was exclusively Black", but it is unclear how age and gender were addressed by the study design. In fact, age may be a potential confounder because older age is likely associated with longer exposure as well as several of the health outcomes. The study also collected information on lifestyle covariates including smoking, drinking, occupation, and recreational activities near the dump sites, but this data was not reported or included in analysis due to high rates of missing data. Without additional information on the characteristics of the participants, residual confounding remains a concern.	
	Metric 10: Covariate Characterization	N/A	Potential covariates/confounders were measured via questionnaire, but are not reported or included in analysis.	
	Metric 11: Co-exposure Counfounding	Low	Co-exposure is present for a long list of chemicals also found on the two Superfund sites (including benzene, naphthalene, lead, toluene, polychlorinated biphenyls, and many others). The exposure measure does not distinguish between different chemicals, so confounding due to co-exposures is very likely.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design and analysis were appropriate for the research objective of comparing health symptom prevalence among residents with higher vs. lower exposure to Superfund sites. Statistical tests were used to test the significance of differences in prevalence rates between high and low exposure groups.	
	Metric 13: Statistical Power	Medium	Statistical power calculations are not reported, but the sample size (n=321 with high exposure and n=351 with low exposure) is likely sufficient to detect effects.	
	Metric 14: Reproducibility of Analyses	Low	Analytical methods are described only briefly. While the methods are largely straightforward, it is unclear exactly what statistical tests were used and how variables were defined.	
	Metric 15: Statistical Analysis	N/A	No statistical models were used. A simple test of significant difference was used to compare the prevalence rates across two exposure groups, but there were no models that required covariate selection	

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1,1,2-Trichloroethane

Human Health Hazard Epidemiology Evaluation

HERO ID: 200292 Table: 1 of 1

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Study Citation:	Dayal, H., Gupta, S., Trieff, N., Maieron, D., Reich, D. (1995). Symptom clusters in a community with chronic exposure to chemicals in two superfund sites. Archives of Environmental Health 50(2):108-111.
Health Outcome(s) Assessed:	Skin and Connective Tissue
Reported Health Effect(s):	Skin rashes, bruising
Chemical:	1,1,2-Trichloroethane- Parent compound
HERO ID:	200292

Domain	Metric	Rating	Comments
Additional Comments:	This retrospective, questionnaire-based survey examined 29 health symptoms in residents living near two Superfund sites (former dumping sites) in Barrett Station, Texas. At least 20 chemicals were reported across the two sites, including two chemicals of interest, 1,2-dichloroethane and 1,1,2-trichloroethane. The study reported significant associations between high exposure to the two Superfund sites (based on distance and length of residence) and prevalence of neurological symptoms, cardiovascular symptoms, and skin rashes. However, these results should be interpreted with caution due to the potential for substantial exposure misclassification, outcome misclassification, and residual confounding. Of particular concern is the surrogate exposure measure, which cannot distinguish between exposure to the chemicals of interest and other chemicals present at the sites. Given these risks of bias, the study is considered uninformative with respect to the effects of 1,2-dichloroethane and 1,1,2-trichloroethane.		

Overall Quality Determination

Uninformative

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Mortality		
Reported Health Effect(s):	All-cause mortality; all cancer mortality; cardiovascular disease mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality; cerebrovascular disease mortality; nervous system disorders mortality; digestive system diseases mortality; genitourinary diseases mortality; acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Mortality			
Reported Health Effect(s):	All-cause mortality; all cancer mortality; cardiovascular disease mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality; cerebrovascular disease mortality; nervous system disorders mortality; digestive system diseases mortality; genitourinary diseases mortality; acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain		Metric	Rating	Comments
	Metric 6:	Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.
	Metric 8:	Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.
	Metric 10:	Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.

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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Mortality			
Reported Health Effect(s):	All-cause mortality; all cancer mortality; cardiovascular disease mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality; cerebrovascular disease mortality; nervous system disorders mortality; digestive system diseases mortality; genitourinary diseases mortality; acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Mortality		
Reported Health Effect(s):	all causes		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Mortality			
Reported Health Effect(s):	all causes			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Statistical power was not calculated for overall mortality. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality was reported for any specific causes.			

Overall Quality Determination

High

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	All cancer mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	All cancer mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	All cancer mortality; trachea, bronchus, and lung cancer mortality; lymphatic and hematopoietic cancer mortality; brain and nervous system cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Cancer-related mortality; malignant neoplasms		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	Cancer-related mortality; malignant neoplasms			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality was reported for any specific cancers.			
Overall Quality Determination		High		

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Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Cancer-related mortality; malignant neoplasms		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
Metric 10:	Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.
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Domain 5: Analysis

Metric 12:	Study Design and Methods	High	The design and statistical approach were appropriate to the research question.
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Metric 15:	Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.

Additional Comments: A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality was reported for any specific cancers.

Overall Quality Determination

High

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Cancer-related mortality; malignant neoplasms		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
Metric 10:	Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.
Health Outcome(s) Assessed:	Cancer/Carcinogenesis
Reported Health Effect(s):	Cancer-related mortality; malignant neoplasms
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	702055

Domain	Metric	Rating	Comments
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.

Domain 5: Analysis

Metric 12:	Study Design and Methods	High	The design and statistical approach were appropriate to the research question.
Metric 13:	Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.
Metric 14:	Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.
Metric 15:	Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.

Additional Comments: A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality was reported for any specific cancers.

Overall Quality Determination

High

Study Citation:	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	Colon cancer			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1069372			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	The study adequately describes participant recruitment and selection, study setting, and inclusion/exclusion criteria. Potential participants who died during recruitment could not be included in analysis. It is possible that those participants who died during the study period, particularly among cases, had higher exposure to chemicals of interest, which would not have been captured by the analysis.	
Metric 2:	Attrition	High	There was little subject withdrawal. An age stratum (<50) was eliminated from analysis due to a large number of female controls with breast cancer. This adjustment was deemed acceptable.	
Metric 3:	Comparison Group	High	Comparison groups and reasonable controls during analysis were both included in the study. Control groups included both cancer patients (with non-gastrointestinal/urinary cancers) and members of the general population. The use of both types of controls was considered a strength. Analysis considered age, sex, and urbanicity as potential confounders.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure was estimated via sampling data and modeling. Chemical levels from 1984-1985 were obtained from state sampling data. Information about participant place of residence across four time points (1951, 1961, 1971, and 1981) was used to estimate the exposure based on drinking water source and the previously mentioned state sampling data. VOCs are highly volatile and challenging to accurately sample, as the study discusses. As a result, it is unlikely that data from 1984-1985 accurately represent exposures during different time points.	
Metric 5:	Exposure Levels	Medium	The study reports 3 levels of exposure including the referent group, low exposure (2-10 micrograms/L), and high exposure (>=10 micrograms/L). While the exposure modeling method was not validated by previous measures or other modeling approaches, the likelihood of differential exposure misclassification is low.	
Metric 6:	Temporality	Low	The study examined cancer cases diagnosed in 1982-1983 and constructed exposure estimates for 1951, 1961, 1971, 1981. However, the data used to model historical exposures was collected from 1984-1986, and the modeling method could not be validated by historic sampling measurements.	
Domain 3: Outcome Assessment				
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Study Citation:	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.			
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1069372			
Domain	Metric	Rating	Comments	
	Metric 7:	Outcome Measurement or Characterization	Medium	Cases were selected based upon physician diagnosis, however the general population controls were selected from motor vehicle license registries. The authors do not explicitly discuss confirmation of the absence of colon cancer in this group. All subjects were followed for the same length of time.
	Metric 8:	Reporting Bias	High	Measured outcomes are reported. Odds ratios are reported with confidence intervals. The authors note the total number of cases and controls used for analyses.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	High	The authors considered age, sex, and urbanicity as potential confounders. These variables were included in the analysis as covariates.
	Metric 10:	Covariate Characterization	High	Potential confounders were assessed via valid and reliable means.
	Metric 11:	Co-exposure Counfounding	Medium	Co-exposure chemicals that would bias the result were not likely to be present.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	Case-control was the appropriate study design chosen to examine chlorinated solvents in drinking water and colon cancer.
	Metric 13:	Statistical Power	Medium	The number of cases (n=347) and controls (639 cancer controls, 611 general population controls) is adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient, including transformation of variables for inclusion in the logistic regression models.
	Metric 15:	Statistical Analysis	High	The model is transparent. The authors reported included variables and a maximum likelihood analysis was conducted.
Additional Comments:	This study employed a case-control design to examine the association between colon cancer and exposure to 1,2-dichloroethylene (an isomer of trans-1,2-Dichloroethylene) and 1,1,1-trichloroethane (an isomer of 1,1,2-Trichloroethane) in Wisconsin municipal groundwater supplies. The study included a robust recruitment of control groups. Exposure modeling and estimates of historical exposure were the primary limitations, however any related misclassification would have been non-differential. Effect sizes were not large, and a dose-response relationship could not be established.			

Overall Quality Determination

Medium

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Lung/Respiratory		
Reported Health Effect(s):	Trachea, bronchus, and lung cancer mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Reported Health Effect(s):	Trachea, bronchus, and lung cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain		Metric	Rating	Comments
	Metric 6:	Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.
	Metric 8:	Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.
	Metric 10:	Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.
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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Trachea, bronchus, and lung cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Lung/Respiratory		
Reported Health Effect(s):	SMRs for respiratory diseases		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Reported Health Effect(s):	SMRs for respiratory diseases			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Statistical power was not calculated for lung/respiratory effects. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to cancer or other category of death for the lung/respiratory system was reported for any specific cancers.			

Overall Quality Determination

High

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Lung/Respiratory		
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported. Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric		Rating	Comments
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			

Overall Quality Determination

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported.Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
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	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported.Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
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	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
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Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			

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Domain	Metric	Rating	Comments
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	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
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	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.
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Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported.Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
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	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
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	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
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Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
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Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
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	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.
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Domain 5: Analysis				
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Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported.Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric		Rating	Comments
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” Additionally, another questionnaire for respiratory symptoms was used to report prevalence of symptoms. These appeared to be self-reported.Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association’s criteria for lupus erythematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Phlegm, chronic bronchitis, shortness of breath, wheezing, shortness of breath with wheezing, normal breathing between attacks, chest tightness, dry cough, cough with mucus, cough with blood, pleurisy (pain on breathing)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric		Rating	Comments
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			
Overall Quality Determination			Low	

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Pulmonary function tests (FVC, FEV1, FEF25-75, FEF75-85, RV/TLC, TLC)
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona). Employment status is not reported for either group of unexposed subjects.
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Pulmonary function tests (FVC, FEV1, FEF25-75, FEF75-85, RV/TLC, TLC)			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Spirometry measurements (i.e., FVC, FEV1, FEF25-75, FEF75-85, RV/TLC, TLC) met criteria outlined by the American Thoracic Society (ATS). However, measurement tools are not described.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Covariates were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.

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Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Pulmonary function tests (FVC, FEV1, FEF25-75, FEF75-85, RV/TLC, TLC)
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Abnormal radiographs
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed"(p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Health Outcome(s) Assessed:	Lung/Respiratory			
Reported Health Effect(s):	Abnormal radiographs			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Medium	Lung opacities and lung volume were interpreted using the International Labour Office criteria (1980) by examining standard posteroanterior and lateral chest X rays. However, the identity and qualifications of the individual(s) interpreting the radiographs were not reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.

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Health Outcome(s) Assessed:	Lung/Respiratory
Reported Health Effect(s):	Abnormal radiographs
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Gastrointestinal		
Reported Health Effect(s):	Digestive system diseases mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Digestive system diseases mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Gastrointestinal		
Reported Health Effect(s):	SMRs for digestive organ diseases		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Human Health Hazard Epidemiology Evaluation

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Reported Health Effect(s):	SMRs for digestive organ diseases
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	702055

Domain	Metric	Rating	Comments
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.

Domain 5: Analysis	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Statistical power was not calculated for gastrointestinal effects. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.

Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due gastrointestinal disease was reported.

Overall Quality Determination	High

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Gastrointestinal		
Reported Health Effect(s):	Nausea, indigestion, loss of appetite, stomach bloats/swells		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Nausea, indigestion, loss of appetite, stomach bloats/swells			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

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Domain	Metric	Rating	Comments	
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Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.	
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Gastrointestinal
Reported Health Effect(s):	Nausea, indigestion, loss of appetite, stomach bloats/swells
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Gastrointestinal
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Nausea, indigestion, loss of appetite, stomach bloats/swells			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.	
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Gastrointestinal
Reported Health Effect(s):	Nausea, indigestion, loss of appetite, stomach bloats/swells
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.			
Health Outcome(s) Assessed:	Gastrointestinal			
Reported Health Effect(s):	Colon cancer			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1069372			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	The study adequately describes participant recruitment and selection, study setting, and inclusion/exclusion criteria. Potential participants who died during recruitment could not be included in analysis. It is possible that those participants who died during the study period, particularly among cases, had higher exposure to chemicals of interest, which would not have been captured by the analysis.	
Metric 2:	Attrition	High	There was little subject withdrawal. An age stratum (<50) was eliminated from analysis due to a large number of female controls with breast cancer. This adjustment was deemed acceptable.	
Metric 3:	Comparison Group	High	Comparison groups and reasonable controls during analysis were both included in the study. Control groups included both cancer patients (with non-gastrointestinal/urinary cancers) and members of the general population. The use of both types of controls was considered a strength. Analysis considered age, sex, and urbanicity as potential confounders.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure was estimated via sampling data and modeling. Chemical levels from 1984-1985 were obtained from state sampling data. Information about participant place of residence across four time points (1951, 1961, 1971, and 1981) was used to estimate the exposure based on drinking water source and the previously mentioned state sampling data. VOCs are highly volatile and challenging to accurately sample, as the study discusses. As a result, it is unlikely that data from 1984-1985 accurately represent exposures during different time points.	
Metric 5:	Exposure Levels	Medium	The study reports 3 levels of exposure including the referent group, low exposure (2-10 micrograms/L), and high exposure (>=10 micrograms/L). While the exposure modeling method was not validated by previous measures or other modeling approaches, the likelihood of differential exposure misclassification is low.	
Metric 6:	Temporality	Low	The study examined cancer cases diagnosed in 1982-1983 and constructed exposure estimates for 1951, 1961, 1971, 1981. However, the data used to model historical exposures was collected from 1984-1986, and the modeling method could not be validated by historic sampling measurements.	
Domain 3: Outcome Assessment				
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Study Citation:	Young, T. B., Kanarek, M. S., Wolf, D. A., Wilson, D. A. (1990). Case-control study of colon cancer and volatile organics in Wisconsin municipal ground water supplies. :373-386.			
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Reported Health Effect(s):	Colon cancer			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1069372			
Domain	Metric	Rating	Comments	
	Metric 7:	Outcome Measurement or Characterization	Medium	Cases were selected based upon physician diagnosis, however the general population controls were selected from motor vehicle license registries. The authors do not explicitly discuss confirmation of the absence of colon cancer in this group. All subjects were followed for the same length of time.
	Metric 8:	Reporting Bias	High	Measured outcomes are reported. Odds ratios are reported with confidence intervals. The authors note the total number of cases and controls used for analyses.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	High	The authors considered age, sex, and urbanicity as potential confounders. These variables were included in the analysis as covariates.
	Metric 10:	Covariate Characterization	High	Potential confounders were assessed via valid and reliable means.
	Metric 11:	Co-exposure Counfounding	Medium	Co-exposure chemicals that would bias the result were not likely to be present.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	Case-control was the appropriate study design chosen to examine chlorinated solvents in drinking water and colon cancer.
	Metric 13:	Statistical Power	Medium	The number of cases (n=347) and controls (639 cancer controls, 611 general population controls) is adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient, including transformation of variables for inclusion in the logistic regression models.
	Metric 15:	Statistical Analysis	High	The model is transparent. The authors reported included variables and a maximum likelihood analysis was conducted.
Additional Comments:	This study employed a case-control design to examine the association between colon cancer and exposure to 1,2-dichloroethylene (an isomer of trans-1,2-Dichloroethylene) and 1,1,1-trichloroethane (an isomer of 1,1,2-Trichloroethane) in Wisconsin municipal groundwater supplies. The study included a robust recruitment of control groups. Exposure modeling and estimates of historical exposure were the primary limitations, however any related misclassification would have been non-differential. Effect sizes were not large, and a dose-response relationship could not be established.			

Overall Quality Determination

Medium

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Renal/Kidney		
Reported Health Effect(s):	Genitourinary disease mortality, acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	Genitourinary disease mortality, acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	Genitourinary disease mortality, acute glomerulonephritis and renal failure mortality; chronic nephritis and renal failure mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Renal/Kidney		
Reported Health Effect(s):	SMRs for genitourinary diseases		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Renal/Kidney			
Reported Health Effect(s):	SMRs for genitourinary diseases			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to any category of death for the renal system was reported.			
Overall Quality Determination		High		

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Hepatic/Liver		
Reported Health Effect(s):	SMRs for cirrhosis of the liver		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Hepatic/Liver			
Reported Health Effect(s):	SMRs for cirrhosis of the liver			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to any category of death for the hepatic system was reported.			
Overall Quality Determination		High		

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Nervous system disorders mortality; cerebrovascular disease mortality, brain and nervous system cancer mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Nervous system disorders mortality; cerebrovascular disease mortality, brain and nervous system cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Nervous system disorders mortality; cerebrovascular disease mortality, brain and nervous system cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	SMRs for benign neoplasm of brain, mental and psychoneurotic disorders, diseases of nervous system		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	SMRs for benign neoplasm of brain, mental and psychoneurotic disorders, diseases of nervous system			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10:	Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.
	Metric 11:	Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The design (SMR) and statistical approach were appropriate to the research question.
	Metric 13:	Statistical Power	Medium	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only this primary tumor types of interest was > 80%. For cancer of the brain and CNS, power was calculated to be 93%.
	Metric 14:	Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.
	Metric 15:	Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to any category of death for the neurological system was reported.			

Overall Quality Determination

High

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).”The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

Overall Quality Determination

Medium

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Medium

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was and used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).”The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.

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Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

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HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

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HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Medium

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Neurological/Behavioral			
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Medium

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
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Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Medium

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Simple reaction time, choice reaction time, balance (sway speed), color vision score, blink reflex, neuropsychological tests scores (cognitive function, culture fair A, vocabulary), perceptual motor speed		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	High	Well-established methods were used for conducting neurophysiological tests. For simple reaction time and visual two-choice reaction, a “computer clock from the appearance of a 6-cm-tall letter A for simple and A or S for two choice on a video screen to its cancellation by striking the A or S on a key pad” was used. For body balance with feet together, “a sound generating stylus on a headband by two microphones mounted 30 cm lateral to the emitter and 38 cm apart” was used and processed in a computer. Blink reflex latency was measured using surface electromyographic electrodes (EMG). “Color discrimination was measured with the desaturated 15 hue test (Lanthony, 1978) and scored by the method of Bowman (1982).” The following neuropsychological tests were utilized: Culture Fair battery 2A, an undefined vocabulary test of 46 words, slotted pegboard, trail making A and B.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

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Health Outcome(s) Assessed:	Neurological/Behavioral
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
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	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
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Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.	
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.	
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Tricholorethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			
Overall Quality Determination		Low		

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

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	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			
Overall Quality Determination			Low	

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.	
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.	
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			
Overall Quality Determination		Low		

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

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	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
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Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

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	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
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Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
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Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
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Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Reduced sense of smell, headache, dizziness, lightheadedly, unusual exhilaration, balance disturbance, loss of consciousness, extreme fatigue, somnolence, cannot fall asleep, wakes frequently, sleeps only a few hours, irritability, lack of concentration, recent memory loss, long-term memory loss, mood instability, decreased libido, decreased alcohol tolerance, numb fingers		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
Continued on next page ...			

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
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Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

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Domain	Metric	Rating	Comments
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	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
	Metric 10: Covariate Characterization	Medium	Confounders were assessed using questionnaires.	
	Metric 11: Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
	Metric 13: Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
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Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
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Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported. Moods were self-assessed using a profile of mood states (POMS) score.	
	Metric 8: Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.	
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Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The study design chosen was appropriate for the research question.	
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Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
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Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		
Overall Quality Determination		Low	

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	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.			
Overall Quality Determination			Low	

Study Citation:	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Neurobehavioral test results and nocturnal oxygen saturation		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	677146		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Subjects were 21 personnel from 5 military printing shops in Belgium or Germany. There was no information on how subjects were selected, numbers of participants/nonparticipants, or calendar time of subject recruitment. Exclusion criteria used for exposed and control groups included "major neurological or medical antecedents, important head trauma, use of psychotropic drugs, and colorblindness"; in addition one control was excluded due to history of alcoholism
Metric 2:	Attrition	Low	Numbers of individuals at important stages were not reported (participants/nonparticipants were not discussed).
Metric 3:	Comparison Group	Medium	Controls were 21 drivers from the army matched on age, sex, education, and language. However, the author did not mention if the exposed and comparison groups were recruited within the same time frame.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Exposure assessed as binary (yes/no) variable. Personal sampling was conducted at each worksite on one work day using 3M Organic Vapor monitors. Average worksite concentrations of 1,1,1-trichloroethane ranged between non-detect and 680.9 mg/m3. Duration of sampling event and analytical methods were not reported. Authors reported that the exposure intensity fluctuated substantially within a year so concentrations were not used in analysis.
Metric 5:	Exposure Levels	Low	Reports 2 levels of exposure (exposed/unexposed)
Metric 6:	Temporality	Medium	Temporality is established; tests were conducted on subjects who had worked on average 15 years in printing shops. However, it is unclear whether exposures fall within relevant exposure windows for the outcome of interest.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	Medium	Outcomes assessed included nocturnal pulse oximetry (to assess sleep apnea), neurotoxicity symptom checklist, and 8 neurobehavioral tests (Simple Reaction Time, Symbol-Digit Substitution, Associate Learning and Recall, Digit Span Forwards and Backwards, Color Word Vigilance, Hand-Eye Coordination). Oximetry results categorized as desaturated at <90%. Subjects tested after 2-4 exposure-free days to avoid acute narcotic effects of exposure on testing. However, no method validation was conducted.
Metric 8:	Reporting Bias	High	Detailed results presented for all outcomes noted in abstract and methods: frequency of oxygen desaturation (graphical), neurotoxicity symptoms, and neurobehavioral test results (mean, SD, and range for each).

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Study Citation:	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.		
Health Outcome(s) Assessed:	Neurological/Behavioral		
Reported Health Effect(s):	Neurobehavioral test results and nocturnal oxygen saturation		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	677146		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	High	Potential confounders evaluated by analysis of covariance for oximetry results; identified smoking interaction with exposure. Neurotoxicity symptom checklist and neurobehavioral test results adjusted for potential confounders (computer experience, alcohol intake, smoking, sleep deprivation, motivation, and/or coffee intake).
	Metric 10: Covariate Characterization	Medium	Covariates evaluated by physical exam (BMI, neck circumference) and questionnaire (occupational and medical history, smoking habits, years of education, coffee intake, computer experience, sleep deprivation the night before testing). The questionnaire was not cited, nor was validity of the questionnaire discussed.
	Metric 11: Co-exposure Counfounding	Low	1,1,1-trichloroethane was present at four of the five worksites; it was measured at the highest concentration at 2 of the four worksites. Co-exposures consisted of at least ten different solvents at each work site. However, the authors did not mention adjusting for co-exposure of these solvents in the statistical models. Thus, no information was provided to control for the co-exposures.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	Study design and statistical methods were appropriate for the research question.
	Metric 13: Statistical Power	Medium	Group sizes were small but sufficient to detect an effect on hand-eye coordination.
	Metric 14: Reproducibility of Analyses	Medium	Description was sufficient to understand what was done and to be conceptually reproducible.
	Metric 15: Statistical Analysis	High	The model for calculating the risk estimates is transparent.
Additional Comments:	This cohort study examined neurobehavioral effects and nocturnal oxygen desaturation in 21 military print workers from 5 sites in Belgium and Germany with VOC exposures including 1,1,1-trichloroethane (ND to 680.9 mg/m3 at different sites) compared with 21 unexposed drivers from the same sites. VOC exposure (evaluated as yes/no) was associated with increased frequency of mood disturbances, impaired performance on tests of hand-eye coordination, and increased frequency and duration of nocturnal oxygen desaturation. A significant interaction between exposure and smoking was observed for nocturnal desaturation, due to greater effect of exposure on nonsmokers. The study did not evaluate effects of 1,1,1-trichloroethane exposure alone.		

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Skin and Connective Tissue		
Reported Health Effect(s):	SMRs for skin diseases		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Skin and Connective Tissue			
Reported Health Effect(s):	SMRs for skin diseases			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%. For malignant melanoma, power of the study was calculated to be 70%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be re-producible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to any category of death for skin and connective tissue was reported.			

Overall Quality Determination

High

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Cardiovascular		
Reported Health Effect(s):	Cardiovascular disease mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Cardiovascular disease mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Cardiovascular disease mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Cardiovascular		
Reported Health Effect(s):	SMRs for diseases of the circulatory system		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	SMRs for diseases of the circulatory system			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to diseases of the circulatory system was reported.			
Overall Quality Determination		High		

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Cardiovascular		
Reported Health Effect(s):	Palpitations, burning in chest		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Palpitations, burning in chest			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Cardiovascular
Reported Health Effect(s):	Palpitations, burning in chest
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Cardiovascular
Reported Health Effect(s):	Palpitations, burning in chest
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Cardiovascular			
Reported Health Effect(s):	Palpitations, burning in chest			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Cardiovascular
Reported Health Effect(s):	Palpitations, burning in chest
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.		
Health Outcome(s) Assessed:	Immune/Hematological		
Reported Health Effect(s):	Lymphatic and hematopoietic cancer mortality		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5452779		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This retrospective cohort study included 4,396 hourly and salaried members of the United Autoworkers (UAW) who were ever employed at 1 of 3 Chrysler automotive electronics manufacturing plants in Huntsville, Alabama from 1972 to 1993. The cohort was generated using compiled using UAW employment records and were updated biannually and available for the entire study cohort for 1967-1970 and 1972-1993. There is no indication of any specific inclusion/exclusion criteria for UAW eligible for the study. It is also not clear what percentage of the total Chrysler workforces at the plants were UAW members. However, the process for recruitment and selection is transparent and there is no specific evidence of selection bias.
Metric 2:	Attrition	Low	653 participants not identified as deceased and either were not in the United Autoworkers pension system or had missing or inactive residential status were submitted for additional vital status follow-up. It is unclear if vital status was able to be ascertained for those 653 individuals, or if they were excluded from the total sample.
Metric 3:	Comparison Group	High	The reference population was a sub-group of the cohort exposed to 1,1,1-trichloroethane for a shorter period of time, thus they were selected from the same population using the same criteria. The authors used several additional comparisons as surrogates for exposure, such as work duration, skilled trade status, calendar period of hire, etc. Adjustments for age, year of birth, sex, and other demographic characteristics were included in the analyses. Healthy worker survivor bias was assessed in some analyses by repeating all analyses with short-term workers (<3 years) excluded.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Chlorinated solvents, including 1,1,1-trichloroethane, were used as degreasers at the plants. Interviews were conducted with 11 participants to collect information about potential exposure concerns. However, employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. There is certainty that 1,1,1-trichloroethane was used at the plant, but specific details of occupational exposure are not described. Professional judgment was used to assume that workers with shorter work durations would be less exposed.
Metric 5:	Exposure Levels	Low	Comparisons were made by duration of work (three levels), calendar period (three levels) and ever/never working in plant 1 or 2 (two levels). However, this is only a measure of duration without specific quantitative data on exposure concentrations.
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	Lymphatic and hematopoietic cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 6: Temporality	Medium	Participants were employed from 1972-1993 and follow-up was concluded at the end of 2016. Exposure was measured well before the final recording of outcomes, thus temporality is established. There is no distribution of mortality date by year, thus it is unknown if mortality outcomes followed shortly after employment and thus unclear whether exposure fell within the etiologically relevant time window. However, visual inspection of the age at death (median age is 66, with an IQR of 56-75) compared to the age at first hire (median age is 32, with an IQR of 25-41) implies that deaths were unlikely to occur close to employment, especially with the median (IQR) years of employment being 9 years (4-12).	
Domain 3: Outcome Assessment				
	Metric 7: Outcome Measurement or Characterization	Medium	Vital status was obtained using the Social Security Death Index, the United Autoworker pension information system, and the National Death Index with searches conducted through December 5, 2016. The underlying cause of death code listed on the death certificate was used to identify the cause of death. All death certificates included death codes classified according to the relevant iteration of the International Classification of Diseases at the time of death. Codes were also categorized according to the NIOSH-119 cause of death classification scheme. The study reports that multiple cause of death codes were examined for outcomes less commonly reported as the cause of death, for example hypertension. The study reports some outcome groups as combined in analysis, such as "Cardiovascular disease", but does not present the relevant ICD codes used. Overall, while there is some uncertainty regarding the study's classification scheme, there is no evidence to suggest their methods had poor validity.	
	Metric 8: Reporting Bias	High	The number of person-years and number of deaths from each cause were reported. The RR and 95% CI were also reported for each analysis.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Adjustments for age, sex, and birth year were made. The study specifies that adjustment variables were chosen a priori. Some results were stratified by sex. Additional stratifications included duration of work, skilled trade status, calendar period of hire, and study plant. Adjustments for race were not made - 80% of the sample (N=3,170) was reported to be white and n=446 participants had missing data on race. The study indicated confounding by smoking status was not likely to be a concern. There is no evidence that key covariates were not considered.	
	Metric 10: Covariate Characterization	Medium	Employment records, the United Autoworkers pension information system, or commercial public databases were used to collect information about the participants. While there is no demonstrated validity for these records, there is no evidence to suggest invalidity.	
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Study Citation:	Debono, N., Richardson, D., Keil, A., Kelly-Reif, K., Robinson, W., Troester, M., Marshall, S. (2019). Employment characteristics and cause-specific mortality at automotive electronics manufacturing plants in Huntsville, Alabama. American Journal of Industrial Medicine 62(4):296-308.			
Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	Lymphatic and hematopoietic cancer mortality			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5452779			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed, but were not adjusted for in any of the analyses. The analyses were conducted for all exposures during employment; there was no analysis of exposure specifically to 1,1,1-trichloroethane. It is probable that exposure to 1,1,1-trichloroethane occurred, but the duration and extent of exposure is not known. The analysis is unable to rule out the influence of other exposures, including TCE.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The retrospective cohort study design was appropriate for assessing the association between occupational exposures and mortality outcomes. Poisson regression models and the Kaplan-Meier survival analysis were used and appropriate.	
	Metric 13: Statistical Power	Medium	The number of participants (n=4,396) was likely adequate to detect an effect in sub-groups of the total population. However, "statistical power was limited for several causes of death categories of interest". However, each analyzed death category had at least one relevant subgroup (duration of work, skilled trade status..) where the number of observed outcomes was greater than 30.	
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.	
	Metric 15: Statistical Analysis	High	The study utilized Poisson regression models to estimate relative risks. Kaplan-Meier survival curves were also generated to compare overall survival. Participants were compared by their duration of work, with "<=5 years" serving as the reference category. While the study does not describe assessing any model assumptions, there is no evidence that model assumptions were violated, and the study utilized multiple sensitivity analyses where short-term workers were censored to account for healthy worker survivor bias.	
Additional Comments:	A group of 4,396 United Autoworkers members who were ever employed at automotive electronics manufacturing plants in Huntsville, AL from 1972 to 1993 were included in this study to examine mortality. Occupational exposures included lead, asbestos, fiberglass dust, conformal coatings, TCE, and 1,1,1-trichloroethane. Employment records did not contain building-specific work histories, no job-exposure matrix was applied, and no industrial hygiene monitoring was performed. The primary concern in this study is the low confidence in the exposure assessment due to no quantitative information on 1,1,1-trichloroethane and no confirmation of exposure. Significantly decreased risk ratios for all-cause mortality, when adjusted for age, year of birth, and sex, were observed among workers who were employed for greater than 15 years compared to those who worked 5 years or less in the overall sample and for females specifically. This effect disappeared when employees who only worked for 3 or less years were excluded. However, co-exposures were not formally accounted for in any analysis, so there is a limited degree of confidence that these results can be reasonably attributed to 1,1,1-trichloroethane.			

Overall Quality Determination

Medium

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Immune/Hematological		
Reported Health Effect(s):	SMRs for diseases of blood and blood forming organs		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	SMRs for diseases of blood and blood forming organs			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due diseases of the immune/hematological system was reported.			
Overall Quality Determination		High		

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Immune/Hematological		
Reported Health Effect(s):	anemia		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Medium	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Health Outcome(s) Assessed:	Immune/Hematological			
Reported Health Effect(s):	anemia			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association's criteria for lupus erthematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study's results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Immune/Hematological
Reported Health Effect(s):	anemia
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.		
Health Outcome(s) Assessed:	Nutrition & Metabolic		
Reported Health Effect(s):	SMR for Diabetes mellitus		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	702055		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	A total of 14,067 subjects were included in a Retrospective study on cohort of all individuals who worked at least 4 years between 1958 and 1982 at aircraft manufacturing company in San Diego County; cohort defined using employment records.
Metric 2:	Attrition	High	Successful tracing/follow-up of 95% of the cohort of 14, 067 subjects for a mean duration of 15.8 years from date of first employment; for subjects who were lost to follow-up, years of observation were counted up to the last date subject was known to be alive.
Metric 3:	Comparison Group	High	SMRs were calculated based on U.S. national mortality rates and also on San Diego County mortality rates. Race, sex, age, calendar year, and cause-specific mortality rates were applied to expected rates from these reference sources.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Study did not measure exposures to specific chemical exposures. Potential exposure was reconstructed from a subset of the cohort (70 subjects) in a previous publication that ascertained exposures (not quantified) for jobs held by the subjects. Commonly used materials and percent of jobs exposed were listed. Indicated 10% of jobs had exposure to 1,1,1-trichloroethane.
Metric 5:	Exposure Levels	Low	Two levels of exposure: exposed (workers) and unexposed (general population). No description is provided on the levels or range of exposure for subjects in the cohort. The study reports that some (10%) jobs of cohort subjects may result in exposure to 1,1,1-trichloroethane.
Metric 6:	Temporality	Medium	Temporality of exposure is established, but for some cancers or other outcomes, the latency may be inadequate.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	Outcome measurement was obtained through vital status search and cause of death indicated by death certificate or California Death tapes; cause of death defined as underlying cause coded by trained nosologist.
Metric 8:	Reporting Bias	High	Specific causes of death investigated were reported; additional causes of death were also presented.
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	High	Appropriate adjustments were made by using race, sex, age, calendar year, and cause-specific mortality rates.
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Study Citation:	Garabrant, D., Held, J., Langholz, B., Bernstein, L. (1988). Mortality of aircraft manufacturing workers in southern California. American Journal of Industrial Medicine 13(6):683-693.			
Health Outcome(s) Assessed:	Nutrition & Metabolic			
Reported Health Effect(s):	SMR for Diabetes mellitus			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	702055			
Domain	Metric	Rating	Comments	
	Metric 10: Covariate Characterization	High	Covariates were determined through employment records, termination reports, and benefits records.	
	Metric 11: Co-exposure Counfounding	Low	Potential co-exposures were listed; however co-exposures were not adjusted for; analysis was for all exposures during employment for all jobs combined. Exposures were re-constructed from a subset of the cohort that included 70 subjects; 10% of the jobs were noted to have exposure to 1,1,1-trichloroethane.	
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The design and statistical approach were appropriate to the research question.	
	Metric 13: Statistical Power	Low	The study design (retrospective cohort study) may be adequate to detect some outcomes of interest. No statistically significant increased risks were found for any specific cause of death or cancer site. Of the power calculations conducted, only one of the primary tumor types of interest was > 80%.	
	Metric 14: Reproducibility of Analyses	Medium	Analysis and statistical methods used to calculate SMRs were described; Information from the national and regional mortality rates used would allow for the study to be reproducible. Results for analysis of all covariates were not presented.	
	Metric 15: Statistical Analysis	High	The method for calculating the SMRs is transparent and included SMRS, and 95% confidence intervals.	
Additional Comments:	A retrospective cohort mortality study was conducted in aircraft manufacturing workers (14,067) in San Diego County between 1958 and 1982. Number of deaths and calculated SMRs by cause for the total cohort were reported. Specific causes of death under investigation included brain and nervous system cancer, malignant melanoma, and testicular cancer, though SMRs for a number of other causes were also reported. SMRs were calculated based on both U.S. national and San Diego county mortality rates. 10% of the jobs were estimated to have exposure to 1,1,1-trichloroethane. No significant excess mortality due to disease of the nutrition/metabolic system was reported.			
Overall Quality Determination		High		

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Musculoskeletal		
Reported Health Effect(s):	Rheumatic pain		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Musculoskeletal			
Reported Health Effect(s):	Rheumatic pain			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 10 rheumatic complaints that make up the American Rheumatism Association's criteria for lupus erthematosus. It is unclear if this is self-reported or professionally diagnosed (Levin et al., 1984 not available in HERO).
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study's results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Musculoskeletal
Reported Health Effect(s):	Rheumatic pain
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination	Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Irritation		
Reported Health Effect(s):	Throat irritation, eye irritation		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Irritation			
Reported Health Effect(s):	Throat irritation, eye irritation			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposures were not assessed in this study.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Irritation
Reported Health Effect(s):	Throat irritation, eye irritation
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Irritation
Reported Health Effect(s):	Throat irritation, eye irritation
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
	Metric 2: Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
	Metric 3: Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
	Metric 4: Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
	Metric 5: Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Irritation			
Reported Health Effect(s):	Throat irritation, eye irritation			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Co-exposures were not assessed in this study.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
	Metric 15:	Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Irritation
Reported Health Effect(s):	Throat irritation, eye irritation
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Additional Comments:	Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.		

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.		
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)		
Reported Health Effect(s):	Finger nail changes, dry mouth		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1576		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)			
Reported Health Effect(s):	Finger nail changes, dry mouth			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)
Reported Health Effect(s):	Finger nail changes, dry mouth
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)
Reported Health Effect(s):	Finger nail changes, dry mouth
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Exposed participants were male and female active jet engine repair workers from Tinker Air Force Base (AFB) in Oklahoma City. Workers were recruited and assessed in July 1993. The method of selecting the 154 participants from approx. 500 workers at Tinker AFB was not reported. The author stated that "most of those tested came from areas where metals were cleaned with the solvents listed" (p. 245). For all endpoints except for blink latencies, unexposed participants were recruited by asking workers to identify unexposed individuals of their age and sex. The author interviewed candidates to confirm no prior exposure to chemicals, but no details on the interview were provided. The study was conducted in response to complaints filed by Tinker AFM workers regarding respiratory problems, raising concerns about the appropriateness of having exposed participants identify unexposed controls for the study. For blink latencies, unexposed participants were recruited from election rolls in Arizona.
Metric 2:	Attrition	Medium	The study does not discuss any subject withdrawals and exclusion criteria. However, authors mention that questionnaire responses were checked for completeness and missing data, so it is presumed that exposure and outcome data among the final analytic sample were largely complete.
Metric 3:	Comparison Group	Low	With the exception of one outcome, unexposed subjects in the study were recruited by exposed workers. According to the study, unexposed individuals were eligible if they matched the exposed group, had not worked at Tinker AFB, and had no history of chemical exposure. However, the paper does not explain how the absence of chemical exposure was verified. Later, the study questions the validity of the unexposed classification and introduces a new comparison group for blink latency outcomes: "The distant unexposed comparison for blink latencies was needed because the Oklahoma "unexposed" subjects blink latencies were found to be prolonged" (p. 245). Unexposed subjects for the blink latency comparisons were recruited using a different method (election rolls) and were from a different state (Arizona).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure measurements were conducted for only six workers to quantify chlorinated solvent levels. Personal and area air samples were collected on April 18, 1993, but although reported, these data were not used in subsequent analysis. The paper notes that most exposed individuals worked in areas where metals were cleaned with the solvents under investigation; however, it does not specify how many exposed participants this included. Additionally, the criteria for classifying unexposed subjects as having no prior chemical exposure are not clearly described.
Metric 5:	Exposure Levels	Low	This study only reported two levels of exposure: exposed and unexposed.

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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.			
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)			
Reported Health Effect(s):	Finger nail changes, dry mouth			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1576			
Domain	Metric	Rating	Comments	
	Metric 6:	Temporality	Low	As a cross-sectional study and due to insufficient documentation on methods of exposure assessment, temporality of exposures and outcomes is uncertain. No information on exposure duration or time since first exposure is provided for the exposed workers. Area sampling and personal sampling for 6 workers was conducted in six workers in April 1993, but it is not clear whether any of these workers were included in the sample of 154 workers tested for outcomes in July 1993.
Domain 3: Outcome Assessment				
	Metric 7:	Outcome Measurement or Characterization	Low	Questionnaire data collected frequencies of 35 different symptoms for “irritative, respiratory, neurologic, and vegetative status.” These appeared to be self-reported.
	Metric 8:	Reporting Bias	Medium	Measured outcomes are described in the methods section. All measured outcomes are reported, though some are lacking detail (e.g., the questionnaire data on rheumatic complaints are described in the text but not presented as accompanying data).
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Exposure groups were age- and sex-matched. For spirometry measurements, values were adjusted for height, sex, and years of cigarette smoking. For neurological test scores, adjustment for different variables (i.e., age, educational level, gender, ethnicity, height, or weight) were made if their coefficients from stepwise linear regression were significant. History of mental health outcomes, use of tranquilizers, and angina pectoris were higher among exposed than unexposed subjects. No data was provided for many of the assessed confounders.
	Metric 10:	Covariate Characterization	Medium	Confounders were assessed using questionnaires.
	Metric 11:	Co-exposure Counfounding	Low	Occupational co-exposures to solvents, adhesives, and asbestos were present among exposed individuals. The discussion notes that herbicide exposure was the only other exposure more prevalent in the exposed group—4.5% compared to 0.6% in the unexposed group—but excluding individuals with herbicide exposure did not alter the study’s results. It is not clear what other exposures were assessed.
Domain 5: Analysis				
	Metric 12:	Study Design and Methods	High	The study design chosen was appropriate for the research question.
	Metric 13:	Statistical Power	Medium	For all outcomes except for blink reflex latency, 154 exposed workers and 112 unexposed subjects were analyzed. For blink latency, 117 unexposed subjects from a different state were compared to the 154 exposed workers. Effects were reported and appeared to be adequate to detect an effect in the exposed population.
	Metric 14:	Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the analysis is insufficient to understand what has been done and to be reproducible.
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Study Citation:	Kilburn, K. H. (1999). Neurobehavioral and respiratory findings in jet engine repair workers: a comparison of exposed and unexposed volunteers. Environmental Research 80(3):244-252.
Health Outcome(s) Assessed:	Other (Finger nails, dry mouth)
Reported Health Effect(s):	Finger nail changes, dry mouth
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	1576

Domain	Metric	Rating	Comments
	Metric 15: Statistical Analysis	Low	Study refers to linear regression models, but there are no descriptions of analyses or assumptions and no quantitative results are presented.

Additional Comments: Overall, exposed subjects in this study reported significantly more respiratory, neurophysiological, neuropsychological, and other symptoms than unexposed subjects. Exposed subjects were occupationally exposed to numerous other chemicals in addition to 1,1,1-Trichloroethane, including adhesives and other solvents. Measured exposures were based on sampling of only six workers, and it is unclear whether these workers were included in the analytic sample.

Overall Quality Determination

Low

Study Citation:	Bove, F. J. (1996). Public drinking water contamination and birthweight, prematurity, fetal deaths, and birth defects. Toxicology and Industrial Health 12(2):255-266.		
Health Outcome(s) Assessed:	Reproductive/Developmental		
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	200239 Linked HERO ID(s): 194932, 200239		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	This cross-sectional study (n=80,938) included all registered singleton live births and fetal deaths (>20 weeks' gestation) in 1985-88 in 75 New Jersey towns located in 4 counties with "some" water supplies contaminated with substances of interest and where: (i) residents were "mostly" served by public water systems; and (ii) births occurred "mostly" in state. Estimated proportions of residents served by public water systems, and of pregnancies/births captured, were not described. However, the inclusion of all eligible registered births, fetal deaths, and birth defects, as well as the selection of towns without knowledge of birth outcome prevalence, limited the likelihood of selection bias.
Metric 2:	Attrition	Medium	All registered births and fetal deaths were included. Attrition due to missing values for multiple variables was not quantified and is therefore uncertain. However, attrition was likely modest as the proportion of missing values for individual variables was relatively low: (i) ~6% of subjects were excluded from analyses of outcomes such as preterm birth due to invalid or missing gestational ages; and (ii) other covariates evaluated as confounders had up to 4.9% missing values.
Metric 3:	Comparison Group	High	After excluding plural pregnancies and chromosomal abnormalities, all registered live births during the study period in the areas included without the outcomes of interest were included in the comparison group. This comprehensive approach limited the potential for bias. Chromosomal abnormalities were not included as outcomes as they were not hypothesized to be associated with the exposures under study but were appropriately excluded given their uncertain etiology.
Domain 2: Exposure Characterization			
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Study Citation:	Bove, F. J. (1996). Public drinking water contamination and birthweight, prematurity, fetal deaths, and birth defects. Toxicology and Industrial Health 12(2):255-266.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	200239 Linked HERO ID(s): 194932, 200239			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Medium	Along with several other contaminants, residential drinking water exposure to 1,1,1-trichloroethane (isomer of 1,1,2-trichloroethane) was assigned based on maternal town of residence at birth. The study also analyzed 1,2-dichloroethane and 'total dichloroethylenes'. Exposure estimates were calculated using the average of water company sampling reports during the first trimester (for birth defects and fetal death) or the duration of pregnancy (for other outcomes). Detection limits and data availability were not specified in detail but were described as below 1 ppb, with reporting compliance >85%. A minimum of 1 sample per 6-month interval was required; variability in the number of measures available across water systems and towns was not described. Additional sources of measurement error included: changes in residence during pregnancy; water from alternate sources (ex. private wells, bottles, workplaces); variability in residential contaminant levels vs measured samples; unknown levels of tap water intake; and errors in estimated dermal and inhalation exposure while bathing or showering. While the extent of exposure misclassification is uncertain, there is no evidence to suggest it was differential rather than random.	
	Metric 5: Exposure Levels	Medium	Due to the high proportion of measures below detection limits, analyses relating exposure to health outcomes used only 2 categories for each of the chlorinated solvents of interest: cutoffs close to detection limits were used to define elevated exposure. The proportion defined as having elevated 1,1,1-trichloroethane was not shown as distributions were included only for association with ORs ≥1.5. An important concern is that relatively low levels of exposure to these contaminants from sources other than residential drinking water, for which data were not available, could potentially have resulted in considerable misclassification.	
	Metric 6: Temporality	High	Exposure levels were assigned based on contaminant exposures estimated during: (i) the first trimester for analyses of birth defects and fetal deaths; and (ii) the duration of pregnancy for other pregnancy outcomes.	
Domain 3: Outcome Assessment				
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Study Citation:	Bove, F. J. (1996). Public drinking water contamination and birthweight, prematurity, fetal deaths, and birth defects. Toxicology and Industrial Health 12(2):255-266.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	200239 Linked HERO ID(s): 194932, 200239			
Domain	Metric	Rating	Comments	
	Metric 7: Outcome Measurement or Characterization	Medium	Outcomes included measures of birthweight (continuous among term births, low term birthweight, very low birthweight), prematurity, fetal death, and congenital anomalies in live births or fetal deaths. The anomalies analyzed included defects of the central nervous system, neural tube, oral cleft, total cardiac, major cardiac, ventricular septum, and any surveillance defect excluding chromosomal defects. All outcomes were identified using birth certificates, fetal death certificates (>20 weeks' gestation), and the NJ congenital birth defect registry (ICD codes provided). These registry data are likely to be sufficiently valid for late pregnancy outcomes. However, their limited ability to capture early pregnancy losses is a weakness. The sample included only 594 fetal deaths (less than 1% of the >80,000 sample). Typical estimates are that 10-20%, of recognized pregnancies ending in losses. Moreover, developmental defects contributing to early pregnancy losses were also not captured. A further limitation is that that potentially etiologically heterogeneous preterm birth types were analyzed together, as these data did not distinguish premature rupture of membranes vs idiopathic prematurity.	
	Metric 8: Reporting Bias	Medium	Models were constructed only for contaminants with associations > 1.0, and tables included only associations with odds ratios ≥1.5. No clear rationale was provided. Several positive odds ratios below the 1.5 cutoff were described in the results text (without confidence intervals), but no null/negative odds ratios were presented or described.	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Medium	Potential confounding by maternal race, education, parity, and prior pregnancy loss, along with infant sex (for birth outcomes) and adequacy of prenatal care, was examined. Gestational age was addressed by analyzing birthweight among full term births, term low birth weight, and small size for gestational age. Only fully adjusted models were presented. In a companion case-control study (with low participation rates), adjustment for other variables not available on birth certificates (ex. maternal smoking, occupational exposures, medical history, and gestational weight gain) did not influence associations with other studied contaminants. This separate study reduces concerns for important confounding bias, but confounding cannot be ruled out.	
	Metric 10: Covariate Characterization	Medium	Data on covariates came from registry data: birth certificates, fetal death certificates, and the NJ congenital birth defects registry.	
	Metric 11: Co-exposure Counfounding	Medium	Co-exposure confounding by drinking water trihalomethane concentrations was evaluated. There was no evidence to suggest substantial confounding by this or other co-exposures.	
Domain 5: Analysis				
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Study Citation:	Bove, F. J. (1996). Public drinking water contamination and birthweight, prematurity, fetal deaths, and birth defects. <i>Toxicology and Industrial Health</i> 12(2):255-266.
Health Outcome(s) Assessed:	Reproductive/Developmental
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	200239 Linked HERO ID(s): 194932, 200239

Domain	Metric	Rating	Comments
Metric 12:	Study Design and Methods	High	Methods were appropriate. The study used logistic regression models to estimate odds ratios and confidence intervals for dichotomous outcomes, and linear regression for analysis of continuous birth weight.
Metric 13:	Statistical Power	Medium	Statistical power was likely to have been limited as a consequence of the small proportion of the sample defined as having "elevated" residential water concentrations of the chemicals of interest. The range of exposure examined was limited, as cutoffs for elevated levels were close to the detection limits of 1 ppb. In addition, for most birth defect outcomes, fewer than 10 cases had elevated exposure.
Metric 14:	Reproducibility of Analyses	Medium	The authors clearly described steps used to estimate exposure-outcome associations, including exposure category cutoffs and criteria for confounding. However, many results were not shown as tables included odds ratios ≥ 1.5 .
Metric 15:	Statistical Analysis	High	The authors estimated coefficients, odds ratios and 95% confidence intervals using adequate methods. Confounding was based on 15% change-in-estimate comparing nested models. Effect modification (ex by infant sex) was not evaluated as there was no a priori evidence to suggest such analyses at that time.

Additional Comments: This study analyzed the association between estimated residential drinking water concentrations of several chlorinated solvents including 1,1,1-trichloroethane (as well as 1,2-dichloroethane and Σ [trans-1,2-dichloroethylene and 1,1-dichloroethylene]) and pregnancy outcomes (size at birth, prematurity, fetal deaths, and congenital birth defects). The sample included more than 80,000 births during 1985-88 for residents of 75 towns in NJ using public water system records to estimate exposure during gestation, and registry data (birth certificate, fetal death certificates for pregnancies >20 weeks, state birth defect registry) to characterize outcomes. Distributions of and associations with 1,1,1-trichloroethane were not presented as odds ratios for this contaminant did not achieve a magnitude above 1.5. Strengths included the large sample size and inclusion of all eligible registered births and fetal deaths in the study period. A critical concern is the inability to capture early fetal deaths and any related malformations (1% of the sample had fetal deaths vs typical estimates of >10%). Small numbers for birth defect outcomes also limited power. Exposure misclassification (ex. drinking water from wells/ work/ bottles, changes in residence, exposure from other sources) is also a concern. However, such misclassification was likely non-differential, and thus more likely to under- vs. to over-estimate associations.

Overall Quality Determination

Medium

Study Citation:	Bove, F. J., Fulcomer, M. C., Klotz, J. B., Esmart, J., Dufficy, E. M., Savrin, J. E. (1995). Public drinking water contamination and birth outcomes. American Journal of Epidemiology 141(9):850-862.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	194932 Linked HERO ID(s): 194932, 200239			
Domain	Metric		Rating	Comments
Domain 1: Study Participation				
	Metric 1:	Participant Selection	Medium	This semi-ecological study (n=80,938) included all registered singleton live births and fetal deaths (>20 weeks) in 1985-88 in 75 New Jersey towns located in 4 counties with “some” water supplies contaminated with substances of interest and where: (i) residents were “mostly” served by public water systems; and (ii) births occurred “mostly” in state. Estimated proportions of residents served by public water systems, and of pregnancies/births captured, were not described. However, the inclusion of all eligible registered births, fetal deaths, and birth defects, as well as the selection of towns without knowledge of birth outcome prevalence, limited the likelihood of selection bias.
	Metric 2:	Attrition	Medium	All registered births and fetal deaths were included. Attrition due to missing values for multiple variables was not quantified and is therefore uncertain. However, attrition was likely modest as the proportion of missing values for individual variables was relatively low: (i) ~6% of subjects were excluded from analyses of outcomes such as preterm birth due to invalid or missing gestational ages; and (ii) other covariates evaluated as confounders had up to 4.9% missing values.
	Metric 3:	Comparison Group	High	After excluding plural pregnancies and chromosomal abnormalities, all registered live births during the study period in the areas included without the outcomes of interest were included in the comparison group. This comprehensive approach limited the potential for bias. Chromosomal abnormalities were not included as outcomes as they were not hypothesized to be associated with the exposures under study but were appropriately excluded given their uncertain etiology.
Domain 2: Exposure Characterization				
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Study Citation:	Bove, F. J., Fulcomer, M. C., Klotz, J. B., Esmart, J., Dufficy, E. M., Savrin, J. E. (1995). Public drinking water contamination and birth outcomes. American Journal of Epidemiology 141(9):850-862.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	194932 Linked HERO ID(s): 194932, 200239			
Domain	Metric	Rating	Comments	
	Metric 4: Measurement of Exposure	Medium	Along with several other contaminants, residential drinking water exposure to 1,1,1-trichloroethane (isomer of 1,1,2-trichloroethane) was assigned based on maternal town of residence at birth. The study also analyzed 1,2-dichloroethane and 'total dichloroethylenes'. Exposure estimates were calculated using the average of water company sampling reports during the first trimester (for birth defects and fetal death) or the duration of pregnancy (for other outcomes). Detection limits and data availability were not specified in detail but were described as below 1 ppb, with reporting compliance >85%. A minimum of 1 sample per 6-month interval was required; variability in the number of measures available across water systems and towns was not described. Additional sources of measurement error included: changes in residence during pregnancy; water from alternate sources (ex. private wells, bottles, workplaces); variability in residential contaminant levels vs measured samples; unknown levels of tap water intake; and errors in estimated dermal and inhalation exposure while bathing or showering. While the extent of exposure misclassification is uncertain, there is no evidence to suggest it was differential rather than random.	
	Metric 5: Exposure Levels	Low	Due to the high proportion of measures below detection limits, analyses relating exposure to health outcomes used only 2 categories for each of the three chemicals of interest: cutoffs close to detection limits were used to define elevated exposure. Proportions defined as having elevated exposure were low (6.2% had 1,1,1-trichloroethane ≥2ppb). An important concern is that relatively low levels of exposure to these contaminants from sources other than residential drinking water, for which data were not available, could potentially have resulted in considerable misclassification.	
	Metric 6: Temporality	High	Exposure levels were assigned based on contaminant exposures estimated during: (i) the first trimester for analyses of birth defects and fetal deaths; and (ii) the duration of pregnancy for other pregnancy outcomes.	
Domain 3: Outcome Assessment				
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Study Citation:	Bove, F. J., Fulcomer, M. C., Klotz, J. B., Esmart, J., Dufficy, E. M., Savrin, J. E. (1995). Public drinking water contamination and birth outcomes. American Journal of Epidemiology 141(9):850-862.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	194932 Linked HERO ID(s): 194932, 200239			
Domain		Metric	Rating	Comments
	Metric 7:	Outcome Measurement or Characterization	Medium	Outcomes included measures of birthweight (continuous among term births, low term birthweight, very low birthweight), prematurity, fetal death, and congenital anomalies in live births or fetal deaths. The anomalies analyzed included defects of the central nervous system, neural tube, oral cleft, total cardiac, major cardiac, ventricular septum, and any surveillance defect excluding chromosomal defects. All outcomes were identified using birth certificates, fetal death certificates (>20 weeks' gestation), and the NJ congenital birth defect registry (ICD codes provided). These registry data are likely to be sufficiently valid for late pregnancy outcomes. However, their limited ability to capture early pregnancy losses is a weakness. The sample included only 594 fetal deaths (less than 1% of the >80,000 sample). Typical estimates are that 10-20%, of recognized pregnancies ending in losses. Moreover, developmental defects contributing to early pregnancy losses were also not captured. A further limitation is that that potentially etiologically heterogeneous preterm birth types were analyzed together, as these data did not distinguish premature rupture of membranes vs idiopathic prematurity.
	Metric 8:	Reporting Bias	Low	Models were constructed only for contaminants with associations > 1.0, and tables included only associations with odds ratios ≥1.5. No clear rationale was provided. Several positive odds ratios below the 1.5 cutoff were described in the results text (without confidence intervals), but no null/negative odds ratios were presented or described.
Domain 4: Potential Confounding / Variability Control				
	Metric 9:	Covariate Adjustment	Medium	Potential confounding by maternal race, education, parity, and prior pregnancy loss, along with infant sex (for birth outcomes) and adequacy of prenatal care, was examined. Gestational age was addressed by analyzing birthweight among full term births, term low birth weight, and small size for gestational age. Only fully adjusted models were presented. In a companion case-control study (with low participation rates), adjustment for other variables not available on birth certificates (ex. maternal smoking, occupational exposures, medical history, and gestational weight gain) did not influence associations with other studied contaminants. This separate study reduces concerns for important confounding bias, but confounding cannot be ruled out.
	Metric 10:	Covariate Characterization	Medium	Data on covariates came from registry data: birth certificates, fetal death certificates, and the NJ congenital birth defects registry.
	Metric 11:	Co-exposure Counfounding	Medium	Co-exposure confounding by drinking water trihalomethane concentrations was evaluated. There was no evidence to suggest substantial confounding by this or other co-exposures.
Domain 5: Analysis				
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Study Citation:	Bove, F. J., Fulcomer, M. C., Klotz, J. B., Esmart, J., Dufficy, E. M., Savrin, J. E. (1995). Public drinking water contamination and birth outcomes. American Journal of Epidemiology 141(9):850-862.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	Fetal growth and development: -Birthweight (term births), low birthweight (term births), very low birthweight, small for gestational age-Preterm birth-Fetal death (>20 weeks' gestation)-Congenital anomalies: (i) nervous system (central nervous system, neural tube defects); (ii) oral cleft; (iii) cardiovascular (total cardiac, major cardiac, ventricular septum defects); and (iv) any surveillance defect excluding chromosomal defects.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	194932 Linked HERO ID(s): 194932, 200239			
Domain	Metric	Rating	Comments	
	Metric 12: Study Design and Methods	High	Methods were appropriate. The study used logistic regression models to estimate odds ratios and confidence intervals for dichotomous outcomes, and linear regression for analysis of continuous birth weight.	
	Metric 13: Statistical Power	Low	Statistical power was likely to have been limited as a consequence of the small proportion of the sample defined as having "elevated" residential water concentrations of the chemicals of interest. The range of exposure examined was limited, as cutoffs for elevated levels were close to the detection limits of 1 ppb. In addition, for most birth defect outcomes, fewer than 10 cases had elevated exposure. However, the authors emphasized the magnitude of associations rather than statistical significance and presented multiple confidence intervals to aid interpretation of the precision of estimates (50%, 90% and 99%).	
	Metric 14: Reproducibility of Analyses	Medium	The authors clearly described steps used to estimate exposure-outcome associations, including exposure category cutoffs and criteria for confounding. However, many results were not shown as tables included odds ratios ≥ 1.5 .	
	Metric 15: Statistical Analysis	High	The authors estimated coefficients, odds ratios and confidence intervals using adequate methods. Confounding was based on 15% change-in-estimate comparing nested models. Effect modification (ex by infant sex) was not evaluated as there was no a priori evidence to suggest such analyses at that time.	
Additional Comments:	This study analyzed the association between estimated residential drinking water concentrations of several chlorinated solvents including 1,1,1-trichloroethane (as well as 1,2-dichloroethane and Σ [trans-1,2-dichloroethylene and 1,1-dichloroethylene]) and pregnancy outcomes (size at birth, prematurity, fetal deaths, and congenital birth defects). The sample included more than 80,000 births during 1985-88 for residents of 75 towns in NJ using public water system records to estimate exposure during gestation, and registry data (birth certificate, fetal death certificates for pregnancies >20 weeks' gestation, state birth defect registry) to characterize outcomes. Strengths included the large sample size and inclusion of all eligible registered births and fetal deaths in the study period. A critical concern is the inability to capture early fetal deaths and any related malformations (1% of the sample had fetal deaths vs typical estimates of >10%). An important limitation was the low percentage of the sample with detectable (> 1ppb) concentrations of these contaminants (<1% to 6.2%). Small numbers for birth defect outcomes also limited power. Exposure misclassification (ex. drinking water from wells/work/ bottles, changes in residence, exposure from other sources) is also a concern. However, such misclassification was likely non-differential, and thus more likely to under- vs. to over-estimate associations.			

Overall Quality Determination

Medium

Study Citation:	Sallmen, M., Lindbohm, M. L., Anttila, A., Kyyronen, P., Taskinen, H., Nykyri, E., Hemminki, K. (1998). Time to pregnancy among the wives of men exposed to organic solvents. Occupational and Environmental Medicine 55(1):24-30.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	time to pregnancy, fecundability density ratio ("If, for example, an exposed group has a FDR of 0.5, its sexually active members are half as likely to achieve clinical pregnancy as corresponding unexposed people at any moment during the fertile period in each menstrual cycle")			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	671475			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	All key elements of the study design are reported. A total of 282 couples were included, and participation rates at each stage, exclusion criteria, and case/control selection were described. The final number of cases vs controls was not provided.	
Metric 2:	Attrition	Medium	Any exclusion of subjects from analyses was adequately addressed, and reasons were documented when subjects were removed from the study or excluded from analyses. 34 out of 316 couples were excluded, and reasons for the exclusions were provided.	
Metric 3:	Comparison Group	High	The study design indicates cases and controls were selected from the same group of participants, and then classified as cases (spontaneous abortion observed) and controls (age-matched at the time of conception in the pregnancy outcome study).	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure level classification was based on self-reported paternal work history and was used to group participants in high or frequent exposure, intermediate or low exposure, and no exposure. Biological monitoring was also incorporated, if available. However, detailed information about job history for each group was not provided. Additionally, biological monitoring of 1,1,1-trichloroethane was only available for two participants (one classified as high exposure to organic solvents and one classified as low to intermediate).	
Metric 5:	Exposure Levels	Medium	Occupational exposure history was used to categorize paternal participants into un-exposed, potentially exposed, or likely exposed, further classifying participants into exposure levels of "high or frequent, intermediate or low, and none."	
Metric 6:	Temporality	Medium	Husbands either had the same jobs as they did 80 days prior to the beginning of their wife's pregnancy, or were re-assessed for exposure status if their work tasks changed during the time to pregnancy. It is unclear whether all exposures fall within relevant exposure windows for the outcome of interest.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	Low	Pregnancies were confirmed using a nationwide database of medically diagnosed pregnancies, but the fecundability density ratio was based on self-report of the menstrual cycle in which the pregnancy occurred.	
Metric 8:	Reporting Bias	Medium	Pregnancy outcomes and fecundability density ratio (FDR) are reported and detailed. Confidence intervals for the FDR analyses are reported. Time to pregnancy in each exposure group (for all of the solvents examined) are provided, but not for each individual solvent.	
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Study Citation:	Sallmen, M., Lindbohm, M. L., Anttila, A., Kyyronen, P., Taskinen, H., Nykyri, E., Hemminki, K. (1998). Time to pregnancy among the wives of men exposed to organic solvents. Occupational and Environmental Medicine 55(1):24-30.		
Health Outcome(s) Assessed:	Reproductive/Developmental		
Reported Health Effect(s):	time to pregnancy, fecundability density ratio ("If, for example, an exposed group has a FDR of 0.5, its sexually active members are half as likely to achieve clinical pregnancy as corresponding unexposed people at any moment during the fertile period in each menstrual cycle")		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	671475		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	High	Appropriate adjustments or explicit considerations were made for potential confounders (see Confounders section and notes for Table 6).
	Metric 10: Covariate Characterization	Medium	Information on confounders was collected using a questionnaire in both parts of the study. A questionnaire was sent to participants to collect information in the second part of the study. It is unclear how the questionnaire was administered to participants in the first part of the study.
	Metric 11: Co-exposure Counfounding	Low	Occupational exposures to several other organic solvents occurred, sometimes at much higher expected concentrations than the target 1,1,1-trichloroethane. Results for biomonitoring of the other organic solvents was provided.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	Low	The study design - an extension of a case-referent study on spontaneous abortion - was not appropriate to investigate time to pregnancy. As the authors note in the discussion: "Pregnancies ending in spontaneous abortion tend to have longer times to pregnancy than those ending in births. Also, the data on time to pregnancy might not be as accurate for spontaneous abortions as for births. Thus, the FDR for exposure to solvents found in the whole study population might be biased."
	Metric 13: Statistical Power	Low	Power calculations were not reported. Analyses by exposure level show that low and intermediate/high subgroups for 1,1,1-trichloroethane were small (n=15 and n=12, respectively).
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15: Statistical Analysis	High	The proportional hazard model was described, and the study authors report that factors that may affect the proportional hazard assumption were accounted for.
Additional Comments:	A group of 282 couples gathered from a prior case-referent study were examined for paternal occupational exposures to organic solvents and time to pregnancy, as assessed by the relative fecundability density ratio (FDR). 1,1,1-Trichloroethane was individually examined, but no statistically significant changes in the FDR were reported. Occupational exposure history was used to categorize paternal participants into unexposed, potentially exposed, or likely exposed, further classifying participants into exposure levels of "high or frequent, intermediate or low, and none."		
Overall Quality Determination		Medium	

Study Citation:	Taskinen, H., Anttila, A., Lindbohm, M. L., Sallmén, M., Hemminki, K. (1989). Spontaneous abortions and congenital malformations among the wives of men occupationally exposed to organic solvents. Scandinavian Journal of Work, Environment and Health 15(5):345-352.		
Health Outcome(s) Assessed:	Reproductive/Developmental		
Reported Health Effect(s):	spontaneous abortion		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	5414		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	High	All key elements of the study design are reported. Participation rates at each stage, exclusion criteria, and case/control selection were described.
Metric 2:	Attrition	Medium	73.3% of referents (370) and 79.1% of cases (136) responded to questionnaires. The final number of participants for matched referents included 120 cases and 251 referents. Reasons for exclusion were provided and were mostly attributed to nonresponse of a case or matched referent.
Metric 3:	Comparison Group	High	The study design indicates cases and controls were selected from the same group of participants, and then classified participants as cases (spontaneous abortion observed) and controls (3 age-matched at the time of conception).
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Low	Exposure level classification based on paternal work history was used to group participants for their likelihood and frequency of exposure. However, detailed information about job history for each group was not provided.
Metric 5:	Exposure Levels	Medium	3 exposure levels were used, but exposure estimates for each group were not reported.
Metric 6:	Temporality	Medium	Husbands' exposure was assessed 80 days prior to the beginning of their wife's pregnancy. It is unclear whether all exposures fall within relevant exposure windows for the outcome of interest.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	High	The outcome (spontaneous abortion) was assessed in cases and controls. Data on medically diagnosed pregnancies were obtained from the National Board of Health Hospital Discharge Register. Data on spontaneous abortions were collected from hospital records.
Metric 8:	Reporting Bias	High	The number of spontaneous abortions in cases and referents were provided for 1,1,1-trichloroethane, as well as an OR and 95% CI (Table 3).
Domain 4: Potential Confounding / Variability Control			
Metric 9:	Covariate Adjustment	Medium	In the only analysis of spontaneous abortions among cases and referents specifically for 1,1,1-trichloroethane, confounders were not adjusted for. However, the distribution of potential confounders among cases and referents was provided.
Metric 10:	Covariate Characterization	Medium	Potential confounders were assessed using mailed questionnaires.
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Study Citation:	Taskinen, H., Anttila, A., Lindbohm, M. L., Sallmén, M., Hemminki, K. (1989). Spontaneous abortions and congenital malformations among the wives of men occupationally exposed to organic solvents. Scandinavian Journal of Work, Environment and Health 15(5):345-352.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortion			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	5414			
Domain	Metric	Rating	Comments	
	Metric 11: Co-exposure Counfounding	Low	Occupational exposures to several other organic solvents occurred, and other unknown occupational exposures were expected. No adjustments were made for the analysis of 1,1,1-trichloroethane.	
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design (case-referent nested cohort) was appropriate to assess the outcome of interest (spontaneous abortion). A conditional logistic regression model was used to assess the data.	
	Metric 13: Statistical Power	Low	The study noted "because of the high prevalence of solvent exposure among the study population, the statistical power todiscover risk associated with exposure was rather high", although noted a 73% probability of detecting a two-fold risk, which is lower than the 80% threshold.	
	Metric 14: Reproducibility of Analyses	Low	Limited details about the statistical analysis were provided. The description of the anal- ysis is insufficient to understand what has been done and to be reproducible.	
	Metric 15: Statistical Analysis	Low	A detailed description of the analyses/assumptions were not provided.	
	Additional Comments:	A group of 371 participants (120 cases, 251 referents) were examined for paternal occupational exposures to several organic solvents and the outcome of spontaneous abortions. Spontaneous abortions were not significantly different among cases when compared with referents for 1,1,1-trichloroethane; however, confounders were not controlled for in this analysis. The study did not perform another analysis of 1,1,1-trichloroethane individually.		

Overall Quality Determination

Medium

Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortions and birth defects			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	708475			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	A total of 1,105 pregnant women were included in this study. Most key elements of the study design are reported and participant selection in or out of the study was described and was not likely to be biased. The final number of exposed/unexposed participants from each location was not provided.	
Metric 2:	Attrition	Medium	Out of a total of 10,055 households, 2,713 women were identified as pregnant during the exposure period and 1,480 were eligible for inclusion. Exclusions were adequately addressed.	
Metric 3:	Comparison Group	High	Two demographically similar census tracts were used as comparators for the two exposed groups. Details on selection were described.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure estimates were calculated using a hydrogeologic computer model and were fully described elsewhere (unpublished manuscript). It is not reported if results were validated.	
Metric 5:	Exposure Levels	Low	There are 4 total groups, classified into 2 exposure groups (exposed and unexposed).	
Metric 6:	Temporality	Medium	Temporality is established, but it is unclear whether exposures fall within relevant exposure windows for the outcome of interest.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	Medium	Information on spontaneous abortions and congenital defects were obtained via questionnaires and cases were validated via medical records or physician report. Based on prior studies showing good agreement between negative reports and medical records, controls were not validated.	
Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and unadjusted effect estimates are reported with a 95% confidence interval. Number of exposed/unexposed reported for the analyses. Not all adjusted odds ratios are reported, and some are missing 95% confidence intervals.	
Domain 4: Potential Confounding / Variability Control				
Metric 9:	Covariate Adjustment	Medium	Appropriate adjustments or explicit considerations were made for potential confounders for each outcome. Results or descriptions of adjusted birth defects and low birth weight were described in the text only.	
Metric 10:	Covariate Characterization	Medium	Potential confounders were assessed for significance and the methods were described. Method validation was not reported specifically for confounders.	

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Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortions and birth defects			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	708475			
Domain	Metric	Rating	Comments	
	Metric 11:	Co-exposure Counfounding	Low	No adjustments were made for other potential exposures from the waste leaked from the underground storage tank that contaminated well 13. 1,1,1-trichloroethane was present at the highest concentration.
Domain 5: Analysis	Metric 12:	Study Design and Methods	High	The study design chosen (case control) was appropriate for the research question (incidence of abnormal births) and appropriate statistical analyses were used and described.
	Metric 13:	Statistical Power	Medium	The number of cases and controls are adequate to detect an effect in the exposed population, but statistical power calculations were not provided.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15:	Statistical Analysis	High	Descriptions for risk estimate calculations for each outcome were provided and the variables used in each analysis were described.
Additional Comments:	The study investigated adverse birth outcomes in pregnant women exposed to leaked wastes from an underground storage tank, primarily 1,1,1-trichloroethane (1,700 ppb), via drinking water in California in the early 1980s. A total of 1,105 exposed and unexposed pregnant women were included in the study, which included previously studied ("original") census tracts as well as new ones. Outcomes were spontaneous abortions, birth defects, and low birth weight in their infants. During the contamination period (1980-1981), significantly increased spontaneous abortions were observed using the original study area when comparing exposed vs unexposed groups, both unadjusted (OR = 3.5, 95% CI 1.2-10.3) and adjusted for confounders (OR = 5.0, 95% CI NR). Significantly increased birth defects were reported in the original study area among the exposed group during the same time period (unadjusted OR = 4.3, 95% CI 1.2-14.7). No significant changes in low birth weight were observed.			

Overall Quality Determination

Medium

Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortions and birth defects			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	708475			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	A total of 1,105 pregnant women were included in this study. Most key elements of the study design are reported and participant selection in or out of the study was described and was not likely to be biased. The final number of exposed/unexposed participants from each location was not provided.	
Metric 2:	Attrition	Medium	Out of a total of 10,055 households, 2,713 women were identified as pregnant during the exposure period and 1,480 were eligible for inclusion. Exclusions were adequately addressed.	
Metric 3:	Comparison Group	High	Two demographically similar census tracts were used as comparators for the two exposed groups. Details on selection were described.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure estimates were calculated using a hydrogeologic computer model and were fully described elsewhere (unpublished manuscript). It is not reported if results were validated.	
Metric 5:	Exposure Levels	Low	There are 4 total groups, classified into 2 exposure groups (exposed and unexposed).	
Metric 6:	Temporality	Medium	Temporality is established, but it is unclear whether exposures fall within relevant exposure windows for the outcome of interest.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	Medium	Information on spontaneous abortions and congenital defects were obtained via questionnaires and cases were validated via medical records or physician report. Based on prior studies showing good agreement between negative reports and medical records, controls were not validated.	
Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and unadjusted effect estimates are reported with a 95% confidence interval. Number of exposed/unexposed reported for the analyses. Not all adjusted odds ratios are reported, and some are missing 95% confidence intervals.	
Domain 4: Potential Confounding / Variability Control				
Metric 9:	Covariate Adjustment	Medium	Appropriate adjustments or explicit considerations were made for potential confounders for each outcome. Results or descriptions of adjusted birth defects and low birth weight were described in the text only.	
Metric 10:	Covariate Characterization	Medium	Potential confounders were assessed for significance and the methods were described. Method validation was not reported specifically for confounders.	
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Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortions and birth defects			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	708475			
Domain	Metric	Rating	Comments	
	Metric 11:	Co-exposure Counfounding	Low	No adjustments were made for other potential exposures from the waste leaked from the underground storage tank that contaminated well 13. 1,1,1-trichloroethane was present at the highest concentration.
Domain 5: Analysis	Metric 12:	Study Design and Methods	High	The study design chosen (case control) was appropriate for the research question (incidence of abnormal births) and appropriate statistical analyses were used and described.
	Metric 13:	Statistical Power	Medium	The number of cases and controls are adequate to detect an effect in the exposed population, but statistical power calculations were not provided.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15:	Statistical Analysis	High	Descriptions for risk estimate calculations for each outcome were provided and the variables used in each analysis were described.
Additional Comments:	The study investigated adverse birth outcomes in pregnant women exposed to leaked wastes from an underground storage tank, primarily 1,1,1-trichloroethane (1,700 ppb), via drinking water in California in the early 1980s. A total of 1,105 exposed and unexposed pregnant women were included in the study, which included previously studied ("original") census tracts as well as new ones. Outcomes were spontaneous abortions, birth defects, and low birth weight in their infants. During the contamination period (1980-1981), significantly increased spontaneous abortions were observed using the original study area when comparing exposed vs unexposed groups, both unadjusted (OR = 3.5, 95% CI 1.2-10.3) and adjusted for confounders (OR = 5.0, 95% CI NR). Significantly increased birth defects were reported in the original study area among the exposed group during the same time period (unadjusted OR = 4.3, 95% CI 1.2-14.7). No significant changes in low birth weight were observed.			

Overall Quality Determination

Medium

Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.			
Health Outcome(s) Assessed:	Reproductive/Developmental			
Reported Health Effect(s):	spontaneous abortions and birth defects			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	708475			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	A total of 1,105 pregnant women were included in this study. Most key elements of the study design are reported and participant selection in or out of the study was described and was not likely to be biased. The final number of exposed/unexposed participants from each location was not provided.	
Metric 2:	Attrition	Medium	Out of a total of 10,055 households, 2,713 women were identified as pregnant during the exposure period and 1,480 were eligible for inclusion. Exclusions were adequately addressed.	
Metric 3:	Comparison Group	High	Two demographically similar census tracts were used as comparators for the two exposed groups. Details on selection were described.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Low	Exposure estimates were calculated using a hydrogeologic computer model and were fully described elsewhere (unpublished manuscript). It is not reported if results were validated.	
Metric 5:	Exposure Levels	Low	There are 4 total groups, classified into 2 exposure groups (exposed and unexposed).	
Metric 6:	Temporality	Medium	Temporality is established, but it is unclear whether exposures fall within relevant exposure windows for the outcome of interest.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	High	Birth weight in cases and controls was assessed using a well-established method (birth certificate data).	
Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and unadjusted effect estimates are reported with a 95% confidence interval. Number of exposed/unexposed reported for the analyses. Adjusted odds ratios are discussed but not quantitatively reported.	
Domain 4: Potential Confounding / Variability Control				
Metric 9:	Covariate Adjustment	Medium	Appropriate adjustments or explicit considerations were made for potential confounders for each outcome. Results or descriptions of adjusted birth defects and low birth weight were described in the text only.	
Metric 10:	Covariate Characterization	Medium	Potential confounders were assessed for significance and the methods were described. Method validation was not reported specifically for confounders.	
Metric 11:	Co-exposure Counfounding	Low	No adjustments were made for other potential exposures from the waste leaked from the underground storage tank that contaminated well 13. 1,1,1-trichloroethane was present at the highest concentration.	

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Study Citation:	Wrensch, M., Swan, S., Lipscomb, J., Epstein, D., Fenster, L., Claxton, K., Murphy, P., Shusterman, D., Neutra, R. (1990). Pregnancy outcomes in women potentially exposed to solvent-contaminated drinking water in San Jose, California. American Journal of Epidemiology 131(2):283-300.
Health Outcome(s) Assessed:	Reproductive/Developmental
Reported Health Effect(s):	spontaneous abortions and birth defects
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane
HERO ID:	708475

Domain	Metric	Rating	Comments
Domain 5: Analysis	Metric 12: Study Design and Methods	High	The study design chosen (case control) was appropriate for the research question (incidence of abnormal births) and appropriate statistical analyses were used and described.
	Metric 13: Statistical Power	Medium	The number of cases and controls are adequate to detect an effect in the exposed population, but statistical power calculations were not provided.
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15: Statistical Analysis	High	Descriptions for risk estimate calculations for each outcome were provided and the variables used in each analysis were described.

Additional Comments: The study investigated adverse birth outcomes in pregnant women exposed to leaked wastes from an underground storage tank, primarily 1,1,1-trichloroethane (1,700 ppb), via drinking water in California in the early 1980s. A total of 1,105 exposed and unexposed pregnant women were included in the study, which included previously studied ("original") census tracts as well as new ones. Outcomes were spontaneous abortions, birth defects, and low birth weight in their infants. During the contamination period (1980-1981), significantly increased spontaneous abortions were observed using the original study area when comparing exposed vs unexposed groups, both unadjusted (OR = 3.5, 95% CI 1.2-10.3) and adjusted for confounders (OR = 5.0, 95% CI NR). Significantly increased birth defects were reported in the original study area among the exposed group during the same time period (unadjusted OR = 4.3, 95% CI 1.2-14.7). No significant changes in low birth weight were observed.

Overall Quality Determination

Medium

Study Citation:	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.		
Health Outcome(s) Assessed:	Other (Sleep apnea or nocturnal arterial oxygen desaturation)		
Reported Health Effect(s):	Sleep apnea or nocturnal arterial oxygen desaturation. Sleep apnea is categorized as the "other" target organs/systems because there are different types of sleep apnea. Different types of sleep apnea can be caused by the throat muscle and the brain's signals to the muscles that control breathing. Without a physician's diagnosis, it is unclear which target organ the sleep apnea should categorize.		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	677146		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Subjects were 21 personnel from 5 military printing shops in Belgium or Germany. There was no information on how subjects were selected, numbers of participants/nonparticipants, or calendar time of subject recruitment. Exclusion criteria used for exposed and control groups included "major neurological or medical antecedents, important head trauma, use of psychotropic drugs, and colorblindness"; in addition one control was excluded due to history of alcoholism.
Metric 2:	Attrition	Low	Numbers of individuals at important stages were not reported (participants/nonparticipants were not discussed).
Metric 3:	Comparison Group	Medium	Controls were 21 drivers from the army matched on age, sex, education, and language. However, the author did not mention if the exposed and comparison groups were recruited within the same time frame.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Exposure assessed as binary (yes/no) variable. Personal sampling was conducted at each worksite on one work day using 3M Organic Vapor monitors. Average worksite concentrations of 1,1,1-trichloroethane ranged between non-detect and 680.9 mg/m3. Duration of sampling event and analytical methods were not reported. Authors reported that the exposure intensity fluctuated substantially within a year so concentrations were not used in analysis.
Metric 5:	Exposure Levels	Low	Reports 2 levels of exposure (exposed/unexposed).
Metric 6:	Temporality	Medium	Temporality is established; tests were conducted on subjects who had worked on average 15 years in printing shops. However, it is unclear whether exposures fall within relevant exposure windows for the outcome of interest.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	Medium	For sleep apnea, three parameters were analyzed: the presence of desaturation during the night, the frequency of desaturation, the duration of the desaturation, and the lowest level of desaturation during the night. All subjects underwent digital oximetry for one night at home using an Oximeter. The outcome measurement was described thoroughly, but no validation was conducted against well-established methods.
Metric 8:	Reporting Bias	High	The measured outcomes of sleep apnea, such as mean duration, frequency, and the lowest level of desaturation, are reported in the figures and Results section. The measured outcomes (mean, SD, and range) can be extracted for the exposure groups and controls.

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Study Citation:	Laire, G., Viaene, M. K., Veulemans, H., Masschelein, R., Nemery, B. (1997). Nocturnal oxygen desaturation, as assessed by home oximetry, in long-term solvent-exposed workers. American Journal of Industrial Medicine 32(6):656-664.			
Health Outcome(s) Assessed:	Other (Sleep apnea or nocturnal arterial oxygen desaturation)			
Reported Health Effect(s):	Sleep apnea or nocturnal arterial oxygen desaturation. Sleep apnea is categorized as the "other" target organs/systems because there are different types of sleep apnea. Different types of sleep apnea can be caused by the throat muscle and the brain's signals to the muscles that control breathing. Without a physician's diagnosis, it is unclear which target organ the sleep apnea should categorize.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	677146			
Domain	Metric	Rating	Comments	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	High	Analysis of covariance was used to study the influence of exposure on the oximetry results. Age, alcohol consumption, coffee consumption, smoking, BMI, and neck circumference were important covariables in the covariance model.	
	Metric 10: Covariate Characterization	Medium	Covariants for oximetry results include age, alcohol consumption, coffee consumption, smoking, BMI, and neck circumference. These covariants were extracted from the questionnaire and physical examination. The questionnaire was not cited, nor was validity of the questionnaire discussed.	
	Metric 11: Co-exposure Counfounding	Low	1,1,1-trichloroethane was present at four of the five worksites; it was measured at the highest concentration at 2 of the four worksites. Co-exposures consisted of at least ten different solvents at each work site. However, the authors did not mention adjusting for co-exposure of these solvents in the statistical models. Thus, no information was provided to control for the co-exposures.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	High	Study design and statistical methods were appropriate for the research question.	
	Metric 13: Statistical Power	Medium	Group sizes were small but sufficient to detect an effect on hand-eye coordination.	
	Metric 14: Reproducibility of Analyses	Medium	Description was sufficient to understand what was done and to be conceptually reproducible.	
	Metric 15: Statistical Analysis	High	The model for calculating the risk estimates is transparent.	
Additional Comments:	None			
Overall Quality Determination		Medium		

Study Citation:	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.		
Health Outcome(s) Assessed:	Other (sick building syndrome)		
Reported Health Effect(s):	The statistical analysis considers all subjective self-reported symptoms together (not segregated by health outcome) as a group health outcome –sick building syndrome. The study compared two conditions for each studied chemical: combined self-reported symptoms to no symptoms. Therefore, only one form 3 was completed.		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1938385		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Low	Residents of a housing estate of 3000 homes were invited to a community meeting to explain the purpose of the study and volunteers were invited to participate. It was not reported whether these volunteers were different from the overall eligible population.
Metric 2:	Attrition	Low	Of the 70 families that agreed to participate, questionnaires were provided by 59. Reasons of uncompleted questionnaires were not fully provided, and there was no comparison between those who participated and those who did not.
Metric 3:	Comparison Group	Low	The overall description of the analysis sample indicated a wide range of ages and lengths of stay at the current residence. Thus it is hard to know that subjects in all exposure groups were similar. In addition, the methods of selecting participants in all exposure groups were not fully reported. The numbers of male and female smokers were reported, respectively, but the smoking status and age were not controlled in the statistical analysis.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	Medium	Exposure concentrations for each home were obtained by diffusion sampling over 24 hrs in the bedroom, kitchen, and outdoors; temperature, the vertical height of samplers, and ventilation (hours windows left open) were reported. Samples were analyzed by GC/MS. The number of samples per home is unclear. The frequency of measurements for each house was not reported.
Metric 5:	Exposure Levels	Low	Median 1,1,1-Trichloroethane concentrations were <=2x the detection limit. The frequency of measurements was not reported, so it is difficult to ascertain the actual exposure range. In addition, the reported exposure levels were median and 95%CI, so they are inadequate to develop an exposure-response estimate.
Metric 6:	Temporality	Uninformative	For 1,1,1-trichloroethane, the study evaluated self-reported symptoms in the past ("since they moved into their flats") and their association with sampling conducted during the study; thus, exposure was measured after the outcome.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	Low	Participants provided self-reported symptoms using a questionnaire. Study authors cited a previous study, Kamijima et al., 2005 (in Japanese, HERO ID 1598645) for further details on the questionnaire. It was not clear whether the questionnaire was validated.
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Study Citation:	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.			
Health Outcome(s) Assessed:	Other (sick building syndrome)			
Reported Health Effect(s):	The statistical analysis considers all subjective self-reported symptoms together (not segregated by health outcome) as a group health outcome –sick building syndrome. The study compared two conditions for each studied chemical: combined self-reported symptoms to no symptoms. Therefore, only one form 3 was completed.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1938385			
Domain	Metric	Rating	Comments	
	Metric 8: Reporting Bias	Low	The study only mentioned subjective symptoms in the abstract or methods. The abstract and method sections did not report the specific symptoms included in the questionnaire or whether the questionnaire was open-ended for symptoms. The questionnaire was cited to Kamijima et al. 2005 (in Japanese).	
Domain 4: Potential Confounding / Variability Control				
	Metric 9: Covariate Adjustment	Low	Comparisons were made separately by sex. The distribution of age and time spent living in residence differed greatly between those reporting symptoms and those not reporting symptoms. Smoking was indicated but not controlled for in the analysis. In short, the statistical analysis only considered a potential confounder, sex, but did not consider other potential confounders, age, time spent living in residence, and smoking.	
	Metric 10: Covariate Characterization	Low	Covariates were presumably evaluated via a questionnaire that was cited to Kamijima et al. 2005 (in Japanese).	
	Metric 11: Co-exposure Counfounding	Low	The analysis did not account for other exposures. A number of other VOCs, HCHO, and NO2 were measured in the homes. The concentrations of several other VOCs and HCHO were much higher than 1,1,1-trichloroethane and may also be associated with these symptoms.	
Domain 5: Analysis				
	Metric 12: Study Design and Methods	Low	The study design is best characterized as cross-sectional. Only one analysis to compare exposure concentrations between those with and without symptoms was adjusted for a confounder, sex, via stratification. Other potential confounders were not adjusted for. Study authors combine responses for symptoms reported before and during the sampling period in one statistical analysis, which may not reflect the relationship between symptoms and contaminants' exposure at each period.	
	Metric 13: Statistical Power	Medium	Statistical power was not reported. The number of participants was sufficient to detect a difference in median concentration between men with and without symptoms but not women.	
	Metric 14: Reproducibility of Analyses	Medium	Study presents sufficient description of analysis (statistical methods) to be conceptually reproducible with access to the raw data.	
	Metric 15: Statistical Analysis	Low	Study uses a Wilcoxon's rank sum test to compare exposure concentrations in persons with and without symptoms; test for equal variance is not reported.	
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Study Citation:	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.		
Health Outcome(s) Assessed:	Other (sick building syndrome)		
Reported Health Effect(s):	The statistical analysis considers all subjective self-reported symptoms together (not segregated by health outcome) as a group health outcome –sick building syndrome. The study compared two conditions for each studied chemical: combined self-reported symptoms to no symptoms. Therefore, only one form 3 was completed.		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1938385		
Domain	Metric	Rating	Comments
Additional Comments:	Concentrations of VOCs, HCHO, and NO2 were measured in the 59 homes of families that agreed to participate after being informed of the nature of the study. Participants completed questionnaires asking about symptoms since they moved into the homes and the concentrations of selected compounds were compared among men and women reporting any symptoms vs no symptoms. Concentrations of 1,1,1-trichloroethane in bedrooms of females with symptoms were higher than in bedrooms without. p-Dichlorobenzene was measured in the homes as well, but median concentration was <DL and no further analysis was made. Unacceptable due to selection bias, lack of confounding control, inadequate outcome characterization, and lack of temporality.		

Overall Quality Determination

Uninformative

Study Citation:	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.			
Health Outcome(s) Assessed:	Other (sick building syndrome)			
Reported Health Effect(s):	The statistical analysis considers all subjective self-reported symptoms together (not segregated by health outcome) as a group health outcome –sick building syndrome. The study compared two conditions for each studied chemical: combined self-reported symptoms to no symptoms. Therefore, only one form 3 was completed.			
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane			
HERO ID:	1938385			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Low	Residents of a housing estate of 3000 homes were invited to a community meeting to explain the purpose of the study and volunteers were invited to participate. It was not reported whether these volunteers were different from the overall eligible population.	
Metric 2:	Attrition	Low	Of the 70 families that agreed to participate, questionnaires were provided by 59. Reasons of uncompleted questionnaires were not fully provided, and there was no comparison between those who participated and those who did not.	
Metric 3:	Comparison Group	Low	The overall description of the analysis sample indicated a wide range of ages and lengths of stay at the current residence. Thus it is hard to know that subjects in all exposure groups were similar. In addition, the methods of selecting participants in all exposure groups were not fully reported. The numbers of male and female smokers were reported, respectively, but the smoking status and age were not controlled in the statistical analysis.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	Medium	Exposure concentrations for each home were obtained by diffusion sampling over 24 hrs in the bedroom, kitchen, and outdoors; temperature, the vertical height of samplers, and ventilation (hours windows left open) were reported. Samples were analyzed by GC/MS. The number of samples per home is unclear. The frequency of measurements for each house was not reported.	
Metric 5:	Exposure Levels	Low	Median formaldehyde concentrations were <=2x the detection limit. The frequency of measurements was not reported, so it is difficult to ascertain the actual exposure range. In addition, the reported exposure levels were median and 95%CI, so they are inadequate to develop an exposure-response estimate.	
Metric 6:	Temporality	Uninformative	For formaldehyde, the study evaluated self-reported symptoms in the past ("since they moved into their flats") and their association with sampling conducted during the study; thus, exposure was measured after the outcome.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	Low	Participants provided self-reported symptoms using a questionnaire. Study authors cited a previous study, Kamijima et al., 2005 (in Japanese, HERO ID 1598645) for further details on the questionnaire. It was not clear whether the questionnaire was validated.	
Metric 8:	Reporting Bias	Low	The study only mentioned subjective symptoms in the abstract or methods. The abstract and method sections did not report the specific symptoms included in the questionnaire or whether the questionnaire was open-ended for symptoms. The questionnaire was cited to Kamijima et al. 2005 (in Japanese).	

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Study Citation:	Guo, P., Yokoyama, K., Piao, F., Sakai, K., Khalequzzaman, M., Kamijima, M., Nakajima, T., Kitamura, F. (2013). Sick building syndrome by indoor air pollution in Dalian, China. International Journal of Environmental Research and Public Health 10(4):1489-1504.		
Health Outcome(s) Assessed:	Other (sick building syndrome)		
Reported Health Effect(s):	The statistical analysis considers all subjective self-reported symptoms together (not segregated by health outcome) as a group health outcome –sick building syndrome. The study compared two conditions for each studied chemical: combined self-reported symptoms to no symptoms. Therefore, only one form 3 was completed.		
Chemical:	1,1,2-Trichloroethane- Isomer: 1,1,1-Trichloroethane		
HERO ID:	1938385		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	Low	Comparisons were made separately by sex. The distribution of age and time spent living in residence differed greatly between those reporting symptoms and those not reporting symptoms. Smoking was indicated but not controlled for in the analysis. In short, the statistical analysis only considered a potential confounder, sex, but did not consider other potential confounders, age, time spent living in residence, and smoking.
	Metric 10: Covariate Characterization	Low	Covariates were presumably evaluated via a questionnaire that was cited to Kamijima et al. 2005 (in Japanese).
	Metric 11: Co-exposure Counfounding	Low	The analysis did not account for other exposures. A number of VOCs plus NO2 were measured in the homes. The concentrations of formaldehyde were higher than the VOCs in general. Several VOCs may also be associated with these symptoms.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	Low	The study design is best characterized as cross-sectional. Only one analysis to compare exposure concentrations between those with and without symptoms was adjusted for a confounder, sex, via stratification. Other potential confounders were not adjusted for. Study authors combine responses for symptoms reported before and during the sampling period in one statistical analysis, which may not reflect the relationship between symptoms and contaminants' exposure at each period.
	Metric 13: Statistical Power	Medium	Statistical power was not reported. The number of participants was sufficient to detect a difference in median concentration between men with and without symptoms but not women.
	Metric 14: Reproducibility of Analyses	Medium	Study presents sufficient description of analysis (statistical methods) to be conceptually reproducible with access to the raw data.
	Metric 15: Statistical Analysis	Low	Study uses a Wilcoxon's rank sum test to compare exposure concentrations in persons with and without symptoms; test for equal variance is not reported.
Additional Comments:	Concentrations of VOCs, HCHO, and NO2 were measured in the 59 homes of families that agreed to participate after being informed of the nature of the study. Participants completed questionnaires asking about symptoms since they moved into the homes and the concentrations of selected compounds were compared among men and women reporting any symptoms vs no symptoms. Concentrations of HCHO in kitchens of men (but not women) with symptoms were higher than in homes without. p-Dichlorobenzene was measured in the homes as well, but median concentration was <DL and no further analysis was made. Unacceptable due to selection bias, lack of confounding control, inadequate outcome characterization, and lack of temporality.		

Overall Quality Determination

Uninformative

Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.		
Health Outcome(s) Assessed:	Renal/Kidney		
Reported Health Effect(s):	renal cell carcinoma		
Chemical:	1,1,2-Trichloroethane- Isomer: Methyl chloroform		
HERO ID:	4697224		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	The details of the study design were reported elsewhere (Chow et al. 1994, HERO ID 701514). Brief details about the setting, date, number of eligible participants, and control matching were reported. Reasons for exclusions/non-participation were not provided.
Metric 2:	Attrition	Low	Of those that responded to the interview, a total of 20 controls and 252 cases were excluded due to being unable to complete the personal questionnaire for the occupational analysis. Study authors state that all next-of-kin interviews were excluded from the analysis. This was imbalanced between cases and controls which may introduce selection bias.
Metric 3:	Comparison Group	Medium	The cases were pulled from the Minnesota Cancer Surveillance System. Controls were selected from the general population of Minnesota; controls age 20-64 years were selected through random digital dialing and controls age 65-85 years were collected from files through the Health Care Financing Administration. Controls were age- and gender-stratified and were of the same race. Characteristics of cases and controls were not provided in the text or a table.
Domain 2: Exposure Characterization			
Metric 4:	Measurement of Exposure	High	Occupational histories were collected and National Cancer institute job exposure matrices were used to determine the exposure status for each participant. Application of the job exposure matrices were described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154).
Metric 5:	Exposure Levels	Low	Exposures were analyzed as the prevalence (i.e., ever/never) of occupational exposure to various solvents. This represents two levels of exposure.
Metric 6:	Temporality	Medium	Occupational questionnaires identified prior exposures based on reported recent and usual occupations as well as duration of employment. Outcome status was determined from registry data. The authors note that some occupational history was incomplete which may result in some uncertainty in regard to temporality.
Domain 3: Outcome Assessment			
Metric 7:	Outcome Measurement or Characterization	Medium	Cases were identified as newly diagnosed and histologically confirmed renal cell carcinoma through the Minnesota Cancer Surveillance System and information about each participant was collected using a questionnaire. Validation was not specified.
Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and ORs were stratified by sex. Effect estimates are reported with a confidence interval.

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.		
Health Outcome(s) Assessed:	Renal/Kidney		
Reported Health Effect(s):	renal cell carcinoma		
Chemical:	1,1,2-Trichloroethane- Isomer: Methyl chloroform		
HERO ID:	4697224		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	High	Appropriate adjustments were made in the final analysis, including age, gender, smoking, hypertension and the use of diuretics and/or anti-hypertension drugs, and BMI. Results were stratified by sex.
	Metric 10: Covariate Characterization	Medium	information about participants was collected using a questionnaire. Validation was not specified.
	Metric 11: Co-exposure Counfounding	Medium	Co-exposures were identified through the job exposure matrices. Chemicals were evaluated individually and as a group.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	The study design chosen (case-control) was appropriate for the research question (renal cell carcinoma risk from occupational organic solvent exposure). Logistic regression models were used to estimate the relative risk and 95% CI.
	Metric 13: Statistical Power	Low	Statistical power calculations were not provided. No significant effects were observed with methyl chloroform. The number of participants are adequate to detect an effect in the participants for other chemicals or the combined risk.
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis was brief, but is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15: Statistical Analysis	High	Model assumptions for logistic regression were met.
Additional Comments:	A group of 438 cases (273 men and 165 women) were selected from the Minnesota Cancer Surveillance System that had been newly diagnosed with renal cell carcinoma. Controls included 687 participants (462 men and 225 women) age- and gender- stratified that were selected from either the general population of Minnesota (age 20-64 years) or from the Health Care Financing Administration files (age 65-85). No significant increase in the risk of renal cell carcinoma was observed with exposure to methyl chloroform among men or women separately, or for all participants exposed.		
Overall Quality Determination		Medium	

Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	renal cell carcinoma			
Chemical:	1,1,2-Trichloroethane- Isomer: Methyl chloroform			
HERO ID:	4697224			
Domain	Metric	Rating	Comments	
Domain 1: Study Participation				
Metric 1:	Participant Selection	Medium	The details of the study design were reported elsewhere (Chow et al. 1994, HERO ID 701514). Brief details about the setting, date, number of eligible participants, and control matching were reported. Reasons for exclusions/non-participation were not provided.	
Metric 2:	Attrition	Low	Of those that responded to the interview, a total of 20 controls and 252 cases were excluded due to being unable to complete the personal questionnaire for the occupational analysis. Study authors state that all next-of-kin interviews were excluded from the analysis. This was imbalanced between cases and controls which may introduce selection bias.	
Metric 3:	Comparison Group	Medium	The cases were pulled from the Minnesota Cancer Surveillance System. Controls were selected from the general population of Minnesota; controls age 20-64 years were selected through random digital dialing and controls age 65-85 years were collected from files through the Health Care Financing Administration. Controls were age- and gender-stratified and were of the same race. Characteristics of cases and controls were not provided in the text or a table.	
Domain 2: Exposure Characterization				
Metric 4:	Measurement of Exposure	High	Occupational histories were collected and National Cancer institute job exposure matrices were used to determine the exposure status for each participant. Application of the job exposure matrices were described elsewhere (Dosemeci et al. 1994, HERO ID 632334; Gomez et al. 1994, HERO ID 702154).	
Metric 5:	Exposure Levels	Low	Exposures were analyzed as the prevalence (i.e., ever/never) of occupational exposure to various solvents. This represents two levels of exposure.	
Metric 6:	Temporality	Medium	Occupational questionnaires identified prior exposures based on reported recent and usual occupations as well as duration of employment. Outcome status was determined from registry data. The authors note that some occupational history was incomplete which may result in some uncertainty in regard to temporality.	
Domain 3: Outcome Assessment				
Metric 7:	Outcome Measurement or Characterization	Medium	Cases were identified as newly diagnosed and histologically confirmed renal cell carcinoma through the Minnesota Cancer Surveillance System and information about each participant was collected using a questionnaire. Validation was not specified.	
Metric 8:	Reporting Bias	Medium	A description of measured outcomes is reported and ORs were stratified by sex. Effect estimates are reported with a confidence interval.	

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Study Citation:	Dosemeci, M., Cocco, P., Chow, W. H. (1999). Gender differences in risk of renal cell carcinoma and occupational exposures to chlorinated aliphatic hydrocarbons. American Journal of Industrial Medicine 36(1):54-59.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	renal cell carcinoma		
Chemical:	1,1,2-Trichloroethane- Isomer: Methyl chloroform		
HERO ID:	4697224		
Domain	Metric	Rating	Comments
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	High	Appropriate adjustments were made in the final analysis, including age, gender, smoking, hypertension and the use of diuretics and/or anti-hypertension drugs, and BMI. Results were stratified by sex.
	Metric 10: Covariate Characterization	Medium	information about participants was collected using a questionnaire. Validation was not specified.
	Metric 11: Co-exposure Counfounding	Medium	Co-exposures were identified through the job exposure matrices. Chemicals were evaluated individually and as a group.
Domain 5: Analysis			
	Metric 12: Study Design and Methods	High	The study design chosen (case-control) was appropriate for the research question (renal cell carcinoma risk from occupational organic solvent exposure). Logistic regression models were used to estimate the relative risk and 95% CI.
	Metric 13: Statistical Power	Low	Statistical power calculations were not provided. No significant effects were observed with methyl chloroform. The number of participants are adequate to detect an effect in the participants for other chemicals or the combined risk.
	Metric 14: Reproducibility of Analyses	Medium	The description of the analysis was brief, but is sufficient to understand precisely what has been done and to be conceptually reproducible with access to the analytic data.
	Metric 15: Statistical Analysis	High	Model assumptions for logistic regression were met.
Additional Comments:	A group of 438 cases (273 men and 165 women) were selected from the Minnesota Cancer Surveillance System that had been newly diagnosed with renal cell carcinoma. Controls included 687 participants (462 men and 225 women) age- and gender- stratified that were selected from either the general population of Minnesota (age 20-64 years) or from the Health Care Financing Administration files (age 65-85). No significant increase in the risk of renal cell carcinoma was observed with exposure to methyl chloroform among men or women separately, or for all participants exposed.		
Overall Quality Determination		Medium	

Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Brain tumors		
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane		
HERO ID:	32901		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
	Metric 1: Participant Selection	Medium	Cases in this case-control study were former Union Carbide Corporation (UCC) chemical plant employees in Texas City, Texas. Cases were identified through death certificate searches and tumor registries, and may have included individuals formerly employed at UCC whose cause of death was unknown to the company. Additionally, control deaths were stated to be pulled from corporate employee benefits department and through locally published obituary notices routinely screened by the medical department - it is possible to assume that cases were identified in a similar manner. The study identified cases of brain tumors by searching death certificates primarily, although tumor registries throughout the state of Texas were also searched. The study clarifies that it is possible that some cases were not found if they survived or died due to another cause - while this is likely to have impacted selection, there is no evidence that this would be differential by exposure status. Overall, there is limited information on the source population of workers from which cases were identified.
	Metric 2: Attrition	Medium	Attrition is not discussed in the study, and outcome data appear to be complete. There was a large proportion of missing exposure data (roughly 50%) due to workers being employed in roles such as maintenance, where exposure to any chemical is possible but unknown. Analyses were run separately where these "unknown" individuals were a) treated as exposed, b) treated as unexposed, or c) treated as unknown and thus excluded. The study only presents results for when these individuals were excluded but specifies that the first scenario resulted in increased exposure estimates for controls relative to cases.
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Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	Brain tumors			
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane			
HERO ID:	32901			
Domain	Metric	Rating	Comments	
	Metric 3: Comparison Group	Medium	The study identifies two series of control groups, selected from all former Union Carbide Corporation (UCC) employees. However, the total number of employees is not stated. Only those who were deceased were used as controls since they had known causes of death and could thus be verified as non-brain tumors. One group of controls excluded employees whose cause of death was due to any malignant neoplasm to allow for the possibility that a general chemical carcinogen may have been associated with cancers of other sites. The other group of controls included deaths from all causes; this included malignant neoplasms other than brain tumors. Both control groups had 80 male employees randomly selected from 450 deceased employees known to the company in June 1979. Control deaths were stated to be pulled from corporate employee benefits department and through locally published obituary notices routinely screened by the medical department - it is possible to assume that cases were identified in a similar manner. The study reports that cases were slightly more likely to have been employed for less than 10 years than controls - the study attributes this in part to the fact that employees whose deaths were known to the company were more likely to have worked for longer - regardless the mean number of years employed was similar between cases and controls. However, cases were more likely to have been terminated from their job for reasons other than death, disability, or retirement (quitting, being fired, etc.), were generally younger at hire, and were less likely to survive to their 70th birthday. None of these factors are controlled for in statistical analyses - however, since controls and cases were pulled from the same population, there is indirect evidence that the groups were similar.	
Domain 2: Exposure Characterization				
	Metric 4: Measurement of Exposure	Medium	Exposure assessment was determined based on official employment records. Records included job title and department assignment codes for each employment from date of hire to date of termination. For each unique department code, UCC and NIOSH industrial hygienists identified principal chemicals used or produced at any time in the history of the plant and correlated those with individual departments. This assessment was not performed on a year-by-year basis due to concerns for recall bias for longer-term employees where less detailed records were kept. An employee was categorized as "exposed" to trichloroethane if they ever worked in a department associated with that chemical. An "unknown" exposure group was also created to account for employees who had only worked in departments for which no specific chemical could be identified.	
	Metric 5: Exposure Levels	Low	The study does not report any quantitative information and only splits exposure into "exposed", "unexposed", and "unknown."	
	Metric 6: Temporality	High	In this study exposure is confirmed to occur before the outcome is measured. The study reports latency periods, with subjects dichotomized into less than 15 years of latency or more than 15 years of latency. The majority of cases and controls had a latency of greater than 15 years, which is sufficiently long for brain tumors.	

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Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.
Health Outcome(s) Assessed:	Cancer/Carcinogenesis
Reported Health Effect(s):	Brain tumors
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane
HERO ID:	32901

Domain	Metric	Rating	Comments
Domain 3: Outcome Assessment			
	Metric 7: Outcome Measurement or Characterization	Medium	Cases were identified through death certificate searches and partially through tumor registries in the state of Texas. Case validation was performed by NIOSH, and 5 different levels of confirmation were reported: 1) tissue specimen interpreted by the Armed Forces Institute of Pathology; 2) autopsy report; 3) histopathology report; 4) clinical diagnosis from hospital record; 5) death certificate diagnosis. Codes 1-3 were considered to be "confirmed" cases of brain tumors, while 4-5 were considered unconfirmed. 5/21 cases were only evaluated using "unconfirmed methods", meaning there is likely a high amount of accuracy in roughly 75% of cases. While no case validation is reported for controls, the study specifies that only controls who had died and thus could be confirmed to be non-brain tumors were included.
	Metric 8: Reporting Bias	Medium	All primary and secondary outcomes that are outlined in the methods are reported in the results. However, the only statistical outcome of their analysis were unadjusted p-values that were not reported and were just described qualitatively.
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	Medium	The only statistical analysis performed were Mantel-Haenszel chi-squared tests, which did not allow for confounder adjustment. The study does not present a distribution of potential confounders by exposure status but by case/control status. Several variables, such as reason for termination, age at hire, and age at death were significantly different between cases and controls and were not accounted for in statistical modeling. The study explains that these differences are not likely to have any epidemiologic significance and appear to be relatively small differences.
	Metric 10: Covariate Characterization	Medium	While the study does not explain where they obtained covariate information, it is reasonable to assume that they gathered the information from company records.
	Metric 11: Co-exposure Confounding	Medium	The study assesses a wide range of other potential occupational co-exposures. While these co-exposures are not adjusted for in any statistical models, effect estimates are presented separately for benzene, diethyl sulfate, ethylene oxide, and vinyl chloride. The distribution of co-exposures across cases and controls is demonstrated to be mostly balanced by comparing proportions of exposed/unexposed between cases and controls. The only notable instance of imbalance is for benzene, where 11.1% of cases were exposed whereas 37.9% of all controls and 19.2% of non-neoplasm related controls were exposed.

Domain 5: Analysis

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Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.
Health Outcome(s) Assessed:	Cancer/Carcinogenesis
Reported Health Effect(s):	Brain tumors
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane
HERO ID:	32901

Domain		Metric	Rating	Comments
	Metric 12:	Study Design and Methods	High	The study chose a case-control design, which was appropriate to study the rare disease of brain tumors and its association with occupational exposures. The only statistical analysis conducted is a Mantel-Haenszel chi-squared test, but there is no reason to suggest that this would be inappropriate.
	Metric 13:	Statistical Power	Medium	The study does not calculate statistical power, but the number of cases (n=21) and controls (n=80 in each analysis) is likely sufficient to detect an effect.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand what was done and could be reproduced given access to the analytic data.
	Metric 15:	Statistical Analysis	High	The only statistical analysis conducted is a Mantel-Haenszel chi-squared test, and all assumptions were met. The statistical process is transparent.

Additional Comments: This case-control study pulled deceased former employees of the Union Carbide Corporation in Texas City, Texas. The study examined dichotomous exposure to a wide range of occupational exposures, including trichloroethane, in relation to brain tumor cases. There is no quantitative estimate of exposure. The only statistical analysis in the study is a Mantel-Haenszel chi-squared test statistic and no statistically significant differences in exposure between cases and controls were observed. The fact that there are no effect estimates, no adjustment for confounders, and no quantitative exposure estimates limits the usefulness of this paper.

Overall Quality Determination

Medium

Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.		
Health Outcome(s) Assessed:	Cancer/Carcinogenesis		
Reported Health Effect(s):	Brain tumors		
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane		
HERO ID:	32901		
Domain	Metric	Rating	Comments
Domain 1: Study Participation			
Metric 1:	Participant Selection	Medium	Cases in this case-control study were former Union Carbide Corporation (UCC) chemical plant employees in Texas City, Texas. Cases were identified through death certificate searches and tumor registries, and may have included individuals formerly employed at UCC whose cause of death was unknown to the company. Additionally, control deaths were stated to be pulled from corporate employee benefits department and through locally published obituary notices routinely screened by the medical department - it is possible to assume that cases were identified in a similar manner. The study identified cases of brain tumors by searching death certificates primarily, although tumor registries throughout the state of Texas were also searched. The study clarifies that it is possible that some cases were not found if they survived or died due to another cause - while this is likely to have impacted selection, there is no evidence that this would be differential by exposure status. Overall, there is limited information on the source population of workers from which cases were identified.
Metric 2:	Attrition	Medium	Attrition is not discussed in the study, and outcome data appear to be complete. There was a large proportion of missing exposure data (roughly 50%) due to workers being employed in roles such as maintenance, where exposure to any chemical is possible but unknown. Analyses were run separately where these "unknown" individuals were a) treated as exposed, b) treated as unexposed, or c) treated as unknown and thus excluded. The study only presents results for when these individuals were excluded but specifies that the first scenario resulted in increased exposure estimates for controls relative to cases.
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Study Citation:	Austin, S. G., Schnatter, A. R. (1983). A case-control study of chemical exposures and brain tumors in petrochemical workers. Journal of Occupational and Environmental Medicine 25(4):313-320.			
Health Outcome(s) Assessed:	Cancer/Carcinogenesis			
Reported Health Effect(s):	Brain tumors			
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane			
HERO ID:	32901			
Domain	Metric	Rating	Comments	
	Metric 3: Comparison Group	Medium	The study identifies two series of control groups, selected from all former Union Carbide Corporation (UCC) employees. However, the total number of employees is not stated. Only those who were deceased were used as controls since they had known causes of death and could thus be verified as non-brain tumors. One group of controls excluded employees whose cause of death was due to any malignant neoplasm to allow for the possibility that a general chemical carcinogen may have been associated with cancers of other sites. The other group of controls included deaths from all causes; this included malignant neoplasms other than brain tumors. Both control groups had 80 male employees randomly selected from 450 deceased employees known to the company in June 1979. Control deaths were stated to be pulled from corporate employee benefits department and through locally published obituary notices routinely screened by the medical department - it is possible to assume that cases were identified in a similar manner. The study reports that cases were slightly more likely to have been employed for less than 10 years than controls - the study attributes this in part to the fact that employees whose deaths were known to the company were more likely to have worked for longer - regardless the mean number of years employed was similar between cases and controls. However, cases were more likely to have been terminated from their job for reasons other than death, disability, or retirement (quitting, being fired, etc.), were generally younger at hire, and were less likely to survive to their 70th birthday. None of these factors are controlled for in statistical analyses - however, since controls and cases were pulled from the same population, there is indirect evidence that the groups were similar.	
Domain 2: Exposure Characterization				
	Metric 4: Measurement of Exposure	Medium	Exposure assessment was determined based on official employment records. Records included job title and department assignment codes for each employment from date of hire to date of termination. For each unique department code, UCC and NIOSH industrial hygienists identified principal chemicals used or produced at any time in the history of the plant and correlated those with individual departments. This assessment was not performed on a year-by-year basis due to concerns for recall bias for longer-term employees where less detailed records were kept. An employee was categorized as "exposed" to trichloroethane if they ever worked in a department associated with that chemical. An "unknown" exposure group was also created to account for employees who had only worked in departments for which no specific chemical could be identified.	
	Metric 5: Exposure Levels	Low	The study does not report any quantitative information and only splits exposure into "exposed", "unexposed", and "unknown."	
	Metric 6: Temporality	High	In this study exposure is confirmed to occur before the outcome is measured. The study reports latency periods, with subjects dichotomized into less than 15 years of latency or more than 15 years of latency. The majority of cases and controls had a latency of greater than 15 years, which is sufficiently long for brain tumors.	

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Domain	Metric	Rating	Comments
Domain 3: Outcome Assessment			
	Metric 7: Outcome Measurement or Characterization	Medium	Cases were identified through death certificate searches and partially through tumor registries in the state of Texas. Case validation was performed by NIOSH, and 5 different levels of confirmation were reported: 1) tissue specimen interpreted by the Armed Forces Institute of Pathology; 2) autopsy report; 3) histopathology report; 4) clinical diagnosis from hospital record; 5) death certificate diagnosis. Codes 1-3 were considered to be "confirmed" cases of brain tumors, while 4-5 were considered unconfirmed. 5/21 cases were only evaluated using "unconfirmed methods", meaning there is likely a high amount of accuracy in roughly 75% of cases. While no case validation is reported for controls, the study specifies that only controls who had died and thus could be confirmed to be non-brain tumors were included.
	Metric 8: Reporting Bias	Medium	All primary and secondary outcomes that are outlined in the methods are reported in the results. However, the only statistical outcome of their analysis were unadjusted p-values that were not reported and were just described qualitatively.
Domain 4: Potential Confounding / Variability Control			
	Metric 9: Covariate Adjustment	Medium	The only statistical analysis performed were Mantel-Haenszel chi-squared tests, which did not allow for confounder adjustment. The study does not present a distribution of potential confounders by exposure status but by case/control status. Several variables, such as reason for termination, age at hire, and age at death were significantly different between cases and controls and were not accounted for in statistical modeling. The study explains that these differences are not likely to have any epidemiologic significance and appear to be relatively small differences.
	Metric 10: Covariate Characterization	Medium	While the study does not explain where they obtained covariate information, it is reasonable to assume that they gathered the information from company records.
	Metric 11: Co-exposure Confounding	Medium	The study assesses a wide range of other potential occupational co-exposures. While these co-exposures are not adjusted for in any statistical models, effect estimates are presented separately for benzene, diethyl sulfate, ethylene oxide, and vinyl chloride. The distribution of co-exposures across cases and controls is demonstrated to be mostly balanced by comparing proportions of exposed/unexposed between cases and controls. The only notable instance of imbalance is for benzene, where 11.1% of cases were exposed whereas 37.9% of all controls and 19.2% of non-neoplasm related controls were exposed.
Domain 5: Analysis			
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Reported Health Effect(s):	Brain tumors
Chemical:	1,1,2-Trichloroethane- Isomer: Trichloroethane
HERO ID:	32901

Domain		Metric	Rating	Comments
	Metric 12:	Study Design and Methods	High	The study chose a case-control design, which was appropriate to study the rare disease of brain tumors and its association with occupational exposures. The only statistical analysis conducted is a Mantel-Haenszel chi-squared test, but there is no reason to suggest that this would be inappropriate.
	Metric 13:	Statistical Power	Medium	The study does not calculate statistical power, but the number of cases (n=21) and controls (n=80 in each analysis) is likely sufficient to detect an effect.
	Metric 14:	Reproducibility of Analyses	Medium	The description of the analysis is sufficient to understand what was done and could be reproduced given access to the analytic data.
	Metric 15:	Statistical Analysis	High	The only statistical analysis conducted is a Mantel-Haenszel chi-squared test, and all assumptions were met. The statistical process is transparent.

Additional Comments: This case-control study pulled deceased former employees of the Union Carbide Corporation in Texas City, Texas. The study examined dichotomous exposure to a wide range of occupational exposures, including trichloroethane, in relation to brain tumor cases. There is no quantitative estimate of exposure. The only statistical analysis in the study is a Mantel-Haenszel chi-squared test statistic and no statistically significant differences in exposure between cases and controls were observed. The fact that there are no effect estimates, no adjustment for confounders, and no quantitative exposure estimates limits the usefulness of this paper.

Overall Quality Determination

Medium

Study Citation:	Wahlberg, J. E. (1984). Edema-inducing effects of solvents following topical administration. <i>Dermatosen in Beruf und Umwelt</i> 32(3):91-94.			
Health Outcome(s) Assessed:	Irritation			
Reported Health Effect(s):	Skin-fold thickness, erythema, edema, fissuring, and scaling			
Chemical:	1,1,2-Trichloroethane- Parent compound			
HERO ID:	5469150			
Domain	Metric	Rating	Comments	
Domain 1: Randomization	Metric 1A:	Was an adequate method used to randomize the administered dose or exposure level?	Medium	Randomization is not applicable; in this study the only participant was a volunteer who was exposed to one dose of 1,1,2-trichloroethane. There was no randomization to a placebo group.
Domain 2: Allocation Concealment and Blinding	Metric 2A:	Was allocation to study groups adequately concealed until recruitment was complete?	Medium	In this intentional dosing study, one volunteer was exposed to the study chemicals. There was no allocation to different groups.
	Metric 2B:	Were the research personnel and human subjects blinded to the study group during the study?	Medium	In this intentional dosing study, one volunteer was exposed to the study chemicals. There was no allocation to different groups. The outcome measure was skin0fold thickness, which is unlikely to be especially at risk of bias due to knowledge of exposure status since it was a directly measured value.
Domain 3: Attrition	Metric 3A:	Were outcome data complete without attrition or exclusion from analysis?	High	No attrition was reported. One volunteer was exposed to the study chemicals and there were no reported exclusions.
Domain 4: Exposure Measurement Bias	Metric 4A:	Can we be confident in the exposure characterization?	Low	Insufficient information provided on the purity and stability of the test substance, which was only described as “1,1,2-trichloroethane (purum) (Fluka AG, Buchs SG, Switzerland).”
Domain 5: Outcome Assessment	Metric 5A:	Can we be confident in the outcome assessment?	Low	Outcomes were changes in skin-fold thickness as well as visual scoring of erythema, edema, fissuring, and scaling. Details on the visual scoring system were not provided.
	Metric 5B:	Selective Reporting: Were all measured outcomes reported?	Medium	All potentially measured outcomes appear to have been reported in the results.
Additional Comments:	In this intentional dosing study, one volunteer was dermally exposed to solvents including 1,1,2-trichloroethane and assessed for signs of irritation. Insufficient information on the study protocol, including blinding, was provided. There is also limited confidence in the study given the sample size of one participant. No symptoms of irritation were reported following daily exposure to 0.1 mL 1,1,2-trichloroethane for 15 days.			

Overall Quality Determination

Medium

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Health Outcome(s) Assessed:	Irritation		
Reported Health Effect(s):	Skin-fold thickness, erythema, edema, fissuring, and scaling		
Chemical:	1,1,2-Trichloroethane- Parent compound		
HERO ID:	5469150		
Domain	Metric	Rating	Comments