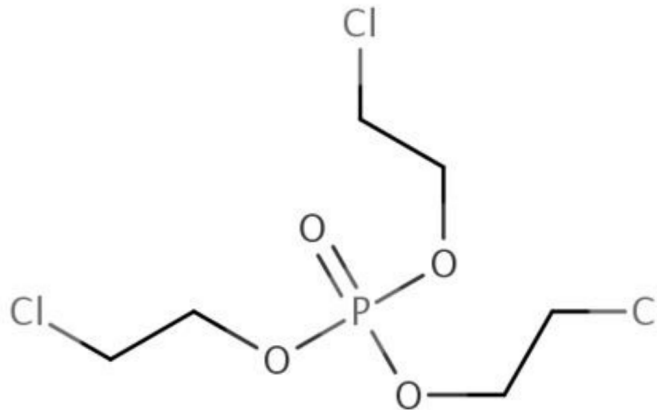# Draft Risk Evaluation for
Tris(2-chloroethyl) phosphate (TCEP)

Systematic Review Supplemental File:

**Data Quality Evaluation Information for
General Population, Consumer, and Environmental Exposure**

CASRN: 115-96-8

December 2023

This supplemental file contains information regarding the data quality evaluation results for data sources that met the PECO screening criteria for the *Draft Risk Evaluation for Tris(2-chloroethyl) Phosphate (TCEP)* (U.S. EPA, 2023, 11151775). EPA conducted data quality evaluation and extraction based on author-reported descriptions and results; additional analyses (e.g., statistical analyses) potentially conducted by EPA are not contained in this supplemental file. EPA performs data quality evaluation as a part of the TSCA systematic review process described in the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* (U.S. EPA, 2021, 10415760). The systematic review steps are further described in the *Draft Risk Evaluation for Tris(2-chloroethyl) phosphate (TCEP) – Systematic Review Protocol* (U.S. EPA, 2023, 11151709).

Additionally, the overall quality determination (OQD) for each reference represents the data as a whole for each evidence stream, not for individual scenarios described within a study. For example, a reference that has both monitoring and experimental data would have OQDs using the data quality evaluation metrics for monitoring and experimental data, respectively. An OQD utilizing the data quality evaluation metrics for monitoring data, or any other single evidence stream, would consider all data pertinent to that evidence stream in the reference. Acronyms and abbreviations used within this supplemental file are defined in the table at the end of this file. This supplemental file may also be referred to as TCEP Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure.

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| Study Citation: | Ohura, T., Amagai, T., Senga, Y., Fusaya, M. (2006). Organic air pollutants inside and outside residences in Shimizu, Japan: Levels, sources and risks. Science of the Total Environment 366:485-499. |
| HERO ID: | 632484 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology detailed and included sampler preparation, sampling time, and sample transport and storage conditions.
	Metric 2:	Analytical Methodology	Medium	Key analytical methods reported. Recoveries supposedly measured but not identified for each chemical.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in indoor and outdoor air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Shimizu, Japan.
	Metric 5:	Currency	Low	Samples collected in 2001.
	Metric 6:	Spatial and Temporal Variability	Medium	There were greater than 10 samples, but no replicates mentioned.
	Metric 7:	Exposure Scenario	High	The source of exposure well characterized. Samples measured pollutants inside and outside residences in Japan.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported. Summary statistics provided, including mean, standard deviation, and 10th and 90th percentile.
	Metric 9:	Quality Assurance	Medium	Key QA reported but no recoveries listed or applied.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Few gaps and limitations reported. Variation, such as SD, reported.

Overall Quality Determination　　　　**Medium**

Study Citation:	FDA, (1995). Accumulated pesticide and industrial chemical findings from a ten-year study of ready-to-eat foods. Journal of AOAC International 78:614-630.		
HERO ID:	659041		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	The sampling methodology is briefly described. Full methods from the FDA Total Diet Study need to be requested.
Metric 2:	Analytical Methodology	Medium	The analytical methodology is briefly described. Full methods from the FDA Total Diet Study need to be requested.
Metric 3:	Biomarker Selection	N/A	The study lists chemicals measured in foods.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The study was conducted in the United States.
Metric 5:	Currency	Low	This study was conducted from 1982-1991.
Metric 6:	Spatial and Temporal Variability	Medium	Measurements were made in 234 ready-to-eat foods, each tested 37 times over the 10-year study period. No replicate sampling was conducted.
Metric 7:	Exposure Scenario	Medium	Information from full methods is needed to determine where foods were from.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The average for each chemical is listed. The full report is needed for each data point.
Metric 9:	Quality Assurance	Medium	QA is not discussed. It is likely that this information is in the full report.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability is captured by 234 different foods. Uncertainty is not discussed. There are no obvious concerns.

Overall Quality Determination   **Medium**

Study Citation:	Yasuhara, A., Shiraishi, H., Nishikawa, M., Yamamoto, T., Nakasugi, O., Okumura, T., Kenmotsu, K., Fukui, H., Nagase, M., Kawagoshi, Y. (1999). Organic components in leachates from hazardous waste disposal sites. Waste Management & Research 17:186-197.		
HERO ID:	659131		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Key sampling methods for landfill leachate samples were reported. Some details, such as duration of sample storage prior to analysis, were lacking.
	Metric 2: Analytical Methodology	Medium	Analytic methodology was described in detail. Some details, such as recovery percentages, were not described.
	Metric 3: Biomarker Selection	N/A	The chemicals of interest were measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were described as collected in Japan.
	Metric 5: Currency	Low	Samples were collected in 1995.
	Metric 6: Spatial and Temporal Variability	Medium	Samples were collected from 11 landfills in 1995. Two types of landfills (open landfills and controlled landfills) were described, as authors noted that sampling from closed landfills was not permitted. Replicate sampling was not conducted.
	Metric 7: Exposure Scenario	Medium	Exposure sources were not well characterized. Table 1 describes landfill and waste type, but no information about microenvironment was provided. Use of exposure controls was lacking.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data and median concentrations were reported in Table 3 of the manuscript. Results in Table 3 were described as presented for chemicals in the order of frequency of detection, however individual chemical-specific detection frequencies were not reported.
	Metric 9: Quality Assurance	Low	Other than use of laboratory blanks, limited QA/QC procedures were reported, however samples were reported as analyzed at the National Institute for Environmental Studies which would utilize standard methodologies.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	This study did not report standard deviations or other measures of variance. Only a few gaps and limitations were reported.

Overall Quality Determination   Medium

Study Citation:	Kanazawa, A., Saito, I., Araki, A., Takeda, M., Ma, M., Saijo, Y., Kishi, R. (2010). Association between indoor exposure to semi-volatile organic compounds and building-related symptoms among the occupants of residential dwellings. Indoor Air 20:72-84.		
HERO ID:	697390		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling methods were described in detail. There is additional follow-up information in Takeda et al., 2009 and Kishi et al., 2009. Air sampling was performed at a height of 1.0"1.5 mfrom a floor and about 1 m from a wall. Dust sampleswere collected using a vacuum cleaner with samples from all over the floor or from multi-surfaces such as tops of doors, shelves, cupboards, and frames.
	Metric 2: Analytical Methodology	High	Analytical methods were described in the appendix. The method detection limits were included. Details regarding equipment information were included.
	Metric 3: Biomarker Selection	N/A	Air and dust samples were collected.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Air and dust sampling for SVOC's was conducted inside residential detached houses of Sapporo, Japan.
	Metric 5: Currency	Medium	Data was collected from October, 2006 through January, 2007.
	Metric 6: Spatial and Temporal Variability	Medium	There were 40 air samples collected during a 48-hour sampling time, as well as 41 multi-surface dust samples, and 41 floor dust samples collected. A single dust sample was obtained from each dwelling, and replicate sampling was not detailed.
	Metric 7: Exposure Scenario	Medium	The potential sources of exposures were briefly described in the text, and Table 3 summarized dwelling characteristics such as wall materials, use of flame retardants and dampness. The temperature and humidity microclimate measures within dwellings were summarized. The use of exposure controls was not detailed.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data were not reported. Summary statistics were reported in Table 5 with method detection limits and included the median and ranges of measured concentrations along with the number of samples for each chemical.
	Metric 9: Quality Assurance	Medium	The appendix text noted that quality assurance was described in Saito et al., 2007. The use of travel blanks was detailed within the main text. Recoveries were not detailed and baseline, pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	The study characterizes variability within reported chemical concentration summary statistic ranges. Multiple potential key study limitations were discussed, but are unlikely to have had a substantial impact on results.

Overall Quality Determination   **Medium**

Study Citation:	Bidwell, J., Becker, C., Hensley, S., Stark, R., Meyer, M. (2010). Occurrence of organic wastewater and other contaminants in cave streams in northeastern Oklahoma and northwestern Arkansas. Archives of Environmental Contamination and Toxicology 58:286-298.		
HERO ID:	697423		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Samples were collected according to publicly available SOPs that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) for the chemical and media of interest.
Metric 2:	Analytical Methodology	High	Limit of detection reported as the instrument reporting level. Analytical methods included.
Metric 3:	Biomarker Selection	N/A	the study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Northeastern Oklahoma and Northwestern Arkansas
Metric 5:	Currency	Medium	May through June 2006
Metric 6:	Spatial and Temporal Variability	Low	only 1 composite sample per location; no replica samples
Metric 7:	Exposure Scenario	Medium	The exposure scenario is described, cave water is not as applicable as traditional streams.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Concentration not calculated; compounds detected given in ng analyte/polar organic chemical integrative samplers (POCISs) or semipermeable membranedevices (SPMDs); no ranges, percentiles, n, or variation provided.
Metric 9:	Quality Assurance	Medium	Compounds detected but not in field blanks, or that exceeded an arbitrary threshold of 2x the compound mass in the field blank, were considered more likely to represent actual water contaminants at a site.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Conclusion discusses variability and uncertainty.

Overall Quality Determination   Medium

Study Citation: Hartmann, P. C., Bürgi, D., Giger, W. (2004). Organophosphate flame retardants and plasticizers in indoor air. Chemosphere 57:781-787.
HERO ID: 779503

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is clear, appropriate and similar to widely accepted protocols for the chemical and media of interest. All pertinent sampling information is provided.
	Metric 2:	Analytical Methodology	Medium	Exact values for LOD/LOQ not provided but a discussion of how those were determined is provided in section 3.1. Analytical quality control.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media (indoor air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Study reported that screening was performed at 12 various locations in and around Zurich, Switzerland.
	Metric 5:	Currency	Low	Could not find sampling date, but published in 2004.
	Metric 6:	Spatial and Temporal Variability	Low	Single samples at 12 different types of indoor locations.
	Metric 7:	Exposure Scenario	Medium	Locations of various locations are applicable and some characterization details provided.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are not reported but individual sample concentrations are reported in the study, allowing summary statistics to be reproduced.
	Metric 9:	Quality Assurance	High	The study applied and documented quality assurance/quality control measures. The recovery for TCEP is acceptable (83%).
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Uncertainties were not discussed

Overall Quality Determination   Medium

Study Citation: Bergh, C., Torgrip, R., Emenius, G., Ostman, C. (2011). Organophosphate and phthalate esters in air and settled dust - a multi-location indoor study. Indoor Air 21:67-76.

HERO ID: 788335

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The study discusses all elements of sampling methods. Sampling sites, and air and dust sampling collection are reported.
	Metric 2:	Analytical Methodology	Low	The analytical methodology is described, but the LOD or LOQ are not provided.
	Metric 3:	Biomarker Selection	N/A	The study tests the parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected at the Stockholm area in Sweden.
	Metric 5:	Currency	Low	Sampling date is not reported, the study was published in 2005.
	Metric 6:	Spatial and Temporal Variability	High	10 samples were collected per environment.
	Metric 7:	Exposure Scenario	High	"Thirty sampling sites (in 10 private homes, 10 workplaces, and 10 daycare centers, all in the Stockholm area) were selected to represent a number of common indoor environments."
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw results and summary of data are reported in the supporting information.
	Metric 9:	Quality Assurance	Low	There is little discussion but can be implied via the use of standards.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability reported in terms of different scenarios. No discussion of uncertainty.

Overall Quality Determination   Medium

Study Citation: Otake, T., Yoshinaga, J., Yanagisawa, Y. (2004). Exposure to phthalate esters from indoor environment. Journal of Exposure Analysis and Environmental Epidemiology 14:524-528.

HERO ID: 789515

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is only briefly described. The study cites another published work for a more complete description.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology is only briefly discussed. Sampling precision and recovery was assessed.
	Metric 3:	Biomarker Selection	N/A	Concentrations were measured in indoor air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Tokyo, Japan.
	Metric 5:	Currency	Low	Sampling was performed in 2000.
	Metric 6:	Spatial and Temporal Variability	Medium	Sampling was performed for 3 consecutive days from a total of 27 homes. The height of sampling from the floor was not specified. It is unclear how many samples per home were collected. Samples for 6 houses were collected in the spring, and samples for the remaining houses were collected in the fall.
	Metric 7:	Exposure Scenario	Medium	The stated study objective was to measure concentrations in contemporary Japanese houses. Only 27 houses or apartments were included, all in one city (Tokyo). All sampled homes belongs to staff affiliated with the researchers' university department. Chemical usage in the homes and characteristics of the homes were not really described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are reported, but missing information includes individual data points and the number of samples per home. Box plots were included, but symbols shown in the plots were not defined.
	Metric 9:	Quality Assurance	Medium	The study tested analytical precision and recovery.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Standard deviations were reported. Uncertainties, limitations, and data gaps were not really discussed.

Overall Quality Determination   Medium

Study Citation:		Mihajlović, I., Miloradov, M. V., Fries, E. (2011). Application of Twisselmann extraction, SPME, and GC-MS to assess input sources for organophosphate esters into soil. Environmental Science and Technology 45:2264-2269.	
HERO ID:		1051336	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Soil sampling methodology described, such as procedures, site information, sample information, storage, and equipment (page 2265) and is scientifically sound.
	Metric 2:	Analytical Methodology	High	Limits of detection (LOD) were calculated to be 0.002-3 ng g-1.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media (soil).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Osnabrueck, Germany.
	Metric 5:	Currency	Low	No sampling date was reported. However, the article was published in 2011.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 6 samples collected from 1 site. No replicates were reported.
	Metric 7:	Exposure Scenario	High	Soil was sampled from a general population area, outside the university campus. Some discussion on possible sources.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data were nor reported. Only mean concentrations were reported.
	Metric 9:	Quality Assurance	High	QA was discussed in detail in page 2267.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There was no discussion on uncertainty, gaps or limitations. Standard deviations were not reported. Samples were collected from 1 site.

Overall Quality Determination   **Medium**

Study Citation:	Bergh, C., Aberg, K. M., Svartengren, M., Emenius, G., Oestman, C. (2011). Organophosphate and phthalate esters in indoor air: a comparison between multi-storey buildings with high and low prevalence of sick building symptoms. Journal of Environmental Monitoring 13:2001-2009.		
HERO ID:	1249459		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Sampling methodology for indoor air was sound and sufficiently detailed. Duration of sample storage was not detailed.
Metric 2:	Analytical Methodology	High	Analytical methodology was sound and sufficiently detailed. Method detection limits were reported within Table 2.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	This study collected indoor air samples within multistory buildings in Stockholm, Sweden participating in the Healthy Sustainable Houses study in Stockholm (3H).
Metric 5:	Currency	Low	Sample collection dates were not provided, however study publication date was 2011.
Metric 6:	Spatial and Temporal Variability	High	Duplicate 24-hour active air samples were collected from two to four apartments (a total of 169 apartments) in each of 45 multistory buildings.
Metric 7:	Exposure Scenario	High	The exposure scenario was well characterized within this study of indoor air within apartments of multistory buildings. Identification of the potential sources of indoor air contaminants was one of the study's main objectives, and a robust discussion of potential sources was presented.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data and detection frequency was not presented. Summary statistics were presented and included mean, median and minimum and maximum concentration levels.
Metric 9:	Quality Assurance	Medium	Quality assurance (QA) methods, such as replicate sampling and use of field blanks, were reported and although QA details were not reported in detail, standard procedures were followed. Authors referenced another study for additional sampling and analytic details (C. Bergh, R. Torgrip and C. " Ostman, Rapid Commun. MassSpectrom., 2010, 24, 2859"2867).
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was described in sampling summary statistics. Median concentration levels were compared with results from previous studies within tables, however a robust discussion of potential study limitations is lacking.

Overall Quality Determination   **Medium**

Study Citation: Rodil, R., Quintana, J. B., Concha-Graña, E., López-Mahía, P., Muniategui-Lorenzo, S., Prada-Rodríguez, D. (2012). Emerging pollutants in sewage, surface and drinking water in Galicia (NW Spain). Chemosphere 86:1040-1049.

HERO ID: 1250860

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for sewage, surface, and drinking water was sufficiently detailed.
	Metric 2:	Analytical Methodology	Medium	No discussion of instrumentation and calibration, although a reference to the method is provided. Rodil et al 2009.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in sewage, surface, and drinking water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Galicia, Northwest Spain.
	Metric 5:	Currency	Medium	Samples were collected between November 2007 and September 2008.
	Metric 6:	Spatial and Temporal Variability	Low	The number of samples is not reported, but can be approximated from the text. There were no replicates mentioned.
	Metric 7:	Exposure Scenario	High	The exposure scenarios are characterized and are relevant to EPA's risk assessment.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	No raw data provided. Several summary statistics were provided, including mean, median, and range.
	Metric 9:	Quality Assurance	Low	No recoveries were provided, but the use of QA/QC was implied through the use of the protocol mentioned. Rodil et al 2009.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Some minimal discussion of variability was provided, but limitations and uncertainties were not discussed.

Overall Quality Determination   Medium

Study Citation: Wallner, P., Kundi, M., Moshammer, H., Piegler, K., Hohenblum, P., Scharf, S., Fröhlich, M., Damberger, B., Tappler, P., Hutter, H. P. (2012). Indoor air in schools and lung function of Austrian school children. Journal of Environmental Monitoring 14:1976-1982.

HERO ID: 1313395

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methods for 252 chemical indoor parameters within 26 substance groups, including formaldehyde (FDH) and tris (2-chloroethyl) phosphate (TCEP) in air, and butyl benzyl phthalate (BBP) in dust were detailed. There was no mention of sample storage or sampler calibration.
	Metric 2:	Analytical Methodology	Low	Analytical methods were briefly described, however there was no mention of sample recoveries or instrument calibration and although the number of samples greater than the LOQ was presented in Table 2, the actual LOQ or LOD was not reported for each chemical sampled.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Austrian elementary schools.
	Metric 5:	Currency	Low	Timing of sample collection for monitoring data is not reported, discussed, or referenced. However, the study was published in 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	The study reported results of samples >LOQ for n=35 air samples and n=36 dust samples for the chemicals of interest. Replicate sampling was conducted as two samples were simultaneously obtained per classroom for one day in two seasons (autumn and spring). Continuous 24-hour active air sampling was conducted. Dust sampling was conducted once a day for one week using vacuum cleaners, with no replicate sampling detailed.
	Metric 7:	Exposure Scenario	High	The exposure scenario was well characterized as the indoor air and dust measurements were obtained from first and second year classrooms in nine elementary schools from Austrian urban and rural regions as part of the Children's Environment and Health Action Plan for Europe (CEHAPE) of WHO and the LUKI project. Exposure sources were briefly detailed. Microclimate information regarding temperature and humidity were measured but not reported or included in models with lung function outcomes. Use of exposure controls was not detailed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data was not reported. Statistical summary measures included median, minimum, and maximum concentrations. Frequency of detection was reported as number of samples >LOQ. Sampling dates were not reported.
	Metric 9:	Quality Assurance	Low	There was no discussion of QA/QC methods or results within the main text, however it can be inferred that proper protocols were followed through the study's use of standard sampling and analytic methods.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The non-random school selection process may have introduced bias in indoor air quality assessment, however of the 19 schools interested in participating, the nine schools selected were representative of a variety of community sizes and types. Potential study limitations were discussed in detail.

Overall Quality Determination   Medium

Study Citation: Hutchins, S. R., Tomson, M. B., Wilson, J. T., Ward, C. H. (1984). Fate of trace organics during rapid infiltration of primary waste water at Fort Devens, Massachusetts (USA). Water Research 18:1025-1036.

HERO ID: 1316091

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology for wastewater, equipment, study site, and storage information is well described for both preliminary and final sampling trip.
	Metric 2:	Analytical Methodology	Medium	No LOD reported. The study described the extraction and analytical methodology, instrument in detail, but missing some information such as calibration.
	Metric 3:	Biomarker Selection	N/A	Study measure parent chemical in wastewater.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Fort Devens, Massachusetts
	Metric 5:	Currency	Low	Samples were collected in 1978-1983
	Metric 6:	Spatial and Temporal Variability	Low	There were 3 samples, one in basin floodwater, one in well 4, and one well 5. 2 more trip replicate samples were taken.
	Metric 7:	Exposure Scenario	High	Samples were collected through infiltration of wastewater at Fort Devens, Massachusetts.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Only individual data provided for basin floodwater, well 4, and well 5, found in table 1. No summary statistics were provided.
	Metric 9:	Quality Assurance	Medium	The paper describes a series of QC measurements with the recovery efficiencies ranging from 12% to 78% .
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Characterized variability in different types of wastewater sites studied. The uncertainty described was related to the analytical method.

Overall Quality Determination   Medium

Study Citation: Jackson, J., Sutton, R. (2008). Sources of endocrine-disrupting chemicals in urban wastewater, Oakland, CA. Science of the Total Environment 405:153-160.

HERO ID: 1408465

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methods were described and a map of study area was included.
	Metric 2:	Analytical Methodology	Low	Samples were analyzed using well-established method EPA 625; LOD was not reported.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the United States.
	Metric 5:	Currency	Medium	Samples were collected in 2006.
	Metric 6:	Spatial and Temporal Variability	Medium	There are 16 wastewater samples. No replicates were reported.
	Metric 7:	Exposure Scenario	Low	The sources of exposure were not well characterized, the data closely represent a relevant wastewater exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were reported, but no LOD was provided.
	Metric 9:	Quality Assurance	Low	Key QA process reported included used of field blanks. Quality control was not discussed, but there was no obvious concerns.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability and uncertainty were not discussed, but there was no obvious concerns of study quality.

Overall Quality Determination   **Low**

Study Citation:	Lebel, G. L., Williams, D. T., Benoit, F. M. (1987). Use of large-volume resin cartridges for the determination of organic contaminants in drinking water derived from the great lakes. Advances in Chemistry 214:309-326.		
HERO ID:	1487184		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	The sampling methods were briefly described, citing previously published literature.
	Metric 2: Analytical Methodology	Low	the analytical methods were described, including recoveries but detection limits were not reported.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in the Great Lakes, Canada.
	Metric 5: Currency	Low	The article was published in 1986.
	Metric 6: Spatial and Temporal Variability	Low	The sample size was not reported but can be inferred to a total of 4 samples (2 for each season) taken at each of the 6 sites.
	Metric 7: Exposure Scenario	Low	The data may represent relevant exposure scenarios related to raw and treated water from the Great Lakes, but the uncertain sample size limits the study's validity.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual sample concentrations seem to be reported in the manuscript. Summary statistics were not reported.
	Metric 9: Quality Assurance	Medium	QA/QC techniques were briefly described, including the use of blanks.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was not characterized. Some discussion of intra laboratory uncertainties.

Overall Quality Determination　　　　　　Low

Study Citation:	Otake, T., Yoshinaga, J., Yanagisawa, Y. (2001). Analysis of organic esters of plasticizer in indoor air by GC-MS and GC-FPD. Environmental Science and Technology 35:3099-3102.		
HERO ID:	1598712		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Samples were collected according to publicly available SOPs that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) for the chemical and media of interest.
Metric 2:	Analytical Methodology	High	Samples were analyzed according to publicly available analytical methods that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) and are appropriate for the chemical and media of interest.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Japan.
Metric 5:	Currency	Low	Timing of sample collection for monitoring data is not reported, discussed, or referenced. However, publication year of 2001 is used as a proxy for sampling year.
Metric 6:	Spatial and Temporal Variability	Medium	There were 5-10 samples collected for a single scenario. No replicates were reported.
Metric 7:	Exposure Scenario	Low	The data somewhat represents relevant indoor air exposure scenarios.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics were included.
Metric 9:	Quality Assurance	Medium	The study applied and documented quality assurance/quality control measures; however, one or more pieces of QA/QC information is not described. Missing information is unlikely to have a substantial impact on results.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Gaps and limitations not reported. There was only a minimal characterization of variability and uncertainty.

Overall Quality Determination　　　　Medium

Study Citation:	Möller, A., Sturm, R., Xie, Z., Cai, M., He, J., Ebinghaus, R. (2012). Organophosphorus flame retardants and plasticizers in airborne particles over the Northern Pacific and Indian Ocean toward the Polar Regions: Evidence for global occurrence. Environmental Science and Technology 46:3127-3134.		
HERO ID:	1610345		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Detailed description of sampling methods provided.
Metric 2:	Analytical Methodology	High	Detailed description of analytical methods provided.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples taken during two polar expeditions in 2010/11, one from East Asia to the high Arctic (CHINARE 4) and another from East Asia toward the Indian Ocean to the Antarctic (CHINARE 27).
Metric 5:	Currency	Medium	Samples were collected between 2010-2011.
Metric 6:	Spatial and Temporal Variability	High	More than 10 samples were collected for a single scenario.
Metric 7:	Exposure Scenario	Medium	Exposure scenario presented in study relates to that of EPA's risk evaluations.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Detailed reporting of results provided.
Metric 9:	Quality Assurance	High	Dedicated QA/QC section presented and no major issues identified.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Some discussion is provided on uncertainties and limitations under Conclusion and Discussion.

Overall Quality Determination   High

Study Citation:	Andresen, J. A., Muir, D., Ueno, D., Darling, C., Theobald, N., Bester, K. (2007). Emerging pollutants in the North Sea in comparison to Lake Ontario, Canada, data. Environmental Toxicology and Chemistry 26:1081-1089.		
HERO ID:	1619118		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sample collection is reported for the German Bight sites including sampling methods, dates, and storage conditions.Uninformative for the Lake Ontario samples, the study only reports sample characteristics and coordinates.
	Metric 2:	Analytical Methodology	High	Analytical methods reported including extraction type, analytical instrumentation, and LOD.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the North Sea (German Bight) and Lake Ontario, Canada. Tables S1 and S2 report sample coordinates.
	Metric 5:	Currency	Medium	Samples from the German Bight were collected from May 25, 2005, to June 6,2005.sample collection date for the Lake Ontario data is not provided.
	Metric 6:	Spatial and Temporal Variability	High	Table S1 reports 14 samples for the German Bight. 6 samples collected from Lake Ontario.
	Metric 7:	Exposure Scenario	High	The study reports the concentration of emergent contaminants in the North Sea and compares data with Lake Ontario. The discussion section mentions microenvironment exposure scenarios.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Data for the German Bight is only reported in the figures with some information of minimum and maximum in the text.Lake Ontario data includes individual data points reported in table S4.
	Metric 9:	Quality Assurance	High	Data regarding the QA/QC is reported in the supplemental file.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Some discussion of uncertainty provided.

Overall Quality Determination   **High**

Study Citation:	Fang, M., Webster, T. F., Gooden, D., Cooper, E. M., Mcclean, M. D., Carignan, C., Makey, C., Stapleton, H. M. (2013). Investigating a novel flame retardant known as V6: measurements in baby products, house dust, and car dust. Environmental Science and Technology 47:4449-4454.		
HERO ID:	1676728		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The description of sampling methodology is limited. Authors did cite previously published peer-reviewed publications for more details.
	Metric 2:	Analytical Methodology	Low	Analytical methods reporting was mostly complete, but detection limits were only reported for V6 and not TCEP even though authors quantified TCEP concentrations.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in baby products, house dust, and car dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from homes, cars, and baby products in Boston, Massachusetts, United States.
	Metric 5:	Currency	Medium	Samples were collected from 2009.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 20 house dust, 20 car dust samples, and 101 baby product samples without replicates.
	Metric 7:	Exposure Scenario	Medium	Exposure to flame retardants via car and house dust is relevant, but more details on the population of interest (e.g., are and how many children are present in these households) would be helpful.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data were provided. Summary statistics were provided, including percent detected, median concentration, geometric mean and range.
	Metric 9:	Quality Assurance	Medium	Some description of QA/QC was included, such as blanks, duplicate dust sample analysis, and recoveries for V6.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The discussion of uncertainties and gaps is limited.

Overall Quality Determination Medium

| Study Citation: | Cristale, J., Katsoyiannis, A., Sweetman, A. J., Jones, K. C., Lacorte, S. (2013). Occurrence and risk assessment of organophosphorus and brominated flame retardants in the River Aire (UK). Environmental Pollution 179:194-200. |
| **HERO ID:** | 1788425 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample methods was briefly described, but sampling storage conditions and duration were not provided.
	Metric 2:	Analytical Methodology	High	Analytical methodology were sufficiently described.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected along the River Aire (UK).
	Metric 5:	Currency	Medium	Samples collected in spring 2011.
	Metric 6:	Spatial and Temporal Variability	Medium	1-2 samples collected from each of the 13 sites along River Aire. No mention of replicates.
	Metric 7:	Exposure Scenario	High	Setting and potential sources of exposure are well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data can be extrapolated from Figure 2.
	Metric 9:	Quality Assurance	Medium	No quality control issues were identified, though some QC information is not described.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited discussion of variability and uncertainties.

Overall Quality Determination   Medium

Study Citation: Ali, N., Dirtu, A. C., van den Eede, N., Goosey, E., Harrad, S., Neels, H., 'T Mannetje, A., Coakley, J., Douwes, J., Covaci, A. (2012). Occurrence of alternative flame retardants in indoor dust from New Zealand: Indoor sources and human exposure assessment. Chemosphere 88:1276-1282.

HERO ID: 1927602

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	A detailed description of the sampling methods is provided.
	Metric 2: Analytical Methodology	Medium	The study does not explicitly mention instrument calibration. The discussion of recovery samples is limited.
	Metric 3: Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The study was conducted in New Zealand.
	Metric 5: Currency	Medium	Samples were collected in 2008.
	Metric 6: Spatial and Temporal Variability	Medium	There is no mention of replicate samples.
	Metric 7: Exposure Scenario	Medium	There is no mention of building characteristics.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	No individual data points are reported.
	Metric 9: Quality Assurance	Low	QA/QC results were not directly discussed. They may be in the SI file.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	The discussion of study limitations and key uncertainties is limited.

Overall Quality Determination   Medium

Study Citation: Van den Eede, N., Dirtu, A. C., Ali, N., Neels, H., Covaci, A. (2012). Multi-residue method for the determination of brominated and organophosphate flame retardants in indoor dust. Talanta 89:292-300.

HERO ID: 1927614

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Low	Sampling methodology not described; reference was provided but not obtained.
	Metric 2: Analytical Methodology	High	LOQ provided. Samples were analyzed according to publicly available analytical methods that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) and are appropriate for the chemical and media of interest.
	Metric 3: Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were collected across Europe, in Romania, Spain, and Belgium.
	Metric 5: Currency	Low	Sample collection date not described; reference was provided but not obtained. However, the publication year of 2012 is used as a proxy for sampling year.
	Metric 6: Spatial and Temporal Variability	Medium	12 samples were collected with no mention of replicate samples; reference was provided but not obtained.
	Metric 7: Exposure Scenario	Low	Study states that the room used for sample collection was not always specified or known.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	Only individual data points reported with no summary statistics.
	Metric 9: Quality Assurance	High	The study applied quality assurance/quality control measures and all pertinent quality assurance information is provided in the data source or companion source.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Limited discussion on study limitations, gaps, and uncertainties

Overall Quality Determination   Medium

Study Citation: Saito, I., Onuki, A., Seto, H. (2007). Indoor organophosphate and polybrominated flame retardants in Tokyo. Indoor Air 17:28-36.
HERO ID: 1927779

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The description of sampling methods is limited.
	Metric 2:	Analytical Methodology	Medium	Analytical methods are described with no mention of instrument calibration.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Tokyo, Japan.
	Metric 5:	Currency	Low	Sampling took place in 2002.
	Metric 6:	Spatial and Temporal Variability	Medium	No replicates for all chemicals measured.
	Metric 7:	Exposure Scenario	Medium	Did not measure air ventilation rates during sampling periods.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No individual data points reported. Only reported summary statistics.
	Metric 9:	Quality Assurance	High	Some QA/QC discussed with no major issues identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited characterization of variability, but provided range.

Overall Quality Determination   Medium

Study Citation:	Yoshida, T., Matsunaga, I., Tomioka, K., Kumagai, S. (2006). Interior air pollution in automotive cabins by volatile organic compounds diffusing from interior materials: I. Survey of 101 types of Japanese domestically produced cars for private use. Indoor and Built Environment 15:425-444.		
HERO ID:	1949033		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	A detailed description of the sampling methodology was provided.
Metric 2:	Analytical Methodology	Low	The description of the analytical methodology provided has a few flaws.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The study was conducted in Japan.
Metric 5:	Currency	Low	The study was conducted in the summer season (June"September) of 2001 (n=14), 2002 (n=28), 2003 (n=47) or 2004 (n=12).
Metric 6:	Spatial and Temporal Variability	High	There were ≥ 10 samples for a single scenario.
Metric 7:	Exposure Scenario	High	The exposure scenario discussed in the monitored study represents the exposure scenario of interest for the chemical.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The presentation of results was good.
Metric 9:	Quality Assurance	Low	The description of QA/QC was poor.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	The presentation of variability and uncertainty was good.

Overall Quality Determination   Medium

Study Citation:	Ali, N., Van den Eede, N., Dirtu, A. C., Neels, H., Covaci, A. (2012). Assessment of human exposure to indoor organic contaminants via dust ingestion in Pakistan. Indoor Air 22:200-211.		
HERO ID:	2150926		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Not all sampling method criteria were reported, but may be found in a referenced study.
Metric 2:	Analytical Methodology	Medium	Analytical methods were briefly mentioned, but recovery metrics were not reported. They may be in a referenced study.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Gujrat, Pakistan.
Metric 5:	Currency	Medium	Data collected in April 2011.
Metric 6:	Spatial and Temporal Variability	Medium	More than 10 samples were collected. No replicates were mentioned.
Metric 7:	Exposure Scenario	High	The exposure scenario discussed in the monitored study does represent the exposure scenario of interest for the chemical.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	No raw data provided, but summary statistics were mentioned, including median, 5th, 10th, 90th, and 95th percentiles, mean, and range.
Metric 9:	Quality Assurance	Low	Storage recoveries, control samples, etc. not reported but may be in a referenced article.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Some discussion of uncertainties and limitations provided.

Overall Quality Determination   Medium

Study Citation:	Shin, H. M., Mckone, T. E., Nishioka, M. G., Fallin, M. D., Croen, L. A., Hertz-Picciotto, I., Newschaffer, C. J., Bennett, D. H. (2014). Determining source strength of semivolatile organic compounds using measured concentrations in indoor dust. Indoor Air 24:260-271.		
HERO ID:	2215665		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	The sampling method was discussed in detail, including sampling procedure, storage conditions, and matrix characterization. Information regarding duration of sample storage prior to analysis was lacking.
	Metric 2: Analytical Methodology	High	The analytical method (GC/MS) was described in terms of instrumentation, extraction, calibration, and recovery, with limits of detection reported within Table S1.
	Metric 3: Biomarker Selection	N/A	This study sampled for chemicals of interest within indoor dust.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected from residences in Northern California, Southeast Pennsylvania, and Northeast Maryland.
	Metric 5: Currency	Medium	Samples were collected during 2009 and 2010.
	Metric 6: Spatial and Temporal Variability	Medium	A total of 30 indoor surface dust samples, one from a single main living room of each house, were collected in an area described as the equivalent of the entire floor surface area of participating homes within Northern California, Southeast Pennsylvania, and Northeast Maryland between 2009 and 2010. Replicate sampling was not detailed.
	Metric 7: Exposure Scenario	High	The exposure scenario was described and was highly relevant (indoor air) and the study used fugacity-based modeling to predict the emission, fate and movement of chemicals in the indoor environment from various consumer product exposure sources. Use of exposure controls was not detailed.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	No individual raw data points were provided. Statistical summary measures included mean, standard deviation, median and maximum concentrations as well as frequency of detection in Table S1.
	Metric 9: Quality Assurance	Medium	Quality assurance measures were applied and described in robust details. Solvent method blanks were used and recoveries were reported. Baseline, pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	The study had a robust discussion of uncertainty and compared results to results of other studies. The study also characterized limitations in details.

Overall Quality Determination   High

Study Citation:	Stapleton, H. M., Misenheimer, J., Hoffman, K., Webster, T. F. (2014). Flame retardant associations between children's handwipes and house dust. Chemosphere 116:54-60.		
HERO ID:	2343712		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sample location, collection techniques and storage are reported in section 2.1.
Metric 2:	Analytical Methodology	High	Sample extraction and analytical method are reported in section 2.2. LOD reported in table 1.
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in USA, North Carolina.
Metric 5:	Currency	Medium	Samples collected during the spring of 2012.
Metric 6:	Spatial and Temporal Variability	High	The study analyses 43 handwipes and 30 samples of house dust.
Metric 7:	Exposure Scenario	High	The study analyzes the association between dust and handwipes.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data is not reported. Table 1 reports GM and range.
Metric 9:	Quality Assurance	High	The study reports, recoveries, the use of laboratory and field blanks, and standard reference materials.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	Variability reported in terms of range, limitations are not reported.

Overall Quality Determination　　　　　High

Study Citation:	Abdallah, M. A. E., Covaci, A. (2014). Organophosphate flame retardants in indoor dust from Egypt: Implications for human exposure. Environmental Science and Technology 48:4782-4789.		
HERO ID:	2345990		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling materials, locations and storage are reported in the sampling methods section.
Metric 2:	Analytical Methodology	High	Sample preparation, extraction and analytical methods reported. LOQ reported in SI table SI-3.
Metric 3:	Biomarker Selection	N/A	Parent chemical tested in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Egypt.
Metric 5:	Currency	Medium	Samples collected between September 2012 and January 2013.
Metric 6:	Spatial and Temporal Variability	Medium	Samples collected in 71 microenvironments, no samples replicates.
Metric 7:	Exposure Scenario	High	The study analyzes a range of microenvironments: "homes (living rooms, n = 20), offices (private and public sector, n = 20), PMEs (public microenvironments represented by 4 coffee shops, 4 restaurants, and 3 supermarkets) and cars (n = 20)".
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Table 1 reports summary of statistics. No raw data reported.
Metric 9:	Quality Assurance	High	The study reports, recoveries, method and field blanks.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability reported as SD in table 1, no limitations reported.

Overall Quality Determination   High

Study Citation: Takeuchi, S., Kojima, H., Saito, I., Jin, K., Kobayashi, S., Tanaka-Kagawa, T., Jinno, H. (2014). Detection of 34 plasticizers and 25 flame retardants in indoor air from houses in Sapporo, Japan. Science of the Total Environment 491-492:28-33.

HERO ID: 2519043

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology is mostly adequately described, but some details are missing (e.g., sample storage conditions/duration). The study does cite some other published works for more complete details.
	Metric 2:	Analytical Methodology	Medium	The analytical methods were described, including LOD but not recoveries.
	Metric 3:	Biomarker Selection	N/A	Concentrations were measured in indoor air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sapporo, Japan.
	Metric 5:	Currency	Medium	Samples were collected in 2012.
	Metric 6:	Spatial and Temporal Variability	Low	It appears that only one sample per home was collected. Six homes were sampled.
	Metric 7:	Exposure Scenario	Medium	The data may represent relevant exposure scenarios related to indoor air in Sapporo Japan but only 6 homes were sampled. One home was sampled during a different season from the other homes.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual sample concentrations were reported, without summary statistics.
	Metric 9:	Quality Assurance	Medium	QA/QC techniques were briefly discussed, including the use of field blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability was not characterized. Very limited discussion of limitations, uncertainties, and data gaps.

Overall Quality Determination　　　　　Medium

Study Citation:	Schreder, E. D., La Guardia, M. J. (2014). Flame retardant transfers from U.S. households (dust and laundry wastewater) to the aquatic environment. Environmental Science and Technology 48:11575-11583.		
HERO ID:	2528320		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The dust and wastewater sampling methods were described in detail.
Metric 2:	Analytical Methodology	High	The analytical methods were described and included recoveries and LOD.
Metric 3:	Biomarker Selection	N/A	The authors analyzed dust and wastewater samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Vancouver and Longview, WA.
Metric 5:	Currency	Medium	Researchers visited homes to collect dust and laundry wastewater in 2011 and 2012.
Metric 6:	Spatial and Temporal Variability	Medium	A total of 20 households' samples were collected, no replicates.
Metric 7:	Exposure Scenario	High	Data closely represent relevant exposure scenarios related to household indoor dust and wastewater from
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Individual FR results are in the SI file. Summary statistics in figures.
Metric 9:	Quality Assurance	High	QA/QC details are in the SI file.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	Variability was characterized (range). Uncertainties and study limitations were briefly discussed.

Overall Quality Determination   High

Study Citation:	Dodson, R. E., Van den Eede, N., Covaci, A., Perovich, L. J., Brody, J. G., Rudel, R. A. (2014). Urinary Biomonitoring of Phosphate Flame Retardants: Levels in California Adults and Recommendations for Future Studies. Environmental Science and Technology 48:13625-13633.		
HERO ID:	2533847		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling method for urine was described in detail.
Metric 2:	Analytical Methodology	Medium	The study described the extraction and analytical methodology, instrument in detail. LOD reported in Table 1 for BCEP. No limit of detection was reported for TCEP.
Metric 3:	Biomarker Selection	High	The study evaluates both the metabolite (BCEP) and the parent chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected for California residents.
Metric 5:	Currency	Medium	Samples were collected in 2011.
Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected for 16 California residents.
Metric 7:	Exposure Scenario	Medium	The study evaluates the association between dust and urine concentrations for California residents.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data is not reported. Table 1 and table SI-3 report summary of statistics.
Metric 9:	Quality Assurance	High	The study reports matrix recoveries and LODs.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Variability reported in terms of range. There is not discussion regarding limitations.

Overall Quality Determination   Medium

Study Citation:	Fromme, H., Lahrz, T., Kraft, M., Fembacher, L., Mach, C., Dietrich, S., Burkardt, R., Völkel, W., Göen, T. (2014). Organophosphate flame retardants and plasticizers in the air and dust in German daycare centers and human biomonitoring in visiting children (LUPE 3). Environment International 71:158-163.		
HERO ID:	2537005		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Study sampling methodology noted as described in Fromme et al., (2013). Sampling equipment, sampling procedures, sample storage conditions (urine) and study site characteristics noted for air, dust, and urine sampling. Insufficient information on duration of "cool" storage prior to freezing as well as frozen storage time prior to analysis for urine samples. Insufficient information on sample storage conditions and duration for air and dust samples. Insufficient information on calibration of sampling equipment.
	Metric 2: Analytical Methodology	Medium	Study analytical methodology noted as described within Fromme et al., (2013) for indoor air and dust, and in accordance with Mach (2014). Analytical extraction methods, instrumentation, calibration (indoor air), chemical-specific LOQ's (indoor air, dust) and LOD (urine) reported for all media. Insufficient information on recovery samples for all media, instrument calibration for dust.
	Metric 3: Biomarker Selection	High	Metabolite biomarker (DCEP) derived from exposure to parent chemical of interest, likely reflects external exposure. This metric is not applicable for air and dust.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Bavaria, Berlin, and North Rhine-Westphalia, Germany.
	Metric 5: Currency	Medium	Study methodology/sampling noted as described within Fromme et al., (2013), and described as "conducted" between November 2011 and May 2012.
	Metric 6: Spatial and Temporal Variability	Medium	Pooled spot and no duplicate sampling with n=312 (urine); 5-10 minutes of dust vacuum sampling at single space and time with n=63 (TCEP) and n=48 (TPhP); single 6-hour air sampling with n=11 (TCEP) for indoor air (n=0 for TPhP samples ≥LOD). Duplicate/replicate sampling not conducted. Authors note evidence from previous studies that concentration profiles vary across daycare centers and different indoor environments, but do not stratify results by potential differing indoor conditions (was sampling done before/after center had their noted daily cleaning?).
	Metric 7: Exposure Scenario	Medium	Air and dust sampling conducted in well-described sampling location of 63 German daycare facilities with notations of ventilation and cleaning frequency. Children providing urine samples well-described in terms of demographics within text, with details of questionnaire recording living characteristics described. Use of field blanks/exposure controls not described as conducted.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary statistics of mean, median, min-max, 95% -ile and N>LOD and chemical-specific LOD's reported for all media. Sampling location and population details provided. Insufficient information on correction for void completeness in urine sampling, and raw data not provided. Fromme (2013) reference might provide raw data.
	Metric 9: Quality Assurance	Medium	Laboratory blanks (dust and air) and method validation procedures (dust) detailed. Insufficient information on biomarker stability (urine), recoveries for all media, and baseline/pre-exposure sampling not described as conducted.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability characterized as concentration ranges for all media, authors discuss some limitations and inconsistencies with previous studies. Authors note daycare centers were cleaned once/day, but do not note sampling timing with respect to this cleaning across centers.

Overall Quality Determination   **Medium**

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Study Citation:	Fromme, H., Lahrz, T., Kraft, M., Fembacher, L., Mach, C., Dietrich, S., Burkardt, R., Völkel, W., Göen, T. (2014). Organophosphate flame retardants and plasticizers in the air and dust in German daycare centers and human biomonitoring in visiting children (LUPE 3). Environment International 71:158-163.
HERO ID:	2537005

Domain	Metric	Rating	Comments

Study Citation:	Bradman, A., Castorina, R., Gaspar, F., Nishioka, M., Colón, M., Weathers, W., Egeghy, P. P., Maddalena, R., Williams, J., Jenkins, P. L., Mckone, T. E. (2014). Flame retardant exposures in California early childhood education environments. Chemosphere 116:61-66.		
HERO ID:	2539068		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Dust sampling within early childhood education centers followed ASTM Standard Practices. Indoor and out-door air sampling methodology was clear and similar to widely accepted protocols. Details were provided within SM.
	Metric 2:	Analytical Methodology	High	MDLs were discussed in paper and reported in in supplementary materials (Tables S3 and S5). Analytic methods were detailed in SM.
	Metric 3:	Biomarker Selection	N/A	Testing for parent chemicals of interest was conducted within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Northern, CA.
	Metric 5:	Currency	Medium	Samples were collected in 2010 and 2011.
	Metric 6:	Spatial and Temporal Variability	High	Duplicates for dust, and air (see SM) samples were collected. A total of n= 39 samples were collected for dust. A total of n= 40 samples were collected for indoor air.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario was detailed with potential sources of exposure in early childhood education centers briefly discussed. Facilities were well characterized, including questionnaires and site visits. There were no exposure control samples.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data was not reported. Summary statistics and frequency of detection within dust and air samples was reported.
	Metric 9:	Quality Assurance	High	QA/QC results (including recoveries and MDLS) were not directly discussed but presented in SM. This study used standard protocols. Baseline pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Sampling was conducted within 40 early childhood education centers in California. Uncertainties and limitations were not discussed.

Overall Quality Determination　　　　**High**

Study Citation: Brandsma, S. H., de Boer, J., van Velzen, M. J., Leonards, P. E. (2014). Organophosphorus flame retardants (PFRs) and plasticizers in house and car dust and the influence of electronic equipment. Chemosphere 116:3-9.

HERO ID: 2540527

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology was briefly described, citing previously published research. Additional sampling details in SI file and reference provided (note: reference was not obtained)
	Metric 2:	Analytical Methodology	Medium	The analytical methods were described, including recoveries. LOD was mentioned but values were not reported. Additional analytical details in SI file and reference provided (note: reference was not obtained).
	Metric 3:	Biomarker Selection	N/A	The authors analyzed dust samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study took place in the Netherlands.
	Metric 5:	Currency	Medium	Eight houses from the Netherlands were sampled for dust in 2012. In 2012 dust was also collected in eight cars from the Netherlands.
	Metric 6:	Spatial and Temporal Variability	Medium	Small sample size (8 houses and 8 cars), without replicates.
	Metric 7:	Exposure Scenario	Medium	The data may represent relevant exposure scenarios related to dust in houses and cars in the Netherlands, but the sample size was small. Floors were not included in the sampling; more details on electronics and cars sampled in the SI file.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points were not reported, only summary statistics (median and range).
	Metric 9:	Quality Assurance	High	QA/QC techniques were described, including the use of blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited characterization of variability was reported (range). Uncertainties were discussed.

Overall Quality Determination   Medium

Study Citation:	Tajima, S., Araki, A., Kawai, T., Tsuboi, T., Ait Bamai, Y., Yoshioka, E., Kanazawa, A., Cong, S., Kishi, R. (2014). Detection and intake assessment of organophosphate flame retardants in house dust in Japanese dwellings. Science of the Total Environment 478:190-199.		
HERO ID:	2542290		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	The dust sampling methodology was described, but sample storage or transport conditions were not discussed.
Metric 2:	Analytical Methodology	Medium	The analytical methods were described, including recoveries and LOD but without discussion of instrument calibration.
Metric 3:	Biomarker Selection	N/A	The authors analyzed dust samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The samples were taken in Japan.
Metric 5:	Currency	Medium	Sampling took place in 2009-2010.
Metric 6:	Spatial and Temporal Variability	Low	The authors collected 2 dust samples from the same room (floor and upper surface) from 48 of the homes sampled, without replicates.
Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to flame retardants in dust from Japanese households.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only summary statistics were reported (percentiles). Individual sample concentrations were not reported.
Metric 9:	Quality Assurance	High	QA/QC techniques were discussed in detail.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was characterized. Multiple uncertainties were identified, but they are unlikely to have a substantial impact on the results beyond what is mentioned in the text.

Overall Quality Determination   Medium

Study Citation:	Eulaers, I., Jaspers, V. L., Halley, D. J., Lepoint, G., Nygård, T., Pinxten, R., Covaci, A., Eens, M. (2014). Brominated and phosphorus flame retardants in White-tailed Eagle Haliaeetus albicilla nestlings: bioaccumulation and associations with dietary proxies ("C, "N and "S). Science of the Total Environment 478:48-57.		
HERO ID:	2542346		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling materials, collection methods and storage conditions are reported in section 2.1.
Metric 2:	Analytical Methodology	High	Analytical methodology reported in the pollutant analysis section. The LOQ is reported in Table 2.
Metric 3:	Biomarker Selection	N/A	The parent chemical is measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Norway.
Metric 5:	Currency	Medium	Samples were collected in 2011.
Metric 6:	Spatial and Temporal Variability	Medium	The collection of replicates is not mentioned in the study. A total of 38 samples were collected including plasma n = 17 and body feathers n =21.
Metric 7:	Exposure Scenario	High	The study evaluates the exposure of high trophic level species to flame retardants using feathers and plasma.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Table 2 reports the summary of data including the median and the range. No raw data reported.
Metric 9:	Quality Assurance	Medium	The study reports the use of internal spikes.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability is reported in terms of range, inter-annual variability, and spatial variability. No information regarding the limitations was reported.

Overall Quality Determination   High

Study Citation: Fan, X., Kubwabo, C., Rasmussen, P. E., Wu, F. (2014). Simultaneous determination of thirteen organophosphate esters in settled indoor house dust and a comparison between two sampling techniques. Science of the Total Environment 491-492:80-86.

HERO ID: 2543095

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The study cites other published works for details on dust sample collection.
	Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation, and is scientifically appropriate for the chemical and media analyzed. LOQ and MDL are reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Dust samples were collected from randomly selected urban Canadian single-family dwellings.
	Metric 5:	Currency	Medium	Samples were collected as part of the Canadian House Dust Study (CHDS), for which sampling was conducted between 2007 and 2010.
	Metric 6:	Spatial and Temporal Variability	High	The study analyzed 134 pairs of fresh dust and household dust samples from 134 homes.
	Metric 7:	Exposure Scenario	High	Exposure to indoor house dust was evaluated.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points were not reported. Raw data are not provided. Paper referred to a previously published work for the raw data and the details of sample collections.
	Metric 9:	Quality Assurance	High	Each batch consists of two matrix blanks, two quality control (QC) samples, and 18 dust samples, including two duplicates. All reported results were blank-corrected. All reported recovery is > 70% .
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study acknowledges that the 134 pairs of dust samples that were analyzed may not be representative of exposure of the general Canadian population, and that associations between characteristics of sampled homes and results have not been analyzed.

Overall Quality Determination   High

Study Citation:		Cheng, W., Sun, L., Huang, W., Ruan, T., Xie, Z., Zhang, P., Ding, R., Li, M. (2013). Detection and distribution of Tris(2-chloroethyl) phosphate on the East Antarctic ice sheet. Chemosphere 92:1017-1021.	
HERO ID:		2552685	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	A thorough explanation of sample collection was provided.
	Metric 2:	Analytical Methodology	Low	The analytical methods were discussed but the LOD and recoveries were not reported.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed environmental samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Antarctica
	Metric 5:	Currency	Medium	The samples were collected in 2010-2011
	Metric 6:	Spatial and Temporal Variability	Medium	n=120 samples on transect from Zhongshan to Kunlun station, without replicates.
	Metric 7:	Exposure Scenario	Medium	The data is likely related to relevant exposure scenarios, but details about the population of interest were not reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	TCEP range of concentrations reported in the text (PDF page 4).
	Metric 9:	Quality Assurance	Medium	QA/QC techniques were discussed, including the use of field and experimental blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability was not characterized. Uncertainties and limitations were not discussed.

Overall Quality Determination　　　　　　　Medium

Study Citation:	Mäkinen, M. S. E., Mäkinen, M. R. A., Koistinen, J. T. B., Pasanen, A. L., Pasanen, P. O., Kalliokoski, P. J., Korpi, A. M. (2009). Respiratory and dermal exposure to organophosphorus flame retardants and tetrabromobisphenol A at five work environments. Environmental Science and Technology 43:941-947.		
HERO ID:	2560628		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	For personal and area pump air sampling, sampling equipment, procedures, storage conditions and duration, calibration of sampler and study site characteristics depicted. For personal patch and handwash sampling, insufficient information provided on calibration, storage duration.
Metric 2:	Analytical Methodology	Medium	Analytical methodology was described, though there was insufficient information on chemical-specific recoveries and LODs (indicated to be within further information in SI).
Metric 3:	Biomarker Selection	N/A	Sampling for parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The location is assumed to be Finland based on site descriptions within SI Table S1.
Metric 5:	Currency	Low	Sampling dates assumed to be within SI Tables S1-S7. The publication date is 2009.
Metric 6:	Spatial and Temporal Variability	Medium	Sample sizes are reported in SI Table S1.
Metric 7:	Exposure Scenario	Medium	Sampling for non-occupational and occupationally relevant locations, including computer classrooms, noted in Table 2.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary stats are reported within Table 2, and additional data are reported within SI.
Metric 9:	Quality Assurance	Medium	Recoveries, field and laboratory blanks are reported, but there was no pre-exposure sampling.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Authors note limitations of high detection limits, however do not discuss use of high detection limit for concentration in samples with > 50% of samples <LOD and variability in area air sampling time between locations.

Overall Quality Determination　　　Medium

Study Citation:	Regnery, J., Püttmann, W., Merz, C., Berthold, G. (2011). Occurrence and distribution of organophosphorus flame retardants and plasticizers in anthropogenically affected groundwater. Journal of Environmental Monitoring 13:347-354.		
HERO ID:	2579610		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The water sampling methodology was described in detail.
	Metric 2: Analytical Methodology	High	The analytical methods were described, including recoveries and LOD.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples collected in Germany.
	Metric 5: Currency	Medium	Samples collected in 2009.
	Metric 6: Spatial and Temporal Variability	High	n=36 samples across three sites (estimated from Table 2).
	Metric 7: Exposure Scenario	High	The data closely represent relevant exposure scenarios related to TCEP in groundwater in Germany.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Only summary statistics (median, max) were reported.
	Metric 9: Quality Assurance	High	QA/QC techniques were described in detail.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was not characterized. Uncertainties were briefly discussed.

Overall Quality Determination　　　High

Study Citation:	Sundkvist, A. M., Olofsson, U., Haglund, P. (2010). Organophosphorus flame retardants and plasticizers in marine and fresh water biota and in human milk. Journal of Environmental Monitoring 12:943-951.		
HERO ID:	2586188		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	For fish samples, sampling equipment and methods were described in reasonable detail, although certain aspects (e.g. equipment used to collect muscular tissue samples) were absent that may have a substantial impact on results. For milk samples, sampling equipment and methods were described in sufficient detail, although certain aspects (e.g. timing of successively collected individual portions, duration of storage) were absent that are unlikely to have a substantial impact on results.
	Metric 2:	Analytical Methodology	Medium	Analytical instrumentation and methods were described in adequate detail for both sample types. However, certain aspects (e.g. instrument calibration, exact LOD) were absent that may have a substantial impact on results. Individual LOD were not universally reported, but instead an average and range (per analyte) for each sample type. Individual LOD were reported for results that fell below the LOD.
	Metric 3:	Biomarker Selection	N/A	The study was testing for the parent chemical of interest in environmental media (relative to the exposure scenario in question).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	This study was conducted in Sweden.
	Metric 5:	Currency	Medium	Samples were collected between 1997 and 2007.
	Metric 6:	Spatial and Temporal Variability	Medium	A combination of pooled and individual samples for fish and for human milk was used, representing 21 different locations over 10 years. Representation of each location varied from 1 individual sample at a location (one fish for location 13) to hundreds of individual samples across several pools at another location (three pooled milk samples of at least 50 individuals each for location 18). Use of replicate samples was not reported.
	Metric 7:	Exposure Scenario	High	Exposure to the chemical of interest is highly relevant to the general population through fish consumption, or to infants through breastfeeding.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data were reported. Summary statistics included median, minimum, and maximum concentrations for each sample type.
	Metric 9:	Quality Assurance	High	QA/QC techniques included the use of blanks and internal standards to determine LOD and internal standard recovery. Across all sample types, recoveries were reported to range from 50% to 132% , and this was used to correct sample data.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Quantitative characterization of variability was reported as the range of concentrations for each sample type. There is a robust qualitative discussion of variability and some discussion of limitations.

Overall Quality Determination　　　　High

Study Citation: Regnery, J., Püttmann, W. (2010). Seasonal fluctuations of organophosphate concentrations in precipitation and storm water runoff. Chemosphere 78:958-964.

HERO ID: 2588430

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling storage is not detailed.
	Metric 2: Analytical Methodology	High	The analytical methodology is described in detail and the LOD is listed.
	Metric 3: Biomarker Selection	N/A	Testing for parent chemical was done in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The study was conducted in middle Germany.
	Metric 5: Currency	Medium	Samples were collected from 2007-2009.
	Metric 6: Spatial and Temporal Variability	High	90, 48, and 29 samples for the 3 sites respectively were collected on different dates.
	Metric 7: Exposure Scenario	High	The scenario represents the population exposed from storm water runoff and precipitation.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data points are not reported.
	Metric 9: Quality Assurance	Medium	Blanks are reported. Some QC information is missing.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	No discussion of limitations is provided. Variability was measured in seasons.

Overall Quality Determination   High

Study Citation:		Quednow, K., Püttmann, W. (2009). Temporal concentration changes of DEET, TCEP, terbutryn, and nonylphenols in freshwater streams of Hesse, Germany: possible influence of mandatory regulations and voluntary environmental agreements. Environmental Science and Pollution Research 16:630-640.			
HERO ID:		2593950			

Domain		Metric	Rating	Comments	
Domain 1: Reliability					
	Metric 1:	Sampling Methodology	Medium	Sampling methods were reported but equipment used was not described.	
	Metric 2:	Analytical Methodology	High	Analytical methods were described and detection limit was reported.	
	Metric 3:	Biomarker Selection	N/A	The analyte tested is the parent chemical in an environmental media.	
Domain 2: Representativeness					
	Metric 4:	Geographic Area	High	The samples were collected in Hessisches Ried region, south of Frankfurt am Main, Germany.	
	Metric 5:	Currency	Medium	The samples were collected in 2003-2006.	
	Metric 6:	Spatial and Temporal Variability	Medium	There are 330 water samples collected during 13 sampling occasions from 26 sampling sites. No replicates were reported.	
	Metric 7:	Exposure Scenario	High	Samples were collected from a river receiving treated wastewater in a densely populated area.	
Domain 3: Accessibility/Clarity					
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics including mean, min, and max were provided.	
	Metric 9:	Quality Assurance	Medium	QC techniques were not reported. Key QA process included calculation of recoveries.	
Domain 4: Variability and Uncertainty					
	Metric 10:	Variability and Uncertainty	Medium	There were no discussion of study limitations. Variations were considered in season measurements.	

Overall Quality Determination   Medium

Study Citation: Regnery, J., Puettmann, W. (2009). Organophosphorus flame retardants and plasticizers in rain and snow from middle Germany. CLEAN - Soil, Air, Water 37:334-342.

HERO ID: 2598725

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology was adequately described, but it is unclear if their protocol was based on a publicly available SOP or widely accepted.
	Metric 2:	Analytical Methodology	High	Study described analytical instrumentation, detection limits, methods, and techniques.
	Metric 3:	Biomarker Selection	N/A	This study measured TCEP levels in rainwater and snow; it is not a biomonitoring study.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Germany.
	Metric 5:	Currency	Medium	Samples were collected between 2007 and 2008.
	Metric 6:	Spatial and Temporal Variability	Medium	There were no replicate samples.
	Metric 7:	Exposure Scenario	High	Study investigated TCEP levels in precipitation as a source of exposure to the aquatic environment.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are provided but raw data are missing.
	Metric 9:	Quality Assurance	High	QA/QC measures were applied; recoveries acceptable at >85% .
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps.

Overall Quality Determination   High

Study Citation:	Mihajlovic, I., Fries, E. (2012). Atmospheric deposition of chlorinated organophosphate flame retardants (OFR) onto soils. Atmospheric Environment 56:177-183.		
HERO ID:	2662833		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methods sufficiently described. Site, equipment, and storage condition were described in detail.
	Metric 2: Analytical Methodology	High	Analytical methods were described and LOD reported.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were collected in Germany.
	Metric 5: Currency	Medium	The samples were collected in 2010-2011.
	Metric 6: Spatial and Temporal Variability	Medium	There are 27 soils samples. No replicate were reported.
	Metric 7: Exposure Scenario	High	Sampling location and sources of exposure were well-described and the data was closely relevant to the exposure scenario.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data points not reported.
	Metric 9: Quality Assurance	Medium	QA/QC techniques are described including recoveries, triplicate measurements.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variation in the medium, such as dry and wet deposition (rain and snow) were studied.

Overall Quality Determination   High

Study Citation:	Hu, M., Li, J.,un, Zhang, B., Cui, Q., Wei, S.,i, Yu, H. (2014). Regional distribution of halogenated organophosphate flame retardants in seawater samples from three coastal cities in China. Marine Pollution Bulletin 86:569-574.		
HERO ID:	2693199		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	The methods are described but there could be more detail.
	Metric 2: Analytical Methodology	High	Analytical methods are described in detail, and LOD was reported.
	Metric 3: Biomarker Selection	N/A	Parent chemical measured in media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in China.
	Metric 5: Currency	Low	No sampling date is provided. Publication date is 2014.
	Metric 6: Spatial and Temporal Variability	Medium	There were 13 samples and no replicates.
	Metric 7: Exposure Scenario	High	Source of exposure and reason for choosing the cities is detailed.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Individual data points and summary statistics are provided.
	Metric 9: Quality Assurance	High	QC, blanks, and recoveries are described in detail.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variation in sites is described in detail.

Overall Quality Determination   High

Study Citation: Kong, L., Kadokami, K., Wang, S., Duong, H. T., Chau, H. T. (2015). Monitoring of 1300 organic micro-pollutants in surface waters from Tianjin, North China. Chemosphere 122:125-130.

HERO ID: 2718045

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling method summary was brief but comprehensive.
	Metric 2:	Analytical Methodology	High	Extraction methods and use of various mass spectrometry was described.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling occurred in three watersheds in China.
	Metric 5:	Currency	Medium	Data was collected in 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	No replicates were collected.
	Metric 7:	Exposure Scenario	High	Potential sources of exposure in surface water were identified.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data was provided in supplemental Excel file.
	Metric 9:	Quality Assurance	High	QA/QC was reported and included blanks, spiked samples, and cleaning procedures.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	No gaps nor limitations were reported.

Overall Quality Determination   High

Study Citation:	Huber, S., Warner, N. A., Nygård, T., Remberger, M., Harju, M., Uggerud, H. T., Kaj, L., Hanssen, L. (2015). A broad cocktail of environmental pollutants found in eggs of three seabird species from remote colonies in Norway. Environmental Toxicology and Chemistry 34:1296-1308.		
HERO ID:	2823276		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology was described, such as sampling procedures, storage conditions, and matrix characteristics.
	Metric 2:	Analytical Methodology	High	LOD reported in tables in supplement. The analytical method sufficiently described.
	Metric 3:	Biomarker Selection	N/A	Analyte is the parent chemical in eggs.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in 2 remote islands, Sklinna and Rost, on the Norwegian coast.
	Metric 5:	Currency	Medium	Eggs collected during breeding season between May and June 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	Eggs collected from three seabird species: 6 eggs from one island and 12 eggs from a second island per species. 3 eggs pooled per location/species (homogenized together) before analysis.
	Metric 7:	Exposure Scenario	High	This is a biomonitoring study where seabird transfer of ingested chemicals to their eggs is analyzed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data for individual pooled samples (3 eggs per) presented in Supplement.
	Metric 9:	Quality Assurance	Medium	QA/QC described briefly in Supplement Section 1.13, including 3 types of blanks. No recoveries discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability and uncertainty not reported.

Overall Quality Determination   High

Study Citation: Staaf, T., Ostman, C. (2005). Organophosphate triesters in indoor environments. Journal of Environmental Monitoring 7:883-887.
HERO ID: 2919496

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling is only briefly discussed. The paper refers to another publication for sampling methodology details.
	Metric 2:	Analytical Methodology	Critically Deficient	Analytical methodology is not discussed. The paper refers to another publication for analytical methodology details.
	Metric 3:	Biomarker Selection	N/A	Concentrations were measured in air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	Location (country, state, etc.) is not reported. The study authors are affiliated with a university in Stockholm, so it seems likely that sampling was performed in Stockholm.
	Metric 5:	Currency	Low	Sampling date is not reported, but a publication date is available.
	Metric 6:	Spatial and Temporal Variability	Medium	Five parallel samples were collected at each of 29 indoor environments.
	Metric 7:	Exposure Scenario	High	The study evaluates exposure in a range of microenvironments including private homes, workplaces, stores, health care facilities, and means of transportation.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Individual data points were not reported. Variance is also not reported. It is unclear whether the single values reported for each indoor environment represent a mean of the 5 parallel sampling measurements.
	Metric 9:	Quality Assurance	Critically Deficient	There is no discussion of quality assurance or quality control.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Some discussion on location causing variability under gen observations.

Overall Quality Determination   Uninformative

Study Citation: Marklund, A., Andersson, B., Haglund, P. (2005). Organophosphorus flame retardants and plasticizers in air from various indoor environments. Journal of Environmental Monitoring 7:814-819.

HERO ID: 2919497

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage conditions and duration were not specified. Not all the locations of the sample are specified.
	Metric 2:	Analytical Methodology	High	LOD is reported. Three blanks and duplicate air sample were analyzed.
	Metric 3:	Biomarker Selection	N/A	Concentrations were measured in air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	Critically Deficient	The geographic location is not explicitly reported, but the authors are affiliated with a university in Sweden.
	Metric 5:	Currency	Low	Sampling time is not reported, but a publication date (2005) is available.
	Metric 6:	Spatial and Temporal Variability	High	A total of 17 samples were collected.
	Metric 7:	Exposure Scenario	High	Exposure to Organophosphorus flame retardants and plasticizers in indoor air.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points and measured of variance were not reported.
	Metric 9:	Quality Assurance	High	Recovery is > 70% . Three blanks were run and duplicate air sample were analyzed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No standard deviations were reported, and there is no substantial discussion of uncertainties/limitations.

Overall Quality Determination   Uninformative

Study Citation: Marklund, A., Andersson, B., Haglund, P. (2003). Screening of organophosphorus compounds and their distribution in various indoor environments. Chemosphere 53:1137-1146.

HERO ID: 2919501

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The study explains sampling procedures, sites, and storage conditions.
	Metric 2:	Analytical Methodology	High	The study explains sampling analysis GC-NPD, reanalysis, calibration, and quantification. LOD is reported as a range.
	Metric 3:	Biomarker Selection	N/A	The study evaluates the parent chemical in dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sweden.
	Metric 5:	Currency	Low	The sample collection date is not reported, but the study publication date is available.
	Metric 6:	Spatial and Temporal Variability	Medium	A range of 1- 5 samples per site were collected, the study reports average over a week.
	Metric 7:	Exposure Scenario	Medium	The study does not provide information on building characteristics but does provide information on product use; dust from vacuum cleaner does not provide exact data on indoor dust levels.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The study reported individual data points from each sampling location, but not the summary of statistics across locations.
	Metric 9:	Quality Assurance	Medium	The study reports calibration and linearity.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The study doesn't report a measure of variance or limitations.

Overall Quality Determination   **Medium**

Study Citation: Ishikawa, S., Taketomi, M., Shinohara, R. (1985). Determination of trialkyl phosphates and triaryl phosphates in environmental samples. Water Research 19:119-126.

HERO ID: 2919504

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling procedures and equipment were only briefly described for river water, seawater and sediment samples. The depth of river and seawater sampling was detailed. It is unclear if there was storage of samples or not.
	Metric 2:	Analytical Methodology	High	Analytical methods were described. Limits of detection were detailed in tables.
	Metric 3:	Biomarker Selection	N/A	This study measured parent chemicals within river water, seawater and sediment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Kitakyushu City, Japan.
	Metric 5:	Currency	Low	Sampling was performed in August of 1980.
	Metric 6:	Spatial and Temporal Variability	Medium	It appears that a single sample of river water was collected from each of 16 sites, a single sample of seawater was collected from each of 9 sites, and a single sample of sediment was collected from each of 6 sites. No replicates were reported.
	Metric 7:	Exposure Scenario	Medium	The sampling site was described as one of the largest industrial regions of Japan and the potential exposure sources were detailed. The microclimate was not detailed and exposure controls were not utilized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data was reported within tables, however results were reported as ng/L concentrations only, with no summary statistics for river water, seawater and sediment sampling results.
	Metric 9:	Quality Assurance	Medium	Recoveries of phosphate esters from purified water controls, river water, seawater and sediment samples was detailed. Baseline, pre-exposure sampling was not conducted. Use of reference standards was detailed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	This study presented variability across multiple sampling sites for each sampling media, but no variability in summary statistics was presented. Authors did not have a formal section for discussion of potential study limitations, but did compare results with those from a previously conducted national environmental survey.

Overall Quality Determination   Medium

Study Citation:		Calderón-Preciado, D., Matamoros, V., Bayona, J. M. (2011). Occurrence and potential crop uptake of emerging contaminants and related compounds in an agricultural irrigation network. Science of the Total Environment 412-413:14-19.	
HERO ID:		2919589	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The study explains sampling procedures, materials, sites, and storage conditions.
	Metric 2:	Analytical Methodology	Medium	The study explains the analytical method. The LOD is reported as a range.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Spain.
	Metric 5:	Currency	Medium	Samples collected in the summer of 2008 and 2009.
	Metric 6:	Spatial and Temporal Variability	Medium	A total of 8 samples were collected.
	Metric 7:	Exposure Scenario	Medium	The study evaluates the concentrations of the parent chemical in surface water from an agricultural area.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The raw data is not reported. Table 1 reports mean and SD.
	Metric 9:	Quality Assurance	Low	There is limited information regarding the QA/QC procedures.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study reports variability in terms of SD and some limitations mentioned in the conclusions.

Overall Quality Determination   Medium

Study Citation:	Kim, J., Isobe, T., Muto, M., Nguyen Minh Tue, Katsura, K., Malarvannan, G., Sudaryanto, A., Chang, K. H., Prudente, M., Pham Hung Viet, Takahashi, S., Tanabe, S. (2014). Organophosphorus flame retardants (PFRs) in human breast milk from several Asian countries. Chemosphere 116:91-97.		
HERO ID:	2921301		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling protocol, sample shipment and storage conditions were described briefly. Study site characteristics were noted to be described in a previous report referenced (Tue et al., 2013). There was insufficient information on sampling equipment, for example, whether pumps or manual expression of milk, as well as sample storage time prior to analysis.
	Metric 2: Analytical Methodology	Medium	Sample extraction methodology, analytical instrumentation (UHPC-UFLC-XR), instrument calibration curves, and recoveries were described by the authors with results reported as adjusted for lipids. There was insufficient information regarding sample adjustment for lipids, etc. and method detection limits reported as range rather than chemical-specific MDL's.
	Metric 3: Biomarker Selection	N/A	The authors of this paper only conducted sampling for the parent chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The sampling was conducted in Kanagawa Prefecture, Japan, Malate and Payatas, the Philippines, as well as Hanoi, Bui Dau and Trang Minh, Vietnam.
	Metric 5: Currency	Medium	The sampling was conducted in 2008, 2009-11.
	Metric 6: Spatial and Temporal Variability	Medium	Total results included a large, pooled sample size (n=87), however country- and region-specific result sample sizes ranged from n=7 (Hanoi, Vietnam) to n=20 (Kanagawa Prefecture, Japan). Non-statistical sampling approach, seemingly no replicate samples as number of samples per participant not detailed. There was insufficient information on representativeness of single sample to characterize periodicity of biological concentrations.
	Metric 7: Exposure Scenario	Medium	Authors note details of sampling location and information on demographics and health variables captured within questionnaire. There is insufficient information regarding timing of sampling, lack of field blanks or exposure controls.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Results reported included lipid adjusted statistical summary data of median, range and detection frequency %, as well as location and year of sampling presented. Raw data was not presented. The number of samples > LOD presented within results was not noted.
	Metric 9: Quality Assurance	Medium	Laboratory procedural was described, but field sampling, blanks, and laboratory recoveries were not described. Baseline/pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	There was limited discussion of limitations (single spot sampling, distance of residence from waste dump or e-recycling, occupation) or potential data gaps. Authors discuss examining relationships between milk concentrations and donor-specific parameters such as age, BMI, parity and diet, but do not discuss dietary relationships and it is unclear if such an analysis was conducted. Geographic, demographic variability examined.

Overall Quality Determination　　　　Medium

Study Citation:		Zheng, X., Xu, F., Chen, K., Zeng, Y., Luo, X., Chen, S., Mai, B., Covaci, A. (2015). Flame retardants and organochlorines in indoor dust from several e-waste recycling sites in South China: Composition variations and implications for human exposure. Environment International 78:1-7.		
HERO ID:		2926978		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling collection methods were described minimally.
	Metric 2:	Analytical Methodology	Medium	Analytical methods lacked reporting of sample recoveries in the main text. Another study was referenced, but was unattainable. The supplemental file mentioned analytical methods but did not mention recoveries.
	Metric 3:	Biomarker Selection	N/A	The study measured parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in South China.
	Metric 5:	Currency	Medium	Samples were collected in 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	Collected multiple samples from each site, but only collected samples at one point in time. No replicates were reported.
	Metric 7:	Exposure Scenario	High	Study evaluated exposure to flame retardants in indoor dust from five villages located in three e-waste recycling regions.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not provided. Summary statistics were reported, but the study did not calculate a measure of variation among samples from the same site, or across sites. The standard deviation was only presented graphically.
	Metric 9:	Quality Assurance	Medium	Sample recoveries were not reported, but they did test procedural blanks and a standard reference material. The levels of analytes were blank-corrected.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Robust discussion on variability across sites, but no discussion of key uncertainties or limitations.

Overall Quality Determination   **Medium**

Study Citation: Brandsma, S. H., Leonards, P., Leslie, H. A., de Boer, J. (2015). Tracing organophosphorus and brominated flame retardants and plasticizers in an estuarine food web. Science of the Total Environment 505:22-31.

HERO ID: 2935128

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sediment, suspended particulate matter (SPM) and biota sampling methodology was well described.
	Metric 2:	Analytical Methodology	High	The analytical methods were described, including recoveries and LOD.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed environmental samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Western Scheldt estuary, situated in the south of the Netherlands.
	Metric 5:	Currency	Medium	Samples collected in 2008.
	Metric 6:	Spatial and Temporal Variability	Low	N=3 for sediment and suspended particulate matter, n=34 for food web, without replicates.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to sediment, SPM and biota in an estuary from the Netherlands.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were reported. Graphical data cannot be digitized because it is drawn in 3 dimensions.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail, including the use of blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (SD, range). Uncertainties were briefly discussed.

Overall Quality Determination   High

Study Citation:	He, C., Zheng, J., Qiao, L.,in, Chen, S., Yang, J., Yuan, J. G., Yang, Z. Y.,i, Mai, B.,iX (2015). Occurrence of organophosphorus flame retardants in indoor dust in multiple microenvironments of southern China and implications for human exposure. Chemosphere 133:47-52.
HERO ID:	2938137

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methods were described minimally. There was no discussion of performance or calibration of sampler nor the sample storage conditions and duration.
	Metric 2:	Analytical Methodology	Medium	Described extraction method, analytical instrument, and sample recoveries, but did not report LOQ values in the text. This information may be in the supplemental file.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Southern China.
	Metric 5:	Currency	Medium	Samples collected between September, 2013 and March, 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	Collected more than 10 samples from each microenvironment. Did not use continuous or repeated monitoring methods.
	Metric 7:	Exposure Scenario	Medium	Discussed production and use rates of target chemical and used exposure controls of urban samples. The study did not discuss building characteristics that may influence exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data seems to be reported in supplemental file, but measures of variation were not reported.
	Metric 9:	Quality Assurance	High	QA/QC techniques were reported, including that sample extracts were blank-corrected. The sample recovery rates were acceptable (76.2 $\pm$ 9%).
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Did not report measures of variation within each microenvironment. No discussion of key limitations and uncertainties.

Overall Quality Determination   **Medium**

Study Citation:	Peverly, A. A., Ma, Y., Venier, M., Rodenburg, Z., Spak, S. N., Hornbuckle, K. C., Hites, R. A. (2015). Variations of flame retardant, polycyclic aromatic hydrocarbon, and pesticide concentrations in Chicago's atmosphere measured using passive sampling. Environmental Science and Technology 49:5371-5379.
HERO ID:	2939998

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The air sampling methodology was described in detail.
	Metric 2:	Analytical Methodology	Low	The analytical methods were described but recoveries and LOD were not reported.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed air samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The samples were collected in Chicago, Illinois.
	Metric 5:	Currency	Medium	Samplers were deployed from 2012 to 2014.
	Metric 6:	Spatial and Temporal Variability	High	n=180 samples taken from 2012-2014 from 13 sites.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to flame retardances in Chicago's atmosphere.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were reported. Individual sample concentrations were not included.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail, including laboratory and field blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited characterization of variability (SE bars). Uncertainties were briefly discussed.

Overall Quality Determination High

| | | Study Citation: | Matsukami, H., Nguyen Minh Tue, Suzuki, G.,o, Someya, M., Le Huu Tuyen, Pham Hung Viet, Takahashi, S., Tanabe, S., Takigami, H. (2015). Flame retardant emission from e-waste recycling operation in northern Vietnam: Environmental occurrence of emerging organophosphorus esters used as alternatives for PBDEs. Science of the Total Environment 514:492-499. |
| | | HERO ID: | 2942545 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology was described but the storage duration of samples was not reported.
	Metric 2:	Analytical Methodology	High	The analytical methods were described, including LOQ and recoveries.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed soil samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Bui Dau, Vietnam.
	Metric 5:	Currency	Medium	The samples were collected in 2012.
	Metric 6:	Spatial and Temporal Variability	Low	n=32 samples in total, without replicates.
	Metric 7:	Exposure Scenario	High	The data likely represent relevant exposure scenarios related to flame retardants in soils from Bui Dau, Vietnam but the sample size limits the results' generalizability.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The study did not report individual sample data for soil measurements, but they did report them for sediment samples. Limited summary statistics were reported.
	Metric 9:	Quality Assurance	Medium	The study did not report if they collected field blanks but they did use procedural blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors reported a limited characterization of variability (range). Uncertainties and limitations were not discussed.

Overall Quality Determination　　　　Medium

Study Citation:	Takeuchi, S., Tanaka-Kagawa, T., Saito, I., Kojima, H., Jin, K., Satoh, M., Kobayashi, S., Jinno, H. (2015). Differential determination of plasticizers and organophosphorus flame retardants in residential indoor air in Japan. Environmental Science and Pollution Research 25:7113-7120.		
HERO ID:	3005686		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	The indoor air and dust sampling methods were described but didn't include details about storage conditions.
	Metric 2: Analytical Methodology	Medium	The analytical methods were described, including LOD. Limited details about recoveries were reported.
	Metric 3: Biomarker Selection	N/A	The authors analyzed environmental samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were collected in in Japan.
	Metric 5: Currency	Medium	The sampling was performed during October 2013and January 2014.
	Metric 6: Spatial and Temporal Variability	Low	n=19 for dust samples, 21 for indoor air samples. No replicates.
	Metric 7: Exposure Scenario	Medium	The data likely represent relevant exposure scenarios related to indoor air and dust in Japanese dwellings, but the small sample size limits the results' generalizability.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Only summary statistics were reported, without individual sample concentrations.
	Metric 9: Quality Assurance	High	QA/QC techniques were described, including the use of field and laboratory blanks.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was not characterized. Uncertainties were briefly discussed.

Overall Quality Determination   Medium

Study Citation:	Kucharska, A., Cequier, E., Thomsen, C., Becher, G., Covaci, A., Voorspoels, S. (2015). Assessment of human hair as an indicator of exposure to organophosphate flame retardants. Case study on a Norwegian mother-child cohort. Environment International 83:50-57.		
HERO ID:	3010225		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Key criteria met, sample storage duration prior to analysis not reported, sampling methods detailed within text and referenced.
	Metric 2: Analytical Methodology	Medium	Most key criteria described and analytic methods referenced. LOQ reported in table 1.
	Metric 3: Biomarker Selection	N/A	The authors analyzed hair samples for the parent chemical (TCEP).
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples provided by participants in Oslo, Norway.
	Metric 5: Currency	Medium	Study conducted January through May, 2012.
	Metric 6: Spatial and Temporal Variability	Medium	Non-statistical sampling methods; multiple maternal (n=244 samples) and child (n=112 samples) spot urine samples over 24 hours (total n=356 samples).
	Metric 7: Exposure Scenario	Medium	Participant characteristics not summarized within main text, however detailed information regarding the cohort described within referenced study.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary statistics provided. Lack of raw data.
	Metric 9: Quality Assurance	Medium	Most key criteria met, analytic methods validated and referenced. Procedural blanks reported. The recoveries for the in-house control samples were always in agreement with the recoveries found in the method validation (Kucharska et al., 2014).
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variability characterized within summary statistics, potential study limitations reported.

Overall Quality Determination　　　　　　**Medium**

Study Citation: La Guardia, M. J., Hale, R. C. (2015). Halogenated flame-retardant concentrations in settled dust, respirable and inhalable particulates and polyurethane foam at gymnastic training facilities and residences. Environment International 79:106-114.

HERO ID: 3012534

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Air, dust, and foam sampling methods were all well described and included details on sampling equipment preparation and sample storage.
Metric 2:	Analytical Methodology	Medium	Extraction protocol was adequately described. Mass spectrometry method was only briefly described, and authors point to other publications for method details.
Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from gyms in Seattle, WA.
Metric 5:	Currency	Low	Sampling date was not reported; the publication date is 2015.
Metric 6:	Spatial and Temporal Variability	Medium	Foam samples were collected in replicates of 4 samples. Air sampling was not replicated beyond 24 hours. Dust sampling replicates are not described.
Metric 7:	Exposure Scenario	High	Potential exposure to gymnasts and coaches were characterized.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data was not presented in the paper but thorough summary data was provided.
Metric 9:	Quality Assurance	High	QA/QC included calculation of recovery, analyzing blanks, and some replicate analysis.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Deviation was calculated but error or uncertainty were not calculated or discussed.

Overall Quality Determination   Medium

Study Citation:	Lai, S., Xie, Z., Song, T., Tang, J., Zhang, Y., Mi, W., Peng, J., Zhao, Y., Zou, S., Ebinghaus, R. (2015). Occurrence and dry deposition of organophosphate esters in atmospheric particles over the northern South China Sea. Chemosphere 127:195-200.		
HERO ID:	3013239		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage conditions and durations until sample analysis were missing. Other information such as weather conditions are not well specified for collection of the air samples.
	Metric 2:	Analytical Methodology	Medium	Detailed description of sample pretreatment and analysis was not provided but included a reference (M"ller et al., 2011; Bollmann et al.,2012). Neither an LOD or LOQ was reported but MDL was reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected over the northern South China Sea.
	Metric 5:	Currency	Medium	Samples were collected over 20 days of September through October 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 10 sets of air samples but no replicates.
	Metric 7:	Exposure Scenario	High	The exposure scenario characterizes occurrence and dry deposition of organophosphate esters in the air.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	The raw data, MDL and SD are reported in the SI.
	Metric 9:	Quality Assurance	High	The concentrations of OPEs are corrected with the recoveries ($> 70\%$) of internal standards. Blanks were analyzed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	No limitations were reported.

Overall Quality Determination   High

Study Citation:	Mizouchi, S., Ichiba, M., Takigami, H., Kajiwara, N., Takamuku, T., Miyajima, T., Kodama, H., Someya, T., Ueno, D. (2015). Exposure assessment of organophosphorus and organobromine flame retardants via indoor dust from elementary schools and domestic houses. Chemosphere 123:17-25.		
HERO ID:	3015040		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling methods for floor surface dust within elementary schools and domestic houses and elementary school commercial floor wax product sampling was described in detail in terms of sampling equipment, procedures, sample storage conditions and study site characteristics. The duration of sample storage prior to analysis was not detailed.
	Metric 2: Analytical Methodology	High	Analytical methods were described in terms of extraction method, instrumentation, recovery samples, and method detection limits.
	Metric 3: Biomarker Selection	N/A	This study obtained dust and consumer product samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Sampling was conducted within elementary schools and domestic houses in Japan.
	Metric 5: Currency	Medium	Sampling was conducted in August of 2009 and 2010.
	Metric 6: Spatial and Temporal Variability	Medium	A single floor dust sample was obtained from a lecture room within 5 schools, a computer room within 6 schools, a gymnastic room within 5 schools, a music room within 1 school, and a library within 1 school. Summary statistics were presented for sampling results within a total of 18 rooms sampled within 12 elementary schools. Replicate sampling was not detailed and the choice of sampling sites appeared judgmental.
	Metric 7: Exposure Scenario	Medium	Exposure sources were discussed mainly as consumer product floor polisher/wax, but other potential domestic sources were detailed within the introduction. There were no exposure controls utilized.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Summary statistics included means, standard deviation, minimum, and maximum concentrations. The number of samples and method detection limits were also reported. Raw data was reported within the Supplemental tables.
	Metric 9: Quality Assurance	High	Quality control (QC) was described in detail in methods section of text and within a separate text QC section and included details on recoveries, field and laboratory blanks as well as referenced studies noted to contain more QC information (Takigami et al., 2009, Matsugami et al., 2014).
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was characterized within statistical summary measures, and results from this study were compared with previously published results, however there was little other discussion of potential study limitations.

Overall Quality Determination   High

| | Study Citation: | Van Den Eede, N., Heffernan, A., Aylward, L. L., Hobson, P., Neels, H., Mueller, J. F., Covaci, A. (2015). Age as a determinant of phosphate flame retardant exposure of the Australian population and identification of novel urinary PFR metabolites. Environment International 74:1-8. |
| | HERO ID: | 3020426 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Samples were taken from surplus stored urine from specimens collected in routine testing within a Community-based lab. Sampling methodology of original specimens was unknown and not referenced. It was unclear if all of the surplus stored urine specimens were used, or if a sample was selected, and there was insufficient information regarding selection of surplus urine specimens. There was limited detail provided regarding procedures, equipment, sample storage conditions and storage time prior to shipment from community lab to analysis lab. There was insufficient information regarding the initial specimen collection storage conditions and the time for the original 'surplus stored urine" samples used for study prior to being selected for use within this study. There was insufficient information regarding storage time of the frozen samples prior to the analysis of pooled frozen samples. Dust sampling was described only as collected as part of a previous referenced study (Toms et al., 2009) from Australian households, with some details also provided within SI.
	Metric 2:	Analytical Methodology	Medium	Analytical methods were noted to be further described within Table S1. The text provides a description of the extraction method, analytical instrumentation (MS/MS), MDL's, method recovery, method precision, sensitivity and procedural blanks as detailed within SI Table S3. Authors discuss the urine MDL for DBP (BCEP) as too high for quantitative analysis (> 3ng/mL) resulting in no quantitative data presented. Authors also note the lower MDLs might have been reported using GC-MD/MS rather than MS/MS. The dust sampling analytical methodology was only very briefly described as similar to the method for urine samples, with details provided in SI page 4.
	Metric 3:	Biomarker Selection	N/A	Sampling was conducted for parent chemical within urine as well as dust samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Urine specimens were collected from surplus stored routine urine collections at a lab in Taringa, QLD, Australia. Dust samples were described as taken from Australian households within South East Queensland as part of a referenced previous study but analyzed within this study.
	Metric 5:	Currency	Low	Sampling campaigns 1 and 2 were described as conducted during 2010-2011 and 2012-2013, however it is unclear if these dates refer to the collections of samples from the community lab or refer to the actual dates of original specimen collection for what is referred to as 'surplus stored urine" that is used within this study. Dust samples were analyzed within this study but dust sampling information was referenced as from within a previous study.
	Metric 6:	Spatial and Temporal Variability	Low	The text notes that 35 individuals contributed to pool 1 and 100 individuals contributed to pool 2 of pooled urine samples. The sampling approach was not described for selection of the samples from the stored surplus urine at the community clinic. No duplicate specimen collection was described. It is assumed that a single specimen was collected per person. Only four dust samples were described as taken from Australian households.
	Metric 7:	Exposure Scenario	Medium	The population for urine specimen collection was described in terms of demographic data of age and gender, with no information provided concerning occupation. Authors noted their concerns for TCEP in urine as dependent upon analytical instrumentation. Dust samples were briefly described as from Australian households in South East Queensland.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data for the urine specimens was not reported within the text, but geometric means, ranges, number of individuals, and detection frequencies were listed in Table 1. Dust results were reported within text as a range for four samples without depiction of detection frequencies or measures of central tendency (or raw data).

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Study Citation: Van Den Eede, N., Heffernan, A., Aylward, L. L., Hobson, P., Neels, H., Mueller, J. F., Covaci, A. (2015). Age as a determinant of phosphate flame retardant exposure of the Australian population and identification of novel urinary PFR metabolites. Environment International 74:1-8.

HERO ID: 3020426

Domain	Metric	Rating	Comments
	Metric 9: Quality Assurance	Medium	Authors noted some method validation results including precision, sensitivity and procedural blanks within SI Table S3 and described the accuracy of TPP (DPHP) and TCEP sampling as between 80% -116% . Duplicate samples and pre-exposure sampling was not conducted, but lab blanks were used. Quality control for dust sampling was described within supplemental information.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Urine sample variability was described in summary statistics in terms of range of concentrations. Study limitations were detailed in terms of potentially imprecise analytical instrumentation use for BCEP analysis (no quantitative results presented) as well as a lack of accounting for potentially relevant confounding factors of indoor air and diet, the use of a convenience population sample, and the use of pooled samples. Results for four dust samples were presented as a range, with no limitations regarding dust sampling discussed in text.

Overall Quality Determination   **Medium**

Study Citation:	Salamova, A., Ma, Y., Venier, M., Hites, R. A. (2014). High levels of organophosphate flame retardants in the great lakes atmosphere. Environmental Science & Technology Letters 1:8-14.		
HERO ID:	3027503		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Previously published papers were cited for details on sampling procedures.
	Metric 2: Analytical Methodology	Low	LOD/LOQ were not reported although it could be available in the reference for the analytical method which was not reviewed.
	Metric 3: Biomarker Selection	N/A	Study tested atmospheric concentrations of TCEP and TPP in select areas of the US.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The geographic locations were five sites around the Great Lakes.
	Metric 5: Currency	Medium	Samples were collected from March 2012 to December 2012.
	Metric 6: Spatial and Temporal Variability	Medium	No replicate samples were collected.
	Metric 7: Exposure Scenario	High	Study collected atmospheric particle samples.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data was not presented but detailed summary data was provided.
	Metric 9: Quality Assurance	High	Quality control information is discussed in the supplementary text.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	There is limited discussion of uncertainties, limitations, or data gaps.

Overall Quality Determination   Medium

Study Citation: Liu, L. Y., Salamova, A., He, K., Hites, R. A. (2015). Analysis of polybrominated diphenyl ethers and emerging halogenated and organophosphate flame retardants in human hair and nails. Journal of Chromatography A 1406:251-257.

HERO ID: 3031004

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology, accuracy and precision of methodology discussed extensively, but sample storage duration prior to analyses not detailed.
	Metric 2:	Analytical Methodology	High	Analytical extraction method, instrumentation, calibration curves, chemical-specific LOQ's (Table 1), recoveries detailed.
	Metric 3:	Biomarker Selection	N/A	Sampling for parent chemicals in hair and nails.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected at Indiana Univ, Bloomington campus.
	Metric 5:	Currency	Low	The sampling date/s are not listed within text. The study was published in 2005.
	Metric 6:	Spatial and Temporal Variability	Low	Five simultaneous hair/nail samples, but unclear if these five samples came from five separate people or if one or more individuals provided more than one sample of each media–sampling approach unclear; no duplicate samples reported.
	Metric 7:	Exposure Scenario	Medium	It is unclear if 'students, colleagues, friends" sampled on campus include those with occ exposures not PECO-relevant (hair/nail salon workers).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw concentration data within Table 2 of each of 5 hair/nail samples, but summary description of most parameters missing–conc range, measures of variation, etc.
	Metric 9:	Quality Assurance	Medium	The recovery details were noted however procedural but not field blanks described; no pre-exposure sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No SD/SE or means/CI; limited discussion of data gaps, study limitations. Author does note hair of different lengths and nails of different fingers can have different concentrations, although does not specify lengths in study or discuss further. Authors note hair/nail samples reflect integrated exposure from both internal and external sources. Authors note gathering finger as well as toenail samples within introduction however only seem to report fingernail sampling.

Overall Quality Determination   Medium

Study Citation:		O'Brien, J. W., Thai, P. K., Brandsma, S. H., Leonards, P. E., Ort, C., Mueller, J. F. (2015). Wastewater analysis of Census day samples to investigate per capita input of organophosphorus flame retardants and plasticizers into wastewater. Chemosphere 138:328-334.	
HERO ID:		3035438	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Authors only described sample preservation, storage, and transportation. There was no information on collection procedures.
	Metric 2: Analytical Methodology	High	QA/QC methodology included analytical instruments, extraction methods, limits of detection, and blank levels in both text and supplemental.
	Metric 3: Biomarker Selection	N/A	This is not a biomonitoring study.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Australia.
	Metric 5: Currency	Medium	Samples were collected in August 2011.
	Metric 6: Spatial and Temporal Variability	Medium	Samples were collected from 11 wastewater treatment plants; there were no replicates.
	Metric 7: Exposure Scenario	High	Characteristics of wastewater treatment plants (e.g., air temperature, daily flow, rainfall) were included, as well as population size they serve.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Summary statistics are provided with individual sample concentrations in the SI.
	Metric 9: Quality Assurance	High	QA/QC reported recoveries, blank levels, and corrected blank values in text and SI.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Range and median values were provided, but there was limited discussion of data gaps, uncertainties, and limitations.

Overall Quality Determination　　　　High

Study Citation:	Woudneh, M. B., Benskin, J. P., Wang, G., Grace, R., Hamilton, M. C., Cosgrove, J. R. (2015). Quantitative determination of 13 organophosphorous flame retardants and plasticizers in a wastewater treatment system by high performance liquid chromatography tandem mass spectrometry. Journal of Chromatography A 1400:149-155.		
HERO ID:	3035593		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Samples were collected from a secondary wastewater treatment plant using 1L amber bottles. Sample storage conditions also reported.
Metric 2:	Analytical Methodology	High	The study reports standards and reagents, sample handling, instrument descriptions, method development and validation. Detection limits reported for both liquid and solid samples in table 1.
Metric 3:	Biomarker Selection	N/A	The study test for the parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The study reports that samples were collected in Canada by Environment Canada.
Metric 5:	Currency	Medium	Samples collected in September of 2014.
Metric 6:	Spatial and Temporal Variability	Low	Two samples were collected per each site.
Metric 7:	Exposure Scenario	High	Samples represent wastewater treatment plant serving approximately 480,000 people.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual data not reported. All data reported as the mean of duplicate measurements.
Metric 9:	Quality Assurance	High	The study follows a high QA/QC, mostly reported at the supplemental information.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Variability or uncertainty are not reported.

Overall Quality Determination   **Medium**

Study Citation:	Schreder, E. D., Uding, N., La Guardia, M. J. (2016). Inhalation a significant exposure route for chlorinated organophosphate flame retardants. Chemosphere 150:499-504.		
HERO ID:	3222316		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The sampling methodology is discussed, scientifically sound and consistent with widely accepted methods/approaches for the chemical and media being analyzed.
Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. LOD is reported.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from urban, suburban, and rural areas of Washington State, USA.
Metric 5:	Currency	Medium	Sample collection data is not specified but can be deduced based on the references used (2005 2015).
Metric 6:	Spatial and Temporal Variability	Medium	10 samples were collected, and 9 samples were analyzed.
Metric 7:	Exposure Scenario	High	Inhalation exposure to chlorinated organophosphate flame retardants is characterized.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Both individual data points and summary stats (min, max, mean, median) are reported.
Metric 9:	Quality Assurance	High	Recovery > 82% is reported. Blank was analyzed. No quality control issues were identified.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There was limited discussion of uncertainties.

Overall Quality Determination High

Study Citation:	Wu, M.,in, Yu, G., Cao, Z., Wu, D., Liu, K.,ai, Deng, S., Huang, J.,un, Wang, B.,in, Wang, Y. (2016). Characterization and human exposure assessment of organophosphate flame retardants in indoor dust from several microenvironments of Beijing, China. Chemosphere 150:465-471.		
HERO ID:	3222715		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The dust sampling methodology was described concisely.
Metric 2:	Analytical Methodology	High	The analytical methods were described in detail, including LOQ and recoveries.
Metric 3:	Biomarker Selection	N/A	The authors analyzed dust samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Beijing, China.
Metric 5:	Currency	Medium	Samples were collected between 2012-2013.
Metric 6:	Spatial and Temporal Variability	High	n=60, including >10 samples per microenvironment.
Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to dust in indoor microenvironments in Beijing, China.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only summary statistics were reported.
Metric 9:	Quality Assurance	High	QA/QC techniques were described, including the use of control samples.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (range, percentiles). Uncertainties and limitations were not discussed.

Overall Quality Determination   High

Study Citation:			Langer, S., Fredricsson, M., Weschler, C. J., Bekö, G., Strandberg, B., Remberger, M., Toftum, J., Clausen, G. (2016). Organophosphate esters in dust samples collected from Danish homes and daycare centers. Chemosphere 154:559-566.
HERO ID:			3223090

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Samples were collected according to publicly available SOPs that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) for the chemical and media of interest.
	Metric 2:	Analytical Methodology	High	LOD provided. Samples were analyzed according to publicly available analytical methods that are scientifically sound and widely accepted (i.e., from trusted or authoritative source) and are appropriate for the chemical and media of interest.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Denmark.
	Metric 5:	Currency	Low	Timing of sample collection for monitoring data is not reported, discussed, or referenced. Another publication (Clausen et al. 2012) is referenced for study design and methods. The paper publication year is 2016.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected from 500 bedrooms and 151 daycare centers.
	Metric 7:	Exposure Scenario	High	Relevant exposure scenarios in daycares and homes were presented.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics are detailed, but no raw data was reported.
	Metric 9:	Quality Assurance	Medium	No major QA/QC issues were identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	According to the authors "there is considerable uncertainly in this assessment."

Overall Quality Determination   Medium

Study Citation: Coelho, S. D., Sousa, A. C., Isobe, T., Kim, J. W., Kunisue, T., Nogueira, A. J., Tanabe, S. (2016). Brominated, chlorinated and phosphate organic contaminants in house dust from Portugal. Science of the Total Environment 569-570:442-449.

HERO ID: 3350460

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods are described which included asking participants to provide vacuum cleaner bags in current use along with a questionnaire. Storage of samples is described.
	Metric 2:	Analytical Methodology	Medium	The extraction of house dust is detailed. The analytical method is briefly described with details reported in another cited study. LODs are reported.
	Metric 3:	Biomarker Selection	N/A	Samples were collected in house dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Aveiro and Coimbra, Portugal.
	Metric 5:	Currency	Medium	Samples were collected between 2010-2011.
	Metric 6:	Spatial and Temporal Variability	Medium	28 houses were sampled but there was no indication of replicate sampling.
	Metric 7:	Exposure Scenario	High	The exposure scenario is well-characterized, with house dust being indicative of indoor air exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data are provided.
	Metric 9:	Quality Assurance	Medium	The application of recoveries is uncertain.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Potential sources of variability in results are discussed. No discussion of study limitations is provided.

Overall Quality Determination   Medium

Study Citation: Ding, J., Xu, Z., Huang, W.,ei, Feng, L., Yang, F. (2016). Organophosphate ester flame retardants and plasticizers in human placenta in Eastern China. Science of the Total Environment 554:211-217.

HERO ID: 3351783

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Low	Sampling methodology only briefly discussed, with few details. Placenta collection was from women who gave birth in hospitals of one of two towns in Eastern China.
Metric 2:	Analytical Methodology	High	Details on extraction method, lipid content for matrix adjustment, and analytical instrumentation (UPLC-ESI) with operating conditions (calibration) presumably in referenced study reported. Method detection limits provided as range in text but specified within SI. Recoveries specified within SI.
Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in eastern China.
Metric 5:	Currency	Medium	Samples were collected in 2005.
Metric 6:	Spatial and Temporal Variability	Medium	Fifty placenta samples, with 25 from women in hospitals with e-waste recycling nearby, and 25 from women in hospitals not near e-waste recycling or factories. Sampling described as randomly collected. No replicate samples.
Metric 7:	Exposure Scenario	High	Relevant exposure scenario through bio placental sample; population described with geographic, maternal sociodemographic data.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics of central tendency and variation with mean (Fig. 1), median, range, number of samples and frequency of detection (Table 1) reported. Sampling location briefly described, authors note hospital location as near/far from e-waste but do not note residence of participants. Authors note placental exposure concentrations were independent of placental lipid content.
Metric 9:	Quality Assurance	Medium	The study applied and documented QA/QC efforts including use of method blanks and correction of placental concentrations for method blanks. Recoveries were reported as range 37% -90% however text indicates chemical-specific recoveries may be found within SI.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Exposure ranges were presented. Authors noted reported placental concentrations were higher than comparisons with previously reported human milk concentrations. Limitations not directly presented but authors discussed potential reasoning for results of no correlation of OPE exposures and maternal food consumption, concentration profile variation by site, and no correlation between OPE concentrations and maternal characteristics.

Overall Quality Determination   Medium

Study Citation:	Kolpin, D. W., Furlong, E. T., Meyer, M. T., Thurman, E. M., Zaugg, S. D., Barber, L. B., Buxton, H. T. (2002). Pharmaceuticals, hormones, and other organic wastewater contaminants in US streams, 1999-2000: A national reconnaissance. Environmental Science and Technology 36:1202-1211.		
HERO ID:	3353787		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Samples were collected by USGS personnel, using consistent protocols and procedures. At each site, a composite water sample was collected from about 4-6 vertical profiles.
Metric 2:	Analytical Methodology	High	Five analytical methods were used and described in page 5.
Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in 30 states across USA.
Metric 5:	Currency	Low	Sampling took place in 1999 and 2000.
Metric 6:	Spatial and Temporal Variability	High	139 streams were sampled. The duplicate samples were used for backup purposes.
Metric 7:	Exposure Scenario	High	The exposure scenario is associated with human, industrial, and agricultural wastewaters.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only maximum and median overall concentrations are reported.
Metric 9:	Quality Assurance	High	Analytical QA/QC was described and summarized in Table 2. Reporting limits are in Table 1.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	There was no measure of variance, and limited discussion of uncertainties, variability, etc. (e.g., implications of the use of unfiltered samples for analysis; the influence of variations in reporting levels on detection frequencies).

Overall Quality Determination　　　　　　High

Study Citation:	Shi, Y. L., Gao, L. H., Li, W. H., Wang, Y., Liu, J. M., Cai, Y. Q. (2016). Occurrence, distribution and seasonal variation of organophosphate flame retardants and plasticizers in urban surface water in Beijing, China. Environmental Pollution 209:1-10.		
HERO ID:	3354640		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Low	The sampling methodology is not fully described. Sampling locations were identified but the collection equipment and method of collection were not described.
	Metric 2: Analytical Methodology	High	Extraction of samples and HPLC system used for analysis was described. LODs were reported in the supplemental material.
	Metric 3: Biomarker Selection	N/A	Water sampling was conducted in this study.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The study was conducted in Beijing, China.
	Metric 5: Currency	Medium	Samples were collected between 2013-2014.
	Metric 6: Spatial and Temporal Variability	Medium	A high number of samples was collected, but there is no indication of replicate samples.
	Metric 7: Exposure Scenario	High	Wastewater, rain water, and runoff water were analyzed for potential impact to surface water exposure for the general Beijing population and also for impacts on aquatic organisms.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	No raw data were reported.
	Metric 9: Quality Assurance	High	QA/QC including calibration curves, recovery rates, and use of field blanks was described.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability in results was discussed in detail, but there was no discussion of the limitations of the study.

Overall Quality Determination   **Medium**

Study Citation:	Xu, F., Giovanoulis, G., van Waes, S., Padilla-Sanchez, J. A., Papadopoulou, E., Magnér, J., Haug, L. S., Neels, H., Covaci, A. (2016). Comprehensive study of human external exposure to organophosphate flame retardants via air, dust, and hand wipes: The importance of sampling and assessment strategy. Environmental Science and Technology 50:7752-7760.		
HERO ID:	3357642		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology in terms of sampling equipment, procedures and study site reported as using a validated and referenced method for air sampling. Insufficient information on sample storage and/or storage duration, although this information might be within SI. Sampling methods for living room floor, surface and vacuum bag dust described and noted as further described within SI.
	Metric 2:	Analytical Methodology	Medium	Chemical-specific MLQ reported for each media sampled. Limited description of analytical methodology, although specifics noted as within SI.
	Metric 3:	Biomarker Selection	N/A	Handwipe concentrations for parent chemicals of interest.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Oslo, Norway.
	Metric 5:	Currency	Medium	Dates of sampling not provided, though a citation is provided for the A-TEAM cohort. The research leading to these results received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement #316665 (A-TEAM project). This means that the research could not have been done prior to 2007.
	Metric 6:	Spatial and Temporal Variability	Medium	For air, continuous, 24-hour area and personal monitoring over the same workday for each participant, no replicate sampling. For dust, single sample from living room floor, surface and vacuum bag dust sampling from single sampling day. For handwipes, four handwipe samples for one day for each participant, with only noon-time sample analyzed.
	Metric 7:	Exposure Scenario	Medium	Personal air samples included time at work as sampling conducted on a workday. Handwipe sample was taken at work with insufficient data on relevancy, details of occupation.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics for all media sampled reported in terms of median, range, MLQ, percent detected, and number of samples. Text indicates data within SI, but there is insufficient information in terms of whether raw data is reported within SI.
	Metric 9:	Quality Assurance	Medium	Results noted as blank-corrected. QA details were reported with text noting more information reported in SI Table S-3.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Range of concentrations was reported. Uncertainties and potential explanations for some reported results explored and detailed within discussion.

Overall Quality Determination   Medium

Study Citation: Kile, M. L., Scott, R. P., O'Connell, S. G., Lipscomb, S., Macdonald, M., Mcclelland, M., Anderson, K. A. (2016). Using silicone wristbands to evaluate preschool children's exposure to flame retardants. Environmental Research 147:365-372.

HERO ID: 3361031

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is clear, with detailed information provided on sampling equipment, procedures, storage time and storage stability analysis, and some study site characteristics in terms of age of home, vacuuming frequency, etc.
	Metric 2:	Analytical Methodology	High	The analytical methodology is well described, detailing extraction methods, instrumentation (GC/MS) and LODs (within SI).
	Metric 3:	Biomarker Selection	N/A	Sampling is for parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Oregon, USA (county specified).
	Metric 5:	Currency	Medium	Samples were collected in 2012-2013.
	Metric 6:	Spatial and Temporal Variability	Low	No replicate samples are described. Self-reported, non-validated time of use compliance information (parent-reported) is described. Monitoring in this study is general, 24-hour passive monitoring. Figure 2 notes there were 64-70 samples for both chemicals.
	Metric 7:	Exposure Scenario	Low	It is unclear if passive sampling concentrations within wristbands represent air/environmental concentrations, concentrations from skin products, or internal concentrations through sweat, etc. The survey included information on household characteristics and vacuuming frequency, but not the preschool environment. It is unclear if or how personal product/lotion use (not assessed) might affect extrapolation. The authors noted that silicone affinity for chemicals differs between compounds. The authors noted a lack of information on time-activity patterns. The study used "trip blank" control wristbands.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Wristband concentration data are noted to be within the SI. It is unclear if raw data or summary statistics are included within the SI. Tests for outliers were conducted. Individual points were not reported.
	Metric 9:	Quality Assurance	High	Field and lab control samples were taken. Wristband chemical stability was tested and discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability was accounted for (SE status, etc.). Limitations were discussed.

Overall Quality Determination   **Medium**

Study Citation:	Kingsbury, J. A., Delzer, G. C., Hopple, J. A. (2008). Anthropogenic organic compounds in source water of nine community water systems that withdraw from streams, 2002–05. Scientific Investigations Report 2008-5208 :68.		
HERO ID:	3364193		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The sampling methods followed standard USGS sampling protocols.
	Metric 2: Analytical Methodology	Medium	Analyzed using USGS approved analytical methods, but recoveries and LOD were not reported.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in United States.
	Metric 5: Currency	Medium	Samples were collected between 2002-2005.
	Metric 6: Spatial and Temporal Variability	High	n=12-17 source-water samples collected at each site over 12-month period; variety of flow conditions; field blanks and replicates.
	Metric 7: Exposure Scenario	High	The data likely represent relevant exposure scenarios related to stream water collected prior to water treatment and then finished water tested at nine community water systems.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	Limited summary statistics were reported DF, n, max concentration reported in appendices.
	Metric 9: Quality Assurance	High	QA/QC techniques were described in detail, including the use of field blanks and replicates.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was not characterized. Section "Changes in Concentration" address uncertainties and need for additional information.

Overall Quality Determination   High

Study Citation:	Gao, L., Shi, Y., Li, W., Liu, J., Cai, Y. (2016). Occurrence and distribution of organophosphate triesters and diesters in sludge from sewage treatment plants of Beijing, China. Science of the Total Environment 544:143-149.		
HERO ID:	3366534		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	The sludge sampling methodology was concisely described, without many details about the sampling procedure.
Metric 2:	Analytical Methodology	High	The analytical methods were discussed in detail, including recoveries and LOD.
Metric 3:	Biomarker Selection	N/A	The authors analyzed sludge samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Beijing, China.
Metric 5:	Currency	Medium	Samples were collected between 2008"2014.
Metric 6:	Spatial and Temporal Variability	Medium	n=43 samples from 8 sewage treatment plants.
Metric 7:	Exposure Scenario	Medium	The data likely represent relevant exposure scenarios related to sludge from sewage treatment plants from Beijing, but details about the population of interest were not reported.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only summary statistics were reported, no individual sample concentrations.
Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail, including the use of experimental blanks.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (range). Uncertainties were briefly discussed.

Overall Quality Determination   Medium

Study Citation:	Liang, K., Liu, J. (2016). Understanding the distribution, degradation and fate of organophosphate esters in an advanced municipal sewage treatment plant based on mass flow and mass balance analysis. Science of the Total Environment 544:262-270.		
HERO ID:	3373199		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling method is described in detail.
	Metric 2:	Analytical Methodology	High	LODs are provided in Table S2.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in the environment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Beijing, China.
	Metric 5:	Currency	Medium	Samples were collected in March 2014.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected over a period of 3 days. Single 24-hour composite water samples of raw sewage and primary, secondary and tertiary effluents were collected by using automatic samplers at a sampling interval of 2 hours. Other solid"liquid and dewatered sludge samples were obtained as time-proportional 24-hour composite samples by combining four grab samples collected four times a day with sampling interval of 6 hours.
	Metric 7:	Exposure Scenario	High	Sewage treatment plant could be an exposure source of the chemical.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual points are not reported.
	Metric 9:	Quality Assurance	High	Blanks, recoveries and other QC methods were applied.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limitations are not discussed.

Overall Quality Determination   High

Study Citation:		Faiz, Y., Zhao, W.,ei, Feng, J., Sun, C., He, H., Zhu, J. (2016). Occurrence of triphenylphosphine oxide and other organophosphorus compounds in indoor air and settled dust of an institute building. Building and Environment 106:196-204.	
HERO ID:		3449324	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling methods are detailed, but information was missing on how samples were transported back to laboratory for analysis.
	Metric 2: Analytical Methodology	High	There was no mention of instrument calibration, but pre-treatment and purification methods were discussed. LOD was reported in SI.
	Metric 3: Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in China.
	Metric 5: Currency	Medium	Sampling took place from November 2014 to February 2015.
	Metric 6: Spatial and Temporal Variability	Medium	4-10 samples of air or dust for each room type were collected.
	Metric 7: Exposure Scenario	High	Indoor air and dust in a teaching building represent potential inhalation exposure for building occupants.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary stats are available for all measurements. Raw data for PM10 concentrations are available in SI. No raw data are available for concentrations of OPs in dust samples.
	Metric 9: Quality Assurance	High	QA/QC was reported and included LOD, MDL, spiked lab samples, and measurement of recoveries.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	There was thorough discussion of variability in results but limited discussion of study limitations.

Overall Quality Determination　　　　　High

Study Citation:　　Kong, L., Kadokami, K., Duong, H. T., Chau, H. T. (2016). Screening of 1300 organic micro-pollutants in groundwater from Beijing and Tianjin, North China. Chemosphere 165:221-230.

HERO ID:　　3453174

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methods were explained in detail.
	Metric 2:	Analytical Methodology	Low	The analytical methods were described in the supplemental materials. No LOQ or LOD provided.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in domestic wells throughout Beijing and Tianjin, China.
	Metric 5:	Currency	High	Samples were collected in April 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 10 samples in wells of Beijing and 17 samples in wells of Tianjin. No replicates were reported.
	Metric 7:	Exposure Scenario	High	The exposure scenarios were discussed throughout the study.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 1 reported raw data. Summary statistics were reported, including median, mean, and range.
	Metric 9:	Quality Assurance	Medium	QA/QC techniques not explicitly described. It can be inferred that proper protocols were followed through the study's use of standard methods.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Characterized variability and uncertainties were discussed.

Overall Quality Determination　　　　　　　High

Study Citation: Lee, S., Jeong, W., Kannan, K., Moon, H. B. (2016). Occurrence and exposure assessment of organophosphate flame retardants (OPFRs) through the consumption of drinking water in Korea. Water Research 103:182-188.

HERO ID: 3455908

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling protocol was generally appropriate and included a description of equipment, procedures, storage conditions, and sample preparation.
	Metric 2:	Analytical Methodology	High	Analytical methodology included instrumentation analysis, detection limits, and recovery samples.
	Metric 3:	Biomarker Selection	N/A	This is not a biomonitoring study.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was performed in South Korea.
	Metric 5:	Currency	Medium	The samples were collected in 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 10 or more samples for each type of drinking water, but no replicates were provided.
	Metric 7:	Exposure Scenario	High	The exposure scenario is relevant as it evaluated different types of drinking water sources (i.e., boiled and unboiled tap water, purified water, bottled water) in multiple Korean cities.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data were reported.
	Metric 9:	Quality Assurance	Low	Almost no QA/QC techniques were discussed, except for reporting of recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability is characterized, but there was no discussion about limitations, uncertainties, or data gaps.

Overall Quality Determination   **Medium**

Study Citation: Liu, D., Lin, T., Shen, K., Li, J., Yu, Z., Zhang, G. (2016). Occurrence and Concentrations of Halogenated Flame Retardants in the Atmospheric Fine Particles in Chinese Cities. Environmental Science and Technology 50:9846-9854.

HERO ID: 3457341

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Some information missing on the description of sampling storage and transport back to lab for analysis.
Metric 2:	Analytical Methodology	High	Analytical methods were sufficiently described in detail with additional details in supplemental information. Method detection limits reported in supplemental information.
Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in air sampling.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in China in the cities of Beijing, Shanghai, Guangzhou, Nanjing, Wuhan, Taiyuan, Chengdu, Lanzhou, Guiyang, and Xinxiang.
Metric 5:	Currency	Medium	Samples were collected in 2013-2014
Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected in 10 sampling sites. No replicates were reported.
Metric 7:	Exposure Scenario	Medium	Particulate matter in China to vary greatly from Particulate matter in the United States.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data were not reported. Several summary statistics were reported, including mean, median, 25th percentile, 75th percentile, and range.
Metric 9:	Quality Assurance	High	QA/QC discussed and included calculation of recoveries, use of blanks, and reporting of detection limits.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There was no discussion about extreme values.

Overall Quality Determination   Medium

Study Citation:	Zhao, F., Wan, Y., Zhao, H., Hu, W., Mu, D., Webster, T. F., Hu, J. (2016). Levels of blood organophosphorus flame retardants and association with changes in human sphingolipid homeostasis. Environmental Science and Technology 50:8896-8903.		
HERO ID:	3463794		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Sampling equipment for fasting blood sample, sampling procedures, sample frozen storage were described. Storage duration prior to sample analysis or calibration of sampling equipment were not described. Study site characterized as mobile center for physical examinations of population within Shenzhen, China.
Metric 2:	Analytical Methodology	Medium	Extraction methods and analytical instrumentation (UPLC-MS/MS) were reported. LOD/LOQ data were presented as range but also noted as within SI Table S2. Recoveries and instrument analytical calibration were reported. There was insufficient information on matrix adjustment.
Metric 3:	Biomarker Selection	N/A	Serum samples for parent chemicals of interest were collected.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from Chinese participants in Shenzhen, China.
Metric 5:	Currency	Low	Authors note recruitment during November, 2012, however fasting blood sample collection dates not specified.
Metric 6:	Spatial and Temporal Variability	Low	255 fasting blood samples were collected, with a single blood sample per participant. Insufficient information was provided on population sampling approach.
Metric 7:	Exposure Scenario	Medium	Population was described as "non-occupational", however industrial occupations such as factory work was noted for some participants. Sociodemographic characteristics of population was reported. Use of field blanks/ exposure controls was described.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary exposure concentration data reported details of total samples, median, range, IQR.
Metric 9:	Quality Assurance	Medium	Measured concentrations were blank-corrected; All analytical procedures were checked for accuracy, precision, reproducibility, linearity, blank contamination, matrix spikes, method limits of detection (LODs), and limits of quantification (LOQs). There were no baseline, pre-exposure samples within this cross-sectional study.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Exposure ranges were presented, however there was limited characterization of variability within single samples for each participant. In terms of limitations, authors only briefly note limitation of single fasting blood samples, but detail reliability of single urine specimens in reflecting long term exposures.

Overall Quality Determination　　　**Medium**

Study Citation: Teo, T. L., Coleman, H. M., Khan, S. J. (2016). Presence and select determinants of organophosphate flame retardants in public swimming pools. Science of the Total Environment 569-570:469-475.

HERO ID: 3464010

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Most sampling information was provided and study site characteristics were well described.
	Metric 2:	Analytical Methodology	High	Samples were extracted through SPE and analyzed by GC-MS. LOQs were reported for the 5 PFRs.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sydney, Australia.
	Metric 5:	Currency	Low	The sampling date is not reported; a publication date is available.
	Metric 6:	Spatial and Temporal Variability	High	15 swimming pools were sampled, and there were 3 samples per pool.
	Metric 7:	Exposure Scenario	High	Swimming pool is a highly relevant exposure scenario and the authors reported demographic information of swimmers. The study provided exposure assessment as well and analyzed leaching from kickboards and swimsuits.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Supplementary or raw data are not reported; a description of the sampling location was reported.
	Metric 9:	Quality Assurance	Medium	Blank control samples were reported to be prepared.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability in different factors of the pools (indoor vs outdoor, amount of people, size) was discussed. Limitations were not discussed.

Overall Quality Determination   High

Study Citation:	Abdollahi, A., Eng, A., Jantunen, L. M., Ahrens, L., Shoeib, M., Parnis, J. M., Harner, T. (2017). Characterization of polyurethane foam (PUF) and sorbent impregnated PUF (SIP) disk passive air samplers for measuring organophosphate flame retardants. Chemosphere 167:212-219.		
HERO ID:	3466615		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods for active and passive outdoor urban air sampling were described in detail in terms of sampling equipment, procedures, sample storage conditions, duration of sample storage and study site characteristics.
Metric 2:	Analytical Methodology	High	Analytical methods were described in detail in terms of analytical instrumentation, extraction and recovery samples. Method detection limits were provided within supplemental information.
Metric 3:	Biomarker Selection	N/A	This study tested for the parent chemical in urban outdoor air.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Sampling was conducted within Toronto, Canada.
Metric 5:	Currency	Medium	Sampling was conducted from March 30 through August 13, 2010.
Metric 6:	Spatial and Temporal Variability	Medium	Outdoor urban air was sampled over several months (March-August). Active sampling was conducted 1-2 times per week over 24 hour periods. Passive samplers were described as deployed for 7, 21, 28, 42, 56, 84, 112, 140, 168, and 197 days. Replicate passive samples were collected on days 28, 84, and 197. The total number of samples for presented results was not detailed.
Metric 7:	Exposure Scenario	High	The potential exposure sources were discussed within the introduction of the text. The microenvironment was described within the supplemental information in terms of average temperature, wind direction and wind speed during outdoor air sampling. There were no exposure control samples.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Sampling results were reported within Table 1 and included concentration means for active sampling and the two types of passive samplers, while overall sampling means with standard deviations were reported within the text. Raw data was not reported. A description of the study site was provided as details regarding climate were provided within the supplemental information. Detection frequencies were not provided.
Metric 9:	Quality Assurance	High	Quality control procedures were described in detail within the supplemental information and included analysis of and correction for field blanks. Recovery methodology was previously evaluated and was noted to have been within the high percentage range, although recovery surrogates were not utilized.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Authors presented summary statistics which included variance within reported standard deviations of results, but there was only a limited discussion of uncertainties, data gaps, or limitations.

Overall Quality Determination **High**

Study Citation:	Zhang, X., Zou, W., Mu, L., Chen, Y., Ren, C., Hu, X., Zhou, Q. (2016). Rice ingestion is a major pathway for human exposure to organophosphate flame retardants (OPFRs) in China. Journal of Hazardous Materials 318:686-693.		
HERO ID:	3468265		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling was adequately described. A map was included.
	Metric 2: Analytical Methodology	Low	Extraction and equipment described. Reference to previous papers provided. LOD not provided.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in China.
	Metric 5: Currency	Low	Sampling date was not provided but was discussed or referenced; "Consumption data for beverages was obtained from USEPA (2011) due to lack of data from China" (supplemental file). This means that the study had to have been conducted after 2011.
	Metric 6: Spatial and Temporal Variability	Medium	Samples count was 7 to 50 depending on food type. Sample count was 45 for hair. There were no replicates.
	Metric 7: Exposure Scenario	High	This is a biomonitoring exposure scenario.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Stats reported included mean, median, range, 95% CI, and frequency % .
	Metric 9: Quality Assurance	High	QA was described in SI; blanks, spikes, recovery were included.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was captured by demographic categories. Uncertainty was not discussed.

Overall Quality Determination   **Medium**

Study Citation:	Focazio, M. J., Kolpin, D. W., Barnes, K. K., Furlong, E. T., Meyer, M. T., Zaugg, S. D., Barber, L. B., Thurman, M. E. (2008). A national reconnaissance for pharmaceuticals and other organic wastewater contaminants in the United States–II) untreated drinking water sources. Science of the Total Environment 402:201-216.		
HERO ID:	3559503		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The samples followed standard field protocols from USGS and the methodology was described in the manuscript.
	Metric 2: Analytical Methodology	Medium	The analytical methods were discussed, including MDL. Recoveries were mentioned but values were not reported.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	United States; Fig 1 provides locations of sites sampled; Table 1 lists sites sampled.
	Metric 5: Currency	Low	Samples were collected during the summer 2001.
	Metric 6: Spatial and Temporal Variability	Low	49 surface water sites (n=73 samples).
	Metric 7: Exposure Scenario	High	The data closely represent exposure scenarios related to untreated surface water used as sources of drinking water, known or suspected of at least some human and(or) animal wastewater sources in upstream or upgradient areas.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	Table 3 provides single max concentration in environment and DF.
	Metric 9: Quality Assurance	High	QA/QC techniques were discussed, including blanks, spikes, duplicate samples were analyzed to evaluate recovery, reproducibility and lab contamination (p.211); results not corrected for recovery.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was not characterized. Uncertainties were briefly discussed.

Overall Quality Determination   Medium

| | Study Citation: | Tokumura, M., Hatayama, R., Tatsu, K., Naito, T., Takeda, T., Raknuzzaman, M., -Al-Mamun, M. H., Masunaga, S. (2017). Organophosphate flame retardants in the indoor air and dust in cars in Japan. Environmental Monitoring and Assessment 189:48. |
| | HERO ID: | 3604490 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling equipment and procedures for active air sampling of the inside of unoccupied vehicles and vacuum sampling of surface dust within vehicles were described. The study site was described. The sample storage conditions and duration of sample storage was not discussed.
	Metric 2:	Analytical Methodology	High	Analytical instrumentation was detailed (GC-MS/MS was used to analyze the samples). The MDL and MQL were provided in Table 2. Recoveries were used.
	Metric 3:	Biomarker Selection	N/A	Sampling was conducted within the interiors of unoccupied vehicles for cabin air and surface dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was described as conducted within several outdoor parking sites of Yokohama and Kawagoe, Japan.
	Metric 5:	Currency	Medium	Sampling was described as conducted November 17 through November 27 of 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	Air and dust samples were collected from the interiors of 25 unoccupied cars. There was no indication of replicate sampling.
	Metric 7:	Exposure Scenario	High	The data closely represented relevant exposure scenarios for car users and the sources of exposure were characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Median concentrations and minimum, maximum concentrations were presented within Table 2 for cabin air samples and Table 3 for inside car surface dust samples. Raw data points were provided for dust samples within Table S4, but no raw data was provided for cabin air samples.
	Metric 9:	Quality Assurance	High	No quality control issues were identified. Quality control details were provided within a Quality Assurance/Quality Control section within the main text.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Some uncertainties and limitations were identified, and variability in concentration results was presented within summary statistics.

Overall Quality Determination   High

Study Citation:	Hu, J., Li, N., Yoshino, H., Yanagi, U., Hasegawa, K., Kagi, N., He, Y., Wei, X. (2017). Field study on indoor health risk factors in households with schoolchildren in south-central China. Building and Environment 117:260-273.		
HERO ID:	3841180		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods and approaches were described in detail in Table 2.
	Metric 2:	Analytical Methodology	Low	Analytical methods were mentioned, but the process was minimally described.
	Metric 3:	Biomarker Selection	N/A	They did not test for biomarkers, as they were not needed.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Changsha, China.
	Metric 5:	Currency	Medium	Samples were collected in 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected in 10 households, from various rooms within households. No replicates were reported.
	Metric 7:	Exposure Scenario	High	Samples were collected from indoor environments.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics were reported in figures and within text, including ranges, minimum, maximum, and averages in Table 3. Raw data were not reported.
	Metric 9:	Quality Assurance	Low	No information on QA/QC techniques, analytical blanks, nor recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Characterized variability between seasons and the uncertainty sources were discussed.

Overall Quality Determination   **Medium**

Study Citation:	Loos, R., Tavazzi, S., Mariani, G., Suurkuusk, G., Paracchini, B., Umlauf, G. (2017). Analysis of emerging organic contaminants in water, fish and suspended particulate matter (SPM) in the Joint Danube Survey using solid-phase extraction followed by UHPLC-MS-MS and GC-MS analysis. Science of the Total Environment 607-608:1201-1212.		
HERO ID:	3860951		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology was well described and included description of grab sampling and handling of sample after collection.
Metric 2:	Analytical Methodology	High	Extraction and analysis was adequately described. LODs and LOQs reported in Table S18.
Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from the Danube River.
Metric 5:	Currency	Medium	Sampling occurred in 2013.
Metric 6:	Spatial and Temporal Variability	High	68 sites were sampled with total of 71 water samples. Summary stats were provided to determine Danube River concentrations as a whole but individual site concentrations were also reported based on single samples.
Metric 7:	Exposure Scenario	High	Scenario is relevant to general population and ecological receptors.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics and chart of individual results shown, but no raw data reported clearly.
Metric 9:	Quality Assurance	High	QA/QC was discussed in detail.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There was limited discussion of variability and uncertainty. No standard deviation was provided when giving summary statistics for Danube river as whole. There was some discussion on the trends based on sampling location.

Overall Quality Determination   High

Study Citation:	He, M. J., Yang, T., Yang, Z. H., Li, Q., Wei, S. Q. (2017). Occurrence and Distribution of Organophosphate Esters in Surface Soil and Street Dust from Chongqing, China: Implications for Human Exposure. Archives of Environmental Contamination and Toxicology 73:349-361.		
HERO ID:	3861290		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample site characteristics were described in detail, but actual sampling equipment and procedures were only briefly provided.
	Metric 2:	Analytical Methodology	High	Reference to a previously described sample extraction and purification method was provided, in addition to extraction methods and analytical instrumentation. LOQ was provided in Table S2.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Chongqing, China.
	Metric 5:	Currency	High	Samples were collected in July 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	5-8 dust and soil samples were collected in the different sites delineated within Chongqing. Duplicate samples are mentioned in QA/QC only.
	Metric 7:	Exposure Scenario	High	Soil and dust samples collected in during stable weather conditions in July 2016. Within the city, sample sites included commercial area, old residential areas, new industrial district, and a national park preserve.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data was reported.
	Metric 9:	Quality Assurance	High	Recoveries, blank values, and standard deviations in duplicates were provided.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited discussion of uncertainties, limitations, and data gaps was provided.

Overall Quality Determination   High

| Study Citation: | Kim, U. J., Oh, J. K., Kannan, K. (2017). Occurrence, removal, and environmental emission of organophosphate flame retardants/plasticizers in a wastewater treatment plant in New York State. Environmental Science and Technology 51:7872-7880. |
| HERO ID: | 3862000 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling procedures adequately detailed in text and SI.
	Metric 2:	Analytical Methodology	High	Extraction methods and analytical instrumentation are described in text. Quantification limits are in Table S3.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in New York State.
	Metric 5:	Currency	High	Samples were collected on a monthly basis from August 2013to April 2014. In addition, composite daily samples were takenfrom April 27 to May 1 and from June 27 to June 28 in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	No replicate samples were collected.
	Metric 7:	Exposure Scenario	High	Composition of flame retardants in types of wastewater treatment plant samples (e.g., influent, effluent, sludge) was characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data was not reported.
	Metric 9:	Quality Assurance	High	QA/QC was discussed in detail in text and SI.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Table 1 characterizes variability with min and max, but there was no discussion of uncertainties, limitations, or data gaps.

Overall Quality Determination   High

Study Citation: Zheng, X., Qiao, L., Covaci, A., Sun, R., Guo, H., Zheng, J., Luo, X., Xie, Q., Mai, B. (2017). Brominated and phosphate flame retardants (FRs) in indoor dust from different microenvironments: Implications for human exposure via dust ingestion and dermal contact. Chemosphere 184:185-191.

HERO ID: 3862171

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Study's sampling methodology described equipment, procedures, and storage conditions in both the text and supplemental. It was based on previously published papers.
	Metric 2:	Analytical Methodology	Medium	Only ranges for the limits of quantification were provided.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in South China.
	Metric 5:	Currency	High	Samples were collected in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	8-9 samples were collected per microenvironment, and no replicate samples were collected.
	Metric 7:	Exposure Scenario	High	Exposure to indoor dust from different indoor microenvironments was analyzed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual sample concentrations were not provided. Only median and range were available in Table 1.
	Metric 9:	Quality Assurance	Low	Some pertinent information presented on QA/QC. Recovery percentages varied between the types of flame retardants. A range was reported for all types, and the low end for each was in the 60s% . It was unclear if/how the authors corrected for those low recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Study characterized variance with range, but there was little discussion about limitations, uncertainties, and data gaps.

Overall Quality Determination   Medium

Study Citation:	Zhou, L., Hiltscher, M., Püttmann, W. (2017). Occurrence and human exposure assessment of organophosphate flame retardants in indoor dust from various microenvironments of the Rhine/Main region, Germany. Indoor Air 27:1113-1127.		
HERO ID:	3862555		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Reported all aspects of sampling method in great detail in text and supplemental, as well as according to previously published protocol.
	Metric 2: Analytical Methodology	High	Reported all aspects of analytical method and QA/QC protocols in great detail in text and supplemental. Referenced SRM 2585.
	Metric 3: Biomarker Selection	N/A	Study measures chemicals in the environment.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Sampling took place in the Rhine/Main region of Germany.
	Metric 5: Currency	High	Sampling took place from January to July 2015.
	Metric 6: Spatial and Temporal Variability	Medium	Collected more than one sample from a variety of different microenvironments, but did not apply continuous or repeated monitoring methods. Some microenvironments had fewer than 10 samples. No replicate samples.
	Metric 7: Exposure Scenario	High	Collected questionnaire data on details on sample site characteristics, including ventilation conditions and use patterns.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Did not report raw data, only summary statistics.
	Metric 9: Quality Assurance	High	Performed many QA/QC protocols (procedural and field blanks, SRM dust sample, and sample recoveries) and no issues were identified.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Robust quantitative and qualitative characterization of variability across microenvironments; robust discussion on key data uncertainties.

Overall Quality Determination **High**

Study Citation:		Li, J., Xie, Z., Mi, W., Lai, S., Tian, C., Emeis, K. C., Ebinghaus, R. (2017). Organophosphate esters in air, snow, and seawater in the North Atlantic and the arctic. Environmental Science and Technology 51:6887-6896.		
HERO ID:		3862723		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Methods are detailed in text and further described in SI.
	Metric 2:	Analytical Methodology	High	The MDLs are listed in SI.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in North Atlantic and Arctic regions.
	Metric 5:	Currency	Medium	Samples were collected in June 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	There was no indication of replicate collection.
	Metric 7:	Exposure Scenario	High	Additional contextual data is provided in the SI.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported.
	Metric 9:	Quality Assurance	High	QA/QC was described in detail.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability and uncertainty are both discussed.

Overall Quality Determination   High

Study Citation:	Castorina, R., Butt, C., Stapleton, H. M., Avery, D., Harley, K. G., Holland, N., Eskenazi, B., Bradman, A. (2017). Flame retardants and their metabolites in the homes and urine of pregnant women residing in California (the CHAMACOS cohort). Chemosphere 179:159-166.		
HERO ID:	3864462		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample collection followed the ASTM Standard Practice D 5438-05 for dust. Urine sampling information is not detailed. Type of sample is not specified, suggesting use of unpooled spot samples. The type of container the samples were collected and stored in was not specified. Urine samples were kept at -80C until analysis.
	Metric 2:	Analytical Methodology	High	Type on instrumentation was reported, though information on analytical methodology was brief. MDL and recoveries were reported in Supplemental Material. Urine samples are reported SG standardized in the study itself and unadjusted and creatinine adjusted in the SI.
	Metric 3:	Biomarker Selection	N/A	TCEP was measured in dust only.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Salinas, California.
	Metric 5:	Currency	Low	Samples were collected between 1999-2001.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 310 urine samples and 125 dust samples, but no replicates. The urine samples were likely unpooled spot samples.
	Metric 7:	Exposure Scenario	High	The study collected specific exposure-related information, such as housekeeping quality. It describes the association between levels of TCEP in dust and the presence of "extremely worn" carpet, among other characteristics of the studied population. It also discusses the association between levels of chemicals in dust and in urine.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual samples are not reported, but the summary of statistics is detailed (mean, CI, Min, Man, and 25th/50th/75th/90th percentiles). Adjusted and unadjusted data were reported for urine samples.
	Metric 9:	Quality Assurance	Medium	Lab recoveries of internal standards were reported for urine and for dust. Field QC samples were not reported, and there was minimal discussion of QA/QC reported in the paper. (It may have been discussed in detail in an earlier paper on the cohort study as a whole.)
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	The study characterizes variability in the population and media. Key limitations are reported (e.g., urine and dust samples were not collected on the same date).

Overall Quality Determination　　　Medium

Study Citation:		Clark, A. E., Yoon, S., Sheesley, R. J., Usenko, S. (2017). Spatial and Temporal Distributions of Organophosphate Ester Concentrations from Atmospheric Particulate Matter Samples Collected across Houston, TX. Environmental Science and Technology 51:4239-4247.		
HERO ID:		3864979		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Preparation of the filters and storage after sampling was not described.
	Metric 2:	Analytical Methodology	Medium	The study references prior papers for analytical methods.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Houston, TX.
	Metric 5:	Currency	Medium	Samples were collected in 2013.
	Metric 6:	Spatial and Temporal Variability	High	40 samples were collected at four sampling sites over two days.
	Metric 7:	Exposure Scenario	High	Ambient air exposure to the general population is characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported.
	Metric 9:	Quality Assurance	High	QA/QC included blanks, recovery calculations, and check standards.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Discussion of variability was adequate, but discussion of uncertainties was limited.

Overall Quality Determination   High

| Study Citation: | Zhao, F., Chen, M., Gao, F., Shen, H., Hu, J. (2017). Organophosphorus Flame Retardants in Pregnant Women and Their Transfer to Chorionic Villi. Environmental Science and Technology 51:6489-6497. |
| **HERO ID:** | 3866506 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling protocol used was not a publicly available SOP from a trusted or authoritative source, but the sampling methodology is clear, appropriate (i.e., scientifically sound). Subjects and sample collection described in the materials and methods section.
	Metric 2:	Analytical Methodology	High	The analytical method used was not a publicly available method from a trusted or authoritative source, but the methodology is clear and appropriate (i.e., scientifically sound). LOQ for tissue samples reported in Table 1 and LOD and LOQ for plasma samples reported in Table S4.
	Metric 3:	Biomarker Selection	High	The study reported parent chemical and metabolite (BCEP) in biological media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Beijing, China.
	Metric 5:	Currency	High	Samples were collected between January 2014 and December 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	The collection of replicate samples was not reported. Fifty decidua samples and fifty chorionic villus samples were collected and tested for the parent chemical, and twenty-five of each of those sample types were tested for the metabolite. Twenty-five paired plasma samples were collected and tested for the parent chemical.
	Metric 7:	Exposure Scenario	Medium	The data likely represent relevant/realistic exposure scenario, but the use of expose controls was not described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data was not reported. Summary statistics (detection frequency, mean, median, SD, range, 25% and 75%) reported in Tables 2, 3, and S2.
	Metric 9:	Quality Assurance	Medium	The use of QA/QC techniques and results were described such as the use of field blanks, procedural blanks, matrix effects determination, standards, and recoveries. However, baseline samples were not reported." Tables 1 and S4 report recovery and matrix effects.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study characterizes variability in the population/media studied and reports measures of variance. The study has limited discussion of key uncertainties, limitations, and data gaps.

Overall Quality Determination   High

Study Citation:		Cui, K., Wen, J., Zeng, F., Li, S., Zhou, X., Zeng, Z. (2017). Occurrence and distribution of organophosphate esters in urban soils of the subtropical city, Guangzhou, China. Chemosphere 175:514-520.	
HERO ID:		3867958	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is discussed, scientifically sound and consistent with widely accepted methods/approaches for the chemical and media being analyzed.
	Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. MDL is reported.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in soil measured.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Guangzhou, China.
	Metric 5:	Currency	Medium	Surface soil samples were collected in December 2011.
	Metric 6:	Spatial and Temporal Variability	High	A total of 67 surface soil samples collected.
	Metric 7:	Exposure Scenario	High	Urban soils of a subtropical city sampled. Detailed settings are described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported. Several summary statistics reported, including range, mean, std deviation, and median.
	Metric 9:	Quality Assurance	High	Key QA reported including blanks and recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Reported SD and correlations however, robust discussion of limitations and uncertainties not provided.

Overall Quality Determination   High

Study Citation:		Ma, Y., Jin, J., Li, P., Xu, M., Sun, Y., Wang, Y., Yuan, H. (2017). Organophosphate ester flame retardant concentrations and distributions in serum from inhabitants of Shandong, China, and changes between 2011 and 2015. Environmental Toxicology and Chemistry 36:414-421.	
HERO ID:		3868251	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology, study site characteristics, sample storage conditions briefly detailed within text, and noted as described further within SI Table S1 in terms of sample number and demographics for each pooled sample. Insufficient information on sample storage duration prior to analysis.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology, instrumentation, extraction methods, LOD's and LOQ's reported as ranges for all 6 OPE's, and acceptable recoveries detailed. Insufficient information on instrument calibration.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in serum sample.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Shandong, China.
	Metric 5:	Currency	High	Samples were collected in 2015 and 2011.
	Metric 6:	Spatial and Temporal Variability	Medium	Total of 305 samples collected in 2011, and 452 samples collected in 2015, but final analysis on 10 pooled samples. Single, non-replicate serum samples collected from non-statistical sampling approach of volunteers within a hospital. Samples were age- and sex-stratified then combined into 10 pools for age groups 20 to 29 yr, 30 to 39 yr, 40 to 49 yr, 50 to 59 yr, and 60 yr.
	Metric 7:	Exposure Scenario	Medium	Serum sampled. Population described briefly in terms of age for pooling strategy, and no other information about demographics were given.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Data described as summarized within SI Table S4"raw data not reported within full text or noted as within SI. Summary statistic data presented within figures in full text, with noted additional detail within SI.
	Metric 9:	Quality Assurance	Medium	Accepted laboratory recoveries and use of method blanks. However, authors did not note final concentration data or blank-corrected due to limited blank concentrations detected. Baseline or pre-exposure sampling not conducted.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Although pooled for analysis, large participant sample size contributed somewhat to characterization of inter-individual serum concentration variability. Single serum samples insufficient to characterize intra-individual variability over time. Concentrations pooled within age-stratified categories, but not presented within full text or supplemental as stratified by age. Limited discussion of uncertainties, limitations, and data gaps.

Overall Quality Determination   Medium

Study Citation: Ma, Y., Xie, Z., Lohmann, R., Mi, W., Gao, G. (2017). Organophosphate ester flame retardants and plasticizers in ocean sediments from the north pacific to the arctic ocean. Environmental Science and Technology 51:3809-3815.

HERO ID: 3868253

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology was briefly described in the supplemental information, including sampling equipment, procedures, and storage conditions. The sampling procedures are lacking in detail.
	Metric 2:	Analytical Methodology	High	Analytical methods were sufficiently detailed in the main study and supplemental information. MDL reported in the supplemental.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in sediment sampling.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Bering Sea, Chukchi Sea, Canada Basin, and Central Arctic Ocean.
	Metric 5:	Currency	Medium	Samples were collected in 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected from 5 different sea areas with multiple sites, no replicates.
	Metric 7:	Exposure Scenario	High	Oceanic sediments in North Pacific to Arctic Ocean.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data is reported in Table 1.
	Metric 9:	Quality Assurance	Medium	Key QC reported included use of blanks and recoveries. TPHP specific recovery not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability of samples was well-described. However, there was only minimal characterization of uncertainty.

Overall Quality Determination   High

Study Citation:	Li, P., Jin, J., Wang, Y., Hu, J., Xu, M., Sun, Y., Ma, Y. (2017). Concentrations of organophosphorus, polybromobenzene, and polybrominated diphenyl ether flame retardants in human serum, and relationships between concentrations and donor ages. Chemosphere 171:654-660.		
HERO ID:	3974754		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some information missing such as serum sampling equipment, procedures, storage conditions/duration. Study site characteristics noted as described within the supplemental information.
	Metric 2:	Analytical Methodology	Medium	Extraction method and analytical instrumentation. LOD noted provided in supplemental information Table S1.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemicals in serum.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in south coast of Laizhou Bay, Shandong Province, China.
	Metric 5:	Currency	Low	Sample collection date was not specified, but the study was published in 2017.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample size of 10 age- and gender-specific categories of pooled sampling results. No replicates were reported.
	Metric 7:	Exposure Scenario	Medium	Serum concentrations of contaminants. Insufficient information on whether serum samples were from individuals with relevant/non-relevant exposures.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics including mean (range) concentration data, number of individuals sampled within each pooled age category, frequency of detection data within text and figures. Raw data not provided.
	Metric 9:	Quality Assurance	Medium	Key QA reported including blanks and recovers. Quality control issues identified were minor.ples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There was limited discussion of uncertainties and limitations.

Overall Quality Determination   Medium

Study Citation: Hopple, J. A., Delzer, G. C., Kingsbury, J. A. (2009). Anthropogenic organic compounds in source water of selected community water systems that use groundwater, 2002-05. SIR 2009-5200 :76.

HERO ID: 3975066

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods for source groundwater and finished drinking water samples prior to distribution were described in detail.
	Metric 2:	Analytical Methodology	High	Analytical methods were described and detailed as using USGS approved analytical methods. Laboratory reporting limits were provided within tables.
	Metric 3:	Biomarker Selection	N/A	Study tested parent chemicals in selected community water systems.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was conducted across the U.S. (Fig 1).
	Metric 5:	Currency	Medium	Sampling was conducted October 2002 through July 2005.
	Metric 6:	Spatial and Temporal Variability	High	Sampling was conducted within 12 principal aquifers across the United States within about 15 wells in each SWQA study with 221 well samples. Replicate sampling was conducted.
	Metric 7:	Exposure Scenario	High	Exposure sources were described for contamination in source water (groundwater) and finished water (drinking water) across the U.S.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistic data was provided in Table 5, Appendix 1, and Appendix 3 and included detection frequency, number of samples, maximum concentration in source water (groundwater) and finished water (drinking water). Raw data was not provided.
	Metric 9:	Quality Assurance	Medium	Quality assurance was detailed within descriptions of use of field blanks, replicate samples, and recoveries. Recoveries were generally within acceptable limits for most compounds but actual numbers were not provided.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Authors did not provide measures of variance within statistical summary measures of results, but maximum groundwater concentrations were presented. There was little discussion of limitations, uncertainties, or data gaps.

Overall Quality Determination   High

Study Citation:		Sugeng, E. J., Leonards, P. E. G., van de Bor, M. (2017). Brominated and organophosphorus flame retardants in body wipes and house dust, and an estimation of house dust hand-loadings in Dutch toddlers. Environmental Research 158:789-797.	
HERO ID:		3975074	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology for hand, mouth, body and accumulation wipes, as well as house dust was outlined and included sampling equipment and procedures. The length of time of sample storage was not discussed, but it says the body wipes were frozen within 12 hours. One weakness of the sampling methodology was dust samples were collected with the vacuum in the home, using special filters, instead of being collected with the same vacuum in all homes. (A "Duststream dust collector and filter" was attached at the end of all the vacuums, but the sucking power of the vacuums could have varied, resulting in pulling in different amounts of dust.)
	Metric 2:	Analytical Methodology	Medium	Elements of analytical methodology discussed include instrumentation, extraction, and use of standards. Recoveries are not detailed. LOD's are reported as a range for dust and as less than a value for wipes.
	Metric 3:	Biomarker Selection	N/A	Body wipes and house dust were analyzed for parent chemicals.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was conducted in the Netherlands.
	Metric 5:	Currency	Medium	Recruitment and home visits for data collection took place between August and October of 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 21 participants. Replicate samples was not conducted. Sampling was conducted on a single home visit day.
	Metric 7:	Exposure Scenario	Medium	They measured chemicals collected on a body wipe at the start of a home visit and then measured chemicals on body wipes from toddlers after 30 min of play activity in their homes. These wipes were used on hands, mouths, and backs. They also collected dust from the homes. These data are representative of a realistic exposure scenario. The researchers also used their data to estimate the total amount of dust that accumulates on toddlers' hands each day. Microclimate information was not detailed, and there were no exposure control samples.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual samples are not reported. There is a summary table that takes all the wipes of each type together (those of a particular body part collected upon the researchers' arrival and after 30 min of play). The table presents median, IQR, and range. The SD is not reported.
	Metric 9:	Quality Assurance	Medium	Field control samples are not reported. The study doesn't report results of QA measures, but it says the QA/QC for each series of samples was based on one NIST SRM 2585 dust reference material and one blank. It also reports on use of a standard. However, recoveries were not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	The study reports key limitations, mainly uncertainties. Variability discussed includes differences by age, gender, and education level of the parents.

Overall Quality Determination   **Medium**

Study Citation:	Fernie, K. J., Chabot, D., Champoux, L., Brimble, S., Alaee, M., Marteinson, S., Chen, D., Palace, V., Bird, D. M., Letcher, R. J. (2017). Spatiotemporal patterns and relationships among the diet, biochemistry, and exposure to flame retardants in an apex avian predator, the peregrine falcon. Environmental Research 158:43-53.		
HERO ID:	3975118		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods described in detail.
Metric 2:	Analytical Methodology	High	Analytical methods described in detail and also in S1. LOD reported.
Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in blood samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected at the Canadian Great Lakes area.
Metric 5:	Currency	Medium	Samples were collected in 2010.
Metric 6:	Spatial and Temporal Variability	Medium	Samples varied from 2-13. No replicates.
Metric 7:	Exposure Scenario	High	Reason for choosing falcon population explained. Source of exposure detailed.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data not presented but summary statistics were very thorough.
Metric 9:	Quality Assurance	Medium	QC briefly discussed- recoveries detailed in section 2.2.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Analytical variability quantified briefly but not discussed in depth. No limitations.

Overall Quality Determination   High

Study Citation: Henríquez-Hernández, L. A., Carretón, E., Camacho, M., Montoya-Alonso, J. A., Boada, L. D., Bernal Martín, V., Falcón Cordón, Y., Falcón Cordón, S., Zumbado, M., Luzardo, O. P. (2017). Potential Role of Pet Cats As a Sentinel Species for Human Exposure to Flame Retardants. Frontiers in veterinary science 4:79.

HERO ID: 3984272

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods for cat and human blood were described in detail.
	Metric 2:	Analytical Methodology	Medium	Analytical methods, gas chromatography, and QA/QC were sufficiently described. Limits of quantification were presented as a range.
	Metric 3:	Biomarker Selection	N/A	Parent chemicals were measured in cat and human serum.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was conducted in the Canary Islands, Spain.
	Metric 5:	Currency	High	Sampling was conducted in between October and December of 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Samples of plasma from 22 cats and 20 humans were collected in a single sample from each subject during 2016. No replicate samples were obtained.
	Metric 7:	Exposure Scenario	Medium	Exposure scenario was described in terms of potential sources of domestic exposure. Use of exposure controls was not detailed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics included number of samples, mean, median and standard deviations of reported concentration data. Raw data was not reported.
	Metric 9:	Quality Assurance	High	Analytical QA/QC procedures were described and included laboratory recoveries and reagent blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was a discussion of variability between exposures for humans and cats, however a comprehensive understanding of exposure sources is not well characterized.

Overall Quality Determination   High

Study Citation:	Guo, J., Venier, M., Salamova, A., Hites, R. A. (2017). Bioaccumulation of Dechloranes, organophosphate esters, and other flame retardants in Great Lakes fish. Science of the Total Environment 583:1-9.		
HERO ID:	3985267		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The sampling methodology for fish and air sampling is discussed, scientifically sound and consistent with widely accepted methods/approaches for the chemical and media being analyzed. Samples from fish were collected following the EPA Great Lakes Fish Monitoring and Surveillance Program (GLFMSP) sampling protocol. Air was sampled according to standard operating procedures of the U.S. Integrated Atmospheric Deposition Network.
	Metric 2: Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. Instrument detection limits are reported in Table S1.
	Metric 3: Biomarker Selection	N/A	The study is testing for the parent chemical in fish and air.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Fish sampling was conducted within each of the five U.S. Great Lakes with sampling locations shown within Figure S1. Air was sampled at five United States Integrated Atmospheric Deposition Network (IADN) sites.
	Metric 5: Currency	Medium	Fish samples were collected in 2010, while air sampling was conducted in January, April, July and October of 2013.
	Metric 6: Spatial and Temporal Variability	High	Results were reported within Table 1 for n=13 fish samples and n=13 air samples for TCEP.
	Metric 7: Exposure Scenario	High	The exposure scenario was described and focused on bioaccumulation in fishes in the Great Lakes as well as results of air sampling.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data was not reported. Summary statistics in Table 1 included the number of samples and geometric mean concentration levels. Frequency of detection and measures of variation were not detailed.
	Metric 9: Quality Assurance	High	Quality assurance was detailed within text and included details regarding recoveries, procedural and field blanks.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Variability was discussed in terms of spatial distribution. Results were compared with previous studies, however a robust discussion of potential study limitations was lacking.

Overall Quality Determination　　　　High

Study Citation: Blum, K. M., Andersson, P. L., Renman, G., Ahrens, L., Gros, M., Wiberg, K., Haglund, P. (2017). Non-target screening and prioritization of potentially persistent, bioaccumulating and toxic domestic wastewater contaminants and their removal in on-site and large-scale sewage treatment plants. Science of the Total Environment 575:265-275.

HERO ID: 4143122

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling method was described in details, and lacked a few details about the storage condition and sampling equipment and specific procedure.
	Metric 2:	Analytical Methodology	Low	The analytical method was described, but LOD was not reported.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sweden.
	Metric 5:	Currency	High	Non-target sampling took place in 2013, and target sampling took place in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample size were not directly reported, but can be inferred than it had replicates.
	Metric 7:	Exposure Scenario	Medium	The exposure matrixes were not described in details.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No individual data points were reported either in main article or SI.
	Metric 9:	Quality Assurance	High	Quality assurance measures were explained in details.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study had limited discussion of limitations and variability.

Overall Quality Determination   Medium

| Study Citation: | Iqbal, M., Syed, J. H., Breivik, K., Chaudhry, M. J. I., Li, J., Zhang, G., Malik, R. N. (2017). E-Waste Driven Pollution in Pakistan: The First Evidence of Environmental and Human Exposure to Flame Retardants (FRs) in Karachi City. Environmental Science and Technology 51:13895-13905. |
| HERO ID: | 4161520 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodologies and equipment, location, storage, distance from facility were identified. The gas/particulate samples and description profiles are noted in table S1
	Metric 2:	Analytical Methodology	High	Analytical methods sufficiently described in supporting information S3.
	Metric 3:	Biomarker Selection	N/A	No biomarkers were tested.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected at recycling sites in Pakistan.
	Metric 5:	Currency	Medium	Samples were collected in August 2014
	Metric 6:	Spatial and Temporal Variability	Medium	There were over 10 samples. There were no replicates mentioned.
	Metric 7:	Exposure Scenario	Medium	Exposure occurred from soil to a relevant general pop relevant, were the recycling e-waste is a occupational scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Descriptive statistics were provided in the supporting information S5 and S6
	Metric 9:	Quality Assurance	High	QA reported included repeatability and the use of blanks, and spiked blanks. QA/QC requirements are discussed in the description of the US EPA method 5055 mentioned. There is discussion of MDLs vs IDLs.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was discussion of inter-site variation, uncertainties in Koa, exposure estimates, and limited air samples. There could have been greater discussion of limitations and uncertainties.

Overall Quality Determination High

Study Citation:	Hoffman, K., Lorenzo, A., Butt, C. M., Hammel, S. C., Henderson, B. B., Roman, S. A., Scheri, R. P., Stapleton, H. M., Sosa, J. A. (2017). Exposure to flame retardant chemicals and occurrence and severity of papillary thyroid cancer: A case-control study. Environment International 107:235-242.		
HERO ID:	4161719		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Household dust sampled by vacuum in main living area using methodology described within previously published methods (Stapleton et al., 2012a). Single vacuum type described as used within all sampling. Insufficient information on frozen sample storage time prior to sample analysis, performance of vacuum. Unclear if vacuuming only on floor.
	Metric 2:	Analytical Methodology	Low	Household dust samples analyzed for TPP and TCEP using methodology described in previously published methods (Hoffman et al., 2015; etc.). Extraction methods, analytical instrumentation (GC/ECNI-MS), recovery TPP described. Insufficient information on instrument calibration, LOD/LOQ, recovery for TCEP.
	Metric 3:	Biomarker Selection	N/A	Household dust sampling for parent chemicals (serum sampling not conducted for chemicals of interest).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Study inclusion restricted to those individuals living within 50 miles of Duke University Hospital.
	Metric 5:	Currency	Low	Sampling dates not specified, however can be inferred from recruitment dates given as between April 2014 and January 2016 along with publication date of 2017 such that sampling must be between 2014 and 2017. It is unclear if sampling started in 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	Single dust vacuuming sampling for each household however n=116 for total (case and control) samples analyzed, dust vacuuming limited to home (rather than office, school, etc) and main living room of home, and no replicate sampling over time. Authors do note that household dust FR concentrations known to be correlated over several years and average time in household sampled noted as 10 years, yet unknown if single sample representative of variability in exposures ultimately necessary for development of cancer outcome.
	Metric 7:	Exposure Scenario	Medium	Dust sampling within the main living room home likely representative of non-occupational exposure. Insufficient information on use of exposure controls or blanks.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics reported (Fig. 1 box plots) for n=116. Insufficient information on whether raw data is reported in SI, detection frequencies.
	Metric 9:	Quality Assurance	Medium	Insufficient information on field and laboratory control, blank samples, and lack of pre-exposure sampling. Recoveries reported for TPP but not TCEP.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited information on variability statistics (box plots in Fig. 1), however authors discussed study limitations of single home environment sampling as a proxy for personal exposure, lack of dust sampling for other living environments contributing to exposure, and note average house occupancy of 10 years that may not be representative of FR dust exposures relevant to development of outcome.

Overall Quality Determination   Medium

Study Citation: Zheng, X., Sun, R., Qiao, L., Guo, H., Zheng, J., Mai, B. (2017). Flame retardants on the surface of phones and personal computers. Science of the Total Environment 609:541-545.

HERO ID: 4162077

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	There was a brief description of wipe sampling. There is no method number or reference provided. The storage conditions were mentioned and blanks were collected.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology is provided and a reference with the analytical parameters is cited.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical only.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Guangzhou, China.
	Metric 5:	Currency	High	Samples were collected in June 2015.
	Metric 6:	Spatial and Temporal Variability	Low	There were 4-13 samples collected per type of phone/PC. No replicated were reported.
	Metric 7:	Exposure Scenario	High	Data represents exposure to indoor air.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Several summary statistics were reported, including detection freq, median, and range provided for data sets of 1) phones and 2) PCs. Fig.1 provides a graphical representation of concentration by brand of phone.
	Metric 9:	Quality Assurance	Medium	Key QA reported included use of blanks. Spiked samples were analyzed but results not provided with no issues being identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Median & range provided but variation not tabulated for data set. No replicated were reported. The limitations section states that it is a preliminary study with further work to be done.

Overall Quality Determination   Medium

Study Citation:			Cristale, J., Aragão Belé, T. G., Lacorte, S., Rodrigues de Marchi, M. R. (2018). Occurrence and human exposure to brominated and organophosphorus flame retardants via indoor dust in a Brazilian city. Environmental Pollution 237:695-703.
HERO ID:			4162250

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling method described in detail including sampling time, and sample handling after collection.
	Metric 2: Analytical Methodology	High	Analytical methods detailed in supplement. Method detection limit reported for each target compound in supplement.
	Metric 3: Biomarker Selection	N/A	Parent chemical measured in dust sample.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples collected in Brazil.
	Metric 5: Currency	Low	No sampling date was provided, but publication date is available.
	Metric 6: Spatial and Temporal Variability	Medium	Collected multiple dust samples from each indoor environment, but only collected dust at one point in time in each environment.
	Metric 7: Exposure Scenario	Medium	Concentration in dust samples measured. Limited characterization of building traits and other microenvironmental factors.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	No raw data reported. Summary statistics provided.
	Metric 9: Quality Assurance	High	QA/QC discussed including calibration, extraction efficiency, and procedural blanks.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Standard deviations reported and variabilities discussed.

Overall Quality Determination   High

Study Citation:	Muenhor, D., Moon, H. B., Lee, S., Goosey, E. (2018). Organophosphorus flame retardants (PFRs) and phthalates in floor and road dust from a manual e-waste dismantling facility and adjacent communities in Thailand. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 53:79-90.		
HERO ID:	4164912		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Referenced a previously described standardized protocol for their sampling methodology and included a summary of pertinent information.
Metric 2:	Analytical Methodology	Medium	Analytical method discussed and LOQ provided. However, instrument calibration not discussed.
Metric 3:	Biomarker Selection	N/A	Study tested the parent chemicals in floor and road dust.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Thailand.
Metric 5:	Currency	Medium	Data collected in May 2014.
Metric 6:	Spatial and Temporal Variability	Medium	5-10 samples collected per microenvironment and no replicate data.
Metric 7:	Exposure Scenario	High	Study examined exposure to floor and road dust from a manual e-waste dismantling facility and impact to nearby communities.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics presented such as mean and range. However, raw data not provided.
Metric 9:	Quality Assurance	High	Pertinent QA/QC info provided, including recoveries and references to previously established protocols.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	No discussion of limitations, data gaps, or uncertainties.

Overall Quality Determination   High

Study Citation:		Li, J., Tang, J., Mi, W., Tian, C., Emeis, K. C., Ebinghaus, R., Xie, Z. (2017). Spatial distribution and seasonal variation of organophosphate esters in air above the Bohai and Yellow Seas, China. Environmental Science and Technology 52:89-97.	
HERO ID:		4165497	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methods were described in cited previously published paper. The details on sample storage prior to analysis is missing from the text.
	Metric 2:	Analytical Methodology	High	Analytical methods were sufficiently detailed. Method detection limits reported in supplement.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in air samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Bohai and Yellow Seas, China.
	Metric 5:	Currency	High	Samples were collected in 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	15 samples were collected. There were no replicates mentioned.
	Metric 7:	Exposure Scenario	Medium	Samples collected from the air above the sea off China's coast is not reflective of US general population exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics were reported, including mean, median, range, and standard deviation.
	Metric 9:	Quality Assurance	High	QA/QC techniques were well described and included blanks, MDLs, and recovery rates.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Characterized variability sufficiently. There was a limited discussion of uncertainty.

Overall Quality Determination   High

Study Citation: Zeng, X., Wu, Y., Liu, Z., Gao, S., Yu, Z. (2017). Occurrence and distribution of organophosphate ester flame retardants in indoor dust and their potential health exposure risk. Environmental Toxicology and Chemistry 37:345-352.

HERO ID: 4168728

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology is briefly discussed. Greater details are included in referenced publication (Liu 2014) instead.
	Metric 2:	Analytical Methodology	High	Analytical methodology is sufficiently described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. LOD is reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in indoor dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Jiang"an and Caidian Districts, Wuhan City, China.
	Metric 5:	Currency	Medium	Samples were collected in 2013.
	Metric 6:	Spatial and Temporal Variability	High	There were 53 indoor dust samples. No replicates were reported.
	Metric 7:	Exposure Scenario	High	Exposure occurred through indoor dust containing organophosphate ester flame retardants.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data for individual samples are not reported. Summary statistics included median, range, mean, 25th, 50th, and 75th percentiles, and detection frequency.
	Metric 9:	Quality Assurance	High	QA/QC techniques were reported, including blanks and spiked standards, with no quality issues found.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Mentioned many other references for comparison but variability and uncertainty is not clearly discussed.

Overall Quality Determination   High

Study Citation:	Kim, H., Tanabe, S. I. (2017). Measuring Degree of Contamination by Semi-volatile Organic Compounds (SVOC) in Interiors of Korean Homes and Kindergartens. Journal of Asian Architecture and Building Engineering 16:661-668.		
HERO ID:	4178500		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The paper's sampling procedures and equipment are clearly detailed.
Metric 2:	Analytical Methodology	High	The authors list the limit of detection, matching the criteria.
Metric 3:	Biomarker Selection	N/A	It is stated that the parent chemical was measured in the environment.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	This study was conducted in South Korea.
Metric 5:	Currency	Medium	The dates reported were from 2013 to 2014.
Metric 6:	Spatial and Temporal Variability	Medium	It is reported that samples were collected over multiple days, but it is unclear how many samples were taken.
Metric 7:	Exposure Scenario	High	The source of exposure, floors, is relevant to study, particularly for children.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual data is not reported.
Metric 9:	Quality Assurance	Medium	There is no specific section but quality assurance but can be implied.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There was variability in media (air and dust), setting (house and kindergarten), and floor material (pvc and wood). There was also no mention of limitations.

Overall Quality Determination   High

Study Citation:	Chen, D., Letcher, R. J., Chu, S. (2012). Determination of non-halogenated, chlorinated and brominated organophosphate flame retardants in herring gull eggs based on liquid chromatography-tandem quadrupole mass spectrometry. Journal of Chromatography A 1220:169-174.		
HERO ID:	4181327		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Low	Sampling methodology was described only briefly as part of the annual egg collection in the Environment Canada's GreatLakes Herring Gull Monitoring Program. A reference (C.E. Hebert, R.J. Norstrom, D.V.C. Weseloh, Environ. Rev. 7 (1999) 147) was mentioned, but it was unclear if sampling methods would be detailed within this referenced study and full text was not obtained.
	Metric 2: Analytical Methodology	High	The method limits of quantification were reported in Table 2. Analytical methodology was described in terms of instrumentation, extraction and recoveries.
	Metric 3: Biomarker Selection	N/A	Parent chemicals were measured in eggs.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Sampling was conducted for eggs within the Laurentian Great Lakes area.
	Metric 5: Currency	Medium	Sampling was conducted in 2010.
	Metric 6: Spatial and Temporal Variability	Medium	Table 2 shows replicates and n=5 for the homogenate for method validation, but Table 3 shows 13 individual herring gull eggs samples. A non-statistical sampling methodology was utilized.
	Metric 7: Exposure Scenario	Medium	Exposure sources were described. Exposure controls were not utilized and microclimate information was not detailed.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary statistics were only presented in terms of number of samples and raw data concentrations for each sample.
	Metric 9: Quality Assurance	Medium	Quality assurance procedure details included reporting use of procedural blanks and recoveries were reported.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Summary statistic variability was not presented. Samples were only described as collected in 2010.

Overall Quality Determination　　　Medium

Study Citation:	Sengupta, A., Lyons, J. M., Smith, D. J., Drewes, J. E., Snyder, S. A., Heil, A., Maruya, K. A. (2014). The occurrence and fate of chemicals of emerging concern in coastal urban rivers receiving discharge of treated municipal wastewater effluent. Environmental Toxicology and Chemistry 33:350-358.		
HERO ID:	4181598		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The water sampling methodology was described in detail.
	Metric 2:	Analytical Methodology	Medium	The analytical methods were described, including LOD but did not report recoveries.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in 2 effluent-dominated rivers in southern California.
	Metric 5:	Currency	Medium	Samples were collected in 2011.
	Metric 6:	Spatial and Temporal Variability	High	Two sampling events at multiple locations on each river; 3 surface grabs collected at each station and subdivided into 3 bottles.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to surface water near water reclamation plants in Southern California.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	The authors only reported limited summary statistics. Mean concentrations and std for the 2 sample events provided (Table 3); in-stream concentration Fig 4A and 5A; more data provided in SI tables.
	Metric 9:	Quality Assurance	Low	QA/QC techniques were briefly described, e.g., including the use of field blanks analyzed in parallel with water samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited characterization of variability (SD). Uncertainties were discussed.

Overall Quality Determination   Medium

Study Citation:	Zeng, X., He, L., Cao, S., Ma, S., Yu, Z., Gui, H., Sheng, G., Fu, J. (2014). Occurrence and distribution of organophosphate flame retardants/plasticizers in wastewater treatment plant sludges from the Pearl River Delta, China. Environmental Toxicology and Chemistry 33:1720-1725.		
HERO ID:	4181703		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Insufficient details on sampling equipment and procedures. Storage conditions were not reported. Additional information on site characteristics is referenced as being in the SI.
Metric 2:	Analytical Methodology	High	Extraction method, analytical instrumentation, and LOQ/LOD were all reported.
Metric 3:	Biomarker Selection	N/A	Study tested for the parent chemical in sludge from wastewater treatment plants.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected from Pearl River Delta, Southern China.
Metric 5:	Currency	Low	No sampling date is provided, but a publication date is available.
Metric 6:	Spatial and Temporal Variability	Medium	The authors collected sludge from 19 WWTPs. Only technical replicates but not replicate sampling available.
Metric 7:	Exposure Scenario	High	Sampled concentration in sludge from WWTPs. The authors provided information about the setting of the study.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual sample concentrations reported in the article, Table 2. Missing summary statistics by chemical, though some were provided for the sum of organophosphate retardants.
Metric 9:	Quality Assurance	High	The authors report all pertinent quality assurance information in the article. There were acceptable recoveries for TCEP. TCEP was detected above LOD in blanks but were background-subtracted.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	The authors provide a short discussion about the variability of the sludge concentrations between plants but not limited measure of variance. They also have very limited discussion on limitations or gaps.

Overall Quality Determination   Medium

Study Citation:	Hu, Y. X., Sun, Y. X., Li, X., Xu, W. H., Zhang, Y., Luo, X. J., Dai, S. H., Xu, X. R., Mai, B. X. (2017). Organophosphorus flame retardants in mangrove sediments from the Pearl River Estuary, South China. Chemosphere 181:433-439.		
HERO ID:	4182476		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology fully explained.
Metric 2:	Analytical Methodology	Medium	The extraction and cleanup procedures for OPFRs in sedimentsamples were described by Tan et al. (2016).
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in sediment.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Study occurred in South China.
Metric 5:	Currency	High	Sediment samples were collected November 2015.
Metric 6:	Spatial and Temporal Variability	Medium	Forty-eight surface sediments collected from three mangrove wetlands. No replicate samples were collected.
Metric 7:	Exposure Scenario	Medium	Samples were collected from mangrove wetlands.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics reported such as range, median, and mean. Individual data points are not reported.
Metric 9:	Quality Assurance	Medium	QA/QC discussed including use of blanks and recoveries. No control samples were used.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Limited discussion of uncertainties/limitations.

Overall Quality Determination   **Medium**

Study Citation: Wan, W., Zhang, S., Huang, H., Wu, T. (2016). Occurrence and distribution of organophosphorus esters in soils and wheat plants in a plastic waste treatment area in China. Environmental Pollution 214:349-353.

HERO ID: 4182528

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methodology was provided (e.g., soil depth, size of sample area, storage conditions, sample locations in the SI). Sampling equipment was described but lacking some details.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology is adequately described in text and supplemental information. LODs were only presented as a range for soil and plants.
	Metric 3:	Biomarker Selection	N/A	Analysis was conducted for the chemical in wheat which was grown in areas with soil samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Hubei Province, China.
	Metric 5:	Currency	Medium	The study took place in 2014.
	Metric 6:	Spatial and Temporal Variability	Low	Four soil samples at each of nine sites (28 soil samples total) were taken, 19 were collected at waste sites, and 9 from nearby farmland. Timing of the collection was not specified. The study only used replicate samples (4) for whole wheat plants but not soil.
	Metric 7:	Exposure Scenario	Medium	While local plastic waste and treatment disposal onto surface soils may not apply to the US, this study's other aim of assessing plant uptake can be relevant, especially with regards to transfer of contaminants into the food chain.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Mean, range, and frequency of detection (90%) were reported but no raw data was in text or supplemental information.
	Metric 9:	Quality Assurance	High	Quality assurance steps listed were listed and external standards were used.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The range was provided on page 350 to characterize variance. There was little discussion of uncertainties, limitations, or data gaps.

Overall Quality Determination   Medium

Study Citation:	Maruya, K. A., Dodder, N. G., Sengupta, A., Smith, D. J., Lyons, J. M., Heil, A. T., Drewes, J. E. (2016). Multimedia screening of contaminants of emerging concern (CECS) in coastal urban watersheds in southern California (USA). Environmental Toxicology and Chemistry 35:1986-1994.		
HERO ID:	4182703		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology for fish, river water and sediment sampling was described in detail: 1L of unfiltered water samples were collected using stainless steel bucket; sediment samples were collected using hand shovel and stored in a glass jar; fish samples were collected and wrapped in foil; storage temperature was defined; Table S1 and S2 provide sampling location and dates.
Metric 2:	Analytical Methodology	High	Analytic methodology was described in detail: solid-phase extraction or accelerated solvent extraction was utilized; LC-MS/MS or GC-NCI/MS was utilized; recoveries were reported; reporting limits were provided in Tables S3 -S6.
Metric 3:	Biomarker Selection	N/A	Sampling was conducted in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Sampling for river water and sediment was conducted in the Santa Clara River watershed in southern California. Fish samples were collected in the Los Angeles-Long Beach Harbor complex.
Metric 5:	Currency	Medium	River water sampling was conducted during 2 low-flow events on 27 July and 15 October of 2013. Bed sediment was collected on 4 September 2013. Fish samples were collected in August of 2013 and May of 2014.
Metric 6:	Spatial and Temporal Variability	High	10 water stations in the river watershed were sampled during 2 low-flow events. Bed sediments collected were collected in a single event (n=22). Fish tissues n=26 were collected in August of 2013 and May of 2014.
Metric 7:	Exposure Scenario	High	The exposure scenario was described. Concentrations in coastal urban waterways, water, sediment, and fish tissue samples from effluent-dominated river and multiple embayments were reported.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Raw data was provided in SI.
Metric 9:	Quality Assurance	Low	Quality assurance details were provided and included recoveries and use of procedural and field blanks. Recovery of TCEP-d12 was variable and less than 10% for 7 of 23 sediment extracts, resulting in higher uncertainty and likely underestimated concentrations.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Some study uncertainties were presented. Results were compared to previous studies. Statistical summary measures of variability were not presented.

Overall Quality Determination　　　　　　**High**

Study Citation: Olofsson, U., Brorström-Lundén, E., Kylin, H., Haglund, P. (2013). Comprehensive mass flow analysis of Swedish sludge contaminants. Chemosphere 90:28-35.

HERO ID: 4182871

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology is discussed in the supplement. The discussion contains most information (site characters, sampling procedure, storage).
	Metric 2:	Analytical Methodology	Medium	Analytical procedure was performed by other labs. LOD was mentioned to be calculated but not reported in the document.
	Metric 3:	Biomarker Selection	N/A	The study tested in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Sweden.
	Metric 5:	Currency	Low	The study took place in Autumn of 2004.
	Metric 6:	Spatial and Temporal Variability	Medium	Sludge samples were collected at seven STPs.
	Metric 7:	Exposure Scenario	Medium	Sludge was reported as the exposure medium.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The supplement contained the individual data points but still lacked a few important information including standard deviation.
	Metric 9:	Quality Assurance	High	Quality assurance and quality checks was discussed in the supplement. No issues were identified
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps.

Overall Quality Determination   **Medium**

Study Citation:	Padhye, L. P., Yao, H., Kung'u, F. T., Huang, C. H. (2014). Year-long evaluation on the occurrence and fate of pharmaceuticals, personal care products, and endocrine disrupting chemicals in an urban drinking water treatment plant. Water Research 51:266-276.		
HERO ID:	4253347		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology detailed in text and further detail in SI.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology described with extra details provided in the supplemental file but only range provided for detection limit.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from Southeast U.S.
	Metric 5:	Currency	Medium	Sampling dates are provided in figure 2 (2009-2010).
	Metric 6:	Spatial and Temporal Variability	Low	Sampled at 5 locations along treatment process but only one river sampled.
	Metric 7:	Exposure Scenario	Medium	Sample collection location was generically described as being a major river in the southeast U.S. representing an urban water source.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Summary statistics provided including range and median. Raw data provided in supplemental file.
	Metric 9:	Quality Assurance	High	QA/QC provided in the supplemental file and included duplicate samples, blanks, as well as recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variabilities addressed. Limited discussion on uncertainties and study limitations.

Overall Quality Determination   **Medium**

Study Citation:	He, C., Wang, X., Thai, P., Baduel, C., Gallen, C., Banks, A., Bainton, P., English, K., Mueller, J. F. (2018). Organophosphate and brominated flame retardants in Australian indoor environments: Levels, sources, and preliminary assessment of human exposure. Environmental Pollution 235:670-679.		
HERO ID:	4285929		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology described in detail for dust and air sampling.
Metric 2:	Analytical Methodology	High	Analytical methods described with additional analytical details provided in SI file. LOQs provided in SI.
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in indoor dust and air.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected from Brisbane and Canberra, Australia.
Metric 5:	Currency	High	Sampling took place from January to March 2015.
Metric 6:	Spatial and Temporal Variability	High	Dust samples collected from 85 indoor settings and air sampled from 16 houses and 29 offices. Replicate dust samples collected dust from multiple rooms in each house sampled and continuous air sampling via air monitoring 48-101 days in each room sampled.
Metric 7:	Exposure Scenario	Medium	Concentration in indoor dust and air. Limited discussion of building characteristics, but did record products present at the time of sampling.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics presented such as percentile range and median. Individual data points not reported.
Metric 9:	Quality Assurance	Medium	QA/QC included blanks and LOD and LOQ quantification. No mention of sample recovery from analytical method or extraction efficiency from PUF sampler.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Minimal discussion of study limitations and sources of uncertainty.

Overall Quality Determination　　　　　High

Study Citation:	Li, Y., Yang, C., Zha, D., Wang, L., Lu, G., Sun, Q., Wu, D. (2018). In situ calibration of polar organic chemical integrative samplers to monitor organophosphate flame retardants in river water using polyethersulfone membranes with performance reference compounds. Science of the Total Environment 610-611:1356-1363.		
HERO ID:	4292112		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	A limited field test of modified environmental sampling technique was conducted.
	Metric 2: Analytical Methodology	High	Performance reference (deuterated) compounds were used. This is likely high confidence as multiple methods were compared with one another; however, details are in the Supplemental Materials and Haserzon et al. (2914b).
	Metric 3: Biomarker Selection	N/A	The parent chemical is being tested in the environmental media (in situ)
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	he study took place in Nanjing, China, with drinking water sources in the Sancha Estuary.
	Metric 5: Currency	High	The study was conducted in 2016.
	Metric 6: Spatial and Temporal Variability	Medium	The collection of field grab samples was co-located with three in situ analytic equipment samples drawn five times over 21 days (n=15 samples for each sampling/analytic technique) taken at the confluence of two rivers.
	Metric 7: Exposure Scenario	Low	The river water not the direct exposure medium.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	The mean and standard deviation are found in the bar graph (Fig. 5) comparing methods, not locations.
	Metric 9: Quality Assurance	High	The authors compare results from different methods; precision, calibration, recovery, and blanks. Some details are in the Supplemental Materials.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Analytic method development is provided, examining analytic uncertainties; this is not an analysis of environmental variation, however.

Overall Quality Determination   Medium

Study Citation:	Christia, C., Poma, G., Besis, A., Samara, C., Covaci, A. (2018). Legacy and emerging organophosphorus flame retardants in car dust from Greece: Implications for human exposure. Chemosphere 196:231-239.		
HERO ID:	4292121		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methods materials, handling, and storage was provided for dust samples. Car dust samples were collected using an 1800W vacuum cleaner equipped with a clean paper bag per sample. Car interiors were sampled according to a modified version of the protocol reported by Harrad et al. (2008).
	Metric 2: Analytical Methodology	High	Analytical methods and QA/QC were described and reported. Equipment included Agilent 6890 GC coupled to an Agilent 5973 MS operated in electron impact (EI) mode.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Thessaloniki, Greece.
	Metric 5: Currency	Medium	Sampling date was not provided. Based on the sample description, sampling occurred after 2015. Samples come from older and new cars (1997 to 2015).
	Metric 6: Spatial and Temporal Variability	Medium	Samples were collected in one city, Thessaloniki, Greece. Variability in cars origins and age was discussed.
	Metric 7: Exposure Scenario	High	Car interior exposure scenario is characterized.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Raw data are available in supplemental info.
	Metric 9: Quality Assurance	High	Analytical QA/QC is described and reported.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variability and uncertainty in the measurements were presented.

Overall Quality Determination　　　　　High

Study Citation:	Deng, W. J., Li, N., Wu, R., Richard, W. K. S., Wang, Z., Ho, W. (2018). Phosphorus flame retardants and Bisphenol A in indoor dust and PM2.5 in kindergartens and primary schools in Hong Kong. Environmental Pollution 235:365-371.		
HERO ID:	4292129		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling equipment, procedures, storage conditions, and site characteristics are described in the paper and SI.
	Metric 2:	Analytical Methodology	Medium	Extraction method and analytical instrumentation were described, but limits of detection were only provided as a range.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Hong Kong.
	Metric 5:	Currency	High	Samples were collected from June 2015-May 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Two primary schools and nine kindergartens were sampled. No replicate samples were collected.
	Metric 7:	Exposure Scenario	High	Children's exposure via indoor dust in kindergartens and primary schools was characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics were presented, but no raw data was presented.
	Metric 9:	Quality Assurance	Low	Recovery ranges were reported in Section 2.3. No other information on QA/QC was presented.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was some characterization of variance (e.g., range). There was little discussion of limitations, data gaps, or uncertainties.

Overall Quality Determination　　　　Medium

| | Study Citation: | Poma, G., Sales, C., Bruyland, B., Christia, C., Goscinny, S., Van Loco, J., Covaci, A. (2018). Occurrence of organophosphorus flame retardants and plasticizers (PFRs) in Belgian foodstuffs and estimation of the dietary exposure of the adult population. Environmental Science and Technology 52:2331-2338. |
| | HERO ID: | 4292130 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sample methodology, including collection, processing, and storage, were described.
	Metric 2:	Analytical Methodology	High	Analytical methods were described in detail. Limits of quantification can be found in the supplemental material.
	Metric 3:	Biomarker Selection	N/A	This is not applicable as it is the parent chemical detected in foods.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study looked at Belgian food stuffs in Belgium.
	Metric 5:	Currency	High	The study was conducted from 2015 to 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	There was a range of 2 to 45 samples per food category.
	Metric 7:	Exposure Scenario	High	The study looked at dietary exposures.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No individual values were provided.
	Metric 9:	Quality Assurance	Medium	There was no report of recovery for each chemical in extraction.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was limited discussion on study limitations.

Overall Quality Determination   High

	Domain	Metric	Rating	Comments

Study Citation: Persson, J., Wang, T., Hagberg, J. (2018). Organophosphate flame retardants and plasticizers in indoor dust, air and window wipes in newly built low-energy preschools. Science of the Total Environment 628-629:159-168.

HERO ID: 4292133

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods and approaches described. Materials, supplies, and storage.
	Metric 2:	Analytical Methodology	High	The chemical analysis was performed by a gas chromatograph (GC;Agilent 7890A) coupled with a mass spectrometer (MS; Agilent5975C). Analytical QA/QC was reported in supplemental, including limits of detection.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in dust, air, and window wipes samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sweden.
	Metric 5:	Currency	High	Samples were collected in 2015 and 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Three preschools, four sampling periods, over 2 years, but only 1 to 2 samples per sample type. No replicates.
	Metric 7:	Exposure Scenario	High	Preschool indoor environment. Although this might not be very applicable to USA preschool indoor environments.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Supplementary data may contain raw data, but these are not publicly accessible.
	Metric 9:	Quality Assurance	Low	QA discussed in supplementary materials but these are not available to review.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Standard deviation reported but no discussion of limitations

Overall Quality Determination　　　　High

Study Citation:	Larsson, K., de Wit, C. A., Sellström, U., Sahlström, L., Lindh, C. H., Berglund, M. (2018). Brominated flame retardants and organophosphate esters in preschool dust and children's hand wipes. Environmental Science and Technology 52:4878-4888.		
HERO ID:	4292136		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methods and approaches described.
	Metric 2: Analytical Methodology	High	Analytical methods provided, including recoveries and LOD.
	Metric 3: Biomarker Selection	N/A	The authors analyzed dust and hand wipes for the parent chemical TCEP.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Sweden.
	Metric 5: Currency	High	Samples were collected in 2015.
	Metric 6: Spatial and Temporal Variability	Medium	One sample per kid, but 100 kids and samples in total.
	Metric 7: Exposure Scenario	High	The data closely represent preschool environment exposure scenarios in Sweden.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data was not available, only summary statistics (ranges, medians)
	Metric 9: Quality Assurance	High	Analytical QA/QC reported and summarized.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was characterized (ranges only). Uncertainties were briefly discussed.

Overall Quality Determination   High

Study Citation:	Matamoros, V., Arias, C. A., Nguyen, L. X., Salvadó, V., Brix, H. (2012). Occurrence and behavior of emerging contaminants in surface water and a restored wetland. Chemosphere 88:1083-1089.		
HERO ID:	4330586		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The water sampling methodology was well described.
	Metric 2: Analytical Methodology	Medium	The analytical methods were described, including recoveries but did not include LOD values.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Denmark.
	Metric 5: Currency	Medium	Samples were collected between September to December 2010.
	Metric 6: Spatial and Temporal Variability	Medium	n=29 water samples in total, with replicates.
	Metric 7: Exposure Scenario	High	The data closely represent relevant exposure scenarios related to TCEP in freshwater in Denmark.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	The authors reported summary statistics only (DF, min, max, and mean provided in Table 1).
	Metric 9: Quality Assurance	Low	QA/QC techniques were briefly described.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Variability was characterized (range). Uncertainties and limitations were not discussed.

Overall Quality Determination   **Medium**

Study Citation:		Kademoglou, K., Xu, F., Padilla-Sanchez, J. A., Haug, L. S., Covaci, A., Collins, C. D. (2017). Legacy and alternative flame retardants in Norwegian and UK indoor environment: Implications of human exposure via dust ingestion. Environment International 102:48-56.	
HERO ID:		4433160	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Some sampling methods such as sampler calibration and sample storage were not well reported. Samples are from a cohort study described in another reference.
	Metric 2: Analytical Methodology	Medium	Some analytical methods such as recovery samples were not reported.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Norway and UK.
	Metric 5: Currency	Medium	Samples were collected in 2013 and 2014.
	Metric 6: Spatial and Temporal Variability	Medium	There were over 10 samples collected, but no replicates were collected.
	Metric 7: Exposure Scenario	High	The exposure scenario characterizes indoor environments. Daily intakes were presented.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data were not reported.
	Metric 9: Quality Assurance	Low	Limited QA was reported.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Few study gaps and limitations were reported.

Overall Quality Determination　　　　Medium

Study Citation:		Been, F., Bastiaensen, M., Lai, F. Y., van Nuijs, A. L. N., Covaci, A. (2017). Liquid chromatography-tandem mass spectrometry analysis of biomarkers of exposure to phosphorus flame retardants in wastewater to monitor community-wide exposure. Industrial and Engineering Chemistry Analytical Edition 89:10045-10053.	
HERO ID:		4457234	

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The article reports sufficient information about the sampling procedure, but the sample storage duration is not mentioned nor information on the autosampler performance.
	Metric 2:	Analytical Methodology	High	The authors reported that their sample preparation and instrumental analysis were validated based on guidelines from European Medicines Agency.
	Metric 3:	Biomarker Selection	N/A	The authors measured TCEP, the parent compound in the wastewater.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors described the study area. Samples collected in Flanders, Belgium.
	Metric 5:	Currency	High	Authors report samples were collected between 2015-2016.
	Metric 6:	Spatial and Temporal Variability	Medium	The authors report that they collected 24 hr composite samples with sampling intervals of 10 minutes over a two day period at 4 different wastewater plants. The total number of samples is assumed to be 8 and no replicate samples are mentioned.
	Metric 7:	Exposure Scenario	Medium	There is not much information overall about exposure to TCEP in the population studied or a control group with varying levels of exposure to TCEP.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors do not report a standard deviation. The frequency of detection for TCEP was also not reported.
	Metric 9:	Quality Assurance	Medium	The authors detailed procedures for recoveries and stability of the biomarkers. The authors reported that there were some cases of TCEP being measured in procedural blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors do not report a standard deviation. They do include a discussion around the limitations of the study, as they only measured on two days, and the potential for the concentration of TCEP in wastewater to be from non-human sources such as consumer products.

Overall Quality Determination   **Medium**

Study Citation: Scott, B. F., Sverko, E., Maguire, R. J. (1996). Determination of benzothiazole and alkylphosphates in water samples from the Great Lakes drainage basin by gas chromatography/atomic emission detection. Water Quality Research Journal of Canada 31:341-360.

HERO ID: 4530235

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Very limited discussion on sampling methodology. Study cites other papers for sampling methodology of archived samples.
	Metric 2:	Analytical Methodology	Low	Detection limits were not reported, but the analytical procedures were outlined.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Great Lakes
	Metric 5:	Currency	Low	Samples were collected in 1994.
	Metric 6:	Spatial and Temporal Variability	Medium	Uncertain if replicate sampling or analysis was conducted. At least 43 samples were collected per site.
	Metric 7:	Exposure Scenario	Medium	Surface water sampling is pertinent to general population exposure but potential sources of exposure was not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not reported. Table 2 has summary stats for each site.
	Metric 9:	Quality Assurance	Low	The QA/QC does not report recovery or LOD.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No standard deviation or measure of variance is provided.

Overall Quality Determination   Low

	Study Citation:	Yadav, I. C., Devi, N. L., Li, J., Zhang, G. (2018). Organophosphate ester flame retardants in Nepalese soil: Spatial distribution, source apportionment and air-soil exchange assessment. Chemosphere 190:114-123.
	HERO ID:	4550202

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Methods were briefly discussed. Details about sampling location and collection procedure were discussed in a referenced paper (Yadav et al., 2017b).
	Metric 2:	Analytical Methodology	Medium	Analytical methods were described in detail. Range of method detection limit (0.51-17.1 ng/g) was given but individual MDLs for each compound weren't reported.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Nepal.
	Metric 5:	Currency	Medium	Sampling occurred in 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	There was no indication of replicate sampling.
	Metric 7:	Exposure Scenario	Medium	Sampling of Nepalese soil is not directly pertinent to exposures to the US general population.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data was reported.
	Metric 9:	Quality Assurance	High	QA/QC was discussed and included blanks, recoveries, and method detection limits, although MDL was only given as a range and not reported for individual compounds.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Potential sources of variability was discussed, but there was limited discussion of uncertainty.

Overall Quality Determination   Medium

Study Citation:	He, M. J., Lu, J. F., Ma, J. Y., Wang, H., Du, X. F. (2018). Organophosphate esters and phthalate esters in human hair from rural and urban areas, Chongqing, China: Concentrations, composition profiles and sources in comparison to street dust. Environmental Pollution 237:143-153.		
HERO ID:	4574307		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology was detailed in terms of equipment, procedures, sample storage conditions, study site characteristics for hair and dust. Insufficient information was provided on sample storage duration prior to analysis.
	Metric 2:	Analytical Methodology	High	Analytical methodology was described in terms of extraction and recovery range and referenced in terms of analytical instrumentation details within previous study and SI. LOD/LOQ information was presented within SI.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Chongqing, China.
	Metric 5:	Currency	Medium	Sampling was conducted in 2014 for hair and dust.
	Metric 6:	Spatial and Temporal Variability	Medium	There was a large sample size for rural (n=154) and urban (n=43) hair samples, but single sampling for each participant and non-statistical sampling methods. There was a moderate sample size for rural (n=6) and urban (n=6) dust samples and authors note replicate (three sub-samples) sampling, but location of dust sampling within the residence was not described within text and non-statistical sampling methodology.
	Metric 7:	Exposure Scenario	High	Participant occupations noted as including government officers, salesmen, students and retired people in urban areas, with agricultural work as the primary occupation of rural participants.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics reported in terms of range, mean (SD), median, number of samples, urban/rural location and detection frequencies. Insufficient information was provided on raw data for individual participants.
	Metric 9:	Quality Assurance	High	Study QA/QC details within text included laboratory control/blanks, recoveries, and blank-correction of lab results with further information within SI.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Range of chemical-specific concentrations was reported, and results were compared with previous work. Potential sources of exposure for sampling media, and limitations in terms of the exogenous and endogenous source exposures for hair analysis due to unwashed hair sampling and limited sample size for dust sampling was discussed. Authors acknowledge lack of gender analysis due to limited number of female participants, but do not discuss this in relation to concentrations related to personal care products in this study, or other potential study limitations (e.g., possible data gaps).

Overall Quality Determination   **High**

Study Citation:		Okeme, J. O., Yang, C., Abdollahi, A., Dhal, S., Harris, S. A., Jantunen, L. M., Tsirlin, D., Diamond, M. L. (2018). Passive air sampling of flame retardants and plasticizers in Canadian homes using PDMS, XAD-coated PDMS and PUF samplers. Environmental Pollution 239:109-117.		
HERO ID:		4659643		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The study reports home air sampling and the sample storage.
	Metric 2:	Analytical Methodology	Low	The analytical procedures were outlined. Section 2.5 discusses how LOD and LOQ are calculated but no values provided.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in greater Toronto area and Ottawa, Canada.
	Metric 5:	Currency	High	Samples were collected in February and August 2015.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected in 32 homes in the Toronto area and 19 in Ottawa (homes included apartments, detached homes, semi-detached homes, townhouses and condos); sampled for 3 weeks; duplicate and field blanks were collected.
	Metric 7:	Exposure Scenario	Medium	The study focused on home sampling; 5 apartments, 34 detached homes, 7 semi-detached; 3 townhouses and 2 condos; number of residents ranged from 1 to 7.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not reported. Section 3.3 reported concentrations (min, max, median, mean, SD) and DF provided in Table S3d.
	Metric 9:	Quality Assurance	Medium	QA/QC reported in Section 2.5; recovery was corrected for individual compounds.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limitations are not reported, variability reported as SD, and comparison between other studies.

Overall Quality Determination　　**Medium**

Study Citation:		Kishi, R., Ketema, R. M., Bamai, Y. A., Araki, A., Kawai, T., Tsuboi, T., Saito, I., Yoshioka, E., Saito, T. (2018). Indoor environmental pollutants and their association with sick house syndrome among adults and children in elementary school. Building and Environment 136:293-301.		
HERO ID:		4728476		

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is discussed, scientifically sound and consistent with widely accepted methods/approaches for the chemical and media being analyzed. The references for the full sampling description are provided.
	Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. LOD is reported. The previous studies are referred for analysis method.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Sapporo, Japan.
	Metric 5:	Currency	Medium	The samples were collected in October and November of 2009 and 2010.
	Metric 6:	Spatial and Temporal Variability	High	There were 128 samples and no replicates.
	Metric 7:	Exposure Scenario	High	Indoor air exposure were measured in the residential house.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Full Raw data are not reported. Only summary statistics were reported.
	Metric 9:	Quality Assurance	High	Quality assurance procedures in sample collection and analysis were reported with most key criteria met.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limitations are well described but variability and uncertainty are not well discussed.

Overall Quality Determination   **High**

Study Citation:	He, R. W., Li, Y. Z., Xiang, P., Li, C., Cui, X. Y., Ma, L. Q. (2018). Impact of particle size on distribution and human exposure of flame retardants in indoor dust. Environmental Research 162:166-172.		
HERO ID:	4728480		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	The study was missing some information on sampling equipment and procedures (e.g., the study reported some dust samples were "collected from air conditioner (AC) filters," but didn't describe how). Sample storage duration was not reported.
Metric 2:	Analytical Methodology	Medium	The study reported a range LODs for the tested organophosphate flame retardants but did not report individual LODs.
Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from indoor environments in Nanjing, China.
Metric 5:	Currency	Low	No sampling date is provided, but a publication date is available.
Metric 6:	Spatial and Temporal Variability	Medium	Indoor dust samples were collected from more than 100 car interiors and 26 indoor environments (e.g., offices, a hotel, a supermarket, etc.). Triplicate samples of each dust were extracted, but it appears that only one sample per site was collected. Dust samples were sieved into 6 fractions.
Metric 7:	Exposure Scenario	Medium	The study does not report information on potential chemical use in the indoor settings that were sampled.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The main study and S1 did not report individual data points and are missing some summary statistics. Mean concentrations are reported in supplemental materials.
Metric 9:	Quality Assurance	High	The study indicated that all glassware used during sample extraction was washed and heated. Method, procedural, and solvent blanks were included. The study reported that TCEP was detected in procedural blanks, and that this was "accounted for during data analysis." Recovery efficiency was reported, and was >90% .
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There is no discussion of uncertainties, limitations, data gaps. There is study in the variation of different dust sizes.

Overall Quality Determination   **Medium**

Study Citation:	Ingerowski, G., Friedle, A., Thumulla, J. (2001). Chlorinated ethyl and isopropyl phosphoric acid triesters in the indoor environment–an inter-laboratory exposure study. Indoor Air 11:145-149.		
HERO ID:	4731349		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	House dust, indoor air, and building materials samples were collected. Missing information on sampling methodologies included: sample storage conditions and duration, and study sample site characteristics. Indoor dust sampling location(s) were not specified. The number of building material samples analyzed was not reported.
	Metric 2: Analytical Methodology	Medium	This is an inter-laboratory study (3 participating labs), but an outline of the analytical methods used to analyze dust samples at only one of the laboratories was provided. A brief description of analytical methods for indoor air samples was also reported. LODs for indoor air and dust analyses were reported. No analytical methods details were provided for building materials samples.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected from homes in western Germany.
	Metric 5: Currency	Low	The sampling period is not reported, but a publication date is available.
	Metric 6: Spatial and Temporal Variability	Medium	It's unclear whether replicate samples were included even though 983 samples were analyzed.
	Metric 7: Exposure Scenario	Medium	The study doesn't include information on TCEP use in the sampled homes, and only minimally characterizes the sample sites. The study indicates that most of the dust samples tested were from clients who were referred to the laboratories because of health complaints, and it's unclear how/whether this affects the representativeness of the samples.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data points were not reported. Means were reported, but measures of variance were not reported. SD values were not specified. Raw data or supplementary data are not provided.
	Metric 9: Quality Assurance	Low	The study reports that analyses were performed to ensure good correspondence between the three participating laboratories. Control analyses were performed to address potential contamination of samples by vacuum cleaners and filter bags. Also, for indoor air measurements, control analysis of the cartridges were performed to ensure no contamination. The study does not include information on other quality control measures.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	No measures of variance were reported, and there is no discussion of uncertainties, limitations, or data gaps.

Overall Quality Determination   **Medium**

Study Citation:	Ait Bamai, Y., Araki, A., Nomura, T., Kawai, T., Tsuboi, T., Kobayashi, S., Miyashita, C., Takeda, M., Shimizu, H., Kishi, R. (2018). Association of filaggrin gene mutations and childhood eczema and wheeze with phthalates and phosphorus flame retardants in house dust: The Hokkaido study on Environment and Children's Health. Environment International 121:102-110.		
HERO ID:	4829235		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The authors report the microenvironment of the dust collection (living room floor), and the sampling equipment. They also reported the storage conditions but not the storage duration.
Metric 2:	Analytical Methodology	Medium	The authors referred to another paper regarding the methods, but they reported the analytical method used and instrumentation. The authors reported LOQ.
Metric 3:	Biomarker Selection	N/A	NA - Dust sample no biomarker needed.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Hokkaido Japan.
Metric 5:	Currency	Medium	Samples were collected in 2013.
Metric 6:	Spatial and Temporal Variability	Medium	The study collected 888 house dust samples, however they did not collect replicate samples.
Metric 7:	Exposure Scenario	Medium	The exposure scenario is relevant.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The authors report the detection frequency, min, max, 25 and 75% . They also reported the number of samples in the data set. No standard deviation was reported, nor individual concentrations.
Metric 9:	Quality Assurance	Medium	The authors refer to another paper regarding their quality control and assurance methods.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	The authors address limitations of the study, variance was reported in terms of percentiles.

Overall Quality Determination　　　　　Medium

Study Citation:		Fan, G., Xie, J., Yoshino, H., Zhang, H., Li, Z., Li, N., Liu, J., Lv, Y., Zhu, S., Yanagi, U., Hasegawa, K., Kagi, N., Zhang, X., Liu, J. (2018). Common SVOCs in house dust from urban dwellings with schoolchildren in six typical cities of China and associated non-dietary exposure and health risk assessment. Environment International 120:431-442.		
HERO ID:		4829253		

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology described in detail.
	Metric 2:	Analytical Methodology	Medium	Analytical methods were described in detail. Detection limits reported. Missing some information such as calibration.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from 6 Chinese cities - Shanghai, Beijing, Changsha, Wuhan, Dalian and Harbin.
	Metric 5:	Currency	Medium	Phase 2 (field measurements of indoor environment) conducted during 2013-2014.
	Metric 6:	Spatial and Temporal Variability	Medium	68 dwellings sampled in winter and 59 in summer. No replicates were reported.
	Metric 7:	Exposure Scenario	High	Dust sampled from apartment houses in urban area that include children.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 2 provides summary statistics including detection rate, max, average, min of chemical by winter and by summer. Concentration statistics by city provided in SI. Individual points not reported.
	Metric 9:	Quality Assurance	Medium	QA/QC discussed in Section 2.5. Lab-introduced contamination was negligible. Does not discuss recovery.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Paper compared findings to previous studies and discusses variation in different seasons and cities as well as limitations.

Overall Quality Determination　　　　　High

Study Citation:		Zhang, H., Zhou, Q., Xie, Z., Zhou, Y., Tu, C., Fu, C., Mi, W., Ebinghaus, R., Christie, P., Luo, Y. (2018). Occurrences of organophosphorus esters and phthalates in the microplastics from the coastal beaches in north China. Science of the Total Environment 616-617:1505-1512.		
HERO ID:		4829473		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some methods not reported such as sample storage conditions. More information provided in other references stated.
	Metric 2:	Analytical Methodology	High	Key analytical methods reported, including extraction methods, analytical instrument, LOD provided in supplementary file.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in China.
	Metric 5:	Currency	High	Samples collected in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	28 samples collected. No replicates mentioned.
	Metric 7:	Exposure Scenario	High	Samples collected from the sand near the sea.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported. Summary statistics such as mean, median, range reported.
	Metric 9:	Quality Assurance	High	Key QA reported. Procedural blanks and high recoveries reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Gaps and limitations not reported. Variation, such as SD, comparison to other studies, and spatial analysis reported.

Overall Quality Determination   High

Study Citation: Blum, K. M., Andersson, P. L., Ahrens, L., Wiberg, K., Haglund, P. (2018). Persistence, mobility and bioavailability of emerging organic contaminants discharged from sewage treatment plants. Science of the Total Environment 612:1532-1542.

HERO ID: 4829919

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology described and preparation of samples detailed in SI.
	Metric 2:	Analytical Methodology	High	Analytical methodology presented in detail. Both LOD and LOQ presented in Tables S8 and S9.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from River Fyris, affected by STP in Uppsala municipality, Sweden.
	Metric 5:	Currency	High	Surface water collected in December 2014, March 2015, June 2015 and September 2015; effluent in November 2015; fish June 2014; sediment September 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	Fish (n=10) caught close to Site A nd B, surface waters from 4 different sites (A, B, C, and S), and catchment area sampled over all four seasons. Replicate samples reported. Sediment sampled once.
	Metric 7:	Exposure Scenario	High	Study sampled a river affected by small to large-scale sewage treatment plants.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Discussion of results in Section 3 with data presented in Figures 2 and 7 and Table 4. SI provided individual data.
	Metric 9:	Quality Assurance	Medium	QA/QC discussion in Section 2.8. Detailed recovery information provided in SI.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability and uncertainty not reported in main text. Limited to samples taken during 1 month in each of the four seasons. Integrative and grab samples results agreed well.

Overall Quality Determination   **High**

Study Citation: Andresen, J. A., Grundmann, A., Bester, K. (2004). Organophosphorus flame retardants and plasticisers in surface waters. Science of the Total Environment 332:155-166.

HERO ID: 4832200

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Low	Sampling site described in detail but methodology details are lacking. No sampling description of sampling equipment or handling.
Metric 2:	Analytical Methodology	Medium	Uncertain based on description if samples were analyzed on-site. GC-MS described and LOQ reported.
Metric 3:	Biomarker Selection	N/A	The parent chemical was tested in water.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The samples were collected in River Ruhr, Germany.
Metric 5:	Currency	Low	The samples were collected in 2002.
Metric 6:	Spatial and Temporal Variability	Medium	>10 locations were sampled along River Ruhr but no replicates were sampled.
Metric 7:	Exposure Scenario	High	River Ruhr was characterized as drinking water source.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data not reported but can be extracted from figures.
Metric 9:	Quality Assurance	Medium	QA/QC not explicitly discussed but field blank was analyzed and recovery was measured. Recovery for TCEP was too variable with high standard deviations so measurements for TCEP were considered indicative and not "true".
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability addressed but uncertainty not discussed.

Overall Quality Determination   Medium

Study Citation: Barnes, K. K., Kolpin, D. W., Furlong, E. T., Zaugg, S. D., Meyer, M. T., Barber, L. B. (2008). A national reconnaissance of pharmaceuticals and other organic wastewater contaminants in the United States–I) groundwater. Science of the Total Environment 402:192-200.

HERO ID: 4832201

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Wastewater sampling methods were described.
	Metric 2:	Analytical Methodology	High	Analytical methods and approaches provided. Limits reported, and other Quality assurance/quality control measures.
	Metric 3:	Biomarker Selection	N/A	Wastewater samples were taken, no biomarker needed.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in the United States.
	Metric 5:	Currency	Low	The study was conducted in 2000.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 37 to 47 samples. There were no replicates of each sample. One sample was taken per location or site.
	Metric 7:	Exposure Scenario	High	Wastewater can be used related to the general population, environment, and animals exposure scenarios.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The study only reported maximum values.
	Metric 9:	Quality Assurance	Medium	Analytical quality assurance was sufficient, reporting levels were provided.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	While variability and uncertainty were discussed, only maximum values were provided there is no understanding of distribution.

Overall Quality Determination   Medium

Study Citation: Li, J., Yu, N., Zhang, B., Jin, L., Li, M., Hu, M., Zhang, X., Wei, S., Yu, H. (2014). Occurrence of organophosphate flame retardants in drinking water from China. Water Research 54:53-61.

HERO ID: 4839241

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling sites were well described, however descriptions of sampling methodology, including method of sampling and equipment description, are missing.
	Metric 2:	Analytical Methodology	Medium	Detection limits listed however it was not described how they were determined.
	Metric 3:	Biomarker Selection	N/A	Water sampling was taken thus it is not relevant.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Nanjing, China.
	Metric 5:	Currency	Medium	The study was conducted in 2012.
	Metric 6:	Spatial and Temporal Variability	High	39 water samples were taken from 8 cities.
	Metric 7:	Exposure Scenario	High	Drinking water and its potential source of contamination was, described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	No raw data was given. There were no tables of summary statistics. Concentrations were written in the text with missing means presented but lacking any other summary stats.
	Metric 9:	Quality Assurance	Medium	The recovery range was reported but not reported for individual chemicals.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was limited discussion on their limitations.

Overall Quality Determination   **Medium**

| | Study Citation: | Buszka, P. M., Yeskis, D. J., Kolpin, D. W., Furlong, E. T., Zaugg, S. D., Meyer, M. T. (2009).　Waste-indicator and pharmaceutical compounds in landfill-leachate-affected ground water near Elkhart, Indiana, 2000-2002. Bulletin of Environmental Contamination and Toxicology 82:653-659. |
| | HERO ID: | 4912133 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methodology parameters were missing such as sampler calibration and storage conditions. Samples were "chilled" but did not provide temperature.
	Metric 2:	Analytical Methodology	Medium	Some analytical methodology parameters were missing, such as calibration. Detailed methods were provided in references listed by the study. LOD reported (Table 3).
	Metric 3:	Biomarker Selection	N/A	Parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The samples were collected in Elkhart, Indiana.
	Metric 5:	Currency	Low	The samples were collected in 2000-2002.
	Metric 6:	Spatial and Temporal Variability	Low	Only 4 wells were sampled. No duplicates were collected.
	Metric 7:	Exposure Scenario	High	The exposure scenario represented closely the environment of wells downgradient from a landfill.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Only individual data but no summary statistics were reported. Data reported in table 2.
	Metric 9:	Quality Assurance	Low	The study reported low recoveries (<70%). Field blanks were reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Comparison of results were made to other studies. No sample variability and key limitations were reported.

Overall Quality Determination　　　　Medium

Study Citation: Greaves, A. K., Letcher, R. J. (2014). Comparative body compartment composition and in ovo transfer of organophosphate flame retardants in North American Great Lakes herring gulls. Environmental Science and Technology 48:7942-7950.

HERO ID: 4931691

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology was briefly described, including the procedure and sample storage.
	Metric 2:	Analytical Methodology	Medium	The analytical methods were described in detail, including recoveries and LOD.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed the presence of parent chemicals in animal tissues.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Canada.
	Metric 5:	Currency	Medium	Samples were collected during 2010.
	Metric 6:	Spatial and Temporal Variability	Low	n=8 herrings, and their eggs (n=16), without replicate samples.
	Metric 7:	Exposure Scenario	High	The data likely represent relevant exposure scenarios related to flame retardants in herrings that inhabit Lake Huron, but the small sample size limits the results' generalizability.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were reported.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (standard error). Uncertainties and limitations were not discussed.

Overall Quality Determination　　　　Medium

Study Citation:		Monclús, L., Lopez-Bejar, M., De la Puente, J., Covaci, A., Jaspers, V. L. B. (2018). First evaluation of the use of down feathers for monitoring persistent organic pollutants and organophosphate ester flame retardants: A pilot study using nestlings of the endangered cinereous vulture (Aegypius monachus). Environmental Pollution 238:413-420.		
HERO ID:		5017003		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods and approaches reported. Materials and chemicals included.
	Metric 2:	Analytical Methodology	High	Analytical methodology discussed. LOQ and average recoveries were reported in text.
	Metric 3:	Biomarker Selection	N/A	Feathers defined as an ideal biomonitoring medium but this study tests differences in down and contour feathers.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from Spain.
	Metric 5:	Currency	High	Samples collected in the breeding season of 2016.
	Metric 6:	Spatial and Temporal Variability	High	Samples taken from 57 nestlings.
	Metric 7:	Exposure Scenario	Low	Feather samples are ideal environmental biomonitoring solutions but application to human exposure is not discussed or immediately evident.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not presented but the summary statistics are detailed.
	Metric 9:	Quality Assurance	High	Analytical QA/QC was included.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Standard error is presented but study limitations are not discussed.

Overall Quality Determination   High

Study Citation:	Kurt-Karakus, P., Alegria, H., Birgul, A., Gungormus, E., Jantunen, L. (2018). Organophosphate ester (OPEs) flame retardants and plasticizers in air and soil from a highly industrialized city in Turkey. Science of the Total Environment 625:555-565.		
HERO ID:	5017070		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Most sampling details, such as equipment, procedures, and site characteristics, were provided in the article and supplemental file. However, storage conditions were missing.
Metric 2:	Analytical Methodology	High	Authors provided a detailed analytical methodology including analytical instrumentation and sample extractions. LOQ provided in supplemental information Table 2.
Metric 3:	Biomarker Selection	N/A	Studied tested for parent chemical in air and soil.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Bursa, Turkey
Metric 5:	Currency	Medium	Samples collected between February and December 2014.
Metric 6:	Spatial and Temporal Variability	Medium	There were 8 sampling sites. No replicates were reported.
Metric 7:	Exposure Scenario	High	Air and soil samples collected in urban, suburban, industrial, rural, and background environments.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data and summary statistics available for air samples but not soil.
Metric 9:	Quality Assurance	High	Robust discussion of QA/QC, including acceptable recovery percentages.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Some characterization of variability and limited discussion of uncertainties.

Overall Quality Determination   High

Study Citation:	Okeme, J. O., Nguyen, L. V., Lorenzo, M., Dhal, S., Pico, Y., Arrandale, V. H., Diamond, M. L. (2018). Polydimethylsiloxane (silicone rubber) brooch as a personal passive air sampler for semi-volatile organic compounds. Chemosphere 208:1002-1007.		
HERO ID:	5017615		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Personal air sampling methodology described within text as incorporating passive polydimethylsiloxane brooch samplers worn within breathing zone of participants, samples stored in air tight glass jars and frozen pending analysis, extensive calibration study of passive samplers compared with active sampling pumps conducted prior to field study described with field study conducted on participants instructed to stay indoors unless going to/ from work. Insufficient information on sample storage time prior to analysis. Sampling methodology within field study unclear as to distribution/collection times of passive samplers"it is unclear if passive sampling brooches were collected daily or if single brooches were worn for seven consecutive days.
Metric 2:	Analytical Methodology	Medium	Extraction methods and analytical instrumentation as GC-MS/ENCI described with data on detection limits and recovery samples described within SI and noted to have met criteria from previous references (Saini et al., 2015; Okeme et al., 2016b). Insufficient information on instrument calibration, although this information may be provided within SI.
Metric 3:	Biomarker Selection	N/A	Personal passive air sampling results with brooch and active sampling pump for parent chemicals of interest.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Canada.
Metric 5:	Currency	High	Sampling conducted in winter of 2016.
Metric 6:	Spatial and Temporal Variability	Low	Field study consisted of three volunteers wearing badges for seven days with unclear methodology description of when/if passive sampling brooches were retrieved and replaced daily or if a single brooch was worn for 24 hours during seven day period. No duplicate/replicate sampling conducted, however 24-hour sampling conducted.
Metric 7:	Exposure Scenario	Medium	Participants are office workers who were instructed to remain indoors (work/home) for the period of study other than transportation to/from work.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Raw data in terms of passive personal brooch sampling results for each participant reported within Table 1, with additional data from calibration in SI. Insufficient information on exact sampling dates, although sampling reported as conducted during "winter of 2016". Insufficient information on summary statistics as only single brooch concentrations, without range, number of brooches, etc. provided. Frequency of detection information described as detailed within SI.
Metric 9:	Quality Assurance	Medium	Recovery and QC data described as detailed within SI (S3). Results described as blank and recovery corrected as appropriate. Pre-exposure sampling not conducted.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Insufficient information on variability characterization as no range or SD information provided for sampling results. Limitations of small sample size (n=3 participants for field study) as well as lack of individual activity data noted. Some uncertainty with effects of humidity on passive sampling brooch while left within bathroom during shower/bathing activities not noted by authors.

Overall Quality Determination   **Medium**

Study Citation:		Chen, Y., Jiang, L., Lu, S., Kang, L., Luo, X., Liu, G., Cui, X., Yu, Y. (2019). Organophosphate ester and phthalate ester metabolites in urine from primiparas in Shenzhen, China: Implications for health risks. Environmental Pollution 247:944-952.	
HERO ID:		5039996	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology is adequately described.
Metric 2:	Analytical Methodology	Medium	LOQ is not stated in the main article, but is reportedly provided in the supplemental materials for this article.
Metric 3:	Biomarker Selection	High	The study evaluates BCEP in urine samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Participants were recruited in Shenzhen Maternal and Child Health Hospital (China).
Metric 5:	Currency	High	Samples were collected between September 2013 and June 2015.
Metric 6:	Spatial and Temporal Variability	Medium	Samples collected from 84 Primiparas but no replicates. First-morning voids were collected as opposed to 24-hr sampling.
Metric 7:	Exposure Scenario	High	The data represent the population of interest.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Summary statistics were detailed and complete but individual data points and measures of variance were not reported.
Metric 9:	Quality Assurance	Medium	Recoveries were measured, and blanks were analyzed. Glassware was cleaned and heated to minimize back-ground contamination. The study reported that trace levels of BCEP were detected in the procedural blanks, and were subtracted to determine the final concentrations in urine samples. Results were normalized by specific gravity.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	No measure of variance is reported. The study briefly discussed its primary limitation (small sample size).

Overall Quality Determination   **High**

Study Citation:	Cao, D., Lv, K., Gao, W., Fu, J., Wu, J., Fu, J., Wang, Y., Jiang, G. (2019). Presence and human exposure assessment of organophosphate flame retardants (OPEs) in indoor dust and air in Beijing, China. Ecotoxicology and Environmental Safety 169:383-391.		
HERO ID:	5043334		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling procedure was described and further details were reported to be included in a previous study. Sampling storage(-20°C in aluminum foil) was described.
	Metric 2: Analytical Methodology	High	LC-MS/MS was used for analysis. MDLs were reported in the SI.
	Metric 3: Biomarker Selection	N/A	Parent chemical was measured in environment.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Beijing, China.
	Metric 5: Currency	High	Samples were collected in 2015.
	Metric 6: Spatial and Temporal Variability	High	Indoor dust samples (n=101), indoor air samples (n=15), andthree paired dust samples from air filters were collected.
	Metric 7: Exposure Scenario	High	The data closely represent relevant exposure scenario: sources of exposure and temporal variability were explored. Also, dose intake were estimated based on the measurements.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data points were not provided in the main article or SI. Summary statistics including mean, min, median, and max were provided in Table 1.
	Metric 9: Quality Assurance	High	The study reported quality control measures in the SI.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Key uncertainties, limitations, and data gaps have been identified. Variability in toddlers and adults, season studied."

Overall Quality Determination   **High**

Study Citation:	Velázquez-Gómez, M., Hurtado-Fernández, E., Lacorte, S. (2019). Differential occurrence, profiles and uptake of dust contaminants in the Barcelona urban area. Science of the Total Environment 648:1354-1370.		
HERO ID:	5043338		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Dust sampling methods were included and described (Vel"zquez-G"mez et al., 2018). Sample collection was performed by gently collecting the accumulation of the settled dust. In houses, cars and in the public places where we had access, the samples were collected by scientific staff with a Bosch BKS4 (14.4 V) vacuum cleaner.
	Metric 2:	Analytical Methodology	Medium	GC-EI-MS/MS analysis. All QA/QC measures reported except reporting limits were not reported in the text.
	Metric 3:	Biomarker Selection	N/A	They did not test for biomarkers; tested for parent chemicals in dust samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Spain.
	Metric 5:	Currency	Low	Sampling date was not reported, but publication date is available, 2019.
	Metric 6:	Spatial and Temporal Variability	Medium	Authors did not collect replicate samples.
	Metric 7:	Exposure Scenario	Medium	Table 1 presents sample site characteristics, but does not include indoor characteristics such as air flow.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Authors did not calculate standard deviation or other measure of variation (besides IQR).
	Metric 9:	Quality Assurance	Medium	QA/QC techniques were discussed, but authors did not report sample recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Authors provided limited discussion on key data uncertainties.

Overall Quality Determination   Medium

Study Citation:	Qi, C., Yu, G., Zhong, M., Peng, G., Huang, J., Wang, B. (2019). Organophosphate flame retardants in leachates from six municipal landfills across China. Chemosphere 218:836-844.		
HERO ID:	5043402		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Details of sampling from 6 landfill leachate sites across China are provided including sample method, sample storage, matrix details. Additional information is provided in Table S2. However, no information provided on sampling equipment and procedure.
Metric 2:	Analytical Methodology	High	Sample extraction, analytical equipment, and operating conditions well described. Additional details are provided in Table S3 and S4 (e.g., LOD/LOQ). Referenced previously published protocol as well.
Metric 3:	Biomarker Selection	N/A	Study tested parent chemicals in landfill leachates.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	6 landfill sites in China. Details provided in text and in Table S2.
Metric 5:	Currency	High	Samples collected in June, 2018.
Metric 6:	Spatial and Temporal Variability	Medium	Raw and final leachates collected from 6 sites in triplicates.
Metric 7:	Exposure Scenario	High	Extensive discussion of characteristics of the landfill sites and relation to the aquatic environment.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The detection frequency, range, mean and median are provided in Table 1. The raw data are not provided.
Metric 9:	Quality Assurance	High	Extensive discussion of quality assurance and quality control. Additional details provided in Table S4 (e.g., recoveries).
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Some discussion of variability and uncertainty. Comparisons with other studies provided.

Overall Quality Determination   High

Study Citation:	Fabiańska, M. J., Kozielska, B., Konieczyński, J., Bielaczyc, P. (2019). Occurrence of organic phosphates in particulate matter of the vehicle exhausts and outdoor environment - A case study. Environmental Pollution 244:351-360.		
HERO ID:	5043433		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods and approaches reported.
	Metric 2:	Analytical Methodology	High	Analytical methods provided and described.
	Metric 3:	Biomarker Selection	N/A	Chemical measured in soil, and vehicle exhaust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Poland.
	Metric 5:	Currency	Low	Sampling date not provided, publication date 2019.
	Metric 6:	Spatial and Temporal Variability	Medium	More than 10 types of each type of vehicle, but only sampled each vehicle once. No replicates reported.
	Metric 7:	Exposure Scenario	Medium	Vehicle exhaust and outdoor/ambient air, although it might not be directly applied to US scenarios.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 3 contains raw data.
	Metric 9:	Quality Assurance	Medium	Brief description of QA/QC techniques found in main text and supplemental text.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Uncertainties and variability explained, but more research is needed to confirm assumptions.

Overall Quality Determination   Medium

Study Citation:	Tan, H., Chen, D., Peng, C., Liu, X., Wu, Y., Li, X., Du, R., Wang, B., Guo, Y., Zeng, E. Y. (2018). Novel and Traditional Organophosphate Esters in House Dust from South China: Association with Hand Wipes and Exposure Estimation. Environmental Science and Technology 52:11017-11026.		
HERO ID:	5043520		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling method procedures, equipment, storage, and description of sampling site were described in detail.
	Metric 2:	Analytical Methodology	Medium	SPE with HPLC was implemented to extract and analyze the samples. LOQ was reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Guangzhou, China.
	Metric 5:	Currency	High	Samples collected between September 2015 to July 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	51 samples for dust and adults' hand wipe, 31 samples for children's hand wipe. No replicates were reported.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenario (indoor dust and hand wipes both reflect relevant exposure).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points were not provided in the main article or SI. Summary statistics were reported sufficiently.
	Metric 9:	Quality Assurance	High	Quality assurance measures were discussed in the main article briefly and in the SI in more details. No major concerns were identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Key uncertainties, limitations, and data gaps have been identified."

Overall Quality Determination   High

Study Citation: Park, H., Choo, G., Kim, H., Oh, J. E. (2018). Evaluation of the current contamination status of PFASs and OPFRs in South Korean tap water associated with its origin. Science of the Total Environment 634:1505-1512.

HERO ID: 5079822

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology for river, lake/reservoir and tap water samples was described, however duration of sample storage prior to analysis was not detailed for tap water samples and storage conditions, duration of sample storage was not detailed for river and lake/reservoir samples.
	Metric 2:	Analytical Methodology	Medium	Analytical methodology was described, recoveries were listed within the text and MDLs were reported as a range.
	Metric 3:	Biomarker Selection	N/A	Sampling was conducted within environmental media for the chemicals of interest.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was conducted in major metropolitan cities of South Korea, including Seoul, Incheon, Suwon, Daejeon, Gwangju,, Daegu, Andong, and Busan.
	Metric 5:	Currency	High	Data was collected in 2017.
	Metric 6:	Spatial and Temporal Variability	Medium	A total of n=20 river water, n=24 lake/reservoir water, and n=44 tap water samples were obtained. Sampling areas were selected to represent four representative watershed areas in Korea. Replicate sampling was not described.
	Metric 7:	Exposure Scenario	High	Exposure scenarios were described as the lake/reservoir water was managed within a protected area and had no direct infput of wastewater. Drinking tap water was described as having potential sources of pollution from nearby industrial facilities. Exposure controls were not utilized and microclimate information was lacking.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data was reported in Supplemental Table S1. Table 1 presented summary statistics in terms of means, medians, standard deviations, minimums and maximums, as well as detection frequencies. The number of samples for each media was reported in the text.
	Metric 9:	Quality Assurance	Medium	Quality assurance procedures were presented in detail. Baseline, pre-exposure sampling was lacking.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Results were compared with previous studies, however a robust discussion of potential study limitations is lacking. Variability of concentrations by sampling location is reported in Table S1.

Overall Quality Determination   **High**

Study Citation:	Sha, B., Dahlberg, A. K., Wiberg, K., Ahrens, L. (2018). Fluorotelomer alcohols (FTOHs), brominated flame retardants (BFRs), organophosphorus flame retardants (OPFRs) and cyclic volatile methylsiloxanes (cVMSs) in indoor air from occupational and home environments. Environmental Pollution 241:319-330.		
HERO ID:	5083520		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Sampling site was described in detail. Sampler handling and storage after sampling and before analysis were not explained.
Metric 2:	Analytical Methodology	Low	Extraction methods were briefly explained but point to another paper. In the QA/QC section of the paper, the author stated the extraction method has not been used previously for the compounds of interest and is evident that methods need to be revised based on low recovery.
Metric 3:	Biomarker Selection	N/A	Chemicals were measured in indoor air.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Sweden.
Metric 5:	Currency	High	Samples were collected in September and November 2016.
Metric 6:	Spatial and Temporal Variability	Medium	Replicate samples appeard to be only collected from one of the buildings. "Three pairs of duplicate samples were collectedin the computer room (CR) in B2, the lecture room (LR3) in B3 andthe dining area (DA1) in B1."
Metric 7:	Exposure Scenario	High	Samples were collected from "three buildings located at the Ultuna campus of the Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden".
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual data points were not reported. Summary statistics including arithmetic mean and range for concentrations were reported in Table 1.
Metric 9:	Quality Assurance	Low	Section 2.7 QA/QC. Replicate sampling was limited to three sample and result of one duplicate sample showed a relative standard deviation of 100% between the two TCEP measurements. Low recoveries were also reported but not used to correct quantitative data.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Limited discussion of limitations were presented in section 3.5 and potential factors affecting the concentrations were discussed.

Overall Quality Determination   **Low**

Study Citation:		Sun, Y., Liu, L. Y., Sverko, E., Li, Y. F., Li, H. L., Huo, C. Y., Ma, W. L., Song, W. W., Zhang, Z. F. (2019). Organophosphate flame retardants in college dormitory dust of northern Chinese cities: Occurrence, human exposure and risk assessment. Science of the Total Environment 665:731-738.	
HERO ID:		5162697	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology briefly described in text, citing a previous study. Further details in SI.
	Metric 2:	Analytical Methodology	High	Analytical methods described with further details in SI. LOQs reported in SI.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in dust samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples from Northern China.
	Metric 5:	Currency	Medium	Samples collected in 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	>10 samples collected but no replicate sampling.
	Metric 7:	Exposure Scenario	High	Indoor air sampled for various building uses.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics provided including median, mean and 95th percentile. No raw data provided.
	Metric 9:	Quality Assurance	Medium	Recovery ranges listed but recovery for individual chemicals not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Some discussion of variability. No gaps or limitations reported.

Overall Quality Determination   High

Study Citation: Meyer, J., Bester, K. (2004). Organophosphate flame retardants and plasticisers in wastewater treatment plants. Journal of Environmental Monitoring 6:599-605.

HERO ID: 5162720

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling process and rationale were described, including sampling materials, storage, and collection of 24-hr samples.
	Metric 2:	Analytical Methodology	High	Analytical instrumentation and description of analytical settings were provided. LOD, recovery and other QA steps were provided in Table 1.
	Metric 3:	Biomarker Selection	N/A	Analytes were measured in water samples; no biomarker was needed.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The samples were collected in North Rhine Westphalia, Germany.
	Metric 5:	Currency	Low	The samples were collected in 2003.
	Metric 6:	Spatial and Temporal Variability	Low	Four types of water samples (unclear how many replicates or if there were replicates) were collected.
	Metric 7:	Exposure Scenario	Medium	The study represented exposure scenario for surface water for two sewage treatment plants and processes within the plant: aeration basin, intermediate settling tank, final setting tank, and primary settling tank. This might not be representative of all plants and their processes.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Tables 2, 3, 4 and 5 provided summary stats for various plant process water.
	Metric 9:	Quality Assurance	Medium	The study provided some steps that were important for QA and QC like spikes for recoveries. Field blanks and other analytical blanks were not mentioned.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Elimination of organophosphates in each treatment stage was discussed but some of the variability and uncertainty limitations were not sufficiently supported.

Overall Quality Determination   **Medium**

Study Citation:	Greaves, A. K., Letcher, R. J., Chen, D., Mcgoldrick, D. J., Gauthier, L. T., Backus, S. M. (2016). Retrospective analysis of organophosphate flame retardants in herring gull eggs and relation to the aquatic food web in the Laurentian Great Lakes of North America. Environmental Research 150:255-263.		
HERO ID:	5162769		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology was provided, including sampling procedure, location (map of samples), and storage.
Metric 2:	Analytical Methodology	Low	Samples were analyzed using LC/MS; only a range of MLOQs was provided.
Metric 3:	Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The samples were collected in Laurentian Great Lakes of North America.
Metric 5:	Currency	Medium	Samples were collected from 2010 and earlier.
Metric 6:	Spatial and Temporal Variability	Low	Sample sizes varied between species (n= 1 to 16).
Metric 7:	Exposure Scenario	High	The exposure scenario closely reflected the environment at the Great Lakes and the species that were affected.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual results were available in the supplemental tables.
Metric 9:	Quality Assurance	Medium	Although the study included all necessary information, LOQs were reported in range rather than per chemical.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	The study discussed variability but some of the conclusions would require more research to confirm.

Overall Quality Determination   Medium

Study Citation:	Khairy, M. A., Lohmann, R. (2019). Organophosphate flame retardants in the indoor and outdoor dust and gas-phase of Alexandria, Egypt. Chemosphere 220:275-285.		
HERO ID:	5162898		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Detailed description of the study area, sampling, extraction and cleanup, instrumental analysis were provided in supplementary information.
Metric 2:	Analytical Methodology	High	Analytical methodology was described GC-MS/MS was used. LODs were reported in supplementary information.
Metric 3:	Biomarker Selection	N/A	Analytes were collected in dust samples. No biomarker was needed.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from Alexandria in Egypt.
Metric 5:	Currency	Medium	Samples were collected in the winter of 2014.
Metric 6:	Spatial and Temporal Variability	Medium	Indoor dust was collected 1 m above the floor from the living (working) areas in apartments (n = 16) and working places (n = 14). FD was collected from selected homes (n = 9). For cars, dust (n = 18) was collected from all the available surfaces. Outdoor dust samples (n = 30) from the same locations as the indoor samples
Metric 7:	Exposure Scenario	High	The exposure scenario closely represented the indoor and outdoor environment for those who might come into contact.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics including range, mean, median were reported in the supplementary material.
Metric 9:	Quality Assurance	High	Sampling and analytical QC samples were clearly described in text and supplemental material.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Description of uncertainty and variability was limited, but performed ANOVA and statistical analysis was described.

Overall Quality Determination   High

Study Citation: Niu, Z., Zhang, Z., Li, J., He, J., Zhang, Y. (2019). Threats of organophosphate esters (OPEs) in surface water to ecological system in Haihe River of China based on species sensitivity distribution model and assessment factor model. Environmental Science and Pollution Research 26:10854-10866.

HERO ID: 5162899

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling procedure and site characteristics well described.
	Metric 2:	Analytical Methodology	High	Analytical methodology well described. LODs reported in supplementary file.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in surface water.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from Haihe River and Dagu Drainage River, China.
	Metric 5:	Currency	High	Samples collected in November 2017.
	Metric 6:	Spatial and Temporal Variability	Medium	Twenty-eight water samples and 3 water samples were gathered from Haihe River and Dagu Drainage River during winter.
	Metric 7:	Exposure Scenario	High	Measured concentration in surface water. Setting and potential sources well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Some summary statistics provided in the text. Raw data not reported.
	Metric 9:	Quality Assurance	High	QA provided including blanks and recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Extensive discussion of uncertainty and data gaps, but minimal characterization of variability.

Overall Quality Determination   High

Study Citation:	Hallanger, I. G., Sagerup, K., Evenset, A., Kovacs, K. M., Leonards, P., Fuglei, E., Routti, H., Aars, J., Strøm, H., Lydersen, C., Gabrielsen, G. W. (2015). Organophosphorous flame retardants in biota from Svalbard, Norway. Marine Pollution Bulletin 101:442-447.		
HERO ID:	5162922		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is discussed, scientifically sound and consistent with widely accepted methods/ approaches for the chemical and media being analyzed.
	Metric 2:	Analytical Methodology	High	LODs were defined as 3 times the signal to noise ratio. Values were provided in table 1 when appropriate.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Svalbard, Norway.
	Metric 5:	Currency	Medium	Samples were collected from 2007 to 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	10 samples were taken per endpoint.
	Metric 7:	Exposure Scenario	High	The study evaluates the exposure to organophosphorus flame retardants in biota.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported but the summary data are detailed.
	Metric 9:	Quality Assurance	High	LOD is reported, recovery was used to correct the concentration and the blank was analyzed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	The study characterizes variability, key uncertainties, limitations, and data gaps. LOD and SD are reported.

Overall Quality Determination   High

Study Citation:		Zhong, M., Tang, J., Mi, L., Li, F., Wang, R., Huang, G., Wu, H. (2017). Occurrence and spatial distribution of organophosphorus flame retardants and plasticizers in the Bohai and Yellow Seas, China. Marine Pollution Bulletin 121:331-338.		
HERO ID:		5163169		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Described, mapped, but details of sampling cruise reported elsewhere. No information about sampling regime or storage conditions
	Metric 2:	Analytical Methodology	High	GC/MS; described calibration curves (8 levels) in report; sample pretreatment described (LOQ and other details provided in in Supporting information). Extraction methods followed previously published procedure.
	Metric 3:	Biomarker Selection	N/A	Study tested for parent chemical in seawater.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from Bohai and Yellow Seas in China; Figure 2 shows sampling locations.
	Metric 5:	Currency	High	Samples were collected in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	50 sampling sites in the two seas; temporal variability not examined. No replicates.
	Metric 7:	Exposure Scenario	High	Studied measured chemical concentrations in saltwater, which has implications for exposure in marine biota.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Geometric mean, maximum, and % freq detection provided; isopleths of concentration ranges at surface and bottom waters provided in Figure 3, panels B1-B2. Raw data in Table S4 of SI.
	Metric 9:	Quality Assurance	High	Described, deuterated surrogates included, with additional details on recoveries, blanks, MDL and LOD available in the SI.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Spatial variation mapped. Uncertainty examined by exploring gradients with distance from shore, depth, and coastal flow patterns. Limited discussion about data gaps and limitations.

Overall Quality Determination   High

Study Citation:	Liu, X., Yu, G., Cao, Z., Wang, B., Huang, J., Deng, S., Wang, Y. (2017). Occurrence of organophosphorus flame retardants on skin wipes: Insight into human exposure from dermal absorption. Environment International 98:113-119.		
HERO ID:	5163218		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling equipment, procedure, storage was reported.
	Metric 2: Analytical Methodology	High	Extraction was described (ultrasonic with n-hexane/acetone). GC-MS was used for sample analysis. MDL was reported in the SI.
	Metric 3: Biomarker Selection	N/A	The authors analyzed hand wipe samples, not biomarkers.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Beijing, China.
	Metric 5: Currency	High	September to December 2015, and March to May 2016.
	Metric 6: Spatial and Temporal Variability	High	36 individuals were selected to provide hand wipe samples. 22 individuals were selected to provide both their hand wipe and dust sample from their offices.
	Metric 7: Exposure Scenario	High	The data closely represent relevant exposure scenario (indoor dust, hand wipe).
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data points were not reported in the main article or SI.
	Metric 9: Quality Assurance	High	No quality control issues were identified or any identified issues were minor and adequately addressed.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps."

Overall Quality Determination   High

Study Citation:	Wang, Y., Sun, H., Zhu, H., Yao, Y., Chen, H., Ren, C., Wu, F., Kannan, K. (2018). Occurrence and distribution of organophosphate flame retardants (OPFRs) in soil and outdoor settled dust from a multi-waste recycling area in China. Science of the Total Environment 625:1056-1064.		
HERO ID:	5163353		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage after collection was not described. Preparation of sample collection instrumentation not discussed.
	Metric 2:	Analytical Methodology	High	MDL and recoveries were reported in the SI.
	Metric 3:	Biomarker Selection	N/A	Parent chemical was measured in soil and dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Tianjin, China.
	Metric 5:	Currency	Low	No sampling date was provided but the referenced was published in 2018.
	Metric 6:	Spatial and Temporal Variability	Medium	No indication of replicate analysis.
	Metric 7:	Exposure Scenario	High	Potential source of exposure characterized and relevant to waste sites
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data was available in the SI.
	Metric 9:	Quality Assurance	Low	No indication if data was corrected with recovery percentages
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Data variability is presented but limitations were not discussed.

Overall Quality Determination   **Medium**

Study Citation:	Zhang, Y., Zheng, X., Wei, L., Sun, R., Guo, H., Liu, X., Liu, S., Li, Y., Mai, B. (2018). The distribution and accumulation of phosphate flame retardants (PFRs) in water environment. Science of the Total Environment 630:164-170.		
HERO ID:	5163356		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods provided, storage and materials used included.
Metric 2:	Analytical Methodology	High	LOQs are available in Table S3.
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in China.
Metric 5:	Currency	Low	Sampling date not stated. Publication date is 2018.
Metric 6:	Spatial and Temporal Variability	Medium	Water, sediments and suspended particulate matter have 11 samples. Fish are 2 to 6 of each type for a total of 26 fish samples
Metric 7:	Exposure Scenario	High	Parent chemical in fish, sediments, and water.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Individual sample results are not available, mean and range are available on Table 1.
Metric 9:	Quality Assurance	High	Analytical QA/QC were reported.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Variability and uncertainty were not discussed.

Overall Quality Determination   **Medium**

Study Citation:	Zhong, M., Wu, H., Mi, W., Li, F., Ji, C., Ebinghaus, R., Tang, J., Xie, Z. (2018). Occurrences and distribution characteristics of organophosphate ester flame retardants and plasticizers in the sediments of the Bohai and Yellow Seas, China. Science of the Total Environment 615:1305-1311.		
HERO ID:	5163370		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Low	Sampling method missing description of sampling procedures and materials used, sample storage described. Field blanks were collected but not described or reported.
Metric 2:	Analytical Methodology	Low	The analytical method described elsewhere (Ma et al., 2017). LODs or LOQs not reported. MDLs available in supplemental. Blanks results reported, unclear if it was analytical blanks or field blanks.
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in sediment.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were taken from the Bohai and Yellow Seas, China.
Metric 5:	Currency	Medium	Samples collected in September 2010.
Metric 6:	Spatial and Temporal Variability	Medium	49 surface sediment samples collected. No replicates reported.
Metric 7:	Exposure Scenario	Medium	Samples collected from two rivers in China.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Individual concentrations per site per chemical provided in supplemental, summary tables in paper.
Metric 9:	Quality Assurance	Low	Section 2.5 discusses quality control and assurance. No control samples reported.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Limited discussion on limitations/uncertainties.

Overall Quality Determination   Low

Study Citation:		Salamova, A., Peverly, A. A., Venier, M., Hites, R. A. (2016). Spatial and temporal trends of particle phase organophosphate ester concentrations in the atmosphere of the great lakes. Environmental Science and Technology 50:13249-13255.	
HERO ID:		5163441	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methodology described including site characteristics, equipment, and procedures.
	Metric 2: Analytical Methodology	Low	Analytical methodology provided. No detection limits are reported.
	Metric 3: Biomarker Selection	N/A	Parent chemical in the atmosphere.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples collected from the North American Great Lakes.
	Metric 5: Currency	Medium	Samples collected 2012 to 2014.
	Metric 6: Spatial and Temporal Variability	High	359 samples collected. Samples collected over 24 hours every 12 days.
	Metric 7: Exposure Scenario	High	Sampled ambient air in the Great Lakes.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary statistics such as percentiles provided. Raw data are not reported.
	Metric 9: Quality Assurance	Medium	Recoveries were over 120% in the 2012 samples, which was corrected in the 2014 samples. Paper indicates some standard recovery problems.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Limited discussion of uncertainties. SI provides correlation, seasonal variation in temporal trends section.

Overall Quality Determination   Medium

		Domain	Metric	Rating	Comments

Study Citation: Zeng, X., Xu, L., Liu, J., Wu, Y., Yu, Z. (2017). Occurrence and distribution of organophosphorus flame retardants/plasticizers and synthetic musks in sediments from source water in the Pearl River Delta, China. Environmental Toxicology and Chemistry 37:975-982.

HERO ID: 5163442

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1: Sampling Methodology	High		Sampling methodology briefly discussed, including sampling equipment, procedures, storage conditions, and site characteristics.
Metric 2: Analytical Methodology	High		Analytical methodology provided. LODs and LOQs listed in Table S2.
Metric 3: Biomarker Selection	N/A		The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4: Geographic Area	High		Sampling from the Pearl River in Southern China.
Metric 5: Currency	Low		No sampling date provided, but article published 2018 (received 2017).
Metric 6: Spatial and Temporal Variability	Medium		15 study locations (water sources for 9 cities) with a total of 15 sediment samples. No replicate samples.
Metric 7: Exposure Scenario	High		Samples from a river that is a drinking water source for surrounding inhabitants, in developed, high-risk region.
Domain 3: Accessibility/Clarity			
Metric 8: Reporting of Results	High		Individual data points provided in Table 2. Summary statistics provided in text, including mean and range.
Metric 9: Quality Assurance	Medium		QA/QC provided, including blanks and spiked samples. Recovery not provided for this chemical.
Domain 4: Variability and Uncertainty			
Metric 10: Variability and Uncertainty	Medium		Some discussion of variation provided.

Overall Quality Determination   **High**

Study Citation:	Phillips, A. L., Hammel, S. C., Hoffman, K., Lorenzo, A. M., Chen, A., Webster, T. F., Stapleton, H. M. (2018). Children's residential exposure to organophosphate ester flame retardants and plasticizers: Investigating exposure pathways in the TESIE study. Environment International 116:176-185.		
HERO ID:	5163584		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sample methodology was reasonably well-described. For the urine samples, the type of cups urine samples were collected and stored in was not reported, but it was reported in other papers about the same data set in which phthalate data was reported. The length of time the samples was stored prior to analysis was not specified, but once handed over to researchers, samples were stored at -20C (and before that they were stored by the participants in their freezers). Urine samples were corrected for specific gravity. Methodology for collecting hand wipe samples and house dust samples was well-described.
	Metric 2:	Analytical Methodology	High	Analytical methodology was well-described for dust, urine, and hand wipe samples. They used standards and calculated recoveries. The MDLs are in Table 1.
	Metric 3:	Biomarker Selection	N/A	TCEP was measured in hand wipes and dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in North Carolina, USA.
	Metric 5:	Currency	High	Samples were collected in 2014-2016.
	Metric 6:	Spatial and Temporal Variability	Medium	There were no sample replicates. They sampled the hands of 202 children and obtained dust from 188 homes.
	Metric 7:	Exposure Scenario	High	The researchers collected multiple types of samples and collected information via home visits and questionnaires to gather information about potential exposures to the toddlers sampled. These data would accurately represent a relevant exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data were provided in this paper. Table 1 includes descriptive statistics: detection frequency, the 10th and 90th percentiles, GM, and max detection.
	Metric 9:	Quality Assurance	High	QA/QC was well-described. They reference field blanks for the hand wipe samples and laboratory blanks for the dust and urine samples. They also used standards to improve accuracy. There were no baseline/pre-exposure studies as the chemicals measured are fairly ubiquitous.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Section 3.7 provides a fairly thorough summary of limitations, including uncertainties, and strengths of this study. Statistical tests were performed to assess relationships between different variables. However, data points such as standard deviation would have provided more information about variability.

Overall Quality Determination   **High**

Study Citation:	He, R., Li, Y., Xiang, P., Li, C., Zhou, C., Zhang, S., Cui, X., Ma, L. Q. (2016). Organophosphorus flame retardants and phthalate esters in indoor dust from different microenvironments: Bioaccessibility and risk assessment. Chemosphere 150:528-535.		
HERO ID:	5163600		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Sampling procedure, equipment, and sample storage details were reported. No calibration method was mentioned.
Metric 2:	Analytical Methodology	High	The analytical methods were described. LOD was reported for each analyte. Recovery samples was used.
Metric 3:	Biomarker Selection	N/A	The authors analyzed environmental samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Nanjing, China.
Metric 5:	Currency	High	Sampling was conducted between January 2014 and March 2015.
Metric 6:	Spatial and Temporal Variability	Low	n=33 samples in total. No replicate samples were mentioned.
Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenario related to flame retardants and phthalate esters in indoor dust from indoor spaces in Nanjing, China.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only summary statistics were reported. Individual data points were not reported in the main article or in the SI.
Metric 9:	Quality Assurance	Medium	QA/QC techniques were described but only mentioned procedural blanks, not field blanks.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (range). Uncertainties were briefly described.

Overall Quality Determination — **Medium**

Study Citation:	Ren, G., Chu, X., Zhang, J., Zheng, K., Zhou, X., Zeng, X., Yu, Z. (2019). Organophosphate esters in the water, sediments, surface soils, and tree bark surrounding a manufacturing plant in north China. Environmental Pollution 246:374-380.		
HERO ID:	5163683		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling methodology is generally appropriate, however, one or more pieces of sampling information is not described. The missing information is unlikely to have a substantial impact on results.
	Metric 2: Analytical Methodology	Low	Analytical methodology is only briefly discussed. Analytical instrumentation is provided and consistent with accepted analytical instrumentation/methods. However, most analytical information is missing and likely to have a substantial impact on results. LOQ, LOD, detection limits, and/or reporting limits not reported.
	Metric 3: Biomarker Selection	N/A	Parent chemical was measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Geographic location is discussed.
	Metric 5: Currency	Low	No sampling date is provided; publication date is 2018.
	Metric 6: Spatial and Temporal Variability	Medium	Sampling approach likely captures variability of environmental contamination in media of interest. Some uncertainty exist, but it is unlikely to have a substantial impact on results. Moderate sample size and no replicate samples.
	Metric 7: Exposure Scenario	Medium	The data likely represent the relevant exposure scenario.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Supplementary or raw data (i.e., individual data points) are not reported, and therefore summary statistics cannot be reproduced.
	Metric 9: Quality Assurance	Medium	The study applied and documented quality assurance/quality control measures; however, one or more pieces of QA/QC information is not described. Missing information is unlikely to have a substantial impact on results.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	The study has limited characterization of variability in the media studied.

Overall Quality Determination   **Medium**

Study Citation:	Rantakokko, P., Kumar, E., Braber, J., Huang, T., Kiviranta, H., Cequier, E., Thomsen, C. (2019). Concentrations of brominated and phosphorous flame retardants in Finnish house dust and insights into children's exposure. Chemosphere 223:99-107.		
HERO ID:	5163693		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology was described, but the procedure was not detailed and did not include sampling storage conditions.
	Metric 2:	Analytical Methodology	Medium	The analytical methods were described, including LOQ and mentioning recoveries without reporting values for the compounds of interest.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed dust samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study took place in Finland.
	Metric 5:	Currency	Low	The study was published in 2019.
	Metric 6:	Spatial and Temporal Variability	Low	This study reported n= 40 sampling sites, without replicates.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to TCEP in dust from children's bedrooms in Kuopio, Finland.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors only reported summary statistics (median, mean, max, LOQ).
	Metric 9:	Quality Assurance	High	QA/QC techniques were described by the authors, including the use of control samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability was characterized (range). Uncertainties were discussed by the authors.

Overall Quality Determination Medium

Study Citation:	Wong, F., De Wit, C. A., Newton, S. R. (2018). Concentrations and variability of organophosphate esters, halogenated flame retardants, and poly-brominated diphenyl ethers in indoor and outdoor air in Stockholm, Sweden. Environmental Pollution 240:514-522.		
HERO ID:	5163827		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	There is no description of how filters were handled after sampling and before being taken to lab for analysis.
	Metric 2:	Analytical Methodology	High	The MDLs are provided in the supplementary data.
	Metric 3:	Biomarker Selection	N/A	Air sampling is an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The geographic location is Stockholm, Sweden.
	Metric 5:	Currency	High	Sampling ended in May of 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	24 urban air samples were collected over time, but there are no replicate samples.
	Metric 7:	Exposure Scenario	High	Indoor and outdoor air exposures are relevant to general population exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	The raw data are provided in SI.
	Metric 9:	Quality Assurance	Low	Recovery for TPhP was reported in SI to be 187% for PUF and 184 for GFF, but there was no correction in the data.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There is limited discussion of study limitations, particularly no addressing of high recovery rates that were not used to correct results.

Overall Quality Determination　　　　**Medium**

Study Citation:		Ji, Y., Wang, Y., Yao, Y., Ren, C., Lan, Z., Fang, X., Zhang, K., Sun, W., Alder, A. C., Sun, H. (2019). Occurrence of organophosphate flame retardants in farmland soils from Northern China: Primary source analysis and risk assessment. Environmental Pollution 247:832-838.		
HERO ID:		5164207		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology is discussed appropriately.
	Metric 2:	Analytical Methodology	Medium	LOD or LOQ is not reported but the method detectedlimits (MDLs) and recovery is discussed. Blank was checked.
	Metric 3:	Biomarker Selection	N/A	Chemical is measured in soil.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Beijing-Tianjin-Hebei core area, Northern China.
	Metric 5:	Currency	High	Samples were collected from September to November 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	98 soil samples were collected, but there were no replicates.
	Metric 7:	Exposure Scenario	Medium	Exposure scenario is not for general population. The scenario is limited to farmers.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data for individual soil samples are not reported.
	Metric 9:	Quality Assurance	Medium	Some of recoveries are reported, <70% but blank-corrected.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability was discussed but uncertainty and limitation was not clearly discussed.

Overall Quality Determination   Medium

Study Citation: Zhao, H., Zhao, F., Liu, J., Zhang, S., Mu, D., An, L., Wan, Y., Hu, J. (2018). Trophic transfer of organophosphorus flame retardants in a lake food web. Environmental Pollution 242:1887-1893.

HERO ID: 5164234

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Site characteristics, types and sample size of species analyzed, and storage conditions were described. However, insufficient details were provided for sampling equipment and procedures.
	Metric 2:	Analytical Methodology	High	LODs were reported in the supplementary text. Extraction methods and analytical instrumentation are described in detail in both the text and SI.
	Metric 3:	Biomarker Selection	N/A	The study tested for parent chemicals in freshwater.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The geographic location is Taihu Lake, China.
	Metric 5:	Currency	Medium	The samples were collected in 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	6 samples were collected per species, except for carp that had 3 samples. No replicates were taken.
	Metric 7:	Exposure Scenario	High	The study evaluated trophic transfer of organophosphorus flame retardants in a lake food web. The lake is heavily burdened by industrial and agricultural discharges.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are not reported but summary statistics are detailed.
	Metric 9:	Quality Assurance	High	Pertinent information, such as recovery and blank-corrected values, were provided as part of method validation.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variation is characterized, but there is limited discussion of uncertainties, limitations, and data gaps.

Overall Quality Determination   High

Study Citation:	Zheng, X., Xu, F., Luo, X., Mai, B., Covaci, A. (2016). Phosphate flame retardants and novel brominated flame retardants in home-produced eggs from an e-waste recycling region in China. Chemosphere 150:545-550.		
HERO ID:	5164239		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sample preparation and analysis methods were taken from another reference. Sample descriptions are found in an alternate reference.
Metric 2:	Analytical Methodology	High	Analytical methodology was described and the LOQ are provided by chemical in table 1.
Metric 3:	Biomarker Selection	N/A	Researchers tested the parent chemical in eggs of free-range chickens.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The coordinates of the location are provided in section 2.1.Samples were collected in China.
Metric 5:	Currency	Medium	Samples were collected July 2010.
Metric 6:	Spatial and Temporal Variability	Medium	Least sampled site had 8 samples, with each sample analysis being replicated three times.
Metric 7:	Exposure Scenario	High	This exposure scenario may be a good surrogate for human exposure through local gardens or just consumption of the free range eggs.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Only ranges and detection frequencies are provided. More data may be available in the supporting information.
Metric 9:	Quality Assurance	High	Lab and field controls are presented along with recoveries and adequate field sample stability measures.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	Data ranges are presented and limitations are discussed.

Overall Quality Determination   **High**

Study Citation:	Santín, G., Eljarrat, E., Barceló, D. (2016). Simultaneous determination of 16 organophosphorus flame retardants and plasticizers in fish by liquid chromatography-tandem mass spectrometry. Journal of Chromatography A 1441:34-43.		
HERO ID:	5164308		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	This paper is primarily a methods development paper so sampling methods are very well documented for biota fish sampling.
	Metric 2: Analytical Methodology	High	Instrumental and method LOD, LOQ, and recoveries are reported for each compound.
	Metric 3: Biomarker Selection	N/A	Fish samples were freeze dried (assuming whole) and homogenized but were not separated by blood, muscle, fat, etc. Authors noted that larger samples contained more fat.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Fish samples were collected from the Llobregat River, Spain.
	Metric 5: Currency	Low	The collection date was not specified in the text, but the acknowledgements section states support from "the Generalitat de Catalunya (Consolidated Research Groups "2014 SGR 418"Water and Soil Quality Unit")." Therefore, the study is inferred to be no older than 2014.
	Metric 6: Spatial and Temporal Variability	Low	Only spiked samples were analyzed in triplicate. Real world samples were not identified to have been replicated. A total of 12 fish samples were analyzed in a single space and time.
	Metric 7: Exposure Scenario	High	The sample fish used are commonly eaten and highly relevant to dietary exposure.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	All data is presented in table 5, which only reports single concentration levels without summary statistic measures of variability. Summary data is not reported within text. Frequency of detection can be inferred from Table 5 from the number of non-detects of each sample for each chemical.
	Metric 9: Quality Assurance	High	Because this study primarily focused on method development QA/QC was very thorough and well documented.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Sample variability and limitation was not well discussed due to the focus of the paper.

Overall Quality Determination　　　Medium

Study Citation:		Brommer, S., Harrad, S., Van Den Eede, N., Covaci, A. (2012). Concentrations of organophosphate esters and brominated flame retardants in German indoor dust samples. Journal of Environmental Monitoring 14:2482-2487.		
HERO ID:		5164389		

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling protocol used was not a publicly available standard operating procedure from a trusted or authoritative source, but the sampling methodology is appropriate (i.e., scientifically sound). However, sample storage duration is not reported, and while the study sites are generally reported, they are not described in detail. Dust sample collection is described in page 2483.
	Metric 2:	Analytical Methodology	Medium	The analytical method used was not a publicly available method from a trusted or authoritative source, but the methodology is clear and appropriate (i.e., scientifically sound). Instrument calibration and recovery samples were not discussed. Limit of quantification was reported in Table 1.
	Metric 3:	Biomarker Selection	N/A	The study tested for the parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Germany.
	Metric 5:	Currency	Medium	Samples were collected between December 2010 and January 2011.
	Metric 6:	Spatial and Temporal Variability	High	The collection of replicate samples was not reported. Samples were collected from 12 cars, 10 offices in the same building, and 6 homes.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant/realistic exposure scenario (exposure to TCEP from indoor dust in Germany).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics (mean, median, concentration range) were reported in Tables 1, SD1, and SD2.
	Metric 9:	Quality Assurance	Low	The use of quality assurance/quality control techniques were described such as the use of a control sample, a standard reference material standard, and laboratory blanks. However, the results were not discussed and recovery samples was not reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Key uncertainties, limitations, and data gaps have been identified. Variability was reported as range.

Overall Quality Determination   Medium

Study Citation:	Yin, H., Wu, D., You, J., Li, S., Deng, X., Luo, Y., Zheng, W. (2019). Occurrence, Distribution, and Exposure Risk of Organophosphate Esters in Street Dust from Chengdu, China. Archives of Environmental Contamination and Toxicology 76:617-629.		
HERO ID:	5164542		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The sampling protocol used was not a publicly available SOP from a trusted or authoritative source, but the sampling methodology is clear, and appropriate. Sampling equipment, procedure, and storage were reported.
Metric 2:	Analytical Methodology	High	Both extraction and analysis methods were described (GC-MS). Recoveries were used. MDL was determined for each OPE.
Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Chengdu, China.
Metric 5:	Currency	Medium	Samples were collected in April 2014.
Metric 6:	Spatial and Temporal Variability	High	Samples were collected from 31 sites.
Metric 7:	Exposure Scenario	High	The data closely represent the relevant exposure scenario in the general population.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Summary statistics are detailed and complete.
Metric 9:	Quality Assurance	High	The study applied quality assurance measures; recoveries were reported; background samples were used.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	The article has very limited discussion of variability.

Overall Quality Determination   High

Study Citation: Wang, Y., Li, W., Martínez-Moral, M. P., Sun, H., Kannan, K. (2019). Metabolites of organophosphate esters in urine from the United States: Concentrations, temporal variability, and exposure assessment. Environment International 122:213-221.

HERO ID: 5164613

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology was described in detail, including storage conditions.
	Metric 2:	Analytical Methodology	High	The analytical methods were described, including recoveries and LOD.
	Metric 3:	Biomarker Selection	High	The analyzed metabolite (Bis(2-chloroethyl) phosphate, BCEP) is closely related to the parent chemical (TCEP).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in NY, USA.
	Metric 5:	Currency	High	Samples were collected during 2018.
	Metric 6:	Spatial and Temporal Variability	High	A total of 213 samples were collected, including replicates, from 19 individuals.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to TCEP metabolites in human urine.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were reported (percentiles, range, geometric mean, arithmetic mean).
	Metric 9:	Quality Assurance	High	QA/QC techniques were discussed, including the use of blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability was characterized (percentiles, range). Uncertainties were discussed.

Overall Quality Determination   High

Study Citation:	Pang, L., Yuan, Y., He, H., Liang, K., Zhang, H., Zhao, J. (2016). Occurrence, distribution, and potential affecting factors of organophosphate flame retardants in sewage sludge of wastewater treatment plants in Henan Province, Central China. Chemosphere 152:245-251.		
HERO ID:	5164862		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling details were provided including location, matrix characteristics, and storage. Additional details are provided in Table S1.
	Metric 2:	Analytical Methodology	High	Sample extraction, analytical equipment, and operating conditions were well described. Additional details are provided in Table S2. Previously published protocols are also cited. Limits of detection are available in Table S3.
	Metric 3:	Biomarker Selection	N/A	The study tested for the parent chemical in sewage sludge of wastewater treatment plants.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in waste water treatment plants from 18 cities in Henan province, China.
	Metric 5:	Currency	High	Samples were collected in March 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	24 samples from waste water treatment plants in 18 cities. It appears that replicate samples are only available for quality control and not actual sampling (Section 2.4).
	Metric 7:	Exposure Scenario	High	There is characterization of the location, treatment techniques, discharge, and more details that will be important for aquatic assessment. Details are available in text and Table S1.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data are provided. Only the raw data and means are provided with no reported measure of variance.
	Metric 9:	Quality Assurance	Medium	There is complete analysis and discussion of quality control measures. Additional information is provided in Table S3. However, for TPP, recovery is <70% from spiked samples but >100% for matrix effect. The authors noted that the recovery for spiked samples is acceptable though.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There is some characterization of variability in the text and in Figure S1's box and whisker plot. There is limited discussion of uncertainties, data gaps, and limitations.

Overall Quality Determination   High

Study Citation:	Gibson, E. A., Stapleton, H. M., Calero, L., Holmes, D., Burke, K., Martinez, R., Cortes, B., Nematollahi, A., Evans, D., Anderson, K. A., Herbstman, J. B. (2018). Differential exposure to organophosphate flame retardants in mother-child pairs. Chemosphere 219:567-573.		
HERO ID:	5165046		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling matrix were described (urine and wristband samples). Specific sampling procedure for urine was reported.
Metric 2:	Analytical Methodology	High	Extraction (solid-phase extraction) and analysis (LC-MS) were reported. MDL was calculated and reported.
Metric 3:	Biomarker Selection	N/A	TCEP Metabolites were not measured in the participants urine. The authors only measured TCEP in wristbands.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples correspond to a birth cohort in New York.
Metric 5:	Currency	High	Data was collected in 2015.
Metric 6:	Spatial and Temporal Variability	Medium	32 mother-child pairs were sampled. For urine samples, spot samples was collected. No replicate samples were mentioned.
Metric 7:	Exposure Scenario	Medium	Sources of the exposure were not clear. But the data likely represent the exposure scenario related to TCEP.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Only summary statistics were reported. Individual data were not reported.
Metric 9:	Quality Assurance	Medium	Recoveries and blanks were used. Samples were normalized by specific gravity.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (percentiles). Study limitations were briefly described.

Overall Quality Determination　　　　High

Study Citation: Kim, J. W., Isobe, T., Sudaryanto, A., Malarvannan, G., Chang, K. H., Muto, M., Prudente, M., Tanabe, S. (2013). Organophosphorus flame retardants in house dust from the Philippines: occurrence and assessment of human exposure. Environmental Science and Pollution Research 20:812-822.

HERO ID: 5165540

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some criteria are not described, such as performance of the sampler. There are also poor matrix characteristics and poor sample quality (the sample was not limited to the surface dust).
	Metric 2:	Analytical Methodology	High	Calibration, recovery, level of detection, and correlation coefficient were reported. Blank analysis was performed.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Malate (a residential area) and Payatas (a municipal dumping area) in the Philippines.
	Metric 5:	Currency	Medium	Data were collected in August, 2008.
	Metric 6:	Spatial and Temporal Variability	Medium	Greater than 10 were collected samples but there are no replicates; house dust samples were collected (n=37).
	Metric 7:	Exposure Scenario	High	The scenario was exposure to organophosphorus flame retardants in house dust.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data were provided.
	Metric 9:	Quality Assurance	High	The blank was analyzed. The method detection limit and recovery (>70%) are reported.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No limitations were discussed and no standard deviation or variance was reported.

Overall Quality Determination   **Medium**

Study Citation:	Zhang, T., Bai, X. Y., Lu, S. Y., Zhang, B., Xie, L., Zheng, H. C., Jiang, Y. C., Zhou, M. Z., Zhou, Z. Q., Song, S. M., He, Y., Gui, M. W., Ouyang, J. P., Huang, H. B., Kannan, K. (2018). Urinary metabolites of organophosphate flame retardants in China: Health risk from tris(2-chloroethyl) phosphate (TCEP) exposure. Environment International 121:1363-1371.		
HERO ID:	5165673		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Sampling procedure and equipment were not explained in details. Study population characters were clearly explained.
Metric 2:	Analytical Methodology	High	LC-MS was used for analysis. LOQ was reported in the SI.
Metric 3:	Biomarker Selection	High	Metabolite (BCEP) biomarker derived from exposure to parent chemical of interest, likely reflects external exposure.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The 13 cities included in this study were distributedacross the Northern, Southern, Eastern, and Southwestern China.
Metric 5:	Currency	Low	Date of sampling was not provided. However, the publication year of 2018 is used as a proxy for sampling year.
Metric 6:	Spatial and Temporal Variability	Medium	There were in total 323 urine samples. More than 20 samples were obtained at each sample location. However, urine samples were all morning void samples.
Metric 7:	Exposure Scenario	Medium	Urinary specimen population was described in terms of demographic data of gender and age, with no other information mentioned.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Supplementary or raw data are not reported, and therefore summary statistics cannot be reproduced."
Metric 9:	Quality Assurance	Medium	Average recoveries were reported to be above 78% . Procedural and instrumental blanks were used. No measure was mentioned to assure biomarker stability or correction for completeness.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps."

Overall Quality Determination   Medium

Study Citation:	Lazarov, B., Swinnen, R., Spruyt, M., Maes, F., Van Campenhout, K., Goelen, E., Covaci, A., Stranger, M. (2015). Air sampling of flame retardants based on the use of mixed-bed sorption tubes-a validation study. Environmental Science and Pollution Research 22:18221-18229.		
HERO ID:	5165777		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Air sampling methods are well-described.
Metric 2:	Analytical Methodology	Medium	The authors characterized variability and discussed uncertainties, focusing on the strengths and limitations of the novel method they described. The authors indicated that the levels measured in indoor environments in this study were comparable to those measured in two other studies and commented on potential sources of the chemicals measured in the indoor environments.
Metric 3:	Biomarker Selection	N/A	Parent chemicals were measured in air.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	This study took place in Belgium.
Metric 5:	Currency	Low	The study was published in 2015, but the time period over which it occurred was not specified.
Metric 6:	Spatial and Temporal Variability	Low	Four indoor environments were sampled, in addition to two "test cells". There were two samples from a living room analyzed by two different methods and an unspecified number of samples from an office, electronics workshop, and kitchen (but the lack of a range reported suggests it was one sample from each of the latter three).
Metric 7:	Exposure Scenario	Medium	This article is missing details about the population of interest and the specific items found in the electronics workshop. It seems that all the indoor environments sampled were set up specifically for the experiment and did not reflect real-life conditions.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	In the settings where two samples were collected, a value with a plus or minus range is listed. Data from the other indoor environments shows only a single concentration measurement.
Metric 9:	Quality Assurance	Medium	The study described quality assurance/quality control techniques and analyzed recoveries, repeatability (which was <10%), and control samples.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	The authors characterized variability and discussed uncertainties, focusing on the strengths and limitations of the novel method they described. The authors indicated that the levels measured in indoor environments in this study were comparable to those measured in two other studies and commented on potential sources of the chemicals measured in the indoor environments.

Overall Quality Determination   **Medium**

Study Citation:	Liu, R., Mabury, S. A. (2019). Organophosphite antioxidants in indoor dust represent an indirect source of organophosphate esters. Environmental Science and Technology 53:1805-1811.		
HERO ID:	5165944		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	There was no description of cotton pad handling after dust collection and before analysis.
	Metric 2: Analytical Methodology	High	Analytical methods were described and further details including method quantification limit were in the SI.
	Metric 3: Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Toronto.
	Metric 5: Currency	High	Samples were collected in April 2018.
	Metric 6: Spatial and Temporal Variability	Medium	Two samples were collected only in some homes but in no offices. The replicates were not paired to test for precision of sampling/analysis.
	Metric 7: Exposure Scenario	High	Indoor dust samples are relevant to general population exposure.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	No raw data was reported for 85 samples.
	Metric 9: Quality Assurance	High	QA/QC methods were described and included recoveries, procedural blanks, and quantification limits.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	There was some discussion on variability and limited discussion on uncertainty.

Overall Quality Determination   High

Study Citation:	Wang, X., Zhong, W., Xiao, B., Liu, Q., Yang, L., Covaci, A., Zhu, L. (2019). Bioavailability and biomagnification of organophosphate esters in the food web of Taihu Lake, China: Impacts of chemical properties and metabolism. Environment International 125:25-32.		
HERO ID:	5165945		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling (e.g., equipment, procedure, capture methods, storage conditions) was fully explained in SI. Number of samples for each type of aquatic organism also provided.
	Metric 2:	Analytical Methodology	Medium	The analytical method & recoveries were sufficiently described; detection limits shown in Table S4.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Zhushan Bay of Taihu Lake, China.
	Metric 5:	Currency	High	Samples were collected in June 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 3 sampling sites within Taihu Lake, with 3-200 samples per type of aquatic organism. No replicate samples were collected.
	Metric 7:	Exposure Scenario	High	Bioavailability and biomagnification in food web (water, sediment and aquatic organisms).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Detailed statistics were provided. Total concentrations by biota, water, and sediment were reported in SI.
	Metric 9:	Quality Assurance	High	Acceptable recoveries, laboratory blanks and validation were discussed. Q/A and Q/C procedures were detailed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Standard deviation provided in Table S5. There was no discussion on limitations, uncertainties, and data gaps.

Overall Quality Determination   High

Study Citation:	Romanak, K. A., Wang, S., Stubbings, W. A., Hendryx, M., Venier, M., Salamova, A. (2019). Analysis of brominated and chlorinated flame retardants, organophosphate esters, and polycyclic aromatic hydrocarbons in silicone wristbands used as personal passive samplers. Journal of Chromatography A 1588:41-47.		
HERO ID:	5165948		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling equipment (black silicone wristband passive exposure monitors) and sampling procedures are detailed within text, Figure one, and noted to be within the supplemental information section, Figure S1. Insufficient information within main text on sample storage duration prior to analysis, as well as calibration of passive wristband samplers.
	Metric 2:	Analytical Methodology	High	The extraction methodology, analytical instrumentation (GC/MS), chemical-specific limits of quantification, recoveries (Table 1), and analytical instrument calibration curves are described within text and supplemental information.
	Metric 3:	Biomarker Selection	N/A	This is not applicable because the wristbands conducted passive sampling for parent chemicals.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted in Bloomington, IN.
	Metric 5:	Currency	Low	Insufficient information was available on the dates of sampling within the text, which may be within supplemental information along with procedures noted to be within Table S1.
	Metric 6:	Spatial and Temporal Variability	Medium	A total of ten participants, with seven participants wearing one wristband personal passive sampler for and three participants wearing duplicates, two wristband personal passive samplers on different wrists for one week. Duplicate sampling was averaged for each participant providing duplicate samples.
	Metric 7:	Exposure Scenario	Medium	Data likely represents PECO-relevant, non-occupational exposures, however the occupations and activities of participants while the wristbands were worn was not detailed. There was insufficient information on the use of field blanks.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Concentrations and summary statistics for each chemical were reported within Table 2 as concentrations (ng) were calculated from ng/g wristband, using average wristband weight. The raw data of ng/g wristband concentrations were not presented within the text but noted as within Table S4. Summary statistics of the calculated concentration medians, and range for each chemical, number of samples, and chemical-specific detection frequencies were provided. There was insufficient information regarding sampling locations, dates.
	Metric 9:	Quality Assurance	Medium	Information on acceptable recoveries, laboratory blanks and validation for quality assurance/quality control procedures was detailed. There is insufficient information on use of field blank wristbands.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Median, minimum and maximum summary statistics are provided and validation of precision procedures is detailed. The authors note that data is comparable to wristband personal passive sampling results of previous studies and offer limited reasoning for higher OPE exposures noted within this study as due to presence of older foam furniture in participants" homes. Key uncertainties and limitations on wristband passive personal sampling are the effects on concentrations, and comparability of data with other studies of keeping wristband on 24 hours/day, while bathing, as well as wristband detection of chemical concentrations within skin were not discussed.

Overall Quality Determination   Medium

Study Citation:	Faiz, Y., Siddique, N., He, H., Sun, C., Waheed, S. (2018). Occurrence and profile of organophosphorus compounds in fine and coarse particulate matter from two urban areas of China and Pakistan. Environmental Pollution 233:26-34.		
HERO ID:	5166026		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling methods were adequately described.
	Metric 2: Analytical Methodology	Medium	LOD and instrument LOD was described. A reference was provided for methodology and analytical instrumentation.
	Metric 3: Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in China & Pakistan.
	Metric 5: Currency	Medium	Samples were collected in summer of 2014 for the site in China and 2012 for the site in Pakistan.
	Metric 6: Spatial and Temporal Variability	High	There were 88 samples total; 52 from the Pakistan site and 36 from the China site.
	Metric 7: Exposure Scenario	Medium	Data represents exposure from urban/industrial pollution.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Table 2 reports summary stats.
	Metric 9: Quality Assurance	Medium	QA/QC was described and reference to details was provided. SI contains blanks and other QC sample results.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variability was discussed in detail.

Overall Quality Determination   Medium

| Study Citation: | Poma, G., Glynn, A., Malarvannan, G., Covaci, A., Darnerud, P. O. (2017). Dietary intake of phosphorus flame retardants (PFRs) using Swedish food market basket estimations. Food and Chemical Toxicology 100:1-7. |
| HERO ID: | 5166285 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sample (food) collection and preparation was well described.
	Metric 2:	Analytical Methodology	High	Analytical methods were adequately described, and LOQs were reported in SI.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in food.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Uppsala, Sweden.
	Metric 5:	Currency	High	Samples were collected in 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	There was no indication of replicate analysis.
	Metric 7:	Exposure Scenario	High	Food and foodstuff exposure scenarios are applicable to the general population.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Both summary statistics (main paper) and raw data (SI) were provided.
	Metric 9:	Quality Assurance	Low	Extraction efficiency was not reported for each individual chemical and therefore its use in correction of the data is unclear. The reported mean recovery range of internal standard was between 53-71% .
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability and uncertainty were adequately discussed.

Overall Quality Determination   High

Study Citation:	Liu, X., Cao, Z., Yu, G., Wu, M., Li, X., Zhang, Y., Wang, B., Huang, J. (2018). Estimation of exposure to organic flame retardants via hand wipe, surface wipe, and dust: Comparability of different assessment strategies. Environmental Science and Technology 52:9946-9953.		
HERO ID:	5166709		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods and storage conditions are documented. Sieving was conducted.
Metric 2:	Analytical Methodology	High	Analytical methods are well described and limits of quantification are provided. Gas chromatography- mass spectroscopy was in EI mode.
Metric 3:	Biomarker Selection	N/A	Wipe samples were taken thus no biomarker is needed.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	This study was conducted in Beijing, China.
Metric 5:	Currency	High	Samples were collected in 2016.
Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected from three different jobs for 20 to 25 people per job type. Samples were collected over 6 months in 2016. However, there were no replicates for a few individuals or all.
Metric 7:	Exposure Scenario	Low	The scenarios may be considered occupational, but the jobs are in environments that the general population would also likely be exposed, although for less time (e.g., taxi driver, security guard). Office workers were also evaluated, but their samples were not analyzed for TCEP or TPP.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Medium, geometric mean, geometric standard deviation, detection frequency, and range were reported. No point values were provided.
Metric 9:	Quality Assurance	High	Wipe removal efficiency was 90% on first wipe. For TCEP, recoveries ranged from 52-112 for low level and 83-111 for high level. Most actual values appear to be closer to the high range. TCEP was detected in the field blank, but samples were blank corrected when a higher contamination level was observed.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	Geometric standard deviation was provided. Uncertainty and limitations were discussed such as a small sample size, the relationship between sample types, and factors such as hand washing.

Overall Quality Determination   **High**

Study Citation: Guo, J. H., Simon, K., Romanak, K., Bowerman, W., Venier, M. (2018). Accumulation of flame retardants in paired eggs and plasma of bald eagles. Environmental Pollution 237:499-507.

HERO ID: 5166846

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	All pertinent sampling procedures are provided in both the article and supplemental information, including references to other studies and collecting permits.
	Metric 2:	Analytical Methodology	High	Analytical methods and instrumentation were described in the text. Table S1 lists method the detection limits.
	Metric 3:	Biomarker Selection	N/A	Study tested for parent chemical in eggs and plasma of bald eagles.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was based in Michigan, United States.
	Metric 5:	Currency	Medium	Samples were collected from 2000 to 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample sizes ranged from 5 to 12, there were no replicates.
	Metric 7:	Exposure Scenario	High	The study measured flame retardants in bald eagles.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	There was no raw data.
	Metric 9:	Quality Assurance	High	Quality assurance/quality control procedures, such as recoveries and blanks, were reported both in the paper and supplemental information.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	There was no characterization of variance or discussion of limitations and uncertainties.

Overall Quality Determination　　　　High

Study Citation:	Li, H., Harvey, E., Sheng, G., Liu, H., Fu, J., La Guardia, M. J., Peng, P., Hale, R. C., Mainor, T. M. (2019). Brominated and organophosphate flame retardants along a sediment transect encompassing the Guiyu, China e-waste recycling zone. Science of the Total Environment 646:58-67.		
HERO ID:	5166925		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The authors reported information on the sampling equipment, procedures, sample storage and study site characteristics.
Metric 2:	Analytical Methodology	Medium	The authors referenced two other studies and only summarized their extraction methods. Authors reported their analytical instrumentation, recovery results, and LOQ (Sec 2.3)
Metric 3:	Biomarker Selection	N/A	The analyte was measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The geographic area is described in the methods section.
Metric 5:	Currency	Medium	Samples were collected in 2013.
Metric 6:	Spatial and Temporal Variability	Medium	Authors collected 29 samples along the mainsteam and tributary rivers. However, the samples were collected over three days, n January 25 and 28 so there was little variation in time.
Metric 7:	Exposure Scenario	Medium	The authors characterized the types of point source pollution along the river.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data provided in SI. The data for TCEP is reported as a relative percentage in a figure (Figure 3), no standard deviation, frequency of detection or summary statistics.
Metric 9:	Quality Assurance	Medium	The authors did not report collecting field blanks, but did analyze laboratory blanks and duplicates. They also reported the results of recovery tests.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	No standard deviation is reported in the main article. It may be reported in the supplemental information. Limited discussion on study limitations

Overall Quality Determination   Medium

Study Citation:	Carlsson, H., Nilsson, U., Becker, G., Ostman, C. (1997). Organophosphate ester flame retardants and plasticizers in the indoor environment: Analytical methodology and occurrence. Environmental Science and Technology 31:2931-2936.		
HERO ID:	5166974		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Stationary air sampling was performed with a personal sampler. The flow rate was set to 3.0 L/min and samples were collected for 700 min, yielding a total air volume of 2.1 m3. Sampling at higher flow rates, at 17.5 L/min, was also performed in order to examine (a) the distribution between the particulate and the semivolatile phase and (b) how the result, in terms of total concentrations of organophosphates, was affected.
	Metric 2: Analytical Methodology	Medium	Gas Chromatography with nitrogen-phosphorus detector (GC-NPD), GC-AED (atomic emission detector), and GC-MS (Mass Spectrometer Detector). Sample extraction was also described using a Soxhelet or ultrasonication to determine efficiencies. Internal standards were added. Missing blanks and LOD/LOQ was reported as less than 5 pg at three times the noise level. Recoveries were also reported.
	Metric 3: Biomarker Selection	N/A	The authors analyzed air samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	Critically Deficient	Authors are from Sweden, but study does not report sampling location.
	Metric 5: Currency	Low	No sampling date is reported. Publication date is 1997.
	Metric 6: Spatial and Temporal Variability	Medium	n= 20 samples in total. Four samples at each location, 5 locations: 3 school, 1 daycare, 1 office. Unclear if the 4 are replicates or consecutive samples.
	Metric 7: Exposure Scenario	Low	The data likely represent relevant exposure scenarios related to indoor environments in schools, daycares, and offices, but the lack of geographic location details limits the validity of the results.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Low	Limited summary statistics were reported in Table 1, no ranges or raw data.
	Metric 9: Quality Assurance	Medium	Missing some analytical QA/QC parameters, e.g., field and laboratory blanks.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Limited characterization of variability (coefficient of variation). Uncertainties and limitations were briefly described.

Overall Quality Determination　　　　　　　**Uninformative**

Study Citation: Stubbings, W. A., Guo, J. H., Simon, K., Romanak, K., Bowerman, W., Venier, M. (2018). Flame retardant metabolites in addled bald eagle eggs from the Great Lakes region. Environmental Science & Technology Letters 5:354-359.

HERO ID: 5167023

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling was described in the methods and in the SI, including the procedure, storage, matrix characteristics.
	Metric 2:	Analytical Methodology	Medium	Methods, equipment, and matrix spike recoveries were reported.
	Metric 3:	Biomarker Selection	N/A	The analyte measured is a metabolite of interest, but in terrestrial species.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Michigan, US.
	Metric 5:	Currency	Medium	Timing of sample collection for monitoring data is less consistent with current or recent exposures (>5 to 15 years) may be expected. The data collected is from 2000 to 2012.
	Metric 6:	Spatial and Temporal Variability	High	Sample size for the inland breeding area was 11 and sample size for the Great Lakes breeding area was 10.
	Metric 7:	Exposure Scenario	High	The data closely represented relevant exposure scenario. It reflected the ecological species which may be affected.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Individual data points are reported in Table S5 and summary statistics including geometric mean, standard error, median, and range were reported in Table S4.
	Metric 9:	Quality Assurance	Medium	QA included matrix spike recoveries. QA was discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability and uncertainty were not explicitly discussed. Only some discussion around the limitation of the study finding was provided at the end of the article.

Overall Quality Determination   High

Study Citation:	Liu, L. Y., He, K., Hites, R. A., Salamova, A. (2016). Hair and nails as noninvasive biomarkers of human exposure to brominated and organophosphate flame retardants. Environmental Science and Technology 50:3065-3073.		
HERO ID:	5176476		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling procedures for hair/nail and serum collection were summarized clearly. Blood samples were described as drawn by trained professional with description of sampling and storage equipment, frozen storage prior to analysis. Hair sampling was conducted immediately following blood draw, with descriptions of sampling procedures, equipment, frozen storage prior to analysis. Nail sampling was described as conducted by study participants within two weeks of blood draw with description of sampling equipment, equipment cleaning procedures supposed to be followed by participants, and specialized shipment to lab for analysis. Insufficient data were reported on study sampling site characteristics and frozen storage time prior to analysis for serum and hair sampling, as well as storage time prior to lab analysis for nail sampling.
	Metric 2:	Analytical Methodology	High	Analytical instrumentation methods were described as using method developed by authors for simultaneous determination of chemical concentrations in hair and nail samples (GC-MS/ECNI). Extraction methods, LOQ method but not chemical-specific LOQ's, and chemical-specific recoveries for hair and nail samples (chemicals of interest not detected within serum) were described. Insufficient information on instrument calibration and chemical-specific LOQ's. However, text notes detailed information can be found within SI.
	Metric 3:	Biomarker Selection	N/A	Exposure sampling for parent chemicals of interest were analyzed in all sampling media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Indiana University, Bloomington campus.
	Metric 5:	Currency	Low	Dates of recruitment, but not dates of actual sampling, were described.
	Metric 6:	Spatial and Temporal Variability	Medium	For hair/nails samples, they were from all ten toes so replicate and n=10, but samples were only taken at one place/time. Authors noted that due to rapid metabolism of OPEs it is unlikely for chemicals of interest transported through body to reach hair/nails such that concentrations within hair/nails likely represent external sources such as absorption from air and dust or contact with nail polish. For blood sample, a single blood sample was collected, no replicate samples were collected.
	Metric 7:	Exposure Scenario	Medium	It was likely that concentrations reported represented non-occupational exposure, however, occupations of participants were not noted and results from living habits and indoor environment survey were not reported.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Insufficient information for all media concerning raw data (not within full text or noted as within SI), and dates of sampling. Summary statistics of geometric mean, median, range and % detection were provided within Table 1.
	Metric 9:	Quality Assurance	Medium	Details for QA/QC procedures and accuracy/precision of methods for all sampling media were described as outlined within referenced previous publication (Liu et al., 2015). Authors noted that concentrations were neither recovery-corrected nor blank-corrected. Baseline/pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Table 1 noted variability in terms of range for all geometric mean concentrations within all media. Nail sampling was conducted within two weeks after serum sampling, however, nail clippings would have been taken from end of nail and would reflect exposures more than two weeks prior to serum sampling. Authors discussed similarity of measured concentrations in all media with previous studies. Chemicals of interest were not detected within serum so no relationship between hair/nail concentrations and serum concentrations could be assessed. Authors noted reasoning for non-detects within serum as possibly due to rapid metabolism of OPEs. Authors noted TCEP level associations between hair and nail sampling, but not TPHP and discuss reason for additional sources of exposure for TPHP (nail polish) on nails versus.

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Study Citation: Liu, L. Y., He, K., Hites, R. A., Salamova, A. (2016). Hair and nails as noninvasive biomarkers of human exposure to brominated and organophosphate flame retardants. Environmental Science and Technology 50:3065-3073.

HERO ID: 5176476

Domain	Metric	Rating	Comments

Overall Quality Determination   Medium

Study Citation:	Marklund, A., Andersson, B., Haglund, P. (2005). Traffic as a source of organophosphorus flame retardants and plasticizers in snow. Environmental Science and Technology 39:3555-3562.		
HERO ID:	5176506		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	Adequate detail was not provided.
Metric 2:	Analytical Methodology	Medium	Adequate detail was not provided.
Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media (snow).
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Sweden.
Metric 5:	Currency	Low	Samples were collected in March 2003.
Metric 6:	Spatial and Temporal Variability	Low	1-2 snow sample replicates were collected per location. One 1-week background air sample was collected. Wet and dry deposition was recorded. Various product samples were taken (Table 2).
Metric 7:	Exposure Scenario	High	The exposure scenario can be used in general population, environmental and animal exposure scenarios.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	There are no statistics as there was one sample per site.
Metric 9:	Quality Assurance	High	Recoveries are provided by each reported value.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	There was no discussion on variability and uncertainties. A few samples were connected to a larger region.

Overall Quality Determination　　　　　Medium

| Study Citation: | Zhao, L., Jian, K., Su, H., Zhang, Y., Li, J., Letcher, R. J., Su, G. (2019). Organophosphate esters (OPEs) in Chinese foodstuffs: Dietary intake estimation via a market basket method, and suspect screening using high-resolution mass spectrometry. Environment International 128:343-352. |
| HERO ID: | 5184238 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage duration was not reported. The sample extraction process was performed twice, and both extracts combined.
	Metric 2:	Analytical Methodology	High	LOQ and LOD were reported in SI.
	Metric 3:	Biomarker Selection	N/A	Concentrations were measured in food samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in China.
	Metric 5:	Currency	High	Samples were collected in 2018.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample size was reported for each food category but there was no indication of replicate analysis.
	Metric 7:	Exposure Scenario	High	Dietary intake for general Chinese population.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual sample concentrations were not reported.
	Metric 9:	Quality Assurance	High	There don't appear to be any major quality assurance/quality control issues in the study. Procedural blanks were included with each extraction to assess lab contamination. Blank concentrations were subtracted from sample concentrations.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study does not include a discussion of limitations.

Overall Quality Determination   High

Study Citation:	Tan, H., Yang, L., Yu, Y., Guan, Q., Liu, X., Li, L., Chen, D. (2019). Co-existence of organophosphate di- and tri-esters in house dust from South China and Midwestern United States: Implications for human exposure. Environmental Science and Technology 53:4784-4793.		
HERO ID:	5184432		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methodology is consistent with widely accepted methods/approaches for the chemical and media being analyzed. scientifically sound), and similar to widely accepted protocols for the chemical and media of interest. All pertinent sampling information is provided in the data source and companion source.
	Metric 2: Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation. LOQ provided.
	Metric 3: Biomarker Selection	High	Metabolite (BCEP) and parent chemical measured in dust samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Geographic locations are reported and discussed. Samples collected in USA and China.
	Metric 5: Currency	Low	No sampling date was provided, but a publication date is available.
	Metric 6: Spatial and Temporal Variability	Medium	Replicate samples were not used. Data collected in 47 sites.
	Metric 7: Exposure Scenario	Medium	The data likely represent the relevant exposure scenario (i.e., population/scenario/media of interest). Exposure activities not discussed.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Supplementary or raw data (i.e., individual data points) are not reported, and therefore summary statistics cannot be reproduced.
	Metric 9: Quality Assurance	High	The study applied quality assurance/quality control measures and all pertinent quality assurance information is provided in the datasource or companion source.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	The study characterizes variability in the population studied. Key uncertainties, limitations, and data gaps have been identified and are minimal.

Overall Quality Determination　　　　High

Study Citation:	Page, D., Miotliński, K., Gonzalez, D., Barry, K., Dillon, P., Gallen, C. (2014). Environmental monitoring of selected pesticides and organic chemicals in urban stormwater recycling systems using passive sampling techniques. Journal of Contaminant Hydrology 158:65-77.		
HERO ID:	5298744		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The water sampling methodology was concisely described.
Metric 2:	Analytical Methodology	Medium	The analytical methods were described, but recoveries and LOD were not reported.
Metric 3:	Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The samples were collected in South Australia.
Metric 5:	Currency	Medium	The samples were collected in 2011 and 2012
Metric 6:	Spatial and Temporal Variability	Medium	n=5 sampling locations with <5 replicates per site.
Metric 7:	Exposure Scenario	High	The data likely represent relevant exposure scenarios related to stormwater in South Australia, but details about the population of interest were missing.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Limited summary statistics were reported. Individual sample concentrations were not reported.
Metric 9:	Quality Assurance	Low	Limited details about QA/QC techniques were reported.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Variability was not characterized. Uncertainties and study limitations were briefly discussed.

Overall Quality Determination   Medium

Study Citation:	Gadelha, J. R., Rocha, A. C., Camacho, C., Eljarrat, E., Peris, A., Aminot, Y., Readman, J. W., Boti, V., Nannou, C., Kapsi, M., Albanis, T., Rocha, F., Machado, A., Bordalo, A., Valente, L. M. P., Nunes, M. L., Marques, A., Almeida, C. M. R. (2019). Persistent and emerging pollutants assessment on aquaculture oysters (Crassostrea gigas) from NW Portuguese coast (Ria De Aveiro). Science of the Total Environment 666:731-742.
HERO ID:	5305891

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling area and procedures were adequately described. Water and sediments were sampled over four seasons and oyster characteristics were measured.
	Metric 2:	Analytical Methodology	High	Details on extraction method, LOD, LOQ, % recovery, reproducibility described in Supplementary Materials.
	Metric 3:	Biomarker Selection	N/A	Parent chemical concentration measured in oyster soft tissues.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Portugal.
	Metric 5:	Currency	High	Samples were collected from 2016 to 2017.
	Metric 6:	Spatial and Temporal Variability	Low	Sampling occurred in 4 seasons. 20 oysters each for chemical analysis were homogenized together and divided into five lots; one lot was analzyed per chemical group. N = 3 triplicate measures per chemical per season.
	Metric 7:	Exposure Scenario	High	The exposure scenario was oysters from aquaculture, which are consumed by people. Water and sediments from the same location were also evaluated.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Mean and SD was reported for homogenized oysters from each of 4 seasons for each chemical. N = 3, for water, sediment, and oysters.
	Metric 9:	Quality Assurance	Medium	QA was discussed generally; details might be provided in Supplementary Materials.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Seasonal variations were discussed and oyster, water, and sediment concentrations were compared. Variation among individual oysters or between different aquaculture locations was not addressed.

Overall Quality Determination   High

Study Citation:	Rauert, C., Harner, T., Schuster, J. K., Eng, A., Fillmann, G., Castillo, L. E., Fentanes, O., Villa Ibarra, M., Miglioranza, K. S. B., Moreno Rivadeneira, I., Pozo, K., Aristizábal Zuluaga, B. H. (2018). Atmospheric Concentrations of New Persistent Organic Pollutants and Emerging Chemicals of Concern in the Group of Latin America and Caribbean (GRULAC) Region. Environmental Science and Technology 52:7240-7249.	
HERO ID:	5386424	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling equipment and study sites were discussed. However, sample storage and calibration were not mentioned.
	Metric 2: Analytical Methodology	Medium	Analytical method (GC-MS/MS) was used. And detection limits were mentioned in the SI.
	Metric 3: Biomarker Selection	N/A	Air samples were collected. No biomarker was needed.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The study included 9 sites covering 7 countries: Mexico (n = 2), Costa Rica (n = 1), Colombia (n = 1), Brazil (n = 2), Bolivia (n = 1), Argentina (n = 1), and Chile (n = 1).
	Metric 5: Currency	High	The deployment of sampling equipment was reported to be 2014-2015.
	Metric 6: Spatial and Temporal Variability	Medium	Replicate samples were not mentioned to be provided. Each site had 1 or 2 samplers collecting samples for at least a quarter of a year.
	Metric 7: Exposure Scenario	High	Air, background mostly. The majority of sites were classified as background sites (n = 5), with 3 urban and 1 agricultural site
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Individual data points were reported in the SI.
	Metric 9: Quality Assurance	High	Quality assurance measures and all pertinent information was provided in the data source or companion source.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	The study has limited discussion of key uncertainties, limitations, and data gaps.

Overall Quality Determination   High

Study Citation:	Giovanoulis, G., Nguyen, M. A., Arwidsson, M., Langer, S., Vestergren, R., Lagerqvist, A. (2019). Reduction of hazardous chemicals in Swedish preschool dust through article substitution actions. Environment International 130:104921.		
HERO ID:	5412073		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Reported key sampling details and cited sampling method previously were described in Papadopoulou et al., 2016 (reference not obtained).
	Metric 2: Analytical Methodology	High	Extraction and analytical methods were well-described; collected replicate samples from each preschool; reported detection limits in Table 1; analyzed the standard reference material (SRM) 2585 (NIST, USA) each time in replicate (n=4) to evaluate accuracy of the analytical method.
	Metric 3: Biomarker Selection	N/A	The analytes were collected as dust samples; biomarker samples were not collected.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were collected in Stockholm area, Sweden.
	Metric 5: Currency	High	Dust sampling took place from January to February 2018.
	Metric 6: Spatial and Temporal Variability	High	The study had a sample size of n=20 and replicate samples from each pre-school. The study collected dust at one point in time (2018), but compared current dust contaminant concentrations to prior concentrations to examine the impact of implementation of "chemical smart" actions.
	Metric 7: Exposure Scenario	High	The study collected questionnaire data during sampling to capture information on indoor materials, daily cleaning routines and ventilation function. It also examined association between dust and indoor parameters to understand product sources of exposure.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data were not reported in main text (does not seem to be reported in SI either, but SI file was not obtained). The standard deviation of summary statistics was not reported in main text.
	Metric 9: Quality Assurance	High	The study analyzed solvent and field blanks. It reported adequate (>70%) sample recoveries; results were in good agreement with previously reported values in the literature.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	The study accounted for variability between chemicals and floor materials (boxplot distributions presented in Fig 1). It discussed key limitations and uncertainties, which likely underestimated risk to children specifically.

Overall Quality Determination   **High**

Study Citation:	He, C., Wang, X., Tang, S., Phong Thai, Li, Z., Baduel, C., Mueller, J. F. (2018). Concentrations of Organophosphate Esters and Their Specific Metabolites in Food in Southeast Queensland, Australia: Is Dietary Exposure an Important Pathway of Organophosphate Esters and Their Metabolites?. Environmental Science and Technology 52:12765-12773.		
HERO ID:	5423396		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	General inclusion of sampling information.
	Metric 2:	Analytical Methodology	Medium	MDL provided, method reference cited, general description of methods.
	Metric 3:	Biomarker Selection	High	Parent chemical and metabolite (BCEP) measured in food. The urine excretion estimates were based on previous studies.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Queensland Australia.
	Metric 5:	Currency	High	Samples collected during March 2018.
	Metric 6:	Spatial and Temporal Variability	Medium	A total of 92 samples were collected (estimated from table S4), 3-5 items per food group.
	Metric 7:	Exposure Scenario	Medium	The data closely represent relevant exposure scenarios related to food (vegetables) and water for consumption in Queensland, Australia.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were provided, without raw data.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described, e.g, recoveries, field blanks, supplemental tables showing analytes in field blanks, duplicate samples for reproducibility of method.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability was characterized (percentiles). Uncertainties were briefly described.

Overall Quality Determination   High

Study Citation:	Kinney, C. A., Furlong, E. T., Kolpin, D. W., Zaugg, S. D., Burkhardt, M. R., Bossio, J. P., Werner, S. L. (2010). Earthworms: Diagnostic indicators of wastewater derived anthropogenic organic contaminants in terrestrial environments. ACS Symposium Series Volume 1048 1048:297-317.		
HERO ID:	5428395		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The biosolid, soil and earthworm sampling methodology were described in detail.
	Metric 2:	Analytical Methodology	Low	The analytical methods were described, mentioning recoveries, instrumentation and LOD, but the values for recoveries and LOD were not reported.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Data collected in Midwestern U.S.
	Metric 5:	Currency	Medium	The samples were collected in 2005.
	Metric 6:	Spatial and Temporal Variability	Low	n=10 (no replicates), estimated from Table II.
	Metric 7:	Exposure Scenario	Medium	The data may represent chemical presence in soil and earthworms evaluated in biosolid amended soils and other soils. The limited sample size limits the results' generalizability.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table II has raw data for each site (average of 3 replicate composite samples). Summary statistics were reported.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability was not characterized. Uncertainties and limitations were not discussed.

Overall Quality Determination　　　　Medium

Study Citation:	Gao, Q., Blum, K. M., Gago-Ferrero, P., Wiberg, K., Ahrens, L., Andersson, P. L. (2019). Impact of on-site wastewater infiltration systems on organic contaminants in groundwater and recipient waters. Science of the Total Environment 651:1670-1679.		
HERO ID:	5428453		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Groundwater monitoring wells were used by local authority for routine monitoring; grab samples were collected and stored at -20C; the samples were filtered.
Metric 2:	Analytical Methodology	High	Discussion included SPE, GC/HRMS or LC-MS/MS. LOD and LOQs listed in Table S3 and recovery rates in Table S4 and S7, which were all >40% .
Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Are municipality (Storlien and Ann) in central Sweden.
Metric 5:	Currency	High	Samples collected from November 2016-August 2017.
Metric 6:	Spatial and Temporal Variability	Medium	There were 5 sampling seasons (see Table 1), and at 2 sites - Storlien, 4 groundwater sampling points (n=20). The 4 sampling points are considered replicates. At 2 lakes (n=4) - Ann, 2 groundwater sampling points (n=10); stream water (n=2) and lake (n=2) sampled in June and August.
Metric 7:	Exposure Scenario	High	The exposure scenario was ground water and surface water in residential Are municipality; more details provided in Table S1.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Raw data was reported in SI; Fig 2 and Fig 5 depicted concentrations; summary statistics were limited in the paper but SI may provide additional detail.
Metric 9:	Quality Assurance	Medium	Section 2.4 discussed QA/QC; recovery > 40% ; additional information in SI.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Paper discusses seasonal variation and compares levels to literature and previous studies.

Overall Quality Determination   **High**

Study Citation: Blum, K. M., Haglund, P., Gao, Q., Ahrens, L., Gros, M., Wiberg, K., Andersson, P. L. (2018). Mass fluxes per capita of organic contaminants from on-site sewage treatment facilities. Chemosphere 201:864-873.

HERO ID: 5428638

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The water sampling methodology was described in detail and is scientifically sound.
	Metric 2: Analytical Methodology	High	The analytical methods were thoroughly described, including LOD and recoveries.
	Metric 3: Biomarker Selection	N/A	The authors analyzed water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The study was conducted in Sweden.
	Metric 5: Currency	Medium	The samples were collected in 2014 and 2015.
	Metric 6: Spatial and Temporal Variability	Low	There were 20 samples in total from five locations (4 replicates).
	Metric 7: Exposure Scenario	High	The data closely represent relevant exposure scenarios related to contaminants of interest in River Fyris, which receives treated sewage.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Summary statistics and individual sample concentrations were reported.
	Metric 9: Quality Assurance	High	QA/QC techniques were reported, including the use of control samples.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variability was characterized (IQR, range). Uncertainties were discussed by the authors.

Overall Quality Determination   High

Study Citation:	Dodson, R. E., Bessonneau, V., Udesky, J. O., Nishioka, M., Mccauley, M., Rudel, R. A. (2019). Passive indoor air sampling for consumer product chemicals: a field evaluation study. Journal of Exposure Science and Environmental Epidemiology 29:95-108.		
HERO ID:	5432871		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The air sampling methodology was well described and is scientifically sound
	Metric 2:	Analytical Methodology	High	The analytical methods were described, including LOD and recoveries.
	Metric 3:	Biomarker Selection	N/A	The authors analyzed air samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Data was collected in Boston, USA.
	Metric 5:	Currency	High	The samples were collected in Oct. 2013-July 2015.
	Metric 6:	Spatial and Temporal Variability	Low	n=37 samples, without replicates.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to consumer product chemicals in indoor air in Boston.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Only summary statistics were reported. Individual sample concentrations were not reported.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail, including the use of control samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability was characterized (range, 95th percentile). Uncertainties and study limitations were discussed in detail.

Overall Quality Determination   High

Study Citation:	Zhang, Y., Zhang, W., Hou, J., Wang, X., Lu, W., Zheng, H., Xiong, W.,ei, Liu, J., Yuan, J. (2019). Seasonal variations of tris (2-chloroethyl) phosphate and cytotoxicity of organic extracts in water samples from Wuhan, China. Journal of Environmental Sciences 76:299-309.		
HERO ID:	5469202		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling raw, finished, and tap water; storage and transport were described.
	Metric 2:	Analytical Methodology	High	Solid-phase extraction and GC/MS methodology were modification of Salamova et al. 2016 and described.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the chemical in an environmental media (drinking water).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Geographic location is reported (China, Wuhan City) and very well described.
	Metric 5:	Currency	High	Sample collection date were reported: May 2015, August 2015, November 2015 and January 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample collected during 4 seasons from 2 drinking water treatment plants with 5 samples from each plant (1 raw, 1 finished, and 3 different tap water). The sample size is 40 samples.
	Metric 7:	Exposure Scenario	High	Study provides concentrations at tap.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data is reported (N = 40 samples, Table 1).
	Metric 9:	Quality Assurance	Medium	The following was described: procedural and solvent blanks; MDL = 3 x SD; recovery % ; calibration curves by season; replicates not specified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Study described sources of variability and uncertainty.

Overall Quality Determination   **High**

Study Citation:	Valcarcel, Y., Valdehita, A., Becerra, E., Lopez de Alda, M., Gil, A., Gorga, M., Petrovic, M., Barcelo, D., Navas, J. M. (2018). Determining the presence of chemicals with suspected endocrine activity in drinking water from the Madrid region (Spain) and assessment of their estrogenic, androgenic and thyroidal activities. Chemosphere 201:388-398.		
HERO ID:	5469210		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The location, details of sampling sites, sampling procedures, and sample storage were well described.
	Metric 2:	Analytical Methodology	Medium	LOD, LOQ, and detection limits were reported. The analytical method was briefly described as a detailed description was provided in a previous publication.
	Metric 3:	Biomarker Selection	N/A	This paper provides the concentrations of endocrine disruptor chemicals monitored, not biomarkers concentrations.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Details of the 4 sampling sites in Spain are provided.
	Metric 5:	Currency	Medium	Samples were collected in November 2013.
	Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected for 7 days from each of the 4 sites. Samples were collected every 8 hours and samples were combined for each 24 hour period.
	Metric 7:	Exposure Scenario	High	Details of the DWTPs and the populations served were provided.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The LOD, LOQ, detection frequency, range and total concentration were provided. The raw data was not provided.
	Metric 9:	Quality Assurance	Medium	Recovery was reported. Details of the analytical procedure and quality assurance methods are provided in a previous publication. They were not provided in the current publication.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	A measure of variance was not provided. There was limited discussion on uncertainty. There was some discussion on the differences between the 4 sampling sites.

Overall Quality Determination   Medium

Study Citation:		Wang, X., Zhu, L., Zhong, W., Yang, L. (2018). Partition and source identification of organophosphate esters in the water and sediment of Taihu Lake, China. Journal of Hazardous Materials 360:43-50.	
HERO ID:		5469212	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Collection locations, storage, filtration, etc. are described.
Metric 2:	Analytical Methodology	Medium	Probably high confidence. The sample pretreatment is described in previous publications and in SI; instrumentation is described briefly and in detail in Ref #6.
Metric 3:	Biomarker Selection	N/A	The parent chemical is being tested for in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The geographic location is Taihu Lake, China.
Metric 5:	Currency	High	The sample collection date is 2016.
Metric 6:	Spatial and Temporal Variability	Medium	Spatial: there are 29 water, suspended particulate, and sediment sampling locations in the lake; there are 9 possible source sampling locations. Temporal: there is only one sampling year and season.
Metric 7:	Exposure Scenario	Low	This is not a direct source of human exposure.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	The presented proportion of all OPEs is measured graphically. The data available in SI are unclear (not yet examined).
Metric 9:	Quality Assurance	High	Calibration, blanks, MDLs, validation standards, and % recovery are reported.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Spatial variability is examined; temporal variability is not examined. Uncertainties regarding the sources of the chemical are discussed.

Overall Quality Determination   Medium

Study Citation:	Wang, Y., Wu, X., Zhang, Q., Hou, M., Zhao, H., Xie, Q., Du, J., Chen, J. (2017). Organophosphate esters in sediment cores from coastal Laizhou Bay of the Bohai Sea, China. Science of the Total Environment 607-608:103-108.		
HERO ID:	5469213		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Details of the collection site and matrix, sampling procedure and storage were reported.
	Metric 2:	Analytical Methodology	High	Sample extraction and analysis procedures were provided. The LOQ was provided.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Details of the location of the sediment cores in 2 locations in China were provided.
	Metric 5:	Currency	High	Samples were collected on September 22-23, 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	The length of the sediment core CA was 60 cm and length of the sediment core CB was 66 cm. Each core was cut into 3 cm pieces yielding 20-23 samples per core but only one sample for each depth.
	Metric 7:	Exposure Scenario	Medium	Some discussion of the temporal trends and sources of deposition. Exposure would be relevant to the aquatic environment.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	The only data provided was the temporal trend in each core and the concentration is reported for each depth measurement of the core providing. The raw data is not provided.
	Metric 9:	Quality Assurance	Medium	No QA issues were identified (no blank contamination). The recovery was only e 82.3 ± 27.8% , and recoveries were corrected with surrogate recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There is some discussion of the temporal variability and uncertainty.

Overall Quality Determination　　　　　Medium

Study Citation:	Wang, Y., Wu, X., Zhang, Q., Zhao, H., Hou, M., Xie, Q., Chen, J. (2018). Occurrence, distribution, and air-water exchange of organophosphorus flame retardants in a typical coastal area of China. Chemosphere 211:335-344.		
HERO ID:	5469215		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Sampling was described but missing information about the storage during transport and materials used for collecting water samples
	Metric 2: Analytical Methodology	High	Analytical instrumentation was described and appropriate. Analysis and QC samples were described and appropriate. MDLs was calculated and provided in text.
	Metric 3: Biomarker Selection	N/A	No biomarker needed because the study used air and water samples.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Dalian, China.
	Metric 5: Currency	High	One water sample per season and one passive air sample per season were collected in 40 day span starting in Sep 2016 to Jul 2017
	Metric 6: Spatial and Temporal Variability	Medium	One water sample per season and one passive air sample per season collected in a 40 day span per location. This method was appropriate, but replicate or triplicates would've been possible given the sampling methodologies and materials.
	Metric 7: Exposure Scenario	High	Ambient air and water were monitored.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data is not provided.
	Metric 9: Quality Assurance	High	Analytical QA/QC was reported and described.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Little information was provided about gaps and limitations. Seasonal variability was found but not seasonality, which is not possible unless study is done in multiple years.

Overall Quality Determination **Medium**

Study Citation:	Xing, L., Zhang, Q., Sun, X., Zhu, H., Zhang, S., Xu, H. (2018). Occurrence, distribution and risk assessment of organophosphate esters in surface water and sediment from a shallow freshwater Lake, China. Science of the Total Environment 636:632-640.		
HERO ID:	5469238		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Medium	A previous study is cited for methodology. Sampling methods is briefly described but missing details on collection equipment and technique.
Metric 2:	Analytical Methodology	High	Analytical methodology is full described. LODs are reported in Table S2.
Metric 3:	Biomarker Selection	N/A	Chemical is measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in China.
Metric 5:	Currency	High	Samples were collected in November 2016.
Metric 6:	Spatial and Temporal Variability	Medium	All samples were collected within one month and there were no replicate analysis.
Metric 7:	Exposure Scenario	High	Site and potential sources are characterized.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data is not reported.
Metric 9:	Quality Assurance	Medium	This study applied quality control measures and no issues were identified.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	This study contains some discussion of variability and limitations.

Overall Quality Determination **High**

Study Citation:	Zhang, B., Lu, S., Huang, M., Zhou, M., Zhou, Z., Zheng, H., Jiang, Y., Bai, X., Zhang, T. (2018). Urinary metabolites of organophosphate flame retardants in 0-5-year-old children: Potential exposure risk for inpatients and home-stay infants. Environmental Pollution 243:318-325.		
HERO ID:	5469244		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology accompanied with questionnaire, morning void samples collected.
	Metric 2:	Analytical Methodology	High	Analytical instrumentation details provided in SI, recoveries, LOQ, provided in main text.
	Metric 3:	Biomarker Selection	High	Metabolite (BCEP) for parent chemical measured.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in China.
	Metric 5:	Currency	High	Samples were collected from October to November 2016.
	Metric 6:	Spatial and Temporal Variability	Medium	Sample replicates were not reported. A total of 227 samples were collected.
	Metric 7:	Exposure Scenario	High	The study evaluates infant exposure to OPFRs.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 1 reports a summary of statistics including the median, GM, min and max. The raw data is not available.
	Metric 9:	Quality Assurance	High	The study has a QA/QC section describing blanks, internal standards, LOQ, and recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability reported in terms of range, no limitations were reported.

Overall Quality Determination   **High**

Study Citation: Pang, L., Yang, H., Wang, Y.,ue, Luo, X., Liu, S., Xiao, J. (2019). Organophosphate flame retardants in total suspended particulates from an urban area of zhengzhou, China: Temporal variations, potential affecting factors, and health risk assessment. Ecotoxicology and Environmental Safety 176:204-210.

HERO ID: 5469253

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology, sample storage, and materials were described.
	Metric 2:	Analytical Methodology	High	Analytical methodology, QA/QC samples were provided and reported. MDLs were reported, but not for LODs or LOQs.
	Metric 3:	Biomarker Selection	N/A	Particulate samples were measured but no biomarker were needed.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Zhengzhou, China.
	Metric 5:	Currency	High	Samples were collected in June to November 2018.
	Metric 6:	Spatial and Temporal Variability	Medium	Thirty samples were collected with no replicates.
	Metric 7:	Exposure Scenario	High	Ambient air was monitored.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data is available in supplemental.
	Metric 9:	Quality Assurance	High	Analytical QA/QC was reported and reliable.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	No study limitations were reported.

Overall Quality Determination   High

Study Citation:	Regnery, J., Püttmann, W. (2010). Occurrence and fate of organophosphorus flame retardants and plasticizers in urban and remote surface waters in Germany. Water Research 44:4097-4104.		
HERO ID:	5469263		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The study sites and matrices, sampling procedures, and sample storage are well described.
Metric 2:	Analytical Methodology	High	The LOD, LOQ, and recovery rates are provided. The analytical method is well described.
Metric 3:	Biomarker Selection	N/A	Chemical in environmental media is tested.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The sampling sites across Germany are well described.
Metric 5:	Currency	Medium	Samples were collected from 2007-2009.
Metric 6:	Spatial and Temporal Variability	High	Samples ranged from 2-42 at each site. Duplicate samples were collected.
Metric 7:	Exposure Scenario	Medium	There is some discussion on exposure to humans and the aquatic environment. There is a range of types of sampling sites and therefore exposure.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The LOD, LOQ, median, and 5th and 95th percentiles are reported. The raw data is not included.
Metric 9:	Quality Assurance	High	No QA issues were identified (no blank contamination and recoveries of TCEP were 95 +/- 2.7%).
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	The 5th and 95th percentiles were reported. There is some discussion of uncertainty and comparison to other studies.

Overall Quality Determination   High

Study Citation:	Scott, P. D., Bartkow, M., Blockwell, S. J., Coleman, H. M., Khan, S. J., Lim, R., Mcdonald, J. A., Nice, H., Nugegoda, D., Pettigrove, V., Tremblay, L. A., Warne, M. S., Leusch, F. D. (2014). A national survey of trace organic contaminants in Australian rivers. Journal of Environmental Quality 43:1702-1712.		
HERO ID:	5469274		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods were described in detail. Grab samples were collected from river water at a depth of 20-30 cm.
Metric 2:	Analytical Methodology	High	Methods included solid-phase extraction, liquid chromatography, and mass spectrometry (SPE, LC-MS/MS). The LOQ was reported.
Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Australia.
Metric 5:	Currency	Medium	Samples were collected in 2011 and 2012.
Metric 6:	Spatial and Temporal Variability	High	Generally there were more than 10 samples from 5 different land-use scenarios in each of four seasons. However, raw data was not presented and data was aggregated at high levels.
Metric 7:	Exposure Scenario	High	The exposure scenario was river water near agricultural, industrial, residential, WWTP, and undeveloped areas.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The detection frequency was reported for each of 4 seasons. Single mean, standard error, 50th and 95th percentiles, and max value was reported for all 285 samples combined (4 seasons x 73 total locations).
Metric 9:	Quality Assurance	Medium	Calibration curves and lab blanks were discussed analysis methods section; SI possibly provides more information on QA.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Variation was not reported by sampling location. Detection frequency reported by season, but mean, SE, and distributional statistics reported across all samples only.

Overall Quality Determination   High

Study Citation:	Laws, B. V., Dickenson, E. R., Johnson, T. A., Snyder, S. A., Drewes, J. E. (2011). Attenuation of contaminants of emerging concern during surface-spreading aquifer recharge. Science of the Total Environment 409:1087-1094.
HERO ID:	5469289

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Detailed methodology were described, especially for the site characterization.
	Metric 2:	Analytical Methodology	High	Analytical methodology were fully explained, including references to standard methods. Method reporting limits are provided in Table 2.
	Metric 3:	Biomarker Selection	N/A	Study tested the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Los Angeles County, California.
	Metric 5:	Currency	Medium	Samples were collected from May-July 2009.
	Metric 6:	Spatial and Temporal Variability	Medium	Samples were collected on 4 different collection dates and from 8 different sample locations with no replicate samples.
	Metric 7:	Exposure Scenario	Medium	Exposure scenario is not fully described.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data are reported.
	Metric 9:	Quality Assurance	Medium	Study documented only some QA/QC measures, such as blank samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited characterization of uncertainties, limitations, and data gaps was described.

Overall Quality Determination　　　　　Medium

Study Citation:		Mcdonough, C. A., De Silva, A. O., Sun, C., Cabrerizo, A., Adelman, D., Soltwedel, T., Bauerfeind, E., Muir, D. C. G., Lohmann, R. (2018). Dissolved organophosphate esters and polybrominated diphenyl ethers in remote marine environments: Arctic surface water distributions and net transport through fram strait. Environmental Science and Technology 52:6208-6216.		
HERO ID:		5469295		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology, including sampling collection, transport, and storage was adequately detailed.
	Metric 2:	Analytical Methodology	High	Analytical methodology, including mass spectrometry details was described. Additional details and detection limits provided in supplemental files.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in the Canadian Arctic.
	Metric 5:	Currency	High	Samples were collected from 2014-2016.
	Metric 6:	Spatial and Temporal Variability	Medium	There were <10 samples for different water sampling types.
	Metric 7:	Exposure Scenario	Medium	There was no clear connection of potential exposure in sampled water body to a population exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data was reported.
	Metric 9:	Quality Assurance	High	QA/QC was described and included recoveries, blanks, and duplicates.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was limited discussion on study limitations.

Overall Quality Determination High

Study Citation:	McGoldrick, D. J., Letcher, R. J., Barresi, E., Keir, M. J., Small, J., Clark, M. G., Sverko, E., Backus, S. M. (2014). Organophosphate flame retardants and organosiloxanes in predatory freshwater fish from locations across Canada. Environmental Pollution 193:254-261.		
HERO ID:	5469297		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods were described in detail.
	Metric 2:	Analytical Methodology	Medium	MLOQs reported in table. Referred to another publication for methods.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Canada.
	Metric 5:	Currency	Medium	Samples were collected in 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	3-10 fish were collected per station.
	Metric 7:	Exposure Scenario	High	Paper detailed how regions and exposure population were relevant and chosen.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary stats (median, mean, SD) were reported. Individual points not reported.
	Metric 9:	Quality Assurance	High	QA was described in detail. Blanks and recoveries were described.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability and uncertainty not discussed. SD is included.

Overall Quality Determination   High

Study Citation:	Liu, Y. E., Luo, X. J., Huang, L. Q., Zeng, Y. H., Mai, B. X. (2019). Organophosphorus flame retardants in fish from Rivers in the Pearl River Delta, South China. Science of the Total Environment 663:125-132.		
HERO ID:	5469298		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology is clear and appropriate. All pertinent sampling information is provided in the data source or SI.
	Metric 2:	Analytical Methodology	High	The analytical procedures were outlined in section 2.2 and 2.3. MDL reported in table S4.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media (biota: fishes).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Geographic location is reported and discussed; major rivers (Dongjiang, Xijiang, Beijiang and Pearl) in the Perl River Delta region of China.
	Metric 5:	Currency	Medium	Samples collected between July and September 2014.
	Metric 6:	Spatial and Temporal Variability	High	Sampling approach accurately captures variability of environmental contamination in media of interest.
	Metric 7:	Exposure Scenario	Medium	The data likely represent the relevant exposure scenario and the study somewhat describes the setting; the study states that exposure of fish to PFRs in the Pearl River Delta region is negligible.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Supplementary or raw data (i.e., individual data points) are not reported , and therefore summary statistics cannot be reproduced.
	Metric 9:	Quality Assurance	High	The study applied quality assurance/quality control measures and all pertinent quality assurance information is provided in the datasource or supplemental information.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study has limited characterization of variability in the media studied and limited discussion of key uncertainties, limitations, and data gaps.

Overall Quality Determination   High

Study Citation:		Choo, G., Cho, H. S., Park, K., Lee, J. W., Kim, P., Oh, J. E. (2018). Tissue-specific distribution and bioaccumulation potential of organophosphate flame retardants in crucian carp. Environmental Pollution 239:161-168.	
HERO ID:		5469301	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Fish captured described in SI; gonad, liver, muscle, and blood sampled from each.
	Metric 2: Analytical Methodology	High	Solid phase extraction; GC/MS described, additional details in SI.
	Metric 3: Biomarker Selection	N/A	The authors analyzed tissue and whole blood of crucian carps for the parent chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in South Korea, Nakdong River.
	Metric 5: Currency	High	Data collected between Sept to Nov 2015.
	Metric 6: Spatial and Temporal Variability	Medium	20 fish (7 male, 13 female) from upstream and midstream sampling locations.
	Metric 7: Exposure Scenario	Medium	Ecological: accumulation in predatory fish. Humans: fish muscle can be consumed by humans.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Range, median, frequency of detection; concentration on wet-weight basis.
	Metric 9: Quality Assurance	High	Blank contamination described in SI; sample concentration estimated by subtracting blanks; linearity, precision, and accuracy determined by tissue type; also for water and sediments.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Possible correlates of higher concentrations examined (e.g., body size), spatial variation examined.

Overall Quality Determination   **High**

Study Citation: Fries, E., Puttmann, W. (2001). Occurrence of organophosphate esters in surface water and ground water in Germany. Journal of Environmental Monitoring 3:621-626.

HERO ID: 5469312

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The study site characteristics, sampling procedure and storage, analytical methods were well described.
Metric 2:	Analytical Methodology	High	Sample extraction, analytical equipment, and operating conditions were well described. Detection limit was reported.
Metric 3:	Biomarker Selection	N/A	Parent chemical tested in water samples.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	The sites in Germany are well described.
Metric 5:	Currency	Low	Samples were collected in 2000.
Metric 6:	Spatial and Temporal Variability	Medium	Surface water samples were taken from 6 rivers, groundwater samples were taken from 45 wells, and there was one rain water and one waste water sample.
Metric 7:	Exposure Scenario	Medium	There is some discussion of environmental exposure.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The concentration is provided for the single samples of surface water from each river in March and November, 2000. The range is reported for the groundwater samples. No other data are reported.
Metric 9:	Quality Assurance	High	No QA issues were identified.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	There is a discussion of temporal trends, and limited discussion on uncertainty.

Overall Quality Determination   Medium

Study Citation:	Fries, E., Puttmann, W. (2003). Monitoring of the three organophosphate esters TBP, TCEP and TBEP in river water and ground water (Oder, Germany). Journal of Environmental Monitoring 5:346-352.		
HERO ID:	5469313		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Low	Sampling equipment and storage are not reported.
	Metric 2: Analytical Methodology	Medium	Some analytical instrumentation details are not described.
	Metric 3: Biomarker Selection	N/A	Chemical was measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples was collected in Germany.
	Metric 5: Currency	Low	Samples were collected from March 2000 to July 2001.
	Metric 6: Spatial and Temporal Variability	Medium	Not all scenarios have replicate samples.
	Metric 7: Exposure Scenario	High	Sampling site and potential sources were well characterized.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Raw data are reported.
	Metric 9: Quality Assurance	Low	There was limited discussion of how quality control measures.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Limited characterization of variability and uncertainties was reported.

Overall Quality Determination   Medium

| | Study Citation: | Gourmelon, M., Caprais, M. P., Mieszkin, S., Marti, R., Wéry, N., Jardé, E., Derrien, M., Jadas-Hécart, A., Communal, P. Y., Jaffrezic, A., Pourcher, A. M. (2010). Development of microbial and chemical MST tools to identify the origin of the faecal pollution in bathing and shellfish harvesting waters in France. Water Research 44:4812-4824. |
| | HERO ID: | 5469315 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling procedures were outlined.
	Metric 2:	Analytical Methodology	Low	Analytical methodology including the instrumentation was reported. LOD were reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Pays de la Loire, France.
	Metric 5:	Currency	Medium	The study doesn't report a sampling date, but it was published in 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	The study analyzes 5 WWTP effluent during two sampling campaigns; measured in triplicate; then 4 wastewater and 20 surface water samples from two rivers; 3 samples from river with intense grazing.
	Metric 7:	Exposure Scenario	Medium	The study evaluates effluent from 5 WWTPs; plants and settings are not described; rivers in agricultural areas and receiving WWTP discharges.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 4 provides concentration at each WWTP during the two sampling campaigns; Table 7 provides concentration in effluent and rivers. Sample replicates were collected.
	Metric 9:	Quality Assurance	Medium	The recoveries for first and second campaigns discussed in 3.1.2; extraction good for first campaign but corrected for second; QA/QC not discussed in detail.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Limitations are not reported, variability reported as RSD provided in Table 4.

Overall Quality Determination   **Medium**

Study Citation:	Barnes, K. K., Christenson, S. C., Kolpin, D. W., Focazio, M., Furlong, E. T., Zaugg, S. D., Meyer, M. T., Barber, L. B. (2004). Pharmaceuticals and other organic waste water contaminants within a leachate plume downgradient of a municipal landfill. Ground Water Monitoring and Remediation 24:119-126.		
HERO ID:	5469339		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Samples were collected by USGS personnel according to established protocols for obtaining representative ground water samples.
Metric 2:	Analytical Methodology	Medium	Detection limits is reported in table 2. Analytical methods were described for chemical groups but not individual compounds.
Metric 3:	Biomarker Selection	N/A	Study tested parent chemical in groundwater downgradient of a landfill.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Norman, Oklahoma.
Metric 5:	Currency	Low	Samples were collected in 2000.
Metric 6:	Spatial and Temporal Variability	Medium	Five wells were sampled and there were no replicate samples.
Metric 7:	Exposure Scenario	High	Contaminants in groundwater was measured from landfill leacheate.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Raw data is provided but no summary statistics were reported.
Metric 9:	Quality Assurance	Low	There is limited discussion of QA/QC. Average recoveries are reported in Table 3 and correction was not discussed for low recoveries ($<$60%). While TCEP was not reported to have a low recovery, our threshold requires correction is 70% . It is possible that TCEP has a recovery $<$70% .
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	No measure of variance or discussion of uncertainties, limitations, and data gaps is discussed.

Overall Quality Determination   **Medium**

Study Citation:	Cao, S., Zeng, X., Song, H.,an, Li, H., Yu, Z., Sheng, G., Fu, J. (2012). Levels and distributions of organophosphate flame retardants and plasticizers in sediment from Taihu Lake, China. Environmental Toxicology and Chemistry 31:1478-1484.		
HERO ID:	5469348		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling method is fully explained.
	Metric 2:	Analytical Methodology	High	Analytical methodology is fully explained.
	Metric 3:	Biomarker Selection	N/A	Chemical was measured in sediment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Taihu Lake, China.
	Metric 5:	Currency	Low	No sampling date was provided but the publication date was in 2012.
	Metric 6:	Spatial and Temporal Variability	Medium	Study reported there were no replicate samples.
	Metric 7:	Exposure Scenario	Medium	Microenvironment information was missing.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No individual data points was reported.
	Metric 9:	Quality Assurance	High	There is a section in the study on quality control and quality assurance.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was limited discussion of uncertainties.

Overall Quality Determination   **Medium**

Study Citation:	Bastiaensen, M., Ait Bamai, Y., Araki, A., Van den Eede, N., Kawai, T., Tsuboi, T., Kishi, R., Covaci, A. (2019). Biomonitoring of organophosphate flame retardants and plasticizers in children: Associations with house dust and housing characteristics in Japan. Environmental Research 172:543-551.		
HERO ID:	5469392		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The sampling methodology is discussed, scientifically sound and consistent with widely accepted methods/approaches for the chemical and media being analyzed.
Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. Both LOD and LOQ are reported.
Metric 3:	Biomarker Selection	N/A	The study measures the parent chemical in urine.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Japan.
Metric 5:	Currency	Medium	Data was collected in 2008.
Metric 6:	Spatial and Temporal Variability	High	The study analyzed a high number of samples (n=128); no replicates reported.
Metric 7:	Exposure Scenario	High	Biomonitoring of organophosphate flame retardants and plasticizers in children exposed to house dust
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data is not reported. Table 3 reported concentrations (min, max, median, mean, SD, 25th and 75th percentile).
Metric 9:	Quality Assurance	High	Quality control samples and blanks were analyzed, and recoveries are reported.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	High	SD is reported and the study well characterizes variability, key uncertainties, limitations, and data gaps were reported.

Overall Quality Determination   High

Study Citation:	Sala, B., Giménez, J., de Stephanis, R., Barceló, D., Eljarrat, E. (2019). First determination of high levels of organophosphorus flame retardants and plasticizers in dolphins from Southern European waters. Environmental Research 172:289-295.		
HERO ID:	5469393		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Low	The study reports an "opportunistic" sampling of dolphins found stranded on coast; sampling methods not described; frozen after receipt at laboratory.
Metric 2:	Analytical Methodology	High	Methodology described for liquid chromatography. LOD detailed in S1.
Metric 3:	Biomarker Selection	N/A	Parent chemicals; dolphins considered ecological receptors of concern.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in Coast of Alboran Sea, Andalusia (Spain).
Metric 5:	Currency	Medium	Samples were collected from dolphins stranded from 2004 to 2010.
Metric 6:	Spatial and Temporal Variability	Low	Samples from 11 dolphins found stranded; same general location over 6 years. Two to five different tissue samples per animal (blubber, brain, kidney, liver, muscle).
Metric 7:	Exposure Scenario	Low	The study doesn't report the exposure scenario, diet and migration of dolphins prior to stranding unknown.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	The median values reported; SI report individual (raw) data.
Metric 9:	Quality Assurance	High	The QA/QC is described primarily in SI.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	The study had biased sample (stranded dolphins). No limitations.

Overall Quality Determination   **Medium**

Study Citation:	Lai, N. L. S., Kwok, K. Y., Wang, X., Yamashita, N., Liu, G., Leung, K. M. Y., Lam, P. K. S., Lam, J. C. W. (2019). Assessment of organophosphorus flame retardants and plasticizers in aquatic environments of China (Pearl River Delta, South China Sea, Yellow River Estuary) and Japan (Tokyo Bay). Journal of Hazardous Materials 371:288-294.		
HERO ID:	5469421		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The sampling description is reported in section 2.1.
Metric 2:	Analytical Methodology	High	The analytical procedures are outlined in SI, optimization, processing software. The MDL is reported in the SI.
Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in China and Japan.
Metric 5:	Currency	High	Samples were collected in China between 2012 and 2015 and in Japan in 2013.
Metric 6:	Spatial and Temporal Variability	Medium	Replicates were not reported, sample number from 3-11 per site.
Metric 7:	Exposure Scenario	High	The study evaluates surface water exposure for eco receptors.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	Raw data is not reported. The SI has summary stats for each site.
Metric 9:	Quality Assurance	High	The QA section indicates recoveries 51-130% s, MDL, LOQs, validation details in SI.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Limitations are not reported, variability reported as range, and comparison between locations.

Overall Quality Determination   High

Study Citation:	Yasuhara, A. (1995). Chemical components in leachates from hazardous wastes landfills in Japan. Toxicological and Environmental Chemistry 51:113-120.		
HERO ID:	5469470		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	Low	Only the purchasing of sampling samples and study site characteristics (i.e., 4 controlled landfills in central Japan and one open landfill in northeastern Japan) were discussed. Nothing else about the sampling methodology, such as equipment, procedure, storage conditions, was available.
Metric 2:	Analytical Methodology	Low	The analytical methodology is discussed in detail and limit of detection is only provided as an approximate range.
Metric 3:	Biomarker Selection	N/A	The parent chemical is measured in environmental media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected from landfills in northeastern and central Japan.
Metric 5:	Currency	Low	No sampling date was provided but the publication year was 1995.
Metric 6:	Spatial and Temporal Variability	Low	Five samples from 5 locations (one from each location) were collected with no replicates.
Metric 7:	Exposure Scenario	Medium	The exposure scenario was briefly described.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Individual and raw data was provided with no summary statistics.
Metric 9:	Quality Assurance	Low	QA/QC was not directly discussed but implied.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	There was no discussion on variability/uncertainty but variability is seen in media studied.

Overall Quality Determination   Low

Study Citation:	Suehring, R., Diamond, M. L., Scheringer, M., Wong, F., Pucko, M., Stern, G., Burt, A., Hung, H., Fellin, P., Li, H., Jantunen, L. M. (2016). Organophosphate esters in Canadian Arctic air: Occurrence, levels and trends. Environmental Science and Technology 50:7409.		
HERO ID:	5469544		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Medium	Information describing how samples were stored is missing.
	Metric 2: Analytical Methodology	Medium	The instrument detection limits were reported instead of the LOD.
	Metric 3: Biomarker Selection	N/A	Parent chemical was measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Canadian artic area.
	Metric 5: Currency	Medium	Sampled were collected in 2007-2013.
	Metric 6: Spatial and Temporal Variability	Medium	Large amount of samples are listed in SI table S5, but only few have replicates.
	Metric 7: Exposure Scenario	Medium	Transport of chemicals are relevant. However, the study doesn't mention how this is relevant to exposure.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Individual points and summary statistics were detailed were detailed in the study and in SI table S5.
	Metric 9: Quality Assurance	High	Blanks and recoveries were mentioned and detailed in SI.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	There were no limitations. There is variation in the areas sampled.

Overall Quality Determination   **Medium**

Study Citation:	Yasuhara, A. (1994). DETERMINATION OF TRIS(2-CHLOROETHYL) PHOSPHATE IN LEACHATES FROM LANDFILLS BY CAPILLARY GAS-CHROMATOGRAPHY USING FLAME PHOTOMETRIC DETECTION. Journal of Chromatography A 684:366-369.		
HERO ID:	5469582		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Low	Authors only discussed where standards were purchased and sample site characteristics.
	Metric 2: Analytical Methodology	High	Extraction and analytical methods are provided in the Materials and Samples section. Detection limits are available in Results and Discussion.
	Metric 3: Biomarker Selection	N/A	Study measured TCEP in leachates form landfills.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were conducted in Japan.
	Metric 5: Currency	Low	The date of data collection was not provided. Study was published in 1994
	Metric 6: Spatial and Temporal Variability	Low	Four samples were collected with no replicates.
	Metric 7: Exposure Scenario	Medium	Not many details were provided about exposure scenario.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data are presented in Table 1 with no summary statistics.
	Metric 9: Quality Assurance	High	Recovery and blank results were discussed.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	No limitations or characterization of variance were provided.

Overall Quality Determination   Medium

Study Citation:	Luongo, G., Oestman, C. (2016). Organophosphate and phthalate esters in settled dust from apartment buildings in Stockholm. Indoor Air 26:414-425.		
HERO ID:	5469670		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling of indoor dust on tops of shelves and furniture as well as indoor air was described. Some criteria were not mentioned like sample storage conditions (may be listed in a referenced study, Bergh et al. (2010, 2011a,b, 2012)).
	Metric 2:	Analytical Methodology	Medium	Some analytic methodology criteria details were not mentioned, such as instrument calibration (but may be described in a referenced study). LOD's were reported.
	Metric 3:	Biomarker Selection	N/A	Sampling was conducted for parent chemicals of interest in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Sampling was conducted in Stockholm, Sweden
	Metric 5:	Currency	Medium	Data was collected in 2008
	Metric 6:	Spatial and Temporal Variability	High	Indoor dust samples were collected in 2008 from 62 apartments in 19 different buildings in the Stockholm city area at a height of 0.8 meters from surfaces of furniture and frames of windows and doors. Indoor air sampling was conducted for 24-hours with duplicate active air samples positioned within a central location in each apartment on the same day as dust sampling.
	Metric 7:	Exposure Scenario	Medium	Source of exposure and population exposed were detailed. There were no exposure controls used.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data was reported in Table S1. Some summary statistics included 25th percentile, median, 75th percentile, and range. Detection frequencies were reported.
	Metric 9:	Quality Assurance	High	QC details were described and included laboratory blanks. Standard reference materials were utilized for quality control samples. Baseline, pre-exposure sampling was not conducted.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	No limitations were described. Variations in toddler and adult exposure was studied.

Overall Quality Determination   High

Study Citation:		Giorgino, M. J., Rasmussen, R. B., Pfeifle, C. M. (2007). Occurrence of organic wastewater compounds in selected surface-water supplies, Triangle Area of North Carolina, 2002-2005. Scientific Investigations Report 2007-5054 :29.	
HERO ID:		5469762	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	USGS study with information on the sampling sites following established protocols and procedures.
	Metric 2: Analytical Methodology	High	Analytical methods reported in the laboratory analysis section, the reporting level is in table 3.
	Metric 3: Biomarker Selection	N/A	The parent chemical is measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in 8 sites of the Triangle Area, North Carolina, USA.
	Metric 5: Currency	Medium	Samples collected from October 2002 to July 2005.
	Metric 6: Spatial and Temporal Variability	High	A total of 42 samples were collected. Sample replicates reported in appendix 2.
	Metric 7: Exposure Scenario	High	The study evaluates the occurrence of organic wastewater compounds in surface-water supplies.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Table 3 reports summary of statistics. Raw data reported in appendix 2.
	Metric 9: Quality Assurance	High	The study reports the use of laboratory and field QA/QC. The information is reported in the Quality Assurance section.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Variability reported in terms of the range, limitations were reported for the number of samples that were analyzed.

Overall Quality Determination   High

| | Study Citation: | He, C., Covaci, A., Heffernan, A. L., Baduel, C., Harden, F. A., Mueller, J. F., Toms, L. M. L., Nele Van Den, E., Hobson, P., Thai, P., Wang, X., Li, Y. (2018). Urinary metabolites of organophosphate esters: Concentrations and age trends in Australian children. Environment International 111:124-130. |
| HERO ID: | | 5469782 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sample collection was undertaken using a methodology describedpreviously (Heffernan et al., 2016).
	Metric 2:	Analytical Methodology	High	The LOD was provided, and the analytical methods are reported in section 2.4.
	Metric 3:	Biomarker Selection	High	The study evaluates BCEP in urine samples. This metric is not applicable for breastmilk, air and dust.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Australia.
	Metric 5:	Currency	High	Data collection started December 2014 through December 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	No replicate samples. Some scenarios have as low as 3 samples.
	Metric 7:	Exposure Scenario	High	The study evaluates the concentrations and age trends in Australian children in different media.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is not provided. Some information reported in a figure.
	Metric 9:	Quality Assurance	High	The study reports a section with QA/QC with internal materials, accuracy and methods blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited information provided on limitations; variability not characterized (no standard deviation or variance reported).

Overall Quality Determination   High

Domain	Metric	Rating	Comments
Study Citation:	Aston, L. S., Noda, J., Seiber, J. N., Reece, C. A. (1996). Organophosphate flame retardants in needles of Pinus ponderosa in the Sierra Nevada foothills. Bulletin of Environmental Contamination and Toxicology 57:859-866.		
HERO ID:	5469881		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling sites and samples were adequately described.
	Metric 2: Analytical Methodology	High	Analytical method was described in detail.
	Metric 3: Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Sierra Nevada.
	Metric 5: Currency	Low	Samples were collected from 1993-1994.
	Metric 6: Spatial and Temporal Variability	Low	There were 4 trees per site.
	Metric 7: Exposure Scenario	Low	The exposure scenario of pine needles to receptor of concern was unclear.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	A single value from each composite sample was reported in Table 2.
	Metric 9: Quality Assurance	Low	Recoveries 42 to 74% performed in triplicate, but quality not discussed.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Variability and uncertainty was not discussed.

Overall Quality Determination　　　　Medium

| Study Citation: | Wang, D., Wang, P., Wang, Y., Zhang, W., Zhu, C., Sun, H., Matsiko, J., Zhu, Y., Li, Y., Meng, W., Zhang, Q., Jiang, G. (2019). Temporal variations of PM2.5-bound organophosphate flame retardants in different microenvironments in Beijing, China, and implications for human exposure. Science of the Total Environment 666:226-234. |
| HERO ID: | 5469991 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology for indoor and outdoor air sampling is clear, appropriate and similar to widely accepted protocols for the chemical and media of interest. All pertinent sampling information is provided in the data source or companion source.
	Metric 2:	Analytical Methodology	Low	Analytical methodology was reported in detail. Individual LODs were not reported, however LODs were reported as a range within the text.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Geographic location is reported as Beijing, China.
	Metric 5:	Currency	High	The sampling period was from March 2016 to February 2017, except January 2017 (holiday).
	Metric 6:	Spatial and Temporal Variability	High	The sampling approach accurately captures variability of environmental contamination in population/scenario/media of interest. The study used a large sample size, replicate samples, and sampling occurred over a sufficient period of time (one year) to characterize seasonal trends.
	Metric 7:	Exposure Scenario	Medium	The data likely represent the relevant exposure scenario (i.e., population/scenario/media of interest). One or more key pieces of information may not be described as for outdoor samples, the study did not describe the setting (industrial, residential, etc.), but the deficiencies are unlikely to have a substantial impact on the characterization of the exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Supplementary or raw data (i.e., individual data points) are not reported , and therefore summary statistics of median, mean, minimum and maximum cannot be reproduced. Frequency of detection was reported in Table 1.
	Metric 9:	Quality Assurance	High	The study applied quality assurance/quality control measures and all pertinent quality assurance information is provided in the data source or companion source. Baseline pre-exposure sampling was not detailed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability in indoor environment type was reported across sampling within activity rooms, dormitories, homes and offices. Potential seasonal variation was detailed. Associations of concentrations with indoor environment furnishing density and air exchange rates were explored. Results were compared with previous studies, but a robust discussion of potential study limitations is lacking.

Overall Quality Determination   **Medium**

Study Citation:	Chokwe, T. B., Okonkwo, J. O. (2019). Occurrence, distribution and ecological risk assessment of organophosphorus flame retardants and plasticizers in sediment samples along the Vaal River catchment, South Africa. Emerging Contaminants 5:173-178.		
HERO ID:	5470119		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling methodology for sediment samples is described in detail and pertinent sampling information is provided. Duration of sample storage prior to analysis is lacking.
	Metric 2:	Analytical Methodology	High	The analytical methodology is described in detail and extraction methods and instrumental analysis were described. Detailed LOD and LOQ data are presented in Table S1.
	Metric 3:	Biomarker Selection	N/A	The chemicals of interest were measured in sediment samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were obtained from the Vaal River catchment, South Africa.
	Metric 5:	Currency	High	Sediment samples were collected between October and December 2017.
	Metric 6:	Spatial and Temporal Variability	High	A total of n=16 (Table 2) sediment samples were collected between October and December of 2017 from 16 sites and triplicate samples were obtained at each site with one sample collected in the middle of the river and two samples from each side of the river banks. Sampling sites were selected as representative of three typical industrialized and urbanized regions.
	Metric 7:	Exposure Scenario	Medium	Sediment samples were taken from Vaal River catchment, South Africa. Microclimate information for region was presented in text as average temperature range. Exposure sources from Vaal River tributaries influencing the pollution of the area were described and included effluents from industrial and domestic wastewater treatment works, agricultural runoffs, textile manufacturing and mining industries as well as rapid economic development and urbanization. Use of exposure controls was not detailed.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual raw data points were not reported. Statistical summary measures within Tables 1 and S2 included mean, median and range of concentrations. Detection frequencies were provided in Table 1.
	Metric 9:	Quality Assurance	Medium	Quality assurance was documented in Section 2.5 and Table S1 and included use of laboratory blanks, standards and reported recoveries within acceptable ranges for chemicals of interest. Use of baseline, pre-exposure sampling was not detailed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Results were compared with previously published studies, but there was limited discussion of uncertainties and potential study limitations.

Overall Quality Determination **High**

Study Citation: Chen, Y., Fang, J., Ren, L., Fan, R., Zhang, J., Liu, G., Zhou, L., Chen, D., Yu, Y., Lu, S. (2018). Urinary metabolites of organophosphate esters in children in South China: Concentrations, profiles and estimated daily intake. Environmental Pollution 235:358-364.

HERO ID: 5470172

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology not described in full, sample storage provided, sample handling after collection described.
	Metric 2:	Analytical Methodology	Medium	Instrumentation provided, and analytical settings. LOD were mentioned and assessed but not reported.
	Metric 3:	Biomarker Selection	High	The metabolite (BCEP) in urine is known to have an accurate and precise quantitative relationship with the external exposure.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in Guangzhou and Shenzhen, China.
	Metric 5:	Currency	High	Samples collected in September 2015.
	Metric 6:	Spatial and Temporal Variability	Medium	411 samples collected but no replicates. Total of 411 children of various ages and locations.
	Metric 7:	Exposure Scenario	High	The study evaluates children's biomonitoring data, urine samples and metabolites.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The raw data is not available, table 1 reports summary of statistics including median, mean, SD, 5th percentile, 95th percentile and range.
	Metric 9:	Quality Assurance	High	The study reports recovery, field blanks, method blanks and other QC parameters.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limitations are not reported, variability reported as SD, and comparison between locations.

Overall Quality Determination   High

Study Citation: Gustavsson, J., Wiberg, K., Ribeli, E., Nguyen, M. A., Josefsson, S., Ahrens, L. (2018). Screening of organic flame retardants in Swedish river water. Science of the Total Environment 625:1046-1055.

HERO ID: 5499542

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology and site characteristics are well described.
	Metric 2:	Analytical Methodology	High	Sampling methodology are well described. MDLs are reported in Supporting Information.
	Metric 3:	Biomarker Selection	N/A	Biomarker of exposure was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Sweden.
	Metric 5:	Currency	Medium	Sampling was conducted in October 2013.
	Metric 6:	Spatial and Temporal Variability	Low	Spatial variability was well characterized, but all samples were collected at one time point with no replicates.
	Metric 7:	Exposure Scenario	High	Study site and potential sources were well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data and summary statistics are reported in supporting information.
	Metric 9:	Quality Assurance	High	Study applied quality control measures and no issues were identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	There was limited discussion about uncertainty and limitations. There is some variability measured in river locations and population density.

Overall Quality Determination   High

Study Citation: Bastiaensen, M., Malarvannan, G., Been, F., Yin, S., Yao, Y., Huygh, J., Clotman, K., Schepens, T., Jorens, P. G., Covaci, A. (2019). Metabolites of phosphate flame retardants and alternative plasticizers in urine from intensive care patients. Chemosphere 233:590-596.

HERO ID: 5562397

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Details in sampling methodology missing such as equipment and storages
	Metric 2:	Analytical Methodology	High	Analytical methodology is described, including analytical instrumentation and scientifically appropriate for the chemical and media analyzed. LOQ is reported.
	Metric 3:	Biomarker Selection	N/A	The parent chemical was measured in urine.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Belgium.
	Metric 5:	Currency	Low	Timing of sample collection for monitoring data is not reported, discussed, or referenced. However, it is referenced in one of the authors' publication in 2015 (Huygh et al., 2015).
	Metric 6:	Spatial and Temporal Variability	High	18 samples were collected.
	Metric 7:	Exposure Scenario	High	Exposure to phosphate flame retardants and alternative plasticizers through various medical devices.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Limited raw data provided for experimental group and no raw data available for control group. Summary of statistics in table 2.
	Metric 9:	Quality Assurance	Low	There is limited information regarding the QA/QC procedures.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Bonferroni correction (p-value) applied to reduce false positive result but SD is not included and limited discussion on the uncertainly.

Overall Quality Determination   Medium

Study Citation:	Polyakova, O. V., Artaev, V. B., Lebedev, A. T. (2018). Priority and emerging pollutants in the Moscow rain. Science of the Total Environment 645:1126-1134.		
HERO ID:	5576453		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methods were described in detail. Sample preparation was carried out according to the US EPA 8270D Method.
Metric 2:	Analytical Methodology	Low	Analytical methods were sufficiently described. LOD not reported.
Metric 3:	Biomarker Selection	N/A	Parent chemical measured in rainwater.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Moscow.
Metric 5:	Currency	High	The samples were collected in the period between April 7 and May 15, 2017.
Metric 6:	Spatial and Temporal Variability	Medium	8 rain samples collected. No replicates mentioned.
Metric 7:	Exposure Scenario	High	Ambient samples of rainwater collected in 2 locations in Moscow.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Raw data reported.
Metric 9:	Quality Assurance	High	Key QA reported including use of blanks and recoveries.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	No limitations or variability mentioned.

Overall Quality Determination   High

Study Citation:	Launay, M. A., Dittmer, U., Steinmetz, H. (2016). Organic micropollutants discharged by combined sewer overflows - Characterisation of pollutant sources and stormwater-related processes. Water Research 104:82-92.		
HERO ID:	5664394		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Wastewater collected during dry weather; 24 hr composite samples collected from WWTP influent; grab samples collected from surface water along the river. Samples are homogenized samples including dissolved and particulate matter. Fig 1 depicts locations.
	Metric 2:	Analytical Methodology	High	Samples analyzed by GC-MS; detailed information about analysis and detection and quantification limits provided in SI.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected in SW Stuttgart, Germany.
	Metric 5:	Currency	Medium	Samples collected in February and July 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	Winter and summer samples included 24 hr composite samples at the WWTP influent (n=9); grab samples at 4 river location for 9 days and at 5 locations along river following 4 CSO events.
	Metric 7:	Exposure Scenario	High	Exposure source is urban catchment; WWTP and surface water; combined sewer overflow (Section 2.1)
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Fig 2b depicts concentration in WWTP influent and CSO samples; raw data provided in SI.
	Metric 9:	Quality Assurance	Medium	Blank samples were analyzed; QA/QC was discussed in SI.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Compared data to other studies; discussed variability due to rainfall events. Additional info potentially in SI.

Overall Quality Determination　　　　　High

| | Study Citation: | Stachel, B., Jantzen, E., Knoth, W., Kruger, F., Lepom, P., Oetken, M., Reincke, H., Sawal, G., Schwartz, R., Uhlig, S. (2005). The Elbe flood in August 2002–organic contaminants in sediment samples taken after the flood even. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 40:265-287. |
| | HERO ID: | 5740077 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Fine-grained, aerobic sediments collected from upper sediment layer using bottom grab or a spatula; little flow activity.
	Metric 2:	Analytical Methodology	Low	Extraction with acetone, GC-FPD; not discussed further. Min <1 indicated LOQ is 1.0.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples collected from river Elbe in Central Europe (Czech Republic to Germany).
	Metric 5:	Currency	Low	Samples collected from September 8 - 16, 2002.
	Metric 6:	Spatial and Temporal Variability	Medium	Fig 1 depicts sampling sites on the river and mouths of tributaries. There were 37 sampling sites along the river; 11 in Czech Republic and 26 in Germany.
	Metric 7:	Exposure Scenario	High	Sediments from one of the major rivers in central Europe characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Table 1 provides range and median; Fig 6 shows concentrations levels; further summary statistics not provided.
	Metric 9:	Quality Assurance	Low	QA/QC was not discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Characterization of variability and uncertainty was absent.

Overall Quality Determination   Medium

Study Citation:	Loraine, G. A., Pettigrov, M. E. (2006). Seasonal Variations in Concentrations of Pharmaceuticals and Personal Care Products in Drinking Water and Reclaimed Wastewater in Southern California. Environmental Science and Technology 40:687-695.		
HERO ID:	5743010		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Detailed sampling methodology is discussed.
Metric 2:	Analytical Methodology	Low	The LODs are mentioned but not reported. The recoveries are not reported and the MDLs are reported.
Metric 3:	Biomarker Selection	N/A	Water was sampled for biomarkers of exposure.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples were collected in California, USA.
Metric 5:	Currency	Low	Sampling was conducted in 2001-2002.
Metric 6:	Spatial and Temporal Variability	High	Sampling was conducted with 4-5 samples per plant from 4 plants and no replicates.
Metric 7:	Exposure Scenario	Medium	Data may represent a relevant exposure scenario. The methods provide limited details on exposure assessment and population of interest.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Medium	The reporting of results included only the summary statistics.
Metric 9:	Quality Assurance	Low	QC/QC issues are only briefly discussed.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Key uncertainties, study limitations and data gaps are not discussed.

Overall Quality Determination   Medium

Study Citation:	Dodson, R. E., Udesky, J. O., Colton, M. D., Mccauley, M., Camann, D. E., Yau, A. Y., Adamkiewicz, G., Rudel, R. A. (2017). Chemical exposures in recently renovated low-income housing: Influence of building materials and occupant activities. Environment International 109:114-127.		
HERO ID:	5755270		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methods are standard SOPs and are detailed in the paper and the SI.
	Metric 2: Analytical Methodology	High	MRLs are tabulated. The paper and SI adequately discuss methodology.
	Metric 3: Biomarker Selection	N/A	Testing for the parent chemical in an environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Boston, MA.
	Metric 5: Currency	Medium	Samples were collected from 2013-2014.
	Metric 6: Spatial and Temporal Variability	High	10 pre-occupancy and $\geq$ 25 post-occupancy samples were collected. Duplicates were collected.
	Metric 7: Exposure Scenario	Medium	Information on potential chemical use not discussed beyond describing the measured concentrations.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Summary statistics were reported, but no raw data were reported (unless provided in the SI).
	Metric 9: Quality Assurance	High	The QAQC discussion was adequate.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	There was sufficient discussion on variability and uncertainty.

Overall Quality Determination   High

Study Citation:	Hart, R. J., Taylor, H. E., Antweiler, R. C., Fisk, G. G., Anderson, G. M., Roth, D. A., Flynn, M. E., Peart, D. B., Truini, M., Barber, L. B. (2005). Physical and chemical characteristics of Knowles, Forgotten, and Moqui Canyons, and effects of recreational use on water quality, Lake Powell, Arizona and Utah. U.S. Geological Survey :116.		
HERO ID:	5821282		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	USGS report; bed-material samples from selected beach areas (fig 1); all samples were collected below the water line (p. 9); 300 g wet sediment collected by inserting an HNO3-cleaned 3-cm diameter by 30-cm long polystyrene tube into the sediment; chilled at less than 5C
	Metric 2: Analytical Methodology	Low	Continuous liquid-liquid extraction with methylene chloride; GC/MS; p. 11; calibration curves for instrumental determinations were established; based on Table 12 seems LDL is 0.5 ug/L.
	Metric 3: Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples collected in Knowles, Forgotten, and Moqui Canyons of Lake Powell in Arizona and Utah.
	Metric 5: Currency	Low	Samples collected in summers of 2001 and 2002.
	Metric 6: Spatial and Temporal Variability	High	More than 10 samples over 4 sampling trips (May 15-17, 2001; September 5-7, 2001; May 20-22, 2002; September 9-12, 2002); refer to Fig 1 and Table 12.
	Metric 7: Exposure Scenario	High	2 and 3 million people visit Glen Canyon National Recreation Area each year; high usage; sites selected to represent camping or other recreational activity use.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Raw data reported in Table 12 (p.1 and 2); no other summary statistics provided.
	Metric 9: Quality Assurance	Medium	Accuracy established by analysis of standard reference materials (primary sediment reference material used was NIST Standard Reference Material (SRM) 2704 Buffalo River Sediment) (p. 14)
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Limited reference to level of contaminants in other studies; nothing chemical specific.

Overall Quality Determination   **Medium**

Study Citation: Environmental Agency (Japan), (1981). An environmental survey report of the environmental monitoring of chemicals. :.
HERO ID: 5904178

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	Critically Deficient	Sampling methodology not described.
	Metric 2: Analytical Methodology	Critically Deficient	Analytical methodology not described.
	Metric 3: Biomarker Selection	N/A	The parent chemical was measured in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Japan.
	Metric 5: Currency	Low	Sampling began in 1975
	Metric 6: Spatial and Temporal Variability	Critically Deficient	Sample size was not reported.
	Metric 7: Exposure Scenario	Medium	The study is missing details about the population and microenvironment of interest.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual sample concentrations were reported, there is not a summary statistics.
	Metric 9: Quality Assurance	Low	The main QA/QC techniques were not discussed.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	The study doesn't report a measure of variance or limitations.

Overall Quality Determination　　　Uninformative

| | Study Citation: | Zeng, X., Hu, Q., He, L., Liu, Z., Gao, S., Yu, Z. (2018). Occurrence, distribution and ecological risks of organophosphate esters and synthetic musks in sediments from the Hun River. Ecotoxicology and Environmental Safety 160:178-183. |
| HERO ID: | | 5918412 |

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The sampling procedures were outlined, but sample storage duration was not reported.
	Metric 2:	Analytical Methodology	Medium	The analytical methods were reported, the LOD was mentioned but not reported.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in sediment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Hun River, China.
	Metric 5:	Currency	Medium	Samples were collected in July 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	40 surface sediment (0"5 cm) samples were collected, but no replicate samples.
	Metric 7:	Exposure Scenario	High	Samples taken from Hun River.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No individual data points reported. Table 1 reports concentration range.
	Metric 9:	Quality Assurance	High	Section 2.4. reports quality assurance and quality control.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limited discussion of uncertainties, variability reported in terms of range.

Overall Quality Determination   Medium

Study Citation:		Brits, M., Brandsma, S. H., Rohwer, E. R., De Vos, J., Weiss, J. M., de Boer, J. (2019). Brominated and organophosphorus flame retardants in South African indoor dust and cat hair. Environmental Pollution 253:120-129.	
HERO ID:		6813729	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Methods including sampling site, equipment, and pretreatment were described.
	Metric 2:	Analytical Methodology	High	Analytical methods were described. LOQ was reported in S1.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in environment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Pretoria, South Africa.
	Metric 5:	Currency	High	Samples were collected in 2018.
	Metric 6:	Spatial and Temporal Variability	Low	Only one sample was collected for V-dust, F-dust, and C-hair for most houses. Some houses don't have F-dust or C-hair samples.
	Metric 7:	Exposure Scenario	High	Data represent exposure to dust and pet hair.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Some summary statistics reported and individual data reported in in S1.
	Metric 9:	Quality Assurance	High	QC section details recoveries and samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	Variability in exposure estimation between toddlers and adults discussed. There is mention of limitation of study size.

Overall Quality Determination   High

Study Citation:	Li, H. L., Liu, L. Y., Zhang, Z. F., Ma, W. L., Sverko, E., Zhang, Z., Song, W. W., Sun, Y., Li, Y. F. (2019). Semi-volatile organic compounds in infant homes: Levels, influence factors, partitioning, and implications for human exposure. Environmental Pollution 251:609-618.		
HERO ID:	6815979		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methodology were provided and described, including sampling procedure, equipment, storage, and matrix characteristics.
	Metric 2: Analytical Methodology	High	Analytical methodology was provided and briefly described. Samples were Soxhlet extracted and analyzed using GC-MS.
	Metric 3: Biomarker Selection	N/A	The analyte measured is the TSCA chemical.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	The samples were collected in China.
	Metric 5: Currency	Medium	Data were collected from December 2013 to March 2014.
	Metric 6: Spatial and Temporal Variability	Medium	25 air samples, 25 dust samples, and 18 window filmsamples were collected. No replicate data were collected.
	Metric 7: Exposure Scenario	High	The samples were collected in indoor environment, which represent the exposure of anyone who comes into contact with these home environment.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Raw data were not reported. Summary statistics including median, mean, and standard deviation were reported.
	Metric 9: Quality Assurance	High	Analytical QA/QC were reported. The recoveries in this study ranged from 64.1% to 132% . All the SVOC concentrations in real samples were corrected with blanks and recoveries.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	High	Some sources of variability and uncertainty were discussed and significance values were reported (p values).

Overall Quality Determination   High

Study Citation:		Maceira, A., Pecikoza, I., Marcé, R. M., Borrull, F. (2020). Multi-residue analysis of several high-production-volume chemicals present in the particulate matter from outdoor air. A preliminary human exposure estimation. Chemosphere 252:126514.	
HERO ID:		6816026	

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling sites are adequately described.
	Metric 2: Analytical Methodology	High	QFF filters are adequately described.
	Metric 3: Biomarker Selection	N/A	Not applicable for parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were collected in Catalonia, Spain.
	Metric 5: Currency	High	Samples were collected from September 2018 - February 2019.
	Metric 6: Spatial and Temporal Variability	High	12 samples were collected at each sampling point (PM10).
	Metric 7: Exposure Scenario	High	Samples collected at two sites influenced by different industrialactivities.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Only summary stats reported, raw data not reported.
	Metric 9: Quality Assurance	High	QA reported on blanks, standard controls, and repeatability.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Medium	Repeatability and reproducibility (inter day and intra day precision) was reported (RSD <11%).

Overall Quality Determination   High

Study Citation:	Araki, A., Bamai, Y. A., Bastiaensen, M., Van den Eede, N., Kawai, T., Tsuboi, T., Miyashita, C., Itoh, S., Goudarzi, H., Konno, S., Covaci, A., Kishi, R. (2020). Combined exposure to phthalate esters and phosphate flame retardants and plasticizers and their associations with wheeze and allergy symptoms among school children. Environmental Research 183:109212.		
HERO ID:	6957526		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage duration was not reported. The study cites a different published work for full details on sampling methodology.
	Metric 2:	Analytical Methodology	Low	The study reports little more than the type of instrumentation used and a description of how the LOQ was calculated. The study cites a different published work for full details on analytical methodology.
	Metric 3:	Biomarker Selection	N/A	The study evaluates the parent chemical in urine samples.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Study was conducted among elementary school children inSapporo, Japan.
	Metric 5:	Currency	Low	No sampling date is provided, but a publication date is available." Also, the articles indicates (reference provided) that details on the collection of samples have been reported elsewhere.
	Metric 6:	Spatial and Temporal Variability	Medium	The study is not clear if urine samples were 24 hrs samples collected (vs first morning).
	Metric 7:	Exposure Scenario	Medium	The study did not discussed product/chemical use in the building or building characteristics. The article often cites that details on collection of samples were reported in other studies.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points were not reported. Several summary statistics were reported, including min, 25th percentile, 50th percentile, 75th percentile, and max.
	Metric 9:	Quality Assurance	Low	Urine sample specific gravity and osmolality were not reported. Quality control/quality assurance was not discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study includes a discussion of its limitations. No measure of variance is reported.

Overall Quality Determination   Medium

Study Citation:		Schmidt, N., Castro-Jimenez, J., Fauvelle, V., Ourgaud, M., Sempere, R. (2020). Occurrence of organic plastic additives in surface waters of the Rhone River (France). Environmental Pollution 257:113637.		
HERO ID:		6966453		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methodology was well described, including sampling procedure, sampling storage, study site characteristics.
	Metric 2:	Analytical Methodology	Medium	Analytical methodologies were well described. LOQ range was reported in paper, all LODs and LOQs may be reported in SI.
	Metric 3:	Biomarker Selection	N/A	The analyte was measured in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected from the Rhone River, France.
	Metric 5:	Currency	High	Samples were collected from May 2017 to April 2018.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected in duplicate over the course of a year.
	Metric 7:	Exposure Scenario	High	Site and potential sources were well characterized. Data represented exposure to anyone who comes into contact with these rivers.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Several summary statistics were reported, including min, max, median, mean, and standard deviation.
	Metric 9:	Quality Assurance	High	The study applied quality assurance measures and no issues were identified. Recovery rates were reported for individual analytes.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	High	The study characterized variability, fluxes, and other sources to the Rhone River. The study described other potential sources that might result in underestimation of the concentrations of analytes in the river.

Overall Quality Determination   High

Study Citation: Shin, H., Moschet, C., Young, T. M., Bennett, D. H. (2019). Measured concentrations of consumer product chemicals in California house dust: Implications for sources, exposure, and toxicity potential. Indoor Air 30:60-75.

HERO ID: 6968217

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Method for recruiting the 38 households not explained.
	Metric 2:	Analytical Methodology	High	Standard LC and GC protocols were described and LODs were reported.
	Metric 3:	Biomarker Selection	N/A	Testing for the parent chemical in an environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Northern California.
	Metric 5:	Currency	High	Samples were collected in 2015-2016.
	Metric 6:	Spatial and Temporal Variability	Medium	No replicates were reported among 38 samples.
	Metric 7:	Exposure Scenario	Medium	Limited information on chemical use.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics were reported.
	Metric 9:	Quality Assurance	Low	No discussion of QA/QC although standard protocols were used. No discussion of recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Some uncertainties and limitations are discussed in the section entitled "Overview and scope of this study".

Overall Quality Determination   Medium

Study Citation:	Evenset A, abrielsen G. W. (2009). Screening of new contaminants in samples from the Norwegian Arctic: Silver, platinum, sucralose, bisphenol A, tetrabrombisphenol A, siloxanes, phtalates (DEHP), phosphorganic flame retardants. Akvaplan-niva rapport, no. 4351-1 :.		
HERO ID:	6992056		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	The sampling methodology is clear and appropriate. All relevant details are included. Method is described on pages 15 to 20.
	Metric 2: Analytical Methodology	High	The analytical methodology is clear and appropriate. Limits of detection are provided in each table.
	Metric 3: Biomarker Selection	N/A	Study is testing parent chemical presence in the muscle of fish, whole fish, and liver of seabirds.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples were taken in the Norwegian Arctic, in the Barents Sea and around Spitsbergen.
	Metric 5: Currency	Medium	Samples were collected in 2004 and 2008.
	Metric 6: Spatial and Temporal Variability	Medium	Number of samples varies by media; however, all scenarios have at least three samples. Sediment, fish and birds have at least 6 samples for chemicals of interest. Replicates are not reported.
	Metric 7: Exposure Scenario	Low	The exposure scenario is not well characterized. Few details on the route of exposure are given.
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	High	Raw data is presented in Table 16.
	Metric 9: Quality Assurance	Low	QA/QC measures were not discussed and issues were not identified.
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Characterization of variability is absent. No standard deviations or coefficients of variance were provided.

Overall Quality Determination   **Medium**

Study Citation: Bohlin-Nizzetto, P., Aas, W., Nikiforov, V. (2019). Monitoring of Environmental Contaminants in Air and Precipitation, 2018. Report M-1419 :.
HERO ID: 6994279

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Air samples were collected using high volume air samplers. All important details were reported and the methodology was scientifically sound.
	Metric 2:	Analytical Methodology	Low	Samples were spiked with internal standards, extracted, and quantified using UPLC-MSMS. All important details were reported and the methodology is scientifically sound. However, while LOD and LOQ were referenced throughout the report, the specific values of these limits were not reported.
	Metric 3:	Biomarker Selection	N/A	This study was testing for the chemical of interest in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Norway.
	Metric 5:	Currency	High	Samples were collected in 2017-2018.
	Metric 6:	Spatial and Temporal Variability	Medium	Active air samples were collected over on a weekly basis over the course of a year. The number of samples per year was reported to be compound and site specific, between 12 and 52, but not explicitly reported for each compound. Further, use of replicates was not reported.
	Metric 7:	Exposure Scenario	High	Air samples were well characterized and highly relevant for possible exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data were not reported. Summary statistics included detection frequency and mean concentrations.
	Metric 9:	Quality Assurance	Medium	Analyses were carried out by NILU laboratories, which were accredited in accordance with NS-EN ISO/IEC 17025. QC measures included field and lab blank samples, but were not further explained.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability was characterized qualitatively over time. There was brief discussion of uncertainty inherent in the more newly developed procedures for "organic contaminants of emerging concern," but was not further explained.

Overall Quality Determination   Medium

Study Citation:	Heimstad, E. S., Nygård, T., Herzke, D., Bohlin-Nizzetto, P. (2019). Environmental Pollutants in the Terrestrial and Urban Environment, 2018. Report M-1402 :.		
HERO ID:	7002451		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Sampling methodology included location, number of samples, date and sampling strategy were reported in section 2.1 and tables 2,3,4, and 5. Coordinates were reported in Appendix 2.
Metric 2:	Analytical Methodology	High	LOD was reported in appendix 1, page 164 for a range of matrices. Analytical methodology for OPFR was reported in page 36.
Metric 3:	Biomarker Selection	N/A	Analysis of TCEP was conducted in a range of environmental samples including soil, eggs and biological media.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Data were collected in Norway. Location coordinates were reported in Appendix 2.
Metric 5:	Currency	High	Samples collected in 2018.
Metric 6:	Spatial and Temporal Variability	Medium	Number of samples per media were reported in table 2. The number of samples ranged from 5 to 10. Sample replicates were only reported for analytical methods.
Metric 7:	Exposure Scenario	High	Analysis was conducted for next 20 chemicals in several trophic levels of a terrestrial food web in Norway.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Individual data points were reported in appendix 1. Summary data of OPFR were reported in table 16 (mean, min and max). Detection rate was reported in table 6.
Metric 9:	Quality Assurance	High	QA was well described in page 36, the study used SRM, laboratory blanks, procedural blanks, replicates and field blanks.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Medium	Recommendations for continuing the monitoring program were reported in page 104. Sample variability for TCEP was not reported since concentrations were <LOD for almost all samples.

Overall Quality Determination   **High**

Study Citation:	Norwegian Environment, Agency (2019). Monitoring of Environmental Contaminants in Freshwater Ecosystems 2018 - Occurrence and Biomagnification. Report M-1411 :.		
HERO ID:	7002468		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	The sampling methodology, including equipment, location and time, is reported in section 2.1 on page 2
Metric 2:	Analytical Methodology	Medium	Analytical methodology for PFR is reported on page 24 in section 2.2.6. LOD is reported in appendix A (raw data for 2018).
Metric 3:	Biomarker Selection	N/A	Concentrations of TCEP was measured in zooplankton, Mysis, E.smelt, Vendance and Brown trout.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples was collected in Lake Mjosa and Lake Femunden in Norway. Location coordinates isi reported in table 1 and table 2.
Metric 5:	Currency	High	Samples were collected in 2018.
Metric 6:	Spatial and Temporal Variability	Medium	Number of samples ranged from 3-15 and there were no sample replicates.
Metric 7:	Exposure Scenario	High	TBBPA concentrations in a freshwater ecosystems in two large lakes in Norway. One lake had several sources of contamination including urban, industrial, wastewater treatment plans and agricultural. The other did not have any important contamination sources.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	High	Raw data is reported in appendix A. Summary of statistics is reported in figure 23 and detection frequency is reported in table 4.
Metric 9:	Quality Assurance	Medium	The study doesn't report clear QA/QC procedures, but it can be implied by the use of standardized methods by the Norwegian Institute for Water Research.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Key limitations are not reported and there variability for TCEP are not reported due to the low detection frequency.

Overall Quality Determination   High

Study Citation:	Norwegian Environment, Agency (2019). Environmental contaminants in an urban fjord, 2018. M-1441 :.		
HERO ID:	7002475		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology	High	Table 1 gives an overview of the samples collected, matrix, locality, frequency and No. for analysis.
Metric 2:	Analytical Methodology	Low	PFR analysis reported in section 2.2.8 page 27. LOD are not reported, but section 2.2.8 describes the method that was used to calculate the LOD.
Metric 3:	Biomarker Selection	N/A	TCEP was measured in effluent water and sludge.
Domain 2: Representativeness			
Metric 4:	Geographic Area	High	Samples collected in Oslofjord, Oslo, Norway. Figure 1 A and B reports the sample location.
Metric 5:	Currency	High	Sampling was conducted in 2018.
Metric 6:	Spatial and Temporal Variability	Low	No sample replicates reported, 2 sludge samples and 2 effluent water.
Metric 7:	Exposure Scenario	High	Monitoring of the anthropogenic chemicals discharged into a fjord system and the implications on the fjord ecosystem, including food web, water and sediment.
Domain 3: Accessibility/Clarity			
Metric 8:	Reporting of Results	Low	Raw data is not reported, data reported as the mean of two samples in figure 34. Most of the data for TCEP is reported as a sum of PFR.
Metric 9:	Quality Assurance	Low	Recoveries are not reported, the laboratories that conducted the study was not accredited for the analysis of PFRs but followed the QA/QC requirements.
Domain 4: Variability and Uncertainty			
Metric 10:	Variability and Uncertainty	Low	Variability reported in terms of matrices, key limitations not reported.

Overall Quality Determination　　　　Medium

Study Citation: Heimstad, E. S., Nygård, T., Herzke, D., Bohlin-Nizzetto, P. (2018). Environmental pollutants in the terrestrial and urban environment, 2017. Report M-1076 :.

HERO ID: 7296058

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	All sample collection (air, soil, terrestrial biota) included adherence to a publicly available SOP that is scientifically sound and widely accepted, "Guidelines for field work in connection with environmental monitoring" (JAMP; OSPAR, 2009).
	Metric 2:	Analytical Methodology	Low	Samples were analyzed by accredited laboratories (NINA, NIVA, and NILU), so it is assumed that scientifically sound analytical methods were conducted. Procedures are described on pages 36-39. However, while LOD and LOQ are referenced throughout the report, the specific values for these limits are not stated.
	Metric 3:	Biomarker Selection	N/A	The study tested for the parent chemical in environmental media (air, soil, terrestrial biota).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected in Oslo, Norway.
	Metric 5:	Currency	High	The samples were collected in 2017 (June to September).
	Metric 6:	Spatial and Temporal Variability	Medium	Air, soil, and terrestrial biota samples were collected from up to 10 locations in Oslo, Norway. Number of samples for each sample type ranged from 3 to 10, and specific sample number and sampling strategy (e.g., pooled vs. individual) are reported for each. However, use of replicates was not reported.
	Metric 7:	Exposure Scenario	High	This study collected air, soil, and terrestrial biota samples from well documented areas around Oslo, Norway to characterize concentrations of the chemical of interest in several trophic levels of a terrestrial food web. As a result, the context of each sample type is well documented and easily extrapolated to other scenarios.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data is reported in Appendix 1 pages 196 to 228. Summary statistics were not reported due to low detection.
	Metric 9:	Quality Assurance	High	The study applied QA/QC measures" by following international requirements for QA/QC, e.g., recommendations of the Arctic Monitoring and Assessment Programme (AMAP) and the requirements in the European quality norm EN 17049. Additionally, samples were analyzed by accredited laboratories (NINA, NIVA, and NILU).
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Variability is not characterized quantitatively or qualitatively due to low detection levels. Uncertainty is briefly discussed regarding the application of uptake rates to passive air samplers.

Overall Quality Determination   **Medium**

Study Citation: Marklund, A., Andersson, B., Haglund, P. (2005). Organophosphorus flame retardants and plasticizers in Swedish sewage treatment plants. Environmental Science & Technology 39:7423-7429.

HERO ID: 8683710

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology	High	Sampling methodology is reported including materials, description of sample sites and sampling storage.
	Metric 2: Analytical Methodology	Medium	Analytical methodology includes sample preparation for both wastewater and sludge, analytical recoveries, analytical instrumentation, and limits. The limits are only reported as a range for all the chemicals..
	Metric 3: Biomarker Selection	N/A	The study test parent chemical in environmental media.
Domain 2: Representativeness			
	Metric 4: Geographic Area	High	Samples collected in sewage treatment plants of Sweden, the detail location is reported in figure 1 and information of each site in table. 1.
	Metric 5: Currency	Low	Samples collected in 2003 as reported in table 1.
	Metric 6: Spatial and Temporal Variability	Low	One weekly composite water sample was collected per site and three composite sludge samples per site.
	Metric 7: Exposure Scenario	High	The study represents wastewater and sludge from a range of sewage treatment plants of Sweden with a range of characteristics (table 1).
Domain 3: Accessibility/Clarity			
	Metric 8: Reporting of Results	Medium	Individual data not reported, data reported as the average of two measurements.
	Metric 9: Quality Assurance	High	The study follows a high QA/QC including blanks, calibration, reference standards and recoveries..
Domain 4: Variability and Uncertainty			
	Metric 10: Variability and Uncertainty	Low	Variability is only reported in terms of differences between sites. Limitations of the study reported in terms of future studies.

Overall Quality Determination   **Medium**

Domain	Metric		Rating	Comments
Study Citation:	Carlsson, H., Nilsson, U., Ostman, C. (2000). Video display units: An emission source of the contact allergenic flame retardant triphenyl phosphate in the indoor environment. Environmental Science and Technology 34:3885-3889.			
HERO ID:	12782			
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Low	The method was described, and a short-term pilot study was conducted. Some test conditions were documented. It appears that TCEP was tested but only found in background emissions, so difficult to determine if all descriptions apply to TCEP.
	Metric 2:	Analytical Methodology	Medium	A description of the extraction methodology and instrumentation was provided. The reporting limit for TCEP was not specifically mentioned in text but could be same as for other reported analytes.
	Metric 3:	Biomarker Selection	N/A	No biomarker information presented in the study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	The test conditions were fairly well documented and representative of an office environment (computer use & background), but for a limited set of conditions.
	Metric 5:	Sample Size and Variability	Medium	TCEP was reported & discussed for background emissions determinations (n=8). It appears that TCEP was a target analyte for other parts of study but was not mentioned in results.
	Metric 6:	Temporality	Low	Authors used "brand new" computer VDUs, but study was published in the year 2000.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Low	The raw data was not provided and there was limited summary statistics.
	Metric 8:	Quality Assurance	Medium	There was some QA/QC described, but not well-documented.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	CV reported for TCEP in background emissions.

Overall Quality Determination   Low

Study Citation:	Fang, M., Webster, T. F., Gooden, D., Cooper, E. M., Mcclean, M. D., Carignan, C., Makey, C., Stapleton, H. M. (2013). Investigating a novel flame retardant known as V6: measurements in baby products, house dust, and car dust. Environmental Science and Technology 47:4449-4454.		
HERO ID:	1676728		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	Little information on sampling methodology but Stapleton et al 2011 probably includes more details since samples were collected as part of that study.
	Metric 2:	Analytical Methodology	Low	Method descriptions for baby products/foam are not as robust as for dust matrix.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Representative of baby products in US found to contain TCEP, primarily nursing pillows (subset of larger sample of products).
	Metric 5:	Sample Size and Variability	Medium	There were 12 baby product samples analyzed for TCEP.
	Metric 6:	Temporality	Medium	Samples are from 2009.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Summary statistics provided without raw data.
	Metric 8:	Quality Assurance	Low	QA measures were described for V6 in dust matrix but not for TCEP in baby products and foam.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Variability was provided as standard deviation for data set of 12 products with detected V6. Not representative of all 101 products initially sampled.

Overall Quality Determination   **Low**

Study Citation:	Kajiwara, N., Noma, Y., Takigami, H. (2011). Brominated and organophosphate flame retardants in selected consumer products on the Japanese market in 2008. Journal of Hazardous Materials 192:1250-1259.
HERO ID:	1927630

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	The paper describes the sampling methodology; however, the paper does not provide any information about the sample storage time or conditions.
	Metric 2:	Analytical Methodology	Medium	The paper does not provide a reference for the analytical method, but it was described in the text. Percent recoveries were provided but the paper does not mention method validation. Verification of extraction efficiency was done for a different analyte. LODs only given for samples with concentrations <LOD.
	Metric 3:	Biomarker Selection	N/A	No biomarker information presented in the study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	The study tested a variety of consumer products.
	Metric 5:	Sample Size and Variability	Low	The study did not mention the use of sample replicates; but single samples were collected from 2 types of curtains, 4 wall papers, 2 electrical outlets, and 2 insulation boards. Single samples of a variety of components from electronic equipment (2 tvs, 1 computer) were collected.
	Metric 6:	Temporality	Medium	All of the materials sampled in this study were bought new in 2008.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Data for individual samples were provided. A statistical summary was not provided.
	Metric 8:	Quality Assurance	Medium	The authors state that established laboratory QC procedures were used but only provided a brief description about them.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Low	No measures of variability were reported. The study measured concentration of flame retardants in consumer products. This study was more of a survey of a variety of items rather than a definitive characterization for a specific consumer product.

Overall Quality Determination   **Medium**

Study Citation:	Saito, I., Onuki, A., Seto, H. (2007). Indoor organophosphate and polybrominated flame retardants in Tokyo. Indoor Air 17:28-36.		
HERO ID:	1927779		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Medium	Sample storage not discussed. Passive absorption IPA method was used for the apartment migration test.
	Metric 2: Analytical Methodology	High	Sample analysis was done using GC-FPD and GC-AED. The paper describes LODs, recoveries, as spiking of samples in the QA section.
	Metric 3: Biomarker Selection	N/A	A biomarker was not used in the study.
Domain 2: Representative			
	Metric 4: Testing Scenario	Medium	Building materials and electronic products are relevant scenarios.
	Metric 5: Sample Size and Variability	Medium	Samples consisted of 7 computer monitors and 8 tv sets. Appears to be 1 sample each for migration rate from wall coverings and ceiling and 2 for flooring.
	Metric 6: Temporality	Low	The electronics were manufactured between 1989 and 2002. The floors and wall coverings are from 2001.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	The average and range were provided for the electronics.
	Metric 8: Quality Assurance	Medium	The study included blanks, recovery studies, breakthrough tests, and duplicates. The duplicates were only for flooring.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Medium	A standard deviation was provided for recovery study (n=3). The study also provided some discussion of uncertainty.

Overall Quality Determination   Medium

Study Citation:	Ionas, A. C., Dirtu, A. C., Anthonissen, T., Neels, H., Covaci, A. (2014). Downsides of the recycling process: Harmful organic chemicals in children's toys. Environment International 65:54-62.		
HERO ID:	2345985		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Medium	Sampling methodology described in detail but no citation provided for publicly available, accepted SOPs or guidelines.
	Metric 2: Analytical Methodology	High	GCMS methodology discussed in detail, with LOQs provided and recovery samples.
	Metric 3: Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative			
	Metric 4: Testing Scenario	High	Exposure from toys is a relevant scenario, and the delineation of material type, year of production, and country of production allow for more nuanced consideration of data.
	Metric 5: Sample Size and Variability	Medium	Sample size varies by chemical group and is divided by sample type (hard plastic, wood, etc.); n=50 for phthalates and n=114 for PFRs.
	Metric 6: Temporality	Medium	Study published in 2014 but the production year of the toys sampled ranges from 1993 to 2012.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	Detection frequency, median, 90th% , and maximum concentration reported by chemical in study; median, mean, and max reported by exposure time and exposure pathway in supplemental file.
	Metric 8: Quality Assurance	High	Reference materials used and accuracy and precision results reported for the methods used; full method validation writeup in supplemental file.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Medium	Uncertainty discussed in exposure potential; variability addressed through toy types and correlation considerations by different parameters.

Overall Quality Determination **High**

Study Citation:	Stapleton, H. M., Klosterhaus, S., Keller, A., Ferguson, P., van Bergen, S., Cooper, E., Webster, T. F., Blum, A. (2011). Identification of Flame Retardants in Polyurethane Foam Collected from Baby Products. Environmental Science and Technology 45:5323-5331.		
HERO ID:	2648828		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Low	Sampling included used baby products donated and shipped by volunteers. Appropriate procedures were described and appear to have been followed but custody questions raised.
	Metric 2: Analytical Methodology	Medium	Brief summary and method reference provided for GC/EI-MS followed by HPLC/HRMS. Samples were also tested by XRF and compared to GC-MS results to evaluate usefulness of XRF for screening. (XRF results are considered semi-quantitative and are not considered for evaluation).
	Metric 3: Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative			
	Metric 4: Testing Scenario	Low	This study provided a survey of a variety of baby products. The donated products reflect use by self-selected population. The study wasn't designed to be comprehensive for all products, product age, or conditions.
	Metric 5: Sample Size and Variability	Medium	There was a total of 101 samples, but no replicates. There were >10 samples for most products (e.g., car seats, nursing pillows, etc.) and 5 samples for a few products. A single sample from each item was collected and multiple samples for each product type.
	Metric 6: Temporality	Low	The study tested products dated 2000-2010.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	The study did not provide raw data or individual sample concentrations. The data shows which products and how many samples had concentrations >1 mg/g foam, as well as mean concentration and a range. The supplemental information shows product information and shows which analytes were detected in each of the 101 individual product samples (but no concentrations.).
	Metric 8: Quality Assurance	Low	The analytical method was followed with a calibration curve and internal standards, but QC samples were not mentioned.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Low	No discussion of characterization of variability and uncertainty, other than variety of product types built in to sample design. For XRF states that additional research is needed to use it for reliable screening (so only GC-MS data evaluated).

Overall Quality Determination　　　　Low

Study Citation:	Stapleton, H. M., Sharma, S., Getzinger, G., Ferguson, P., Gabriel, M., Webster, T. F., Blum, A. (2012). Novel and High Volume Use Flame Retardants in US Couches Reflective of the 2005 PentaBDE Phase Out. Environmental Science and Technology 46:13432-13439.		
HERO ID:	2648833		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Low	The sampling protocol and sample information is described and well-documented for foam samples from donated couches. Would be higher but involvement of many volunteers raises some questions.
	Metric 2:	Analytical Methodology	Medium	The samples were analyzed using a GC/MS method and the method was briefly described. However, the method was not cited in the study.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Foam samples from a variety of couches purchased in US. Certain criteria were met, but it's a survey involving volunteers and may not be representative of entire US population.
	Metric 5:	Sample Size and Variability	Low	The overall study has 102 samples, but replicate tests were not performed.
	Metric 6:	Temporality	Low	The couches were purchased between 1985 and 2010.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Low	The raw data was not reported. An average of 2 concentrations was reported. Limited extractable concentration data for TCEP in text. In results table, TCEP concentration is reported as a combined concentration with V6.
	Metric 8:	Quality Assurance	Low	Standard analytical procedures were followed but limited discussion of QA/QC samples or results were provided.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Low	The study did not provide any measures of variability. There was some discussion of limitations.

Overall Quality Determination   Low

Study Citation:	La Guardia, M. J., Hale, R. C. (2015). Halogenated flame-retardant concentrations in settled dust, respirable and inhalable particulates and polyurethane foam at gymnastic training facilities and residences. Environment International 79:106-114.		
HERO ID:	3012534		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	Adequate discussion of sampling of foam blocks from gym pits; some description of composite sample creation.
	Metric 2:	Analytical Methodology	Medium	Adequate discussion of approved analytical methods for extraction, purification and analysis using UPLC-APPI/MS. Multiple media are discussed and additional detail found in a prior publication.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Exposure to foam is highly applicable, however, activity level varies.
	Metric 5:	Sample Size and Variability	Medium	Study had a small sample size. Samples 4a-4e samples were in triplicate and sample 2a was as a composite sample.
	Metric 6:	Temporality	High	This study was published in 2015.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Raw data is provided for the foam block (sample 2a). Triplicate averages are provided for the other samples. The FR composition between each of the six blocks varied substantially.
	Metric 8:	Quality Assurance	Medium	The study included triplicate or composite sampling, low percent RSD, and five-point calibration curves constructed from analytical standards. A laboratory blank was analyzed with each sample set. All results were corrected for surrogate recoveries, except where interferences were encountered.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Small sample size from two gyms does not allow for in-depth discussion. Analysis notes the FR composition between each of the six blocks varied substantially.

Overall Quality Determination   **Medium**

Study Citation:	Teo, T. L., Coleman, H. M., Khan, S. J. (2016). Presence and select determinants of organophosphate flame retardants in public swimming pools. Science of the Total Environment 569-570:469-475.		
HERO ID:	3464010		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Medium	Sample collection and handling were generally appropriate; however, the authors did not mention sample storage conditions and duration.
	Metric 2: Analytical Methodology	Medium	The experimental procedures did not follow a stated method, but the authors claim that their procedures have been previously validated. The authors describe good calibration results but do not clarify the recovery levels.
	Metric 3: Biomarker Selection	N/A	Biomarkers were not relevant to the experiment.
Domain 2: Representative			
	Metric 4: Testing Scenario	Low	The authors do not clarify the temperatures that applied to the soaking portion of the experiment. The authors speculate that temperature may affect the amount of the chemical that leaches from the product, so it is unclear to what extent temperature may have been a factor in the results.
	Metric 5: Sample Size and Variability	Medium	The authors do not clarify how many swimsuits were tested (i.e., one or more than one). In this experiment, a total of 1 g for swimsuits and 2 g for kickboards samples used and it is speculated that one swim suit and two kick boards were used. It is acceptable to have a single sample for testing concentrations in a product. The investigators included triplicate samples for the experiments.
	Metric 6: Temporality	Medium	The source of the tested items is likely current based on the publication date, March 2016. However, the experiment could've been completed 2016 or before.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	It appears that summary statistics are reported in Figure 1. The authors do not specify the source of the value for the central dot; it can be presumed to be the mean. Also, it is unclear whether these points represent the results of triplicate samples from one swimsuit or more than one swimsuit.
	Metric 8: Quality Assurance	Medium	The investigators included blanks in the experiments, and the control samples for the swimsuits did not have detectable levels of the tested chemicals. The authors mention accounting for incomplete recoveries but do not present results of the tests.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Low	The investigators mention that the small sample size limits the applicability of the results to only indications of the chemical. The authors also speculate that temperature may have an effect on the amount of tested chemical that would leach out of the swimsuit material. The authors did not clarify the temperature(s) that applied to the soaking portion of the experiments, so there is also uncertainty associated with that aspect of the tests that would limit the utility and comparability of the results.

Overall Quality Determination   **Medium**

Study Citation:	Miyake, Y., Tokumura, M., Nakayama, H., Wang, Q., Amagai, T., Ogo, S., Kume, K., Kobayashi, T., Takasu, S., Ogawa, K., Kannan, K. (2017). Simultaneous determination of brominated and phosphate flame retardants in flame-retarded polyester curtains by a novel extraction method. Science of the Total Environment 601-602:1333-1339.		
HERO ID:	4175610		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Medium	Sampling methods and key parameters are detailed but not all conditions are provided.
	Metric 2: Analytical Methodology	Medium	Methods and instrumentation described in detail, recoveries of 91 to 121% for BFRs and 82 to 122% for PFRs, calculation of LOQ given but not LOD.
	Metric 3: Biomarker Selection	N/A	Biomarker was not used.
Domain 2: Representative			
	Metric 4: Testing Scenario	Medium	Flame-retarded curtains are a consumer product that could reasonably create an exposure scenario, but the 40 curtains sampled may be specific to the Japanese market.
	Metric 5: Sample Size and Variability	Low	There were 40 samples taken per chemical (one for each curtain), no replicates.
	Metric 6: Temporality	Medium	Curtains sampled are from those available on the market in 2014.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	The supplemental information file provides raw concentration for curtain samples by chemical but no summary statistics. Only five compounds were detected in all samples.
	Metric 8: Quality Assurance	Medium	QA/QC discussed and addressed with recovery tests with fortified blank samples.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Medium	Some variability discussed in the curtain types and differences between the proposed method and dissolution method; some uncertainties discussed in the lack of quantifiable data, positing novel compounds.

Overall Quality Determination   **Medium**

| | Study Citation: | Liang, Y., Liu, X., Allen, M. R. (2018). Measurements of parameters controlling the emissions of organophosphate flame retardants in indoor environments. Environmental Science and Technology 52:5821-5829. |
| | HERO ID: | 4442465 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	High	Sampling methodology is scientifically sound and was cited in text.
	Metric 2:	Analytical Methodology	High	Analytical methodology is scientifically sound and was fully described.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Chamber study so microenvironment was controlled. Authors included three types of tests to compare results.
	Metric 5:	Sample Size and Variability	Medium	Microchamber test was conducted twice; Diffusive Sampling Test - samples were taken at three positions at various times generating three sets of data.
	Metric 6:	Temporality	High	Tested items appear to be current.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Additional information is reported in the supplemental file, but raw data was not provided.
	Metric 8:	Quality Assurance	High	Paper describes the quality assurance project plan and included duplicate samples.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Paper identifies and describes variability and uncertainty. Uncertainties are unlikely to have substantial impact on the results.

Overall Quality Determination   High

Study Citation:	Ingerowski, G., Friedle, A., Thumulla, J. (2001). Chlorinated ethyl and isopropyl phosphoric acid triesters in the indoor environment–an inter-laboratory exposure study. Indoor Air 11:145-149.		
HERO ID:	4731349		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Sampling Methodology and Conditions	Low	Minimal discussion on the sampling methodology utilized to sample household items suspected of contributing to household dust concentrations.
Metric 2:	Analytical Methodology	Low	Utilized three different laboratories for analytical testing. A representative procedure previously described in detail in another publication is only briefly outlined here. Different extraction agents and extraction methods between the three labs. Table 1 briefly shows 4.6-4.9 LODs.
Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative			
Metric 4:	Testing Scenario	Medium	Relevant exposure scenario but minimally discussed.
Metric 5:	Sample Size and Variability	Low	Because of the corroborating indoor dust monitoring data, and the section on "other materials" on page 146 describing the materials analysis, consider the 'spot check" analysis to be a sample size of 1.
Metric 6:	Temporality	Low	This paper was published in the year 2000.
Domain 3: Accessibility/Clarity			
Metric 7:	Reporting of Results	Low	Table 4 gives maximum concentrations of potential sources of TCEP. The study lacks representative data for each type of material tested. The highest TCEP concentration found in a given specimen by one of the three laboratories is shown. The number of samples tested was not reported for each category.
Metric 8:	Quality Assurance	Low	Minimal discussion on quality assurance. Table 1 provides extraction procedures and results of an internal quality control experiment (mg/kg).
Domain 4: Variability and Uncertainty			
Metric 9:	Variability and Uncertainty	Low	The study provided minimal to no discussion of the housing materials. A brief reference was mentioned to surface area of materials tested and corresponding air concentrations.

Overall Quality Determination   Low

Study Citation:	Lazarov, B., Swinnen, R., Spruyt, M., Maes, F., Van Campenhout, K., Goelen, E., Covaci, A., Stranger, M. (2015). Air sampling of flame retardants based on the use of mixed-bed sorption tubes-a validation study. Environmental Science and Pollution Research 22:18221-18229.		
HERO ID:	5165777		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	High	Air sampling methodology was well-described in the data source, including sampling equipment, sampler performance, storage, and method validation results.
	Metric 2:	Analytical Methodology	High	Analytical and extraction methodology was well-described in the data source, including analytical instrumentation, calibration and method validation results. MDL reported.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	The part of the study relevant to experimental involved field and lab emission chamber (FLEC) testing of flame-retardant treated insulation for comparison of the method under development and standard XAD-2 method.
	Metric 5:	Sample Size and Variability	Low	Only 2 samples (duplicates) were analyzed for each method (total of 4 samples).
	Metric 6:	Temporality	Medium	Sources of tested items not reported, but study was published in 2015.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Low	Sample results reported as average but were non-detect (see Table 5). Individual data and summary statistics not reported.
	Metric 8:	Quality Assurance	High	QA control measures were described for overall method validation effort. High recoveries (>70%).
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Low	There was some discussion of variability and uncertainty, but mainly for other analytes and indoor air monitoring samples. No limitations reported.

Overall Quality Determination　　　　**Medium**

Study Citation:	Wu, Y., Miller, G. Z., Gearhart, J., Romanak, K., Lopez-Avila, V., Venier, M. (2019). Children's car seats contain legacy and novel flame retardants. Environmental Science & Technology Letters 6:14-20.		
HERO ID:	5167126		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	Study provides a good description of the sampling methodology. The sampling and product information is available in the supplemental material.
	Metric 2:	Analytical Methodology	High	The study provides detailed analytical method descriptions including the LODs.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	A variety of car seats were tested under one set of conditions.
	Metric 5:	Sample Size and Variability	High	There were 18 car seats, 31 fabric samples (including 16 laminated foam/fabric composites) and 5 foam samples.
	Metric 6:	Temporality	High	The car seats were manufactured between 2017 and 2018.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	High	The number of samples, detection frequencies, minimum, maximum, mean, and median are provided in the study. The supplemental information file provides raw data for 18 samples and LOD.
	Metric 8:	Quality Assurance	High	Procedural blank concentrations and matrix spike recoveries are provided in the study.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Limited discussion of uncertainty, but raw data show duplicate samples from same car seats.

Overall Quality Determination   High

Study Citation:	Gomes, G., Ward, P., Lorenzo, A., Hoffman, K., Stapleton, H. M. (2016). Characterizing flame retardant applications and potential human exposure in backpacking tents. Environmental Science and Technology 50:5338-5345.		
HERO ID:	5176516		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	High	Sampling methodology is clearly described and appropriate, including sampling materials, equipment, conditions, procedures and storage. Reference citations are also provided for wipes (Stapleton et al 2008) and air (Allen et al 2007).
	Metric 2:	Analytical Methodology	Medium	Analytical methodology, including extraction and instrumentation, is briefly discussed, with reference citations provided (Stapleton et al 2011 and Keller et al 2014 for tent textiles, Hoffman et al 2014 and Allen et al 2007 for wipes and air analysis). MDL was reported for wipe and air analysis but not for tent textiles.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	High	Representative of US-produced camping tent exposure to flame retardants. Note that "indoor" air samples from tent are not representative of typical indoor air samples from buildings, but are representative of the exposure scenario. Pre exposure samples were taken from hand wipes to assess background levels before contacting the tent.
	Metric 5:	Sample Size and Variability	High	There were 15 samples (5 tent styles with 3 replicate tests).
	Metric 6:	Temporality	Medium	Testing was conducted in 2014.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Individual data points for hand wipes and air are shown in Figures 2 and 3 but are difficult to read. Summary statistics in Tables 1, S3 and S4 include average and standard deviation for textiles, wipes and air, respectively.
	Metric 8:	Quality Assurance	Medium	QA/QC includes blanks and laboratory recoveries, with correction for concentrations in field blanks. Recovery reported for TPHP and not specifically for other chemicals.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	High	Standard deviations were reported for tests with concentrations above detection limit. Uncertainty, data gaps and limitations were discussed.

Overall Quality Determination   **High**

Study Citation:	Stubbings, W. A., Drage, D. S., Harrad, S. (2016). Chlorinated organophosphate and "legacy" brominated flame retardants in UK waste soft furnishings: A preliminary study. Emerging Contaminants 2:185-190.		
HERO ID:	5470041		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Sampling Methodology and Conditions	Medium	The sampling methodology appears scientifically sound but was not from a referenced source.
	Metric 2: Analytical Methodology	High	The analytical methods appear scientifically sound and are cited.
	Metric 3: Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative			
	Metric 4: Testing Scenario	Medium	The testing scenario was based on soft furnishing that were designated as waste.
	Metric 5: Sample Size and Variability	Low	The concentrations are reported for 14 products and 8 different offices; however, no replicate tests were performed.
	Metric 6: Temporality	Medium	The approximate age of the sampled materials were provided in the study.
Domain 3: Accessibility/Clarity			
	Metric 7: Reporting of Results	Medium	All data appear to be reported but does include detailed summary statistics.
	Metric 8: Quality Assurance	Medium	Supplementary files are included with QA/QC information. This information includes blanks and LOD values. A potential outline was identified and explained in the text.
Domain 4: Variability and Uncertainty			
	Metric 9: Variability and Uncertainty	Medium	Discussion of uncertainty of TCEP sample appears on page 188.

Overall Quality Determination　　　Medium

Study Citation:			Gu, J., Wensing, M., Uhde, E., Salthammer, T. (2019). Characterization of particulate and gaseous pollutants emitted during operation of a desktop 3D printer. Environment International 123:476-485.
HERO ID:			5708386

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	Medium	The study consisted of basic thermoplastic filaments used in 3D printing. The filaments were used in a 3D printer as they would normally, but the 3D printer was placed in a stainless steel chamber to capture emissions while in use. The sampling procedure was not cited but it was briefly described in the study.
	Metric 2:	Analytical Methodology	Medium	A GC/MS method was used to analyze the samples.
	Metric 3:	Biomarker Selection	N/A	A biomarker was not used in this study.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	This can potentially be an exposure scenario in DIY settings.
	Metric 5:	Sample Size and Variability	Medium	Adequate sample size per sampling type.
	Metric 6:	Temporality	High	The study was published in 2019.
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Low	The study did not provide raw sample data nor an LOD or LOQ. The was provided in tabular format (Table 3).
	Metric 8:	Quality Assurance	Medium	Adequate discussion; Filter sampling of the chamber blank was taken in a separate test (sampling for 4 h in the empty chamber).
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Adequate discussion of future research direction based on outcomes. Discussed methods that were not successful. Detailed difficulty in obtaining the particle chemical composition due to low concentration and the limitation of the air sampling volume. Sample flow rate is limited by the chamber size, air exchange rate and a short printing time.

Overall Quality Determination　　　　Medium

Study Citation:	U.S. EPA, U.S.G.S. and National Water Quality Monitoring Council (2022). Tris(2-chloroethyl) phosphate (TCEP) (CAS RN: 115-96-8): WQP Output (NWIS, STEWARDS & STORET), Site data & sample results (physical/chemical metadata). :.		
HERO ID:	10663361		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling methodology information is provided in columns AF to AJ, including the sampling method code and the equipment used. No information was provided on transportation or storage conditions for any sample. Note that for a large portion of the samples the sampling methodology was reported as "UNKNOWN".
	Metric 2:	Analytical Methodology	High	18 different analytical method codes are reported in column BO and BS. 37 point values do not have an analytical method. Description of the methods reported in column BQ and detection limit in column BY. A detection limit was not provided for all samples. While there is heterogeneity in the information provided, the confidence rating of high is based on the samples with the most complete data.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Column X reports the location identifier code. All samples are from the U.S. The station.xlsx file included as part of the HERO reference provides detailed information on the sites sampled. The information of each code can be found at https://waterdata.usgs.gov/nwis/si
	Metric 4:	Temporal	High	Data reported from 1988 to 2022. The date is reported in column G.
	Metric 5:	Exposure Scenario	Medium	Media are reported in column E and F; location and time are also reported. The station.xlsx file included as part of the HERO reference provides, for some samples, more detailed information on the sites sampled, such as sample depth. There is no information provided on sources of chemicals.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	High	The database is widely accepted and a user guide is available which describes all of the data fields.
	Metric 7:	Reporting Results	Medium	The database does not report summary of statistics, only point values. While the data are well organized, since the data originates from numerous different entities (states) and monitoring programs, some data may be difficult to interpret due to the lack of populated data fields or discrepancies between columns.
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	Medium	Uncertainty is characterized by the inclusion of data qualifier column AR; however, not all rows have a data qualifier code where expected. Column AS reports the results status identifier that indicates the acceptability of the result with respect to QA/QC criteria.

Overall Quality Determination   High

Study Citation: CDC, (2022). Bis(2-chloroethyl)phosphate (CAS RN: 3040-56-0): NHANES Biomonitoring Data (Urine). :.
HERO ID: 10668533

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Widely accepted sampling methodology from a source known to use sound approaches. Information on sampling design can be found at https://wwwn.cdc.gov/nchs/nhanes/tutorials/SampleDesign.aspx.
	Metric 2:	Analytical Methodology	High	Widely accepted analytical methodology, outlined at https://www.cdc.gov/exposurereport/data_sources_analysis.html. Additional detail is listed in references listed at https://www.cdc.gov/exposurereport/biomonitoring_references.html.
Domain 2: Representative				
	Metric 3:	Geographic Area	High	Samples were collected from the US population.
	Metric 4:	Temporal	High	Data reported from 2011 to 2018.
	Metric 5:	Exposure Scenario	Medium	Exposure to flame retardants for the civilian, noninstitutionalized population in the United States based on age, gender, and race/ethnicity. There is no information provided on sources of exposure to the chemical, amount of exposure, or microenvironments.
Domain 3: Accessibility/Clarity				
	Metric 6:	Availability of Database and Supporting Documents	High	The database is widely accepted and well known. There is an abundance of information online about the database.
	Metric 7:	Reporting Results	High	The database reports summary statistics (geometric mean, 50th/75th/90th/95th percentiles). The years of collection and sample size is reported for each row. Raw data can be downloaded from the CDC website https://wwwn.cdc.gov/nchs/nhanes/default.aspx
Domain 4: Variability and Uncertainty				
	Metric 8:	Variability and Uncertainty	High	There is no characterization of uncertainty. Variability reported as summary of statistics and the analysis of data by age, gender, and race/ethnicity. NHANES does not include state-level data. Considerations related to the data are discussed at https://www.cdc.gov/exposurereport/data_interpretation.html

Overall Quality Determination   High

Study Citation:	Wensing, M., Uhde, E., Salthammer, T. (2005). Plastics additives in the indoor environment - flame retardants and plasticizers. Science of the Total Environment 339:19-40.		
HERO ID:	1336629		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	The technical approach for data collection is well described in the experimental techniques section.
Domain 2: Representative			
	Metric 2: Exposure Scenario	High	The study evaluates the general population exposure to flame retardants and plasticizers from indoor plastic additives.
Domain 3: Accessibility/Clarity			
	Metric 3: Documentation of References	High	The study documents all sources of information in tables and text.
Domain 4: Variability and Uncertainty			
	Metric 4: Variability and Uncertainty	Medium	Variability is reported in different tables as ranges and percentiles and some uncertainty and limitations identified.

Overall Quality Determination   High

Study Citation:	ECB, (2009). European Union risk assessment report: Tris(2-chloroethyl) phosphate, TCEP. European Chemicals Bureau :213.		
HERO ID:	3809216		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	Low	The assessment uses technical approaches generally accepted by the scientific community. Analytical methods for referenced studies environmental and biological sampling not discussed. Data needs that would reduce the uncertainties within risk assessment were not discussed.
Domain 2: Representative			
	Metric 2: Exposure Scenario	Medium	Exposure activity assessed likely represents the scenarios of interest, with a wide variety of exposure sampling scenarios and sampling media reviewed within the literature including for surface water, precipitation (rain, snow, glacier ice), wastewater treatment plant influent and effluent, landfill leachate, sewage sludge, river sediment, and pine needle samples. Location of sampling generally presented for results from studies conducted in countries such as the Germany, the Netherlands, Italy, United Kingdom (UK), England, Wales, and the U.S. Additional details, such as number of samples, number of sampling sites, year of sampling often lacking, however references provided.
Domain 3: Accessibility/Clarity			
	Metric 3: Documentation of References	Medium	References are available and provided, however some references may not be publicly available or are not from peer reviewed sources.
Domain 4: Variability and Uncertainty			
	Metric 4: Variability and Uncertainty	Low	Study characterization of variability within the population/media concentration data presented (range) for some results (Table 4.6), but not most. Discussion of uncertainty and variability in exposures lacking, however general uncertainties in risk assessment presented.

Overall Quality Determination   Low

Study Citation: Toxicology Excellence for Risk Assessment (TERA) (2016). Flame retardant exposure assessment. :.
HERO ID: 5155521

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	High	Methodology outlined and assumptions provided.
Domain 2: Representative			
	Metric 2: Exposure Scenario	High	The data closely represent exposure scenarios of interest.
Domain 3: Accessibility/Clarity			
	Metric 3: Documentation of References	High	References are available for all reported data, inputs, and defaults; and are publicly available and from peer reviewed sources.
Domain 4: Variability and Uncertainty			
	Metric 4: Variability and Uncertainty	High	Uncertainties discussed for various exposure factors and calculations.

Overall Quality Determination　　　　　High

Study Citation:	ECHA, (2018). Screening report: An assessment of whether the use of TCEP, TCPP and TDCP in articles should be restricted. :.		
HERO ID:	5155555		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Methodology	Low	The assessment uses technical approaches generally accepted by the scientific community, however mathematical models and equations utilized for estimated exposures and dose not outlined within text. Model inputs and default assumptions not detailed. Migration data from Danish EPA sources referenced. Literature search briefly mentioned, however search strategy not in great detail.
Domain 2: Representative			
	Metric 2: Exposure Scenario	Medium	Exposure activity assessed likely represents the scenarios of interest as authors note samples were taken from areas where children would have the most direct contact. However, number of products (seven) utilized for migration data from Danish EPA estimates noted as not representative of the Danish, EU, UK and Ireland markets.
Domain 3: Accessibility/Clarity			
	Metric 3: Documentation of References	Medium	References are available and provided, however some references may not be publicly available or are not from peer reviewed sources.
Domain 4: Variability and Uncertainty			
	Metric 4: Variability and Uncertainty	Low	Study characterization of variability limited in exposure estimates. Uncertainties including limited migration data as well as childcare article textile barriers to migration detailed.

Overall Quality Determination   Low

Study Citation: Environment Canada, (2009). Screening Assessment for the Challenge: Ethanol, 2-chloro-, phosphate (3:1) (Tris(2-chloroethyl) phosphate [TCEP]). :.
HERO ID: 5160070

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	Trusted source that used standard risk assessment methodology for a screening assessment, however, robust details not provided.
Domain 2: Representative				
	Metric 2:	Exposure Scenario	High	Canadian screening assessment applicable general pop and consumers. 2009 assessment.
Domain 3: Accessibility/Clarity				
	Metric 3:	Documentation of References	High	References cited for all reported data and generally appear to be from publicly available and peer reviewed sources.
Domain 4: Variability and Uncertainty				
	Metric 4:	Variability and Uncertainty	High	Uncertainty and confidence adequately discussed.

Overall Quality Determination   High

Study Citation: NICNAS, (2010). Ethanol, 2-chloro-, phosphate (3:1): Human health tier III assessment. :.
HERO ID: 5185320

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Methodology	Medium	The assessment uses technical approaches generally accepted by the scientific community for estimated daily intake calculations. Mathematical models and equations utilized for estimated exposures and outlined within text. Model inputs and default assumptions detailed. Review of previously reported concentration data within various media did not include discussion of sampling and analytical methods, however data sources referenced.
Domain 2: Representative				
	Metric 2:	Exposure Scenario	Medium	Exposure activity assessed likely represents the scenarios of interest as multiple exposure routes and sources reported from Australia within this report noted to likely be representative of those in other countries. Authors note exposure via other potential sources and routes cited from other agencies may not be representative of the Australian population. Concentration data reported from multiple media including indoor air, drinking water, indoor dust, food, human milk and children's products. Data derived from previously published reports from multiple countries including Denmark, U.S., Japan, Sweden, Canada, Vietnam and the Phillipines.
Domain 3: Accessibility/Clarity				
	Metric 3:	Documentation of References	Medium	References are available and provided, however some references may not be publicly available or are not from peer reviewed sources.
Domain 4: Variability and Uncertainty				
	Metric 4:	Variability and Uncertainty	Medium	Study characterization of variability limited in exposure estimates. Uncertainties and assumptions in both exposure and hazard and risk assessments reported in detail.

Overall Quality Determination   Medium

Study Citation:	Ali, N., Dirtu, A. C., van den Eede, N., Goosey, E., Harrad, S., Neels, H., 'T Mannetje, A., Coakley, J., Douwes, J., Covaci, A. (2012). Occurrence of alternative flame retardants in indoor dust from New Zealand: Indoor sources and human exposure assessment. Chemosphere 88:1276-1282.		
HERO ID:	1927602		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	No equation provided but citation to another journal article (Jones-Otazo et al 2005) included in description of methodology.
	Metric 2: Model Evaluation	Low	Jones-Otazo et al 2005 is published and used in many studies, but formality or quality of peer review unclear.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Exposure to indoor dust is reasonable, but sampling is from 2012 and New Zealand.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Citation included with description of intake, but model not clearly described in primary reference.
	Metric 5: Model Inputs and Defaults	Medium	Inputs and defaults are provided but cannot fully validate without equation.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	High and mean estimates for adults and children provided, with some discussion of uncertainties and assumptions.

Overall Quality Determination   **Medium**

| | Study Citation: | Shin, H. M., Mckone, T. E., Nishioka, M. G., Fallin, M. D., Croen, L. A., Hertz-Picciotto, I., Newschaffer, C. J., Bennett, D. H. (2014). Determining source strength of semivolatile organic compounds using measured concentrations in indoor dust. Indoor Air 24:260-271. |
| | HERO ID: | 2215665 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Most equations provided in text, with additional equations and figures provided in the supplemental file with citations. Equations for surface area emission rates, gas/dust concentrations, and saturation concentrations were also provided.
	Metric 2:	Model Evaluation	Medium	All equations have peer reviewed citations, estimated emission rates only compared to reported values in two studies for DEHP.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Estimates and models relevant for plastics and building materials but not personal care products; Whole-house context, individual product emissions unknown.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Equations are all provided and supplemental documentation is available.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs listed in supplemental table 2 and throughout paper after their relevant equations; most of the inputs are secondary or estimated.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Uncertainty analysis conducted for the input variables (table s2). Additional discussion of variability, uncertainty is provided in the implications /limitations section of the study.

Overall Quality Determination   High

Study Citation:	Abdallah, M. A. E., Covaci, A. (2014). Organophosphate flame retardants in indoor dust from Egypt: Implications for human exposure. Environmental Science and Technology 48:4782-4789.		
HERO ID:	2345990		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Equation was referenced and from a peer reviewed source.
	Metric 2: Model Evaluation	Low	There was a comparison of values with other published values. An evaluation was conducted by the author, but no more formal evaluation was mentioned.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Sampling occurred in 2012-2013.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	Equation source was found online, free and available to the public.
	Metric 5: Model Inputs and Defaults	High	Inputs are described and referenced.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Paper mentions high levels of variability and uncertainty in the model inputs used.

Overall Quality Determination　　　　Medium

		Domain	Metric	Rating	Comments

Study Citation: Tajima, S., Araki, A., Kawai, T., Tsuboi, T., Ait Bamai, Y., Yoshioka, E., Kanazawa, A., Cong, S., Kishi, R. (2014). Detection and intake assessment of organophosphate flame retardants in house dust in Japanese dwellings. Science of the Total Environment 478:190-199.

HERO ID: 2542290

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Intake equation given with no citation, while the dust ingestion equation has a citation.
	Metric 2:	Model Evaluation	Low	Intake estimates briefly compared to other published studies, but limited discussion was provided.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Low	The concentrations and some of the exposure factors used to estimate intake may be particular to Japanese children.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Equations can be followed using inputs provided and the results could be replicated.
	Metric 5:	Model Inputs and Defaults	High	Inputs described and values cited where relevant.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Median and 95th percentile intakes estimated for toddlers and children for both floor dust and upper surface dust. A discussion of limitations of school vs home and ingestion vs inhalation of dust was provided. Weak points and limitations were discussed.

Overall Quality Determination　　　Medium

Study Citation:	Mihajlovic, I., Fries, E. (2012). Atmospheric deposition of chlorinated organophosphate flame retardants (OFR) onto soils. Atmospheric Environment 56:177-183.		
HERO ID:	2662833		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	High	Equations are referenced (from other peer reviewed publications).
	Metric 2: Model Evaluation	Medium	Equations are referenced from peer reviewed sources - no mention of a more formal evaluation.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Low	Sampling was conducted in 2010 and 2011.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Some of the referenced papers are not freely available to the public.
	Metric 5: Model Inputs and Defaults	High	All model inputs are described and referenced when applicable.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	A discussion was included on variability and uncertainty. The author describes seasonal variability.

Overall Quality Determination   Medium

Study Citation:	Marklund, A., Andersson, B., Haglund, P. (2005). Organophosphorus flame retardants and plasticizers in air from various indoor environments. Journal of Environmental Monitoring 7:814-819.		
HERO ID:	2919497		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	No equations are provided, but the methodology for estimating indoor air and dust ingestion exposure is described. Presumably paper is following basic intake calculations, but calculations cannot be easily followed.
	Metric 2:	Model Evaluation	Low	The outputs are briefly compared to dietary intakes and guideline values.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Low	The measured indoor air and dust concentrations represent conditions of a scenario of interest, but the daily doses estimate do not indicate which scenario is being represented (as the air samples cover many different locations).
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	No equations are provided, and the provided documentation is not easily followed.
	Metric 5:	Model Inputs and Defaults	Low	It appears most inputs are provided (inhalation and ingestion rates, body weight) but the concentration used is not identified.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	A range of inhalation and dust ingestion doses are provided, but there is limited discussion on the variability or uncertainty within the provided minimums and maximums. Data is provided for adults and children.

Overall Quality Determination   Low

		Domain	Metric	Rating	Comments

Study Citation: Kim, J., Isobe, T., Muto, M., Nguyen Minh Tue, Katsura, K., Malarvannan, G., Sudaryanto, A., Chang, K. H., Prudente, M., Pham Hung Viet, Takahashi, S., Tanabe, S. (2014). Organophosphorus flame retardants (PFRs) in human breast milk from several Asian countries. Chemosphere 116:91-97.

HERO ID: 2921301

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	The daily intake equation was provided, and the equation is sound.
	Metric 2:	Model Evaluation	Medium	Concentrations used in DI calculations compared to other published studies, but the DIs were only compared to RfDs.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	The 2014 concentration data is relatively representative of current conditions, but the DIs represent conditions in various Asian countries.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	The author described the equation and provided inputs. The method used can be followed.
	Metric 5:	Model Inputs and Defaults	Medium	Most inputs are provided with citations, though the concentrations are not explicitly identified (i.e., if median value is used).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Variability exhibited in the range of data, doses calculated for each sampling event, but the data are presented in a figure. Uncertainties and limitations of the study discussed, particularly around individual chemical and individual pathway limitations.

Overall Quality Determination　　　　Medium

Study Citation:		He, C., Zheng, J., Qiao, L.,in, Chen, S., Yang, J., Yuan, J. G., Yang, Z. Y.,i, Mai, B.,iX (2015). Occurrence of organophosphorus flame retardants in indoor dust in multiple microenvironments of southern China and implications for human exposure. Chemosphere 133:47-52.		
HERO ID:		2938137		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Equation not provided, but citations and inputs enough to infer that intake calculations were done using measured concentrations and various exposure factors.
	Metric 2:	Model Evaluation	Low	Model not provided, only citations for values, so the level or formality of peer review of the other studies is unclear.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Exposure via dust ingestion in the four microclimates may be reasonable pathway and route, but the intakes are based on Chinese sampled data from 2015, limiting relevance to current U.S. scenarios.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equations not provided for intake calculations.
	Metric 5:	Model Inputs and Defaults	Medium	Some inputs are described with citations, but without the equation, it remains unclear if all inputs were provided.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	House dust ingestion intakes estimate for four microclimates under median and 95th percentile concentrations for adults and toddlers. Limited discussion of uncertainties and model inputs.

Overall Quality Determination   **Medium**

Study Citation:	Malarvannan, G., Belpaire, C., Geeraerts, C., Eulaers, I., Neels, H., Covaci, A. (2015). Organophosphorus flame retardants in the European eel in Flanders, Belgium: Occurrence, fate and human health risk. Environmental Research 140:604-610.		
HERO ID:	3010476		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Low	Equation is not provided for daily intakes, but the methodology is generally described with the inputs and appears sound.
	Metric 2: Model Evaluation	Medium	The estimated intake values are discussed in comparison to other studies' results with consideration of how the models and data sources differ.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	For the scenario of interest, exposure via eel consumption in the Belgian population, the model inputs reflect relevant conditions, though the data are from 2015 or older.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Equation not provided.
	Metric 5: Model Inputs and Defaults	Medium	The body weight and consumption rates are provided with citations, while the concentrations are assumed from the study. Without the equation, cannot validate that all inputs are provided.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Variability exhibited and discussed in the general population compared to the high intake group (fishermen) and within each (mean, median, range provided). Uncertainties and limitations of the estimates discussed.

Overall Quality Determination   **Low**

Study Citation: Schreder, E. D., Uding, N., La Guardia, M. J. (2016). Inhalation a significant exposure route for chlorinated organophosphate flame retardants. Chemosphere 150:499-504.

HERO ID: 3222316

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	No equations provided for inhalation or dust exposure. Inputs provided for what is likely a basic intake calculation.
	Metric 2:	Model Evaluation	Low	Inhalation estimates briefly compared to one other study, but limited discussion and not specific to TCEP.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Exposure to flame retardants and dust at home is relevant. The data current and based on U.S. homes.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	The equations are not provided and therefore, the values could not be verified.
	Metric 5:	Model Inputs and Defaults	Medium	Some inputs are provided, including inhalation and ingestion rates cited to U.S. EPA, but unclear if all inputs are provided without an equation.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Estimated intakes provided for adults and children based on median and max concentrations in air and dust. Some discussion of the uncertainties and assumptions used in calculations.

Overall Quality Determination   Low

Study Citation:	Wu, M.,in, Yu, G., Cao, Z., Wu, D., Liu, K.,ai, Deng, S., Huang, J.,un, Wang, B.,in, Wang, Y. (2016). Characterization and human exposure assessment of organophosphate flame retardants in indoor dust from several microenvironments of Beijing, China. Chemosphere 150:465-471.		
HERO ID:	3222715		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	High	Equation for EDI provided in supplemental file with citation (methodology taken from prior published study) and appears sound.
	Metric 2: Model Evaluation	Low	Some discussion of results against previous findings but no formal evaluation process beyond assumed peer review for publication. There were some comparisons to indoor dust ingestion values across countries (China, New Zealand, Germany, Belgium, Pakistan).
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Ingestion of dust is a reasonable consumer exposure scenario in the environments where sampled, but relevance of Beijing homes, offices, and daycares may not be direct parallel to American environments.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Equation is provided in supplemental file, but it is not freely accessible.
	Metric 5: Model Inputs and Defaults	Medium	Most inputs detailed with citations or explanations. The inputs include dust ingestion rates, time spent in each environment, and body weight for toddlers, adults, and the elderly.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Variability characterized in locations of possible dust exposure, average/high scenarios, and age groups. Some discussion was provided on the uncertainties (e.g., influence of body weight vs hand-to-mouth behavior for toddlers).

Overall Quality Determination　　　　**Medium**

Study Citation:	Xu, F., Giovanoulis, G., van Waes, S., Padilla-Sanchez, J. A., Papadopoulou, E., Magnér, J., Haug, L. S., Neels, H., Covaci, A. (2016). Comprehensive study of human external exposure to organophosphate flame retardants via air, dust, and hand wipes: The importance of sampling and assessment strategy. Environmental Science and Technology 50:7752-7760.		
HERO ID:	3357642		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Equations were provided from existing literature for inhalation exposure, dust ingestion exposure, dermal absorption via handwipe, and dermal absorption via dust (Section 4. in supplemental file).
	Metric 2: Model Evaluation	Medium	The equations are cited from previously published literature, so assumption is that there was some evaluation during peer review and publication. Author provided some evaluation in comparison of individual participant to general population data.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Exposure via inhalation, dust ingestion, and dermal absorption all relevant scenarios, but samples all represent conditions in Oslo, Norway rather than USA.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Exposure calculations can be followed with information provided in supplemental file, but it is not freely and publicly accessible.
	Metric 5: Model Inputs and Defaults	Medium	Inputs to the model are outlined but they are not explicitly cited. A range of references was provided for a variety of inputs.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Exposure estimates include variation by age and sex, surface vs floor dust, and stationary vs personal air. There was some discussion of uncertainty related to personal air sampling concentrations and lack of data leading to assumptions for certain chemicals.

Overall Quality Determination   **Medium**

Study Citation:	Lee, S., Jeong, W., Kannan, K., Moon, H. B. (2016). Occurrence and exposure assessment of organophosphate flame retardants (OPFRs) through the consumption of drinking water in Korea. Water Research 103:182-188.		
HERO ID:	3455908		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Intake calculation was described in text as multiplying ingestion rate of drinking water with concentrations of OPFR measured in the study.
	Metric 2: Model Evaluation	Low	Basic calculation for estimated daily intake is widely accepted but no validation for their scenario, particularly with assumptions of various water intakes.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Samples collected in 2014.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Insufficient information in data source to verify the model. References are provided for model inputs which may provide additional documentation.
	Metric 5: Model Inputs and Defaults	Medium	Model inputs and defaults are briefly identified and described, with references.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Low	Uncertainties identified may have a substantial impact on the exposure assessment. Estimated daily intake calculations that are reported cannot be verified for most of the age groups. Results of the intakes are presented in median and 95th percentile but median drinking water concentrations cannot be easily interpreted.

## Overall Quality Determination	Low

Study Citation:	Teo, T. L., Coleman, H. M., Khan, S. J. (2016). Presence and select determinants of organophosphate flame retardants in public swimming pools. Science of the Total Environment 569-570:469-475.		
HERO ID:	3464010		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equation based on EnHealth Guidelines from Australian and EPA methods.
	Metric 2:	Model Evaluation	High	Sources are from Australian and US federal regulatory agencies and methods are expected to have undergone evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	The paper was published in 2016.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	All sources are from EnHealth or the US EPA and published materials are available online for free.
	Metric 5:	Model Inputs and Defaults	High	Inputs are mostly exposure factors handbook values which are described and referenced.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	The discussion on variability and uncertainty is included in section 3.3.

Overall Quality Determination   High

Study Citation:	Zhang, X., Zou, W., Mu, L., Chen, Y., Ren, C., Hu, X., Zhou, Q. (2016). Rice ingestion is a major pathway for human exposure to organophosphate flame retardants (OPFRs) in China. Journal of Hazardous Materials 318:686-693.		
HERO ID:	3468265		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	Medium	Equation provided for estimated dietary intake with a citation, but is not from a widely known or authoritative source.
Metric 2:	Model Evaluation	Low	No indication of model evaluation, but assumption that it is valid based on previous peer review publications.
Domain 2: Representative			
Metric 3:	Exposure Scenario	Medium	The model equation represents a relevant exposure scenario of dietary intake but the inputs and scenarios used with the model in this paper may be particular to only Chinese people and foods.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	High	Equation and input data provided, no model guide or program needed.
Metric 5:	Model Inputs and Defaults	Medium	Model inputs are provided, including consumption rates and concentrations in food samples, but not all are clearly cited. While the beverage consumption input came from the EPA.
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	Variability in food samples and male and female exposure. Some limitations discussed related to regional and dietary differences.

Overall Quality Determination   **Medium**

Study Citation: Tokumura, M., Hatayama, R., Tatsu, K., Naito, T., Takeda, T., Raknuzzaman, M., -Al-Mamun, M. H., Masunaga, S. (2017). Organophosphate flame retardants in the indoor air and dust in cars in Japan. Environmental Monitoring and Assessment 189:48.

HERO ID: 3604490

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Equations are not referenced, but they are based on a scientifically sound approach that is commonly used.
	Metric 2:	Model Evaluation	Low	Paper has been peer reviewed and methods are accepted among the scientific and regulatory community.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling conducted in 2013.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	No additional documentation is available.
	Metric 5:	Model Inputs and Defaults	High	Inputs are described and referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	The paper provides typical and worst case estimates, but key uncertainties and limitations are not discussed.

Overall Quality Determination **Low**

Study Citation:	He, M. J., Yang, T., Yang, Z. H., Li, Q., Wei, S. Q. (2017). Occurrence and Distribution of Organophosphate Esters in Surface Soil and Street Dust from Chongqing, China: Implications for Human Exposure. Archives of Environmental Contamination and Toxicology 73:349-361.		
HERO ID:	3861290		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	Medium	Daily intake equation for dust ingestion provided with citation to Guo and Kannan 2011 which is not authoritative source but appears scientifically sound.
Metric 2:	Model Evaluation	Low	The outputs were compared to RfDs, and there is an assumption of some evaluation due to previous peer publication of the equation cited.
Domain 2: Representative			
Metric 3:	Exposure Scenario	Medium	Exposure to chemicals in outdoor dust is a relevant scenario of interest, using 2017 data, but the street samples are from China which may not reflect US conditions.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	Low	The methods can be mostly followed with the given documentation, but the inputs used to develop the percentile estimates are not explicitly identified.
Metric 5:	Model Inputs and Defaults	Medium	Inputs to the DI equation, values and assumptions are are mostly identified and cited. Some descriptions are left generalized such as listing the percentiles of weight but not including the data points for weight.
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	Variability characterized through mean and high dust ingestion rates and body weights.

Overall Quality Determination   Low

Study Citation:		Zheng, X., Qiao, L., Covaci, A., Sun, R., Guo, H., Zheng, J., Luo, X., Xie, Q., Mai, B. (2017). Brominated and phosphate flame retardants (FRs) in indoor dust from different microenvironments: Implications for human exposure via dust ingestion and dermal contact. Chemosphere 184:185-191.	
HERO ID:		3862171	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Ingestion and dermal exposure equations provided and seem sound however, no citation is provided.
	Metric 2:	Model Evaluation	Low	No obvious evaluation of the model besides assumption of peer review required for publication.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Ingestion and dermal exposure to dust in different locations and products are scenarios of interest, but the samples used to estimate exposure were collected in Chinese bedrooms and offices which may not be directly parallel with American environments.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Most of the equations and inputs are provided in the study, but details on the dermal method are not freely accessible because they are only in the SI file.
	Metric 5:	Model Inputs and Defaults	High	Input values provided with citations, some of which are EPA and additional clarification for parameters in the SI. TCEP had literature value for fraction absorbed, while the average value of TCEP, TCIPP, and TDCIPP was used for TPHP.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Some variability in locations and limited discussion of the assumptions made and uncertainties in the estimates, such as contact with bedding while sleeping.

Overall Quality Determination   **Low**

Study Citation:		Zhou, L., Hiltscher, M., Püttmann, W. (2017). Occurrence and human exposure assessment of organophosphate flame retardants in indoor dust from various microenvironments of the Rhine/Main region, Germany. Indoor Air 27:1113-1127.			
HERO ID:		3862555			

Domain		Metric	Rating	Comments	
Domain 1: Reliability					
	Metric 1:	Mathematical Equations	High	Equations are provided and referenced in Section 4 of the supplemental material.	
	Metric 2:	Model Evaluation	High	Equations are from previously peer reviewed sources and used in a peer-reviewed source.	
Domain 2: Representative					
	Metric 3:	Exposure Scenario	Medium	Exposure based on sampling conducted in 2015.	
Domain 3: Accessibility/Clarity					
	Metric 4:	Model and Model Documentation Availability	Low	Equations are found in the supplemental material which is not freely available to the public.	
	Metric 5:	Model Inputs and Defaults	High	Model inputs are all described (section 4) and provided in the supplemental material (table s5).	
Domain 4: Variability and Uncertainty					
	Metric 6:	Variability and Uncertainty	High	Variability and uncertainty are discussed in Section 3.4 and the conclusion.	

Overall Quality Determination   High

Study Citation:	La Guardia, M. J., Schreder, E. D., Uding, N., Hale, R. C. (2017). Human Indoor Exposure to Airborne Halogenated Flame Retardants: Influence of Airborne Particle Size. International Journal of Environmental Research and Public Health 14:507.		
HERO ID:	3863211		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Equations originate from CDC and ASTDR and are adapted by other peer reviewed methods.
	Metric 2:	Model Evaluation	Low	Different equations were used by the authors and the results were then compared to each other.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Paper published in 2017.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	All referenced methods are not available to the public for free.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are all described and referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The paper demonstrates uncertainties about re-estimating inhalable vs respirable fraction of intakes.

Overall Quality Determination　　　　　Medium

		Domain	Metric	Rating	Comments

Study Citation: Castorina, R., Butt, C., Stapleton, H. M., Avery, D., Harley, K. G., Holland, N., Eskenazi, B., Bradman, A. (2017). Flame retardants and their metabolites in the homes and urine of pregnant women residing in California (the CHAMACOS cohort). Chemosphere 179:159-166.

HERO ID: 3864462

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Dust ingestion equation from ATSDR and the internal dose equations are provided with citations from other studies.
	Metric 2:	Model Evaluation	Medium	Oral dose model from ASTDR and assumed peer review for internal dose model based on the publication.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Non-dietary ingestion of dust is a relevant scenario and this paper is specific to pregnant women.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Most of the model and inputs are outlined.
	Metric 5:	Model Inputs and Defaults	Medium	Most inputs are detailed and cited. The median, 95th percentile, and max dust concentrations are used.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Some variability in demographics sampling. Some discussion of limitations but primarily related to the sampling rather than the modeling and limited discussion of uncertainty.

Overall Quality Determination   Medium

Study Citation:	Iqbal, M., Syed, J. H., Breivik, K., Chaudhry, M. J. I., Li, J., Zhang, G., Malik, R. N. (2017). E-Waste Driven Pollution in Pakistan: The First Evidence of Environmental and Human Exposure to Flame Retardants (FRs) in Karachi City. Environmental Science and Technology 51:13895-13905.		
HERO ID:	4161520		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations are from the US EPA (exposure factors handbook).
	Metric 2:	Model Evaluation	High	Methods are from the US EPA and are expected to have undergone evaluation (exposure factors handbook).
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling conducted in 2014.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	References for the equations are available to the public.
	Metric 5:	Model Inputs and Defaults	High	Inputs are provided in the supplemental material.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion is included on the variability and uncertainty of the paper.

Overall Quality Determination   **High**

Study Citation:	Cristale, J., Aragão Belé, T. G., Lacorte, S., Rodrigues de Marchi, M. R. (2018). Occurrence and human exposure to brominated and organophosphorus flame retardants via indoor dust in a Brazilian city. Environmental Pollution 237:695-703.		
HERO ID:	4162250		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	High	Estimated daily intakes are cited and from a peer reviewed source.
	Metric 2: Model Evaluation	Medium	Estimated Daily Intake equations are accepted among the scientific community.
Domain 2: Representative			
	Metric 3: Exposure Scenario	High	Paper is published in 2017.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Reference for the dose equation is not available to the public for free (Ale et al 2013).
	Metric 5: Model Inputs and Defaults	High	All model inputs are described, values provided, and referenced when applicable.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	High	Discussion included on variability and uncertainty.

Overall Quality Determination   High

Study Citation:	Muenhor, D., Moon, H. B., Lee, S., Goosey, E. (2018). Organophosphorus flame retardants (PFRs) and phthalates in floor and road dust from a manual e-waste dismantling facility and adjacent communities in Thailand. Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering 53:79-90.		
HERO ID:	4164912		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Exposure equation not provided but inputs and assumptions are described to follow procedures for standard dust ingestion exposure.
	Metric 2:	Model Evaluation	Low	Exposure estimates are compared to RfDs and the concentrations used in the estimates are compared against other studies.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Data on floor and road dust are from 2018 and represent exposures to e-waste.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equation for exposure is not provided.
	Metric 5:	Model Inputs and Defaults	Low	Various inputs are identified, described, and cited (body weight, exposure time, ingestion rate) but cannot validate that all inputs have been provided without the equation.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Limited discussion on the uncertainties in the data or limitations of the study.

Overall Quality Determination   Low

Study Citation:	Zeng, X., Wu, Y., Liu, Z., Gao, S., Yu, Z. (2017). Occurrence and distribution of organophosphate ester flame retardants in indoor dust and their potential health exposure risk. Environmental Toxicology and Chemistry 37:345-352.		
HERO ID:	4168728		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	Medium	Exposure equation provided, with citations, relating concentration, daily intake of dust, ingestion rate, and body weight.
Metric 2:	Model Evaluation	Low	No indication of evaluation but the methodology is cited from published studies. Concentration values used in the model were compared to other studies.
Domain 2: Representative			
Metric 3:	Exposure Scenario	High	Indoor dust ingestion is a relevant exposure scenario.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	Low	Analyses were run in SPSS, which is not free to the public.
Metric 5:	Model Inputs and Defaults	Medium	Most inputs are cited except assumptions of default dust intake values (average and high for children and adults).
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	Some discussion of limitations, such as additional exposure routes and the relation between the Chinese findings and those in other countries.

Overall Quality Determination   Medium

Study Citation:	He, C., Wang, X., Thai, P., Baduel, C., Gallen, C., Banks, A., Bainton, P., English, K., Mueller, J. F. (2018). Organophosphate and brominated flame retardants in Australian indoor environments: Levels, sources, and preliminary assessment of human exposure. Environmental Pollution 235:670-679.		
HERO ID:	4285929		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	All equations are referenced and based on scientifically sound approaches.
	Metric 2:	Model Evaluation	High	Equations are referenced and are from peer-reviewed journals.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling was done in 2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	All reference sources were not freely available to the public (Tajima et al 2014).
	Metric 5:	Model Inputs and Defaults	High	All model inputs were defined and provided in section 3.5.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The authors discuss inhalation vs dermal and compare the values among children and adults. There is a brief mention of aggregation with ingestion rates that may lead to more concern.

Overall Quality Determination   **Medium**

Study Citation:	Christia, C., Poma, G., Besis, A., Samara, C., Covaci, A. (2018). Legacy and emerging organophosphorus flame retardants in car dust from Greece: Implications for human exposure. Chemosphere 196:231-239.		
HERO ID:	4292121		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Dose equations are referenced and from an EPA source.
	Metric 2:	Model Evaluation	High	Dose equations are referenced and are from an EPA source which implies they have undergone evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Paper was published in 2017.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Besis et al 2017 is not publicly available for free.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are explained and values used are provided and referenced.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Limited discussion included on variability and uncertainty.

Overall Quality Determination   Medium

Study Citation:	Deng, W. J., Li, N., Wu, R., Richard, W. K. S., Wang, Z., Ho, W. (2018). Phosphorus flame retardants and Bisphenol A in indoor dust and PM2.5 in kindergartens and primary schools in Hong Kong. Environmental Pollution 235:365-371.		
HERO ID:	4292129		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	High	Equations are provided in the supplemental information and are cited from US EPA sources.
	Metric 2: Model Evaluation	High	Equations are from US EPA sources, it is assumed they have undergone evaluation.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Sampling conducted between 2015-2016.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	All equations are from sources that are free to the public (EPA source).
	Metric 5: Model Inputs and Defaults	High	Inputs which are mostly exposure factors handbook values are described and referenced.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Some discussion about non-dietary vs dietary intake from various schools.

Overall Quality Determination   **High**

Study Citation:	Poma, G., Sales, C., Bruyland, B., Christia, C., Goscinny, S., Van Loco, J., Covaci, A. (2018). Occurrence of organophosphorus flame retardants and plasticizers (PFRs) in Belgian foodstuffs and estimation of the dietary exposure of the adult population. Environmental Science and Technology 52:2331-2338.		
HERO ID:	4292130		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Calculation of dietary intake is described in Section 2.4, along with description of inputs with reference.
	Metric 2: Model Evaluation	Medium	Commonly used simple intake model was described in Section 2.4. Sample calculation check agreed with reported data. Results for total PFRs were compared with Swedish study.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Samples collected 2015-2016 and based on a Belgian diet.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	Simple intake model described in data source; additional information may be provided in reference (WIV-ISP 2016).
	Metric 5: Model Inputs and Defaults	Medium	Model inputs generally identified, referenced and described.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	High	Dietary intake results determined using upper, medium and lower-bound basis are reported in Table S6.

Overall Quality Determination　　　　　　**Medium**

Study Citation:	Larsson, K., de Wit, C. A., Sellström, U., Sahlström, L., Lindh, C. H., Berglund, M. (2018). Brominated flame retardants and organophosphate esters in preschool dust and children's hand wipes. Environmental Science and Technology 52:4878-4888.		
HERO ID:	4292136		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Dose equations were referenced and are from EPA sources.
	Metric 2:	Model Evaluation	High	Dose equations were referenced and are from EPA sources, it is assumed they have undergone evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling was conducted in 2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	While references on equations were free and publicly available, the concentrations were found using STATA, a statistical software that is not free/publicly available.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are described and values are provided and referenced.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion included on variability and uncertainty.

Overall Quality Determination   **High**

Study Citation:	Kademoglou, K., Xu, F., Padilla-Sanchez, J. A., Haug, L. S., Covaci, A., Collins, C. D. (2017). Legacy and alternative flame retardants in Norwegian and UK indoor environment: Implications of human exposure via dust ingestion. Environment International 102:48-56.		
HERO ID:	4433160		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Eqn. 1 for daily exposure via dust ingestion is from USEPA Exposure Factors Handbook (1997).
	Metric 2:	Model Evaluation	High	Model from USEPA is assumed to be fully validated.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Samples collected 2011-2013; residential and office exposure scenarios for Europe.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Model and documentation are publicly available.
	Metric 5:	Model Inputs and Defaults	High	Key model inputs are provided in data source (Tables SI-9, 11, 13 and 14).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Summary statistics for input concentrations (SI Tables 9, 11, 13) include standard deviation. Discussion of uncertainty mentions that sample size is relatively low: 10 homes each for Norway and UK, 6 office samples UK and 6 store samples UK.

Overall Quality Determination   High

Study Citation:	Liang, Y., Liu, X., Allen, M. R. (2018). Measurements of parameters controlling the emissions of organophosphate flame retardants in indoor environments. Environmental Science and Technology 52:5821-5829.		
HERO ID:	4442465		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations provided throughout the paper with citations if needed. Also includes mass balance equations for concentrations in chamber and on the surface.
	Metric 2:	Model Evaluation	Medium	Estimated values compared to measured or previously published values for concentrations and surface/air partition coefficient.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Indoor exposure to building and consumer materials (PVC floor, textiles, etc) is a relevant scenario and the tested foam was made in America.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	All equations provided, but equations solved using MATLAB, not free or open to the public.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs are all provided with values from test measurements or from citations. Some inputs were estimated using PARAMS (EPA). However, not all inputs are provided for every chemical (some only given for TCPP, not TCEP).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Not all values are varied in the same way, but most are estimated for a variety of materials. Limitations for the given equations are outlined, such as relevance to SVOCs with low volatility or to pervious materials.

Overall Quality Determination   **Medium**

Study Citation:	Liang, Y., Liu, X., Allen, M. R. (2018). Measuring and modeling surface sorption dynamics of organophosphate flame retardants on impervious surfaces. Chemosphere 193:754-762.		
HERO ID:	4678306		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Multiple equations provided relating concentration to volume and chemical parameters (e.g. gas and material coefficients), including sorption on stainless steel and emissions from foam. Two model fits proposed, Langmuir and Freundlich.
	Metric 2: Model Evaluation	Medium	Langmuir and Freundlich models fitted to measured chamber data.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Emissions to indoor air and sorption to surfaces represent exposure scenarios of interest, but the study's relevance to real world situations is limited in its assumptions and failure to exactly fit the measured data. 2018 study.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	The equations and inputs are provided, but the data were fit to the models using MATLAB, which is not freely accessible.
	Metric 5: Model Inputs and Defaults	High	All inputs clearly identified for each model and test with citations or equations.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Two models evaluated with a discussion on the limitations of the study and each model.

Overall Quality Determination   Medium

Study Citation:	He, R. W., Li, Y. Z., Xiang, P., Li, C., Cui, X. Y., Ma, L. Q. (2018). Impact of particle size on distribution and human exposure of flame retardants in indoor dust. Environmental Research 162:166-172.		
HERO ID:	4728480		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	High	Equation provided for average daily dose vs dust ingestion however this is not cited to an authoritative source but appears scientifically sound.
Metric 2:	Model Evaluation	Medium	The ADD values briefly discussed and compared against other published data. Most of the evaluation related to concentrations and particle size.
Domain 2: Representative			
Metric 3:	Exposure Scenario	Medium	Dust samples collected in 2018 from various locations in China and represent relevant exposure scenarios.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	High	Equation, inputs and outputs are all provided.
Metric 5:	Model Inputs and Defaults	High	Ingestion rate, BW provided with citations and chemical concentrations presented in the SI.
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	Some discussion on the uncertainties in the assessment and variability in the data across locations (office, public environment, car) and particle sizes.

Overall Quality Determination   **High**

Study Citation:		Ingerowski, G., Friedle, A., Thumulla, J. (2001). Chlorinated ethyl and isopropyl phosphoric acid triesters in the indoor environment–an inter-laboratory exposure study. Indoor Air 11:145-149.		
HERO ID:		4731349		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Equation not provided for oral and inhalation exposure estimates, but inputs and outputs are described. Back calculation is possible.
	Metric 2:	Model Evaluation	Low	Assumption of some evaluation during peer review, but evaluation not directly discussed.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Low	Exposure to chemicals in dust and indoor air is a scenario of interest.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equation is not provided in the paper.
	Metric 5:	Model Inputs and Defaults	Low	Daily uptake of dust and concentrations in dust provided to estimate oral exposure and inhalation rate and indoor air concentrations provided to estimate daily inhalation intakes. Citations not provided.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Limited discussion on the uncertainties of the estimates based on assumptions and lack of data. Variability is also not characterized outside of a provided range.

Overall Quality Determination   **Low**

Study Citation:	Okeme, J. O., Nguyen, L. V., Lorenzo, M., Dhal, S., Pico, Y., Arrandale, V. H., Diamond, M. L. (2018). Polydimethylsiloxane (silicone rubber) brooch as a personal passive air sampler for semi-volatile organic compounds. Chemosphere 208:1002-1007.		
HERO ID:	5017615		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Simple calculation to determine inhalation exposure was described in data source but no equation was provided.
	Metric 2:	Model Evaluation	Medium	TCEP inhalation exposure values were evaluated against exposure results from a different study using a different sampling method (Schreder et al 2016).
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Canadian study was published in 2018.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	There is limited description of the simple inhalation exposure model but there may be additional information in the reference for inhalation rate (USEPA 2011, Exposure Factors Handbook).
	Metric 5:	Model Inputs and Defaults	Medium	Model inputs and defaults are generally identified, described and referenced.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The study characterizes and discusses variability in the personal air concentration inputs and sampling rates used in the exposure calculation. Uncertainty and data limitations are also discussed.

Overall Quality Determination   **Medium**

Study Citation:		Chen, Y., Jiang, L., Lu, S., Kang, L., Luo, X., Liu, G., Cui, X., Yu, Y. (2019). Organophosphate ester and phthalate ester metabolites in urine from primiparas in Shenzhen, China: Implications for health risks. Environmental Pollution 247:944-952.	
HERO ID:		5039996	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Estimated daily intake equation was referenced and based on a scientifically sound approach.
	Metric 2:	Model Evaluation	Medium	Intake equation was referenced from peer reviewed sources; no mention of a more formal review.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling was conducted 2013 to 2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equation references are not free to the public (e.g., Guo et al 2011a).
	Metric 5:	Model Inputs and Defaults	High	All model inputs are defined, values provided, and referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion was included on variability and uncertainty. Page 950 discusses uncertainty of using Fraction urinary excretion.

Overall Quality Determination   Medium

Study Citation:	Cao, D., Lv, K., Gao, W., Fu, J., Wu, J., Fu, J., Wang, Y., Jiang, G. (2019). Presence and human exposure assessment of organophosphate flame retardants (OPEs) in indoor dust and air in Beijing, China. Ecotoxicology and Environmental Safety 169:383-391.		
HERO ID:	5043334		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Equations were not referenced but were based on known widely accepted methods.
	Metric 2:	Model Evaluation	Low	Exposure estimates were compared by the authors to previously published literature.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling conducted in 2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	No additional information provided on equations and some of the references for inputs are not freely available to the public.
	Metric 5:	Model Inputs and Defaults	High	Inputs defined and values were referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion included on variability and uncertainty.

Overall Quality Determination   **Medium**

Study Citation:	Velázquez-Gómez, M., Hurtado-Fernández, E., Lacorte, S. (2019). Differential occurrence, profiles and uptake of dust contaminants in the Barcelona urban area. Science of the Total Environment 648:1354-1370.		
HERO ID:	5043338		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	High	Total daily intake equation provided, explained, and cited.
	Metric 2: Model Evaluation	Medium	Exposure levels compared to other published studies for similarity.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Dust exposure is a relevant scenario, but the concentrations used in the exposure calculations may not be transferrable to US as they are from Spanish monitoring studies. Additionally, the time of collection is not specified, but refers to a previous sampling study.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	Equations are given and references included. Exposure estimation methods based on Cristale et al 2018 and Gevao et al 2006.
	Metric 5: Model Inputs and Defaults	High	Key inputs (dust ingestion rates) are from Ali et al 2012 and Jones-Otazo et al 2005 for mean and high exposure situations.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Not much discussion included about uncertainty and variability. Median and high scenarios based on concentrations from multiple locations. Toddlers and teenagers considered separately from adults as 'staff' at the key locations.

Overall Quality Determination   High

| | Study Citation: | Park, H., Choo, G., Kim, H., Oh, J. E. (2018). Evaluation of the current contamination status of PFASs and OPFRs in South Korean tap water associated with its origin. Science of the Total Environment 634:1505-1512. |
| | **HERO ID:** | 5079822 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Daily intake via drinking water equation provided and cited to US EPA 2011.
	Metric 2:	Model Evaluation	High	US EPA equation accepted among scientific and regulatory communities.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Daily intakes estimated for water consumption via tap water using data that represents a current scenario of interest, though the concentrations and exposure factors used are representative of Korea.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Equations and inputs are provided to follow methodology.
	Metric 5:	Model Inputs and Defaults	Low	Inputs are described but text indicates summary in Table S4, which does not appear in the SI file. Citation is provided to original data.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Daily intakes provided for four age groups (toddlers, children, teenagers, adults) and one value reported for each. Uncertainties discussed in total OPFR terms rather than per chemical.

Overall Quality Determination Medium

Study Citation:	Sha, B., Dahlberg, A. K., Wiberg, K., Ahrens, L. (2018). Fluorotelomer alcohols (FTOHs), brominated flame retardants (BFRs), organophosphorus flame retardants (OPFRs) and cyclic volatile methylsiloxanes (cVMSs) in indoor air from occupational and home environments. Environmental Pollution 241:319-330.		
HERO ID:	5083520		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	High	Daily exposure dose (DED) equation provided and described, described, and scientifically sound with a 1989 EPA citation. Air concentration equation also provided for relationship to disk samples, sampling duration, and sampling/uptake rate.
Metric 2:	Model Evaluation	Medium	Model is cited from EPA indicating acceptance in scientific/regulatory community, but limited comparison of DED values against other studies for the specific scenario(s) of the study.
Domain 2: Representative			
Metric 3:	Exposure Scenario	Medium	2018 study estimating exposure via inhalation in homes and offices, but all samples are from Sweden, potentially limiting the relevance to US scenarios.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	High	Model equations and inputs are all provided and can be followed and/or replicated as needed.
Metric 5:	Model Inputs and Defaults	High	Inputs all described and values provided, either via sampling, questionnaire, or secondary data source.
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	Limited variability in sampling, with some discussion of uncertainties and gaps in the results, including a discussion of the limitations of the exposure estimates.

Overall Quality Determination   **High**

Study Citation:		Sun, Y., Liu, L. Y., Sverko, E., Li, Y. F., Li, H. L., Huo, C. Y., Ma, W. L., Song, W. W., Zhang, Z. F. (2019). Organophosphate flame retardants in college dormitory dust of northern Chinese cities: Occurrence, human exposure and risk assessment. Science of the Total Environment 665:731-738.	
HERO ID:		5162697	

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations were provided and referenced from a peer-reviewed source in the supplemental material (S2.1).
	Metric 2:	Model Evaluation	High	Equations are from a peer-reviewed source and are based on concepts accepted by the scientific community.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Exposures are based on samples taken in 2014.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Model equations are provided in the supplemental material, which is not available for free to the public.
	Metric 5:	Model Inputs and Defaults	High	All model inputs are described and provided in the supplemental material (S2.1 and S8).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion included on variability and uncertainty in Section 3: Results and Discussion. The authors include comparisons with different concentration values. Section 3.3.1 has some description on data gaps (college dorm dust).

Overall Quality Determination   High

Study Citation: Khairy, M. A., Lohmann, R. (2019). Organophosphate flame retardants in the indoor and outdoor dust and gas-phase of Alexandria, Egypt. Chemosphere 220:275-285.

HERO ID: 5162898

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations for daily dose via inhalation, ingestion, and dermal contact are reported and cited to the US EPA risk assessment guidelines.
	Metric 2:	Model Evaluation	High	US EPA models accepted in scientific and regulatory communities.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Relevant models and current data reflect conditions of exposure to dust and gas in homes, workplaces, cars, and outdoors, but concentrations represent the environment in Egypt.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Model equations, inputs, and outputs are provided.
	Metric 5:	Model Inputs and Defaults	High	All model inputs are identified, described, and have values with citations.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Variability characterized in the best and worst case ingestion scenarios for working and non-working females and toddlers. Uncertainties in the physicochemical parameters of chemicals were identified and tested.

Overall Quality Determination   High

Study Citation:	Liu, X., Yu, G., Cao, Z., Wang, B., Huang, J., Deng, S., Wang, Y. (2017). Occurrence of organophosphorus flame retardants on skin wipes: Insight into human exposure from dermal absorption. Environment International 98:113-119.		
HERO ID:	5163218		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	One dermal dose equation adapted from an EPA source and the other from a peer reviewed literature source.
	Metric 2:	Model Evaluation	Medium	Authors compared values with other values in published peer reviewed literature.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling was conducted in 2016.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	All references for equations are not freely available to the public.
	Metric 5:	Model Inputs and Defaults	High	The model inputs are described and values are referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	The authors repeated samples for the same individual over four months and discussed uncertainties of modeled methods.

Overall Quality Determination   Medium

Study Citation:	Wang, Y., Sun, H., Zhu, H., Yao, Y., Chen, H., Ren, C., Wu, F., Kannan, K. (2018). Occurrence and distribution of organophosphate flame retardants (OPFRs) in soil and outdoor settled dust from a multi-waste recycling area in China. Science of the Total Environment 625:1056-1064.		
HERO ID:	5163353		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
Metric 1:	Mathematical Equations	High	Estimated daily intake (EDI) equation cited to the United States EPA 2011 guidelines.
Metric 2:	Model Evaluation	Medium	Estimated daily intake (EDI) equation cited to EPA 2011 guidelines.
Domain 2: Representative			
Metric 3:	Exposure Scenario	Medium	Exposure to outdoor settled dust as "uppermost surface layer of soil" and "particles that have settled onto outdoor objects and surfaces" are pathways identified by the EPA.
Domain 3: Accessibility/Clarity			
Metric 4:	Model and Model Documentation Availability	High	Equations and input values are given and are sufficient enough to repeat the process.
Metric 5:	Model Inputs and Defaults	High	Concentrations given from soil samples; input values and citations given for ingestion rates (EPA citation), exposure duration, body weight, and absorption rate.
Domain 4: Variability and Uncertainty			
Metric 6:	Variability and Uncertainty	Medium	The authors provide some discussion on uncertainties related to particle size. The 5th, 95th percentiles and median EDI values are given for average and high ingestion scenarios.

Overall Quality Determination   High

Study Citation: He, R., Li, Y., Xiang, P., Li, C., Zhou, C., Zhang, S., Cui, X., Ma, L. Q. (2016). Organophosphorus flame retardants and phthalate esters in indoor dust from different microenvironments: Bioaccessibility and risk assessment. Chemosphere 150:528-535.

HERO ID: 5163600

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Dose equation is referenced and is from a peer reviewed source.
	Metric 2:	Model Evaluation	Low	The authors compared values to previous studies on in vitro methods.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling conducted between 2014-2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	All references for equations are not freely available to the public.
	Metric 5:	Model Inputs and Defaults	High	Inputs are defined, and values are referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion included on variability and uncertainty. Defined the use of different microenvironments, adult and infant measurements, in vitro and in vivo comparisons and limitations with bio-accessibility values.

Overall Quality Determination   Medium

Study Citation:	Rantakokko, P., Kumar, E., Braber, J., Huang, T., Kiviranta, H., Cequier, E., Thomsen, C. (2019). Concentrations of brominated and phosphorous flame retardants in Finnish house dust and insights into children's exposure. Chemosphere 223:99-107.		
HERO ID:	5163693		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Model equations and references are provided, with robust descriptions.
	Metric 2:	Model Evaluation	High	Model evaluation of the exposure intake estimates involved analysis using input parameter values from various sources and comparison of exposure intakes found in other studies. Model evaluation of the dust-air partition model (for determining predicted concentrations) was performed by comparison of ratios of measured dust concentration/predicted air concentration from this study to ratios of measured dust/measured air concentration from a relevant monitoring study.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	The paper was published in 2019, but the model was validated based on a Norwegian study and the scenario in this study applies to Finnish households.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Documentation and model descriptions are available in the study and companion documents (Weschler and Nazaroff 2010, Little et al 2012, and Abdallah et al 2016).
	Metric 5:	Model Inputs and Defaults	High	Key model inputs and defaults are identified, referenced and clearly described. Parameters such as air and dust concentration, partition coefficients, inhalation rate, ingestion rate, exposure duration, body weight, etc. are provided in the text and Table S5.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The study has extensive discussion of limitations and uncertainties. It provides a comparison of data with other studies and discusses reasons for possible over estimation of calculated values. In addition, QA/QC measures associated with the monitoring data (such as use of SRMs) were rigorous. However, characterization of variance among modeled/predict data was limited.

Overall Quality Determination　　　　**High**

Study Citation: Brommer, S., Harrad, S., Van Den Eede, N., Covaci, A. (2012). Concentrations of organophosphate esters and brominated flame retardants in German
                       indoor dust samples. Journal of Environmental Monitoring 14:2482-2487.
HERO ID: 5164389

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Critically Deficient	Methods and parameters are described for the ingestion model, but the model or equation itself is not given.
	Metric 2:	Model Evaluation	Critically Deficient	Since the model or equation is not given, it cannot be evaluated.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	This is a relatively recent study, but based on data from Germany rather than the US.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	The model is not provided in this document.
	Metric 5:	Model Inputs and Defaults	Low	Some model inputs and parameters are given, but as the model itself is not, it cannot be determined whether the given inputs and parameters are sufficient.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Variability is discussed. No particular discussion of uncertainty or limitations.

Overall Quality Determination   **Uninformative**

Study Citation:	Yin, H., Wu, D., You, J., Li, S., Deng, X., Luo, Y., Zheng, W. (2019). Occurrence, Distribution, and Exposure Risk of Organophosphate Esters in Street Dust from Chengdu, China. Archives of Environmental Contamination and Toxicology 76:617-629.		
HERO ID:	5164542		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations are from an EPA source.
	Metric 2:	Model Evaluation	High	Equations are from an EPA source and assumed to have undergone evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampling was conducted in 2014.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	The references for equations are all available to the public for free.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are defined and values are provided along with references when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion of variability and uncertainty including the effect of particulates on varying cities.

Overall Quality Determination   **High**

	Study Citation:	Wang, Y., Li, W., Martínez-Moral, M. P., Sun, H., Kannan, K. (2019). Metabolites of organophosphate esters in urine from the United States: Concentrations, temporal variability, and exposure assessment. Environment International 122:213-221.
	HERO ID:	5164613

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Exposure dose equation (Eq 1) is referenced from a peer reviewed journal and follows a scientifically sound approach.
	Metric 2:	Model Evaluation	Medium	Equation is from a peer reviewed source and no formal evaluation described.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Samples were collected in 2018.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equation is referenced, but some of the referenced papers are not free to the public (e.g., Chen et al 2018).
	Metric 5:	Model Inputs and Defaults	High	All inputs are described, values provided, and referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion was included on variability and uncertainty, which included temporal variability analysis.

Overall Quality Determination   High

Study Citation:	Kim, J. W., Isobe, T., Sudaryanto, A., Malarvannan, G., Chang, K. H., Muto, M., Prudente, M., Tanabe, S. (2013). Organophosphorus flame retardants in house dust from the Philippines: occurrence and assessment of human exposure. Environmental Science and Pollution Research 20:812-822.		
HERO ID:	5165540		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Basic intake equation provided with limited discussion and sources. Final values are divided by body weight which is described in text rather than the equation.
	Metric 2: Model Evaluation	Low	Assumption of peer review based on publication, but limited discussion of values in comparison to other published studies.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	House dust ingestion is an exposure scenario of concern, but the sampled concentrations and resulting intakes represent homes in Philippines that may not parallel the US.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	Equations and inputs are outlined in the paper.
	Metric 5: Model Inputs and Defaults	Medium	Inputs are all outlined, with only primary data being the measured concentrations. Absorption into body, dust ingestion, body weight are all secondary data with citations.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Variability in the high/median scenarios for adults and toddlers and concentrations based on two locations (Malate and Payatas). There is limited discussion on uncertainty behind dust ingestion data.

Overall Quality Determination　　　　Medium

Study Citation:	Zhang, T., Bai, X. Y., Lu, S. Y., Zhang, B., Xie, L., Zheng, H. C., Jiang, Y. C., Zhou, M. Z., Zhou, Z. Q., Song, S. M., He, Y., Gui, M. W., Ouyang, J. P., Huang, H. B., Kannan, K. (2018). Urinary metabolites of organophosphate flame retardants in China: Health risk from tris(2-chloroethyl) phosphate (TCEP) exposure. Environment International 121:1363-1371.		
HERO ID:	5165673		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Total daily intake equation provided (in SI) and cited to peer reviewed studies (Fromme et al 2014, Hoffman et al 2017, Chen et al 2018).
	Metric 2:	Model Evaluation	Medium	Some discussion comparing the doses to data published in other studies and assumption of evaluation based on peer review.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Data are recent and inputs are sound, but doses represent Chinese populations rather than US.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Model equations, inputs, and outputs are provided.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are described, tabulated, and cited.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion of uncertainties in the molar fractions of metabolite to parents, but limited variability characterized in the data. Single doses provided.

Overall Quality Determination   **Medium**

Study Citation: Poma, G., Glynn, A., Malarvannan, G., Covaci, A., Darnerud, P. O. (2017). Dietary intake of phosphorus flame retardants (PFRs) using Swedish food market basket estimations. Food and Chemical Toxicology 100:1-7.

HERO ID: 5166285

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Method for estimating per capita intake is described in text with citations for inputs and theories.
	Metric 2:	Model Evaluation	Low	Some comparison of exposure data to modeled data from other studies.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Data are relevant and accurately reflect dietary exposures in Sweden.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Methods are described and inputs are provided.
	Metric 5:	Model Inputs and Defaults	High	Inputs are described and provided with citations.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Variability characterized in food groups and lower and upper bound investigations. Uncertainties discussed and the gap related to animal products ("food of animal origin") identified.

Overall Quality Determination   **Medium**

Study Citation:	Liu, X., Cao, Z., Yu, G., Wu, M., Li, X., Zhang, Y., Wang, B., Huang, J. (2018). Estimation of exposure to organic flame retardants via hand wipe, surface wipe, and dust: Comparability of different assessment strategies. Environmental Science and Technology 52:9946-9953.		
HERO ID:	5166709		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Daily uptake estimation equations given on page S13 of supplemental material appear reasonable, though basis for these equations is not specifically cited.
	Metric 2:	Model Evaluation	Low	Uptake estimation equations appear to be of a standard type, but no specific discussion of evaluation or suitability for the scenarios being modeled.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Study was published in 2018 but is based on occupational data from China, which may limit applicability for modeling US populations.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Equations and variables are given on page S13 of the supplemental material.
	Metric 5:	Model Inputs and Defaults	Medium	Table S10 in supplemental material gives most model inputs (which generally seem to cite known sources) but some are based on questionnaire responses, where the methodology is not specifically described.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The last several paragraphs of the paper discuss some uncertainties and limitations of the results, such as the differences from the various sampling methods used.

Overall Quality Determination　　　　Medium

Study Citation: Gomes, G., Ward, P., Lorenzo, A., Hoffman, K., Stapleton, H. M. (2016). Characterizing flame retardant applications and potential human exposure in backpacking tents. Environmental Science and Technology 50:5338-5345.

HERO ID: 5176516

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Equation for exposure via inhalation not provided but assumptions and inputs are described and appear standard and scientifically sound.
	Metric 2:	Model Evaluation	Low	No direct evaluation of exposure estimates but assumption of peer review during publication.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Published in 2016 and represents a reasonable scenario of interest.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Equations are not provided.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs to the exposure assessment are described and values are provided, cited to the EPA Exposure Factors Handbook, but the completeness cannot be validated without the equation.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Ranges (min and max) of inhalation exposures provided for adults and children 6-11. There is some discussion around the variability between ages, but limited characterization of uncertainties.

Overall Quality Determination　　　　　Low

Study Citation:	Zhao, L., Jian, K., Su, H., Zhang, Y., Li, J., Letcher, R. J., Su, G. (2019). Organophosphate esters (OPEs) in Chinese foodstuffs: Dietary intake estimation via a market basket method, and suspect screening using high-resolution mass spectrometry. Environment International 128:343-352.		
HERO ID:	5184238		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	The relevant equations are provided in section 2.5 and are cited to a previously published source.
	Metric 2:	Model Evaluation	Medium	No specific discussion of evaluation, but the modeling equation appears to be drawn from previous peer-reviewed works.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Paper was published in 2019 but based on food consumption and demographic data from China that may not be applicable to the US population.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Section 2.5 provides sufficient information for estimated dietary intake equation.
	Metric 5:	Model Inputs and Defaults	High	Sources are provided for per capita daily consumption values (Table 1) and average body weight used in modeling EDI calculations.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion of how regional factors in diet or food preparation may be responsible for variability.

Overall Quality Determination   High

Study Citation:		Giovanoulis, G., Nguyen, M. A., Arwidsson, M., Langer, S., Vestergren, R., Lagerqvist, A. (2019). Reduction of hazardous chemicals in Swedish preschool dust through article substitution actions. Environment International 130:104921.		
HERO ID:		5412073		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Daily intake equation provided and described. No source or citation for the equation but appears scientifically sound.
	Metric 2:	Model Evaluation	Low	No discussion of model evaluation in the study, but assumption of some evaluation during peer review process.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Dust exposure in preschools is realistic scenario, but preschools sampled are in Sweden, potentially limiting the comparative value to the US.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Equation provided to follow calculations of daily intakes.
	Metric 5:	Model Inputs and Defaults	Medium	All inputs provided. BW cited to EPA and concentration of dust in the monitoring samples, but ingestion rates not cited.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Intermediate and high ingestion rates considered, and daily intakes presented for median, mean, and 95th percentile concentrations. Correlation considerations provided in supplemental file. Limited discussion of uncertainties related to monitoring samples used in model.

Overall Quality Determination **Medium**

		Domain	Metric	Rating	Comments

Study Citation: He, C., Wang, X., Tang, S., Phong Thai, Li, Z., Baduel, C., Mueller, J. F. (2018). Concentrations of Organophosphate Esters and Their Specific Metabolites in Food in Southeast Queensland, Australia: Is Dietary Exposure an Important Pathway of Organophosphate Esters and Their Metabolites?. Environmental Science and Technology 52:12765-12773.

HERO ID: 5423396

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	Equation for estimated daily intake via ingestion provided with a citation to a peer reviewed study.
	Metric 2: Model Evaluation	Medium	Assumption of peer review based on publication of model in a previous study.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Daily intakes estimated may be reflective of Australian dietary exposure, but the EDIs are based on Australian consumption patterns and concentrations.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	High	The equation, inputs, and outputs that are provided in this study are sufficient.
	Metric 5: Model Inputs and Defaults	Medium	Inputs to the total EDI equation are provided and cited when needed, but intermediate values are not provided (such as the daily intake for each food group, e.g. cereals).
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Only average intake value provided, but strengths and limitations of the study and results are discussed.

Overall Quality Determination   Medium

Study Citation:		Xing, L., Zhang, Q., Sun, X., Zhu, H., Zhang, S., Xu, H. (2018). Occurrence, distribution and risk assessment of organophosphate esters in surface water and sediment from a shallow freshwater Lake, China. Science of the Total Environment 636:632-640.	
HERO ID:		5469238	

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equation 3 for ADD is clearly described with 2 citations provided.
	Metric 2:	Model Evaluation	Medium	Basic dose calculation with 2 references cited. ADD is used in risk assessment which is more thoroughly evaluated.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Sampled in 2016 in China.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Citations are provided and published in scientific journals. Model is a basic dose calculation.
	Metric 5:	Model Inputs and Defaults	Medium	Model inputs are identified, referenced and described.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Primary concentration data used for input are from one area in China, secondary data for comparison are also from China. Geographic trends affecting occurrence & distribution are discussed.

Overall Quality Determination   Medium

Study Citation:	Zhang, B., Lu, S., Huang, M., Zhou, M., Zhou, Z., Zheng, H., Jiang, Y., Bai, X., Zhang, T. (2018). Urinary metabolites of organophosphate flame retardants in 0-5-year-old children: Potential exposure risk for inpatients and home-stay infants. Environmental Pollution 243:318-325.		
HERO ID:	5469244		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Estimated daily intake (EDI) equation provided and appears scientifically sound, though no source or citation.
	Metric 2:	Model Evaluation	Low	No discussion of model evaluation but assumption of a degree of evaluation during the peer review process. EDI equation appears to follow standard intake estimate methodology.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Exposure risk to flame retardants is a reasonable scenario and data are recent (2018), but the urinary samples are for Chinese children and may not translate to exposure levels in US.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Model equation provided with description of methodology and required inputs.
	Metric 5:	Model Inputs and Defaults	High	Inputs are provided with citations where necessary or from sampled data.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Some discussion on the limitations of the study, such as lack of contaminant source identification. Two urinary excrete molar fractions considered in EDI calculations for comparison.

Overall Quality Determination　　　　**Medium**

Study Citation:	Pang, L., Yang, H., Wang, Y.,ue, Luo, X., Liu, S., Xiao, J. (2019). Organophosphate flame retardants in total suspended particulates from an urban area of zhengzhou, China: Temporal variations, potential affecting factors, and health risk assessment. Ecotoxicology and Environmental Safety 176:204-210.		
HERO ID:	5469253		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	Equation was referenced and is from a peer reviewed source.
	Metric 2:	Model Evaluation	Medium	Standard equations conducted by authors and then compared values to other published values.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Sampling conducted in 2018.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Referenced sources for the equation are not available to the public for free.
	Metric 5:	Model Inputs and Defaults	High	Model inputs are all described and values are referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The paper discusses seasonal variations, proximity to sampling sites and compares intake values with other studies.

Overall Quality Determination   Medium

Study Citation: Liu, Y. E., Luo, X. J., Huang, L. Q., Zeng, Y. H., Mai, B. X. (2019). Organophosphorus flame retardants in fish from Rivers in the Pearl River Delta, South China. Science of the Total Environment 663:125-132.

HERO ID: 5469298

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	The equation is present but does not provide more detail.
	Metric 2:	Model Evaluation	Medium	Dose equations are accepted by the scientific community. No mention of a more formal evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Samples taken in 2014.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Input reference is not freely available to the public.
	Metric 5:	Model Inputs and Defaults	Medium	All inputs are defined. Values are provided for most inputs (DC value is not provided).
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion on the variability and uncertainty was included.

Overall Quality Determination   Medium

| | Study Citation: | Pawar, G., Abdallah, M. A.,e, De Sáa, E. V., Harrad, S. (2017). Dermal bioaccessibility of flame retardants from indoor dust and the influence of topically applied cosmetics. Journal of Exposure Science and Environmental Epidemiology 27:100-105. |
| | HERO ID: | 5469614 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Low	Bioaccessibility and dose equation did not included references, but are considered acceptable based on scientifically sound approaches.
	Metric 2:	Model Evaluation	Low	Bioaccessibility and dose equation did not included references, but are considered acceptable based on scientifically sound approaches.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Publication is from 2016.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Model documentation is not available (equations are not referenced).
	Metric 5:	Model Inputs and Defaults	High	Key model inputs are identified, described, and referenced when applicable.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Some discussion on variability and uncertainty.

Overall Quality Determination   Low

Study Citation:		Luongo, G., Oestman, C. (2016). Organophosphate and phthalate esters in settled dust from apartment buildings in Stockholm. Indoor Air 26:414-425.		
HERO ID:		5469670		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	No equation is provided but model is described in words and assumed to be: household dust contribution to daily dust intake, as fraction x [(dust ingestion rate x concentration in indoor dust)/bw]. Determinations made using various inputs and defaults for average and high intake scenarios with adults and toddlers agreed with Table 6 reported values.
	Metric 2:	Model Evaluation	Medium	Study monitoring data used as inputs were compared with literature values. General calculations for intake values widely used but no validation for their specific scenario.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	This study was conducted in 2008 in Sweden.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	There appears to be sufficient documentation in data source and/or possibly references.
	Metric 5:	Model Inputs and Defaults	Medium	Model inputs & defaults are generally identified, referenced and described.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Average and high estimated daily dust exposures were determined for adults and toddlers with some discussion of uncertainty and limitations.

Overall Quality Determination　　　**Medium**

Study Citation:	He, C., Covaci, A., Heffernan, A. L., Baduel, C., Harden, F. A., Mueller, J. F., Toms, L. M. L., Nele Van Den, E., Hobson, P., Thai, P., Wang, X., Li, Y. (2018). Urinary metabolites of organophosphate esters: Concentrations and age trends in Australian children. Environment International 111:124-130.		
HERO ID:	5469782		

Domain	Metric	Rating	Comments
Domain 1: Reliability			
	Metric 1: Mathematical Equations	Medium	The EDI equation for daily intake of breast milk was provided. The equation was not cited, but it is considered scientifically sound.
	Metric 2: Model Evaluation	Low	Model evaluated in discussion by author and there is no information provided regarding model peer review in journal publication.
Domain 2: Representative			
	Metric 3: Exposure Scenario	Medium	Model inputs reflect conditions for exposure via breastfeeding in Australia, but may not reflect US conditions.
Domain 3: Accessibility/Clarity			
	Metric 4: Model and Model Documentation Availability	Low	Model equation and inputs are sufficient, but the model and documentation are not available.
	Metric 5: Model Inputs and Defaults	High	Concentrations, intake, and body weight are provided and cited.
Domain 4: Variability and Uncertainty			
	Metric 6: Variability and Uncertainty	Medium	Variability across sexes discussed in concentrations. There was some discussion of limitations, such as not considering other sources of exposure besides breastfeeding.

Overall Quality Determination   **Medium**

		Domain		Metric	Rating	Comments

Study Citation: Wang, D., Wang, P., Wang, Y., Zhang, W., Zhu, C., Sun, H., Matsiko, J., Zhu, Y., Li, Y., Meng, W., Zhang, Q., Jiang, G. (2019). Temporal variations of PM2.5-bound organophosphate flame retardants in different microenvironments in Beijing, China, and implications for human exposure. Science of the Total Environment 666:226-234.

HERO ID: 5469991

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	US EPA equation was cited.
	Metric 2:	Model Evaluation	High	US EPA equation was cited and expected to have undergone evaluation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	High	Sampling conducted 2016 - 2017.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Cited equation reference is available to the public for free but supplemental information is not.
	Metric 5:	Model Inputs and Defaults	High	All inputs are described and referenced when applicable; most inputs are from the Chinese Exposure Factors Handbook.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	High	Discussion included on variability and uncertainty. Included daily intake estimates for different seasons and compared to other studies.

Overall Quality Determination　　　　High

Study Citation:	Chen, Y., Fang, J., Ren, L., Fan, R., Zhang, J., Liu, G., Zhou, L., Chen, D., Yu, Y., Lu, S. (2018). Urinary metabolites of organophosphate esters in children in South China: Concentrations, profiles and estimated daily intake. Environmental Pollution 235:358-364.		
HERO ID:	5470172		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	The EDI equation is based on a previous study which is referenced and based on a scientifically sound method.
	Metric 2:	Model Evaluation	Medium	The model has acceptance among the scientific community (accepted in peer reviewed articles), but it is unknown if the equation has been evaluated using other models or monitoring data.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Samples were taken in 2015.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	The EDI equation is based on Fromme et al 2014 - this paper is not publicly available for free.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs to the EDI equations are all defined, explained, and referenced when applicable; but all values for each chemical are not reported. Paper just states to use molecular weight instead of listing those values.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Low	Limited discussion of variability and uncertainty are included with respect the EDI.

Overall Quality Determination   **Medium**

| | Study Citation: | Brits, M., Brandsma, S. H., Rohwer, E. R., De Vos, J., Weiss, J. M., de Boer, J. (2019). Brominated and organophosphorus flame retardants in South African indoor dust and cat hair. Environmental Pollution 253:120-129. |
| | HERO ID: | 6813729 |

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	Medium	No equation provided; simple intake calculation can be assumed with inputs and outputs provided.
	Metric 2:	Model Evaluation	Low	Outputs compared to other studies, but no direct evaluation without the equation.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Exposure to indoor dust is a relevant scenario, but the data may be particular to South African environments.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	Low	Without an equation, the calculations cannot be immediately followed or validated.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs are provided in the human exposure estimation description, with many exposure factors cited to U.S. EPA. Without the equation, cannot validate all inputs are provided.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	Uncertainty addressed in the median and high concentrations used in the estimates, and estimates provided for toddlers and adults under a mean and high ingestion scenario.

Overall Quality Determination   **Medium**

Study Citation:	Li, H. L., Liu, L. Y., Zhang, Z. F., Ma, W. L., Sverko, E., Zhang, Z., Song, W. W., Sun, Y., Li, Y. F. (2019). Semi-volatile organic compounds in infant homes: Levels, influence factors, partitioning, and implications for human exposure. Environmental Pollution 251:609-618.		
HERO ID:	6815979		

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Mathematical Equations	High	Equations provided in supplemental document for EDI via air inhalation, air dermal absorption, dust non-dietary ingestion, dust dermal absorption. All equations are described in detail and have citations, some US EPA.
	Metric 2:	Model Evaluation	Medium	Model evaluation not directly conducted by author, but models are secondary. Assumed peer review and some evaluation during initial publication.
Domain 2: Representative				
	Metric 3:	Exposure Scenario	Medium	Model inputs seem appropriate for estimating total daily intakes for infants via dust and air; not all intermediate values provided for each route and the population is limited to the region in China.
Domain 3: Accessibility/Clarity				
	Metric 4:	Model and Model Documentation Availability	High	Model equations and inputs are sufficient.
	Metric 5:	Model Inputs and Defaults	Medium	Inputs are described and values provided with citations. Data quality criteria not discussed but values appear appropriate.
Domain 4: Variability and Uncertainty				
	Metric 6:	Variability and Uncertainty	Medium	The study characterizes the variability in intakes across chemicals but for a single population (infants) and in one scenario (combined air and dust); correlation analysis conducted to identify major routes and influence of each chemical.

## Overall Quality Determination		**Medium**

Table 368: Glossary of Select Terms for Data Extraction Tables

Term	Definition
ABS	Acrylonitrile Butadiene Styrene
AM	Arithmetic Mean
ASA	Acrylonitrile Styrene Acrylate
ASD	Arithmetic Standard Deviation
AQ	Antarctica
AR	Argentina
AT	Austria
AU	Australia
BCEP	Bis(2-chloroethyl) Phosphate
BE	Belgium
BO	Bolivia
BR	Brazil
CHAMACOS	Center for the Health Assessment of Mothers and Children of Salinas
CA	Canada
CA, US	California, United States
CH	Switzerland
CL	Chile
CN	China
CO	Colombia
CO, US	Colorado, United States
CR	Costa Rica
CWS	Community Water System
CV	Coefficient of Variation
CZ	Czech Republic
DCEP	Di-(2-chloroethyl) Phosphate
DE	Germany
DF	Detection Frequency
DK	Denmark
DWTP	Drinking Water Treatment Plant
EPA	Environmental Protection Agency
ES	Spain
FI	Finland
FL	Florida
FR	Faroe Islands
GB	Great Britain
GM	Geometric Mean
GR	Greece
HIPS	High Impact Polystyrene
HK	Hong Kong

Table 368 ... continued from previous page

Term	Definition
IL	Illinois
IN	Indiana
IR	Iran
ISO	International Organization for Standardization
IT	Italy
JP	Japan
KR	Republic of Korea
LOD	Limit of Detection
LOQ	Limit of Quantification
m	meter
MA	Massachusetts
MD	Maryland
MDL	Method Detection Limit
MRL	Method Reporting Limit
MR	Madrid Region
mg/day	milligrams per day
mg/g	milligrams per gram
mg/kg	milligrams per kilograms
mg/kg/day	milligrams per kilograms per day
mg/L	milligrams per liter
mg/mL	milligrams per millileter
MI	Michigan
MX	Mexico
n	Sample Size
ng	nanograms
ng/day	nanograms per day
ng/g	nanograms per gram
ng/g/d	nanograms per gram per day
ng/kg	nanograms per kilogram
ng/kg bw/day	nanograms per kilograms bodyweight per day
ng/L	nanograms per liter
ng/mL	nanograms per millileter
ng/m^2	nanograms per square meter
ng/m^3	nanograms per cubic meter
ng/POCIS	nanograms per polar organic chemical integrative sampler
ng/PDMS	nanograms per polydimethylsiloxane rubber composites
ng/SPMD	nanograms per semipermeable membrane device
NC	North Carolina
ND	Non-Detect
NL	Netherlands
nmol/g	nanomole per gram
NO	Norway

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Term	Definition
NR	Not Reported
NSW	New South Wales
NY	New York
NZ	New Zealand
OFR	Organophosphate Flame Retardants
OH	Ohio
OR	Oregon
OQD	Overall Quality Determination
PA	Pennsylvania
PC	Printed Circuit
PCABS	Polycarbonate Acrylonitrile Butadiene Styrene
PETG	Polyethylene Terephthalate Glycol
pg/kg BW/day	picograms per kilograms per bodyweight per day
pg/m^3	picograms per meters cubed
$pg/\mu L$	picograms per microliter
PH	Philippines
PL	Poland
PM	Particulate Matter
ppbv	parts per billion volume
PR	Puerto Rico
PT	Portugal
PUF-PAS	Polyurethane foam-passive air samplers
RO	Romania
RSD	Relative Standard Deviation
SE	Sweden
STP	Sewage Treatment Plant
SVOC	Semi-Volatile Organic Compound
SWHT	Storm water holding tank
TH	Thailand
TR	Turkey
TX	Texas
$\mu g/ft^2$	micrograms per feet squared
$\mu g/g$	micrograms per gram
$\mu g/kg$	micrograms per kilogram
$\mu g/kg/day$	micrograms per kilogram per day
$\mu g/L$	micrograms per liter
$\mu g/m^2/h$	micrograms square meter per hour
$\mu g/m^3$	micrograms per cubic meter
UK	United Kingdom
US or USA	United States of America
VDU	Visual Display Unit
VA	Virginia

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Term	Definition
VEAS	Vestfjorden Avløpsselskap
VN	Vietnam
WA	Washington