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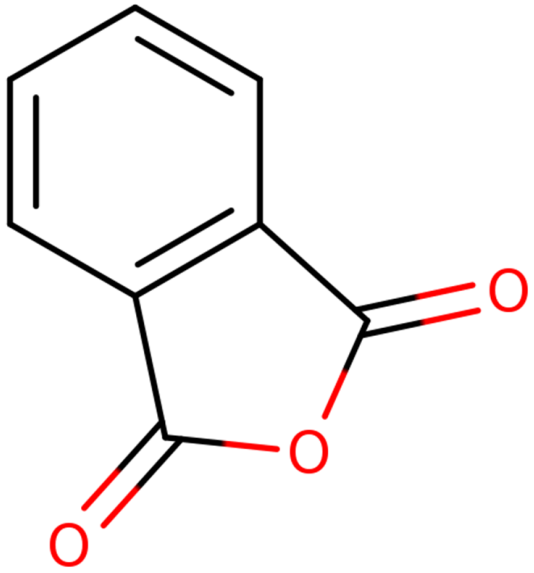
Office of Chemical Safety and
Pollution Prevention

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

Systematic Review Support Document for the Draft Risk Evaluation

CASRN: 85-44-9



March 2026

This supplemental file contains information regarding the data quality evaluation results for data sources that met the PECO (Population, Exposure, Comparator or Scenario, and Outcomes) screening criteria for the *Draft Consumer and Indoor Exposure Assessment for Phthalic Anhydride*, and the *Draft Environmental Media and General Population and Environmental Exposure for Phthalic Anhydride*, 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*, (referred hereafter as the "2021 Draft Systematic Review Protocol"). The systematic review steps are further described in the *Draft Systematic Review Protocol for Phthalic Anhydride*,

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

Table of Contents

Phthalic anhydride

Study Citation:	Kotowska, U., Bieganska, K., Isidorov, V. A. (2012). Screening of trace organic compounds in municipal wastewater by gas chromatography-mass spectrometry. Polish Journal of Environmental Studies 21(1):129-138.
HERO ID:	1106739

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Insufficient description of sampling methodology. Missing details on sampling equipment and procedures
	Metric 2:	Analytical Methodology	Low	No LOD or LOQ reported
	Metric 3:	Biomarker Selection	N/A	Study tested for parent chemical in wastewater.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Poland
	Metric 5:	Currency	Low	No date of sampling reported, but publication date (2011) was available
	Metric 6:	Spatial and Temporal Variability	Low	The only information authors provided about sample size is "Average daily samples of influent and effluent wastewater were taken five times between February and November." It is unclear what the total number of samples is. Ten samples between Feb and Nov, or 10 samples per month, or somewhere in between?
	Metric 7:	Exposure Scenario	High	Discharge of contaminated municipal wastewater to surface water
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data unavailable. Table 1 appears to provide a range or mean of concentrations and SD for influent and effluent sewage. This is an assumption because of the +/- symbol. Note that the column heading says "Content, [%]" so it's also possible that these are frequency of detection and the SD for them. Metric is being scored as low because of the guesswork.
	Metric 9:	Quality Assurance	Medium	no recoveries or blanks reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Limited characterization of variability and no uncertainties, data gaps, or limitations reported
Overall Quality Determination			**Medium**	

Study Citation:	Kong, X. J.,i, Li, D., Cao, L., Zhang, X., Zhao, Y.,an, Lv, Y., Zhang, J.,ie (2008). Evaluation of municipal sewage treatment systems for pollutant removal efficiency by measuring levels of micropollutants. Chemosphere 72(1):59-66.
HERO ID:	1322141

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Details on sampling methods such as how samples were collected are lacking. Collection container described.
	Metric 2:	Analytical Methodology	Low	level of detection, recovery % not listed for phthalic anhydride because phthalic anhydride was not quantified
	Metric 3:	Biomarker Selection	N/A	environmental media
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Harbin municipal sewage treatment system, China
	Metric 5:	Currency	Medium	May 2007
	Metric 6:	Spatial and Temporal Variability	Medium	Unclear if replicate sampling was conducted. No statistics reported in quantification of chemicals
	Metric 7:	Exposure Scenario	High	Source of exposure identified
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	raw data reported but unclear if there were replicates in each sample to yield summary statistics
	Metric 9:	Quality Assurance	High	QA/QC issues identified & described
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Not discussed

Overall Quality Determination Medium

Study Citation:	Narukawa, M., Kawamura, K., Li, S. M., Bottenheim, J. W. (2002). Dicarboxylic acids in the Arctic aerosols and snowpacks collected during ALERT 2000. Atmospheric Environment 36(15-16):2491-2499.
HERO ID:	2473370

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling methods, storage, equipment were described.
	Metric 2:	Analytical Methodology	Low	LOD was not reported.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental medium
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were collected at Alert, Nunavut, Canada.
	Metric 5:	Currency	Low	Data was collected in 2000.
	Metric 6:	Spatial and Temporal Variability	High	In total, four aerosol and four snowpack samples were collected during the winter period, and five aerosol and five snowpack samples during the spring period.
	Metric 7:	Exposure Scenario	High	Transportation and deposition of these chemicals could lead to exposure.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No raw data, the summary of statistics was provided.
	Metric 9:	Quality Assurance	Medium	Recoveries and blanks reported for group of chemical and not specific ones.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	No limitations reported. Variations in season analyzed.

Overall Quality Determination Medium

Study Citation:	Tian, F., Liu, Y., Liu, C., Gu, H., Liu, H. (2016). Pollution status and multimedia fate simulation of phthalate acid esters (PAEs) in an arid city. Polish Journal of Environmental Studies 25(1):325-331.
HERO ID:	3367249

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sampling procedure and study site characters were described in the method. A few information (sample storage, calibration) were missing.
	Metric 2:	Analytical Methodology	Low	Detection limits or reporting limits were not reported.
	Metric 3:	Biomarker Selection	N/A	Environmental media
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Changji-Tianshan region in China
	Metric 5:	Currency	Medium	The samples were collected early each month from Octoberto December, 2014.
	Metric 6:	Spatial and Temporal Variability	High	For air, soil, organic film, plants, and water, every kind of sample was taken 4 times at each sampling point. 5 soil and plantsub-samples were collected from the surroundings of eachsite.
	Metric 7:	Exposure Scenario	High	The sample matrixes covered air, soil, water, terrestrial plants.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Supplementary or raw data were not reported, and therefore summary statistics cannot be reproduced.
	Metric 9:	Quality Assurance	Medium	Limited discussion about quality assurance was provided (field blanks were used).
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:	Malits, J., Attina, T. M., Karthikraj, R., Kannan, K., Naidu, M., Furth, S., Warady, B. A., Vento, S., Trachtman, H., Trasande, L. (2018). Renal function and exposure to bisphenol A and phthalates in children with chronic kidney disease. Environmental Research 167:575-582.
HERO ID:	4829246

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage duration is unclear.
	Metric 2:	Analytical Methodology	Low	The main study does not include information on analytical methods, but states that detailed methods can be found in the supplementary materials for the article.
	Metric 3:	Biomarker Selection	Medium	The biomarker (urine) is acceptable.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was performed in the USA.
	Metric 5:	Currency	Medium	The majority of samples were collected from 2005 to 2008, and some were collected between 2009 and 2014.
	Metric 6:	Spatial and Temporal Variability	Medium	There were 538 study participants. Samples were fresh void samples, not 24-hr samples.
	Metric 7:	Exposure Scenario	Medium	The data likely represent the exposure scenario.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Results were adjusted for urinary creatine. Mean values with 95% confidence intervals were reported. Raw data were not included in the main study (it is unclear whether these data are contained in the supplementary materials).
	Metric 9:	Quality Assurance	Low	The study reports that no QC/QC measures were in place during sampling.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study included a brief discussion of the limitations of its cross-sectional design.
Overall Quality Determination			**Medium**	

Phthalic acid

Study Citation:	Satsumabayashi, H., Kurita, H., Yokouchi, Y., Ueda, H. (1989). Mono- and di-carboxylic acids under long-range transport of air pollution in central Japan. Tellus. Series B, Chemical and Physical Meteorology 41B(3):219-229.
HERO ID:	45467

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	minimum sampling details; map included
	Metric 2:	Analytical Methodology	Medium	extraction and equipment described; detectable limits provided
	Metric 3:	Biomarker Selection	N/A	air samples
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Japan
	Metric 5:	Currency	Low	1983 and 1986
	Metric 6:	Spatial and Temporal Variability	Low	~30 timepoints, 2 locations, over 4 days
	Metric 7:	Exposure Scenario	High	airborne aerosols
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	timepoint bar graph - would need digitization. Individual points not reported.
	Metric 9:	Quality Assurance	Low	QA not discussed; no obvious concerns
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability shown in raw data by timepoint. No limitations discussed.

Overall Quality Determination Medium

Study Citation:	Ray, J., Mcdow, , S. R. (2005). Dicarboxylic acid concentration trends and sampling artifacts. Atmospheric Environment 39(40):7906-7919.
HERO ID:	115831

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Authors reported the sampling procedures, equipment. Storage conditions and duration were not explicitly reported but the authors referenced another paper referring to the sampling procedures.
	Metric 2:	Analytical Methodology	Low	Authors referenced another paper referring to the analytical procedures, but they mentioned the analytical equipment, extraction method, calibration experiments, and recovery experiments. However, the limit of detection is not reported.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report on the geographical location (Philadelphia, PA).
	Metric 5:	Currency	Low	Samples were collected in 1999.
	Metric 6:	Spatial and Temporal Variability	High	The overall number of samples was not explicitly reported by the authors, but the data points in Figure 1 show there were at least 44 samples. The study collected replicate samples and collected samples over different times of day, over multiple days.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors did not report individual data points, although some individual data is reported in Figure 1, but it is unclear if the figure shows all samples. The authors report the mean concentration and range of concentrations, but no standard deviation. It can be assumed from Table 1 that all samples were above the LOD but it is not explicitly stated.
	Metric 9:	Quality Assurance	Medium	The authors completed recovery experiments, collected and analyzed travel blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The study did not present a measurement of variance. The study does address some variation as it shows the change in concentration over multiple days and times.
Overall Quality Determination			**Medium**	

Study Citation:	Fine, P. M., Chakrabarti, B., Krudysz, M., Schauer, J. J., Sioutas, C. (2004). Diurnal Variations of Individual Organic Compound Constituents of Ultrafine and Accumulation Mode Particulate Matter in the Los Angeles Basin. Environmental Science & Technology 38(5):1296-1304.
HERO ID:	141283

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The authors describe the sampling procedure and sampling equipment. Storage duration and conditions were not reported.
	Metric 2:	Analytical Methodology	Low	Authors reported the extraction method, analytical equipment, recovery studies. Authors did not report on calibration studies. Detection limits were not reported by the authors.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report the geographic area of the study (Los Angeles and Riverside, CA).
	Metric 5:	Currency	Low	Samples were collected in 2002 and 2003.
	Metric 6:	Spatial and Temporal Variability	Medium	The authors did not report a clear total sample number but from Figure 7, it can be inferred that there were at least 16 samples collected and the text in the Experimental Section it appears that a total of 20 samples were collected in each season for a total of 40 samples.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual sample concentrations are not reported in the main study or in a supplement. The authors only present data in Figure 7, which shows averages. Standard deviations are not explicitly reported
	Metric 9:	Quality Assurance	Medium	The authors reported analyzing field blanks, and completing recovery studies.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors do not report a standard deviation. The authors discuss some limitations in discussing seasonal trends given that only one week of sampling per season was conducted.

Overall Quality Determination Medium

Study Citation:	Balducci, C., Cecinato, A. (2010). Particulate organic acids in the atmosphere of Italian cities: Are they environmentally relevant?. Atmospheric Environment 44(5):652-659.
HERO ID:	378962

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The authors reported the sampling equipment, sampling locations and combining of samples. The authors did not report any sampler calibration or sample storage conditions and duration.
	Metric 2:	Analytical Methodology	High	The authors report the analytical equipment, extraction method, conducting recovery studies, calibration studies. The authors also reported an LOD.
	Metric 3:	Biomarker Selection	N/A	Air sampling
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report the study location.
	Metric 5:	Currency	Medium	Samples were collected in 1991, 1996, 1999-2000, 2002, 2003-2004, 2006-2007.
	Metric 6:	Spatial and Temporal Variability	Medium	Sampling occurred at various locations and yearly measurements were taken for various periods (i.e. 1996, 2003-2004, 2006-2007). Particulates were collected daily and joined to process weekly samples; the analytical results were averaged on a monthly basis. Sample size be inferred to be >10 but not explicitly stated. Use of replicate samples (other than to test inter-day precision) was not reported.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	The total number of samples is not clearly reported. It seems that the authors report the monthly averages and standard deviations in Tables 1 and 2. The study does not report individual sample concentrations or frequency of detection or range.
	Metric 9:	Quality Assurance	Medium	The authors processed blank samples and performed recovery studies. 81.9% recovery was calculated for phthalic acid but there was no indication of correction in the presented results
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors discussed variability in the concentrations based on season but did not discuss data gaps or limitations.

Overall Quality Determination Medium

Study Citation:	Calafat, A. M., Slakman, A. R., Silva, M. J., Herbert, A. R., Needham, L. L. (2004). Automated solid phase extraction and quantitative analysis of human milk for 13 phthalate metabolites. Journal of Chromatography B: Analytical Technologies in the Biomedical and Life Sciences 805(1):49-56.
HERO ID:	673259

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	The study includes minimal details about the human milk sampling methodology.
	Metric 2:	Analytical Methodology	High	The analytical methods were described in detail, including LODs and recoveries.
	Metric 3:	Biomarker Selection	High	The study tested for metabolites closely related to the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study was conducted by the CDC in Atlanta but the geographic data was not confirmed in the manuscript.
	Metric 5:	Currency	Low	The study was published in 2004.
	Metric 6:	Spatial and Temporal Variability	Low	The study did not report sample size clearly. Section 2.5 reads: "each batch consisted of 50 samples" but it is not specified if it refers to human milk.
	Metric 7:	Exposure Scenario	High	The data closely represent relevant exposure scenarios related to phthalate metabolites present in human milk.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data and limited summary statistics for human milk concentrations were reported.
	Metric 9:	Quality Assurance	High	QA/QC techniques were described in detail, e.g., use of controls and recoveries.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability for human milk concentrations was briefly characterized in the text (SD). Uncertainties were discussed.

Overall Quality Determination Medium

Study Citation:	Silva, M. J., Reidy, J. A., Samandar, E., Herbert, A. R., Needham, L. L., Calafat, A. M. (2005). Detection of phthalate metabolites in human saliva. Archives of Toxicology 79(11):647-652.
HERO ID:	787994

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Some sampling methods not reported
	Metric 2:	Analytical Methodology	Medium	Recovery samples not reported
	Metric 3:	Biomarker Selection	Medium	Acceptable biomarkers
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	USA
	Metric 5:	Currency	Low	Sample data collected before 2005
	Metric 6:	Spatial and Temporal Variability	Medium	>10 samples; no replicates
	Metric 7:	Exposure Scenario	Medium	Exposure source not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported
	Metric 9:	Quality Assurance	Low	Limited QA reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Few gaps and limitations reported

Overall Quality Determination Medium

Study Citation:	Sheesley, R. J., Deminter, J. T., Meiritz, M., Snyder, D. C., Schauer, J. J. (2010). Temporal trends in motor vehicle and secondary organic tracers using in situ methylation thermal desorption GCMS. Environmental Science & Technology 44(24):9398-9404.
HERO ID:	1011957

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The study authors report the sampler equipment, but they did not report the sample storage conditions. They also did not describe in detail the study site characteristics.
	Metric 2:	Analytical Methodology	High	The authors describe the analytical equipment, calibration studies, and recovery studies, and the limit of detection.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study reports the geographic location.
	Metric 5:	Currency	Medium	The samples were collected in summer 2005.
	Metric 6:	Spatial and Temporal Variability	High	Samples were collected in five hour blocks, which can be considered replicate samples. The total sample size can be inferred from the experimental section, with 7 data collection days, one sample collected in four-a-day blocks, so a total of 28 samples.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	The authors did not report any summary statistics for phthalic acid in the main article. Individual sample concentrations are reported in the supporting material. Detection frequency was not reported by authors in the main body.
	Metric 9:	Quality Assurance	High	The authors performed recovery studies, collected and analyzed field blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors did not report a standard deviation. They discussed variability in sample concentrations across time of day.

Overall Quality Determination Medium

Study Citation:	Hyder, M., Genberg, J., Sandahl, M., Swietlicki, E., Jonsson, J. (2012). Yearly trend of dicarboxylic acids in organic aerosols from south of Sweden and source attribution. Atmospheric Environment 57 (Sep 2012):197-204.
HERO ID:	1447247

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The authors report the study site, sampling equipment and storage conditions. The authors did not report the storage duration or sampler calibration.
	Metric 2:	Analytical Methodology	Medium	The authors reported the extraction method, analytical equipment, instrumentation calibration, recovery studies, and limits of detection. LOD reported in range instead of chemical specific.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study reports the geographical location- Sweden.
	Metric 5:	Currency	Medium	Samples were collected in 2008 to 2009.
	Metric 6:	Spatial and Temporal Variability	Medium	The study collected and analyzed 35 samples. The study did not report collecting replicate samples.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is plausible but is not well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The study reports the total number of samples, range of concentrations, mean, standard deviation, and frequency of detection. The study does not report individual sample concentrations.
	Metric 9:	Quality Assurance	Low	The study did perform recovery studies, however the recovery for phthalic acid is 69.4% and the study did not correct for the low recovery. The study also did not report analyzing blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study discusses variability and reports a standard deviation but has a limited discussion on limitations and gaps.

Overall Quality Determination Medium

Study Citation:	Natesan, U. (2013). Accumulation of organic pollutants in aquatic organisms from Ennore estuary, Chennai, India. Asian Journal of Chemistry 25(5):2392-2394.
HERO ID:	1598293

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Following USEPA 8280 procedure
	Metric 2:	Analytical Methodology	Low	LOD not reported
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Chennai, India
	Metric 5:	Currency	Critically Deficient	Published in 2012 but the date of sample/data collection not reported.
	Metric 6:	Spatial and Temporal Variability	Low	6 samples; no replicates
	Metric 7:	Exposure Scenario	Medium	Organic pollutants in aquatic organism
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	No raw data.
	Metric 9:	Quality Assurance	Low	No QA/QC reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	limitations not reported; No discussion on variability and uncertainty

Overall Quality Determination Uninformative

Study Citation:	Kawamura, K., Steinberg, S., Kaplan, I. R. (1996). Concentrations of monocarboxylic and dicarboxylic acids and aldehydes in southern California wet precipitations: Comparison of urban and nonurban samples and compositional changes during scavenging. Atmospheric Environment 30(7):1035-1052.
HERO ID:	1962324

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 in the data source.
	Metric 2:	Analytical Methodology	Low	No LOD reported.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical in an environmental media (water).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Geographic location is reported, Southern California.
	Metric 5:	Currency	Low	Data collected from 1982 to 1984.
	Metric 6:	Spatial and Temporal Variability	Medium	> 10 samples; not true replicates.
	Metric 7:	Exposure Scenario	High	The data represent the relevant exposure scenario (i.e., population/scenario/media of interest). The study describes the setting (location, climate, urban, rural etc.).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Individual sample concentrations reported in the study, allowing summary statistics to be reproduced.
	Metric 9:	Quality Assurance	Medium	The study applied 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	Some limitations reported.
Overall Quality Determination			**Medium**	

Study Citation:	Wang, G., Kawamura, K., Hatakeyama, S., Takami, A., Li, H., Wang, W. (2007). Aircraft measurement of organic aerosols over China. Environmental Science & Technology 41(9):3115-3120.
HERO ID:	2468973

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The authors report the study site characteristics, sampling procedure, sampling equipment, sample storage conditions or duration or but they did not report the sampler calibration results.
	Metric 2:	Analytical Methodology	Low	The authors report the extraction method, and analytical instrumentation. The authors cited other papers that detailed the recovery experiments but they did not report on calibration experiments. The authors did not report limits of detection.
	Metric 3:	Biomarker Selection	N/A	The study is testing for the parent chemical.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report the geographic location of the study, China.
	Metric 5:	Currency	Low	Samples were collected between 2002-2004.
	Metric 6:	Spatial and Temporal Variability	Medium	The authors reported collecting samples in different seasons (winter, spring and summer). They collected a total of 47 field samples. They did not report replicate samples.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors reported summary statistics by season, total sample number, range, mean, and standard deviation. They also reported the frequency of detection. They did not report individual sample concentrations.
	Metric 9:	Quality Assurance	High	The authors mentioned conducting recovery studies, collecting field blanks and that field samples were corrected for the blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors reported a standard deviation and presented data across seasons. They also discussed how the concentrations varied at different altitudes. The authors did not discuss limitations of uncertainty in the study.

Overall Quality Determination Medium

Study Citation:	Hansen, A. M. K., Kristensen, K., Nguyen, Q. T., Zare, A., Cozzi, F., Nøjgaard, J. K., Skov, H., Brandt, J., Christensen, J. H., Ström, J., Tunved, P., Krejci, R., Glasius, M. (2014). Organosulfates and organic acids in Arctic aerosols: Speciation, annual variation and concentration levels. Atmospheric Chemistry and Physics 14(15):7807-7823.
HERO ID:	2523992

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	The authors report the study site characteristics, the sampling equipment, sampling procedure, sample storage conditions and duration. The authors did not report on sampler calibration.
	Metric 2:	Analytical Methodology	Medium	The authors reported the extraction method, recovery experiments, analytical equipment, calibration experiments. The authors reported only a detection limit range that is aggregated for all chemicals analyzed.
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemicals in environment.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report the geographic area of the study - Greenland and Svalbard.
	Metric 5:	Currency	Medium	The samples were collected in 2008 and 2010.
	Metric 6:	Spatial and Temporal Variability	Medium	The authors do not explicitly state the total sample number, but it can be inferred from the methods section to be 12 samples from Station Nord in Greenland (every 4 weeks throughout the year) and 26 samples from Zeppelin Mountain in Svalbard (every 2 weeks throughout the year). The study authors do not mention collecting replicate samples.
	Metric 7:	Exposure Scenario	High	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors report the range, median and mean of concentrations but they do not report the standard deviation. The frequency of detection can be inferred based on the minimum being above the detection limit. The total number of samples in the dataset is not explicitly stated but can be inferred from the methods section. Individual sample concentrations are not provided.
	Metric 9:	Quality Assurance	Medium	The study reported on recovery studies but it is unclear if blank samples were collected and analyzed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The authors reported the overall uncertainty on measurements for the study (15%). The authors also briefly discuss data gaps. Limited characterization of variability; only ranges are provided.

Overall Quality Determination — Medium

Study Citation:	Fu, P., Kawamura, K., Barrie, L. A. (2009). Photochemical and other sources of organic compounds in the Canadian high Arctic aerosol pollution during winter-spring. Environmental Science & Technology 43(2):286-292.
HERO ID:	2592659

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	The sampling methodology was reported.
	Metric 2:	Analytical Methodology	High	Analytical methodology was well described in the text.
	Metric 3:	Biomarker Selection	N/A	Parent chemical measured in environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The geographic location is reported, Canadian high Arctic.
	Metric 5:	Currency	Low	Data collected Feb to June 1991. Timing of sample collection for monitoring data is not consistent with when current exposures (>15 years old) may be expected and likely to have a substantial impact on results.
	Metric 6:	Spatial and Temporal Variability	Low	Sample size not reported but samples collected weakly from February to June.
	Metric 7:	Exposure Scenario	High	Chemicals in the Canadian high Arctic aerosol.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Supplementary or raw data (i.e., individual data points) are reported in the supplemental file, allowing summary statistics to be calculated or reproduced.
	Metric 9:	Quality Assurance	High	The study applied QA/QC measures such as field and lab control samples. Recoveries were high. No QA/QC issues identified.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No limitations and uncertainties discussed. However, no standard deviation or other measure of variance is provided.

Overall Quality Determination Medium

Study Citation:	Pietrogrande, M. C., Bacco, D., Visentin, M., Ferrari, S., Poluzzi, V. (2014). Polar organic marker compounds in atmospheric aerosol in the Po Valley during the Supersito campaigns - Part 1: Low molecular weight carboxylic acids in cold seasons. Atmospheric Environment 86:164-175.
HERO ID:	2675586

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	The authors reported that sample collection equipment, but did not give many details about the sampling procedure. They referenced a European Standard that was followed for equilibration and weighing. Sample storage conditions and duration was not reported.
	Metric 2:	Analytical Methodology	High	The authors reported the extraction method, analytical instrumentation, recovery studies, and calibration studies on reproducibility. The authors also report detection limits.
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The authors report the study geographic location.
	Metric 5:	Currency	Medium	Samples were collected in 2011-2013.
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	The total number of samples is not explicitly reported and cannot be inferred based on the methods section.
	Metric 7:	Exposure Scenario	Medium	The exposure scenario is of interest.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	The authors report the range, mean, and standard deviation but they do not report the total sample number. The authors do not clearly report a frequency of detection. Individual sample concentrations are also not reported.
	Metric 9:	Quality Assurance	Medium	The authors mentioned performing calibration and recovery studies and that they produced good reproducibility and recoveries. The authors did not report collecting or analyzing control samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	The authors discussed variability in the concentrations as they measured concentrations in two different places (urban and rural) in three different points in the year over three years. However there was little to no discussion of data gaps or limitations of the study.

Overall Quality Determination — Uninformative

Study Citation:	Kundu, S., Kawamura, K. (2014). Seasonal variations of stable carbon isotopic composition of bulk aerosol carbon from Gosan site, Jeju Island in the East China Sea. Atmospheric Environment 94:316-322.
HERO ID:	2697187

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methods not included, such as sample storage duration and calibration of the sampler
	Metric 2:	Analytical Methodology	Low	LOD nor LOQ reported
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Jeju Island, South Korea
	Metric 5:	Currency	Low	April 2003 to April 2004
	Metric 6:	Spatial and Temporal Variability	High	>10 samples (n=84) and replicates
	Metric 7:	Exposure Scenario	Medium	Exposure source not well characterized. Origin/source of TC characterized but exposure scenario not well explained.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	raw data not reported
	Metric 9:	Quality Assurance	Low	Limited QA/QC reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Limited gaps and limitations reported. Showed SD in graph but numerical value of SD not provided.

Overall Quality Determination Medium

Study Citation:	Ho, K. F., Huang, R. J., Kawamura, K., Tachibana, E., Lee, S. C., Ho, S. S. H., Zhu, T., Tian, L. (2015). Dicarboxylic acids, ketocarboxylic acids, alpha-dicarbonyls, fatty acids and benzoic acid in PM2.5 aerosol collected during CAREBeijing-2007: An effect of traffic restriction on air quality. Atmospheric Chemistry and Physics 15(6):3111-3123.
HERO ID:	3016569

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Pertinent sampling methods were described.
	Metric 2:	Analytical Methodology	High	Key analytical methods reported
	Metric 3:	Biomarker Selection	N/A	Study measured parent chemical in the air.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	China
	Metric 5:	Currency	Medium	Samples collected in 2007
	Metric 6:	Spatial and Temporal Variability	Medium	Two sampling locations but no replicates
	Metric 7:	Exposure Scenario	Medium	Exposure source not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported
	Metric 9:	Quality Assurance	Low	Limited QA reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Authors reported a standard deviation, but few gaps and limitations.

Overall Quality Determination Medium

Study Citation:	Wang, H., Kawamura, K., Ho, K. F., Lee, S. C. (2006). Low molecular weight dicarboxylic acids, ketoacids, and dicarbonyls in the fine particles from a roadway tunnel: Possible secondary production from the precursors. Environmental Science & Technology 40(20):6255-6260.
HERO ID:	3220971

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	All key sampling methods reported
	Metric 2:	Analytical Methodology	High	All key analytical methods reported
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Hong Kong
	Metric 5:	Currency	Low	Samples collected in 2003 and 2004
	Metric 6:	Spatial and Temporal Variability	High	> 10 samples and replicates (n=16)
	Metric 7:	Exposure Scenario	High	Exposure source well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data reported in Table 2
	Metric 9:	Quality Assurance	Low	Limited QA/QC reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Limitations and gaps not well characterized

Overall Quality Determination High

Study Citation:	Li, J., Wang, G., Ren, Y., Wang, J., Wu, C., Han, Y., Zhang, L., Cheng, C., Meng, J. (2016). Identification of chemical compositions and sources of atmospheric aerosols in Xi'an, inland China during two types of haze events. Science of the Total Environment 566-567:230-237.
HERO ID:	3230356

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	All key sampling methods described
	Metric 2:	Analytical Methodology	Medium	Key analytical methods described. LOD reported as a range and not for each chemical.
	Metric 3:	Biomarker Selection	N/A	Parent chemical in environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Xi'an, China
	Metric 5:	Currency	Medium	December 2012
	Metric 6:	Spatial and Temporal Variability	Medium	202 samples. Unclear if there are replicates.
	Metric 7:	Exposure Scenario	High	Exposure scenario characterized by haze event
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	raw data not provided
	Metric 9:	Quality Assurance	Medium	QA/QC not directly discussed but reported, such as recoveries and blanks. Recoveries not reported for individual chemicals.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Variability in the different hazes studied. No limitations reported.

Overall Quality Determination Medium

Study Citation:	Suzuki, Y., Kawakami, M., Akasaka, K. (2001). H-1 NMR application for characterizing water-soluble organic compounds in urban atmospheric particles. Environmental Science & Technology 35(13):2656-2664.
HERO ID:	3347907

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methods not reported such as sampler calibration and storage
	Metric 2:	Analytical Methodology	High	Key analytical methods reported
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Kobe City, Japan
	Metric 5:	Currency	Low	Study conducted in 2001
	Metric 6:	Spatial and Temporal Variability	Critically Deficient	Sample size not reported
	Metric 7:	Exposure Scenario	Medium	exposure sources not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	raw data not reported
	Metric 9:	Quality Assurance	Low	Limited QA/QC reproted
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Few gaps and limitations reported

Overall Quality Determination Uninformative

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 & Technology 36(6):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	Low	Only maximum and median overall concentrations are reported. Additionally, because this chemical was routinely detected in laboratory blanks, concentrations were considered estimated.
	Metric 9:	Quality Assurance	Critically Deficient	The study indicates that this compound was routinely detected in laboratory blanks.
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 — Uninformative

Study Citation:	Ren, Y. Q., Wang, G. H., Li, J. J., Wu, C., Cao, C., Li, J., Wang, J. Y., Ge, S. S., Xie, Y. N., Li, X. R., Meng, F., Li, H. (2019). Evolution of aerosol chemistry in Xi'an during the spring dust storm periods: Implications for heterogeneous formation of secondary organic aerosols on the dust surface. Chemosphere 215:413-421.
HERO ID:	5380289

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	sampling methodology described,
	Metric 2:	Analytical Methodology	Medium	Detailed analytical procedure has been published elsewhere (Li et al., 2018; Ren et al., 2017a). detector described, LOD not described
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	China
	Metric 5:	Currency	Medium	2013
	Metric 6:	Spatial and Temporal Variability	Medium	Dust storm(n=27)Transition(n=15)Non-dust storm(n=22); no replicates
	Metric 7:	Exposure Scenario	Medium	rooftop of a three-story building on the campus of Institute of Earth Environment in Xi'an
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	mean, SD, range provided
	Metric 9:	Quality Assurance	Medium	Quality assurance not discussed, no obvious concerns
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	hourly variations considered, range of concentrations provided

Overall Quality Determination Medium

Study Citation: Han, S. W., Lee, H., Han, S. Y., Lim, D. S., Jung, K. K., Kwack, S. J., Kim, K. B., Lee, B. M. (2009). An exposure assessment of di-(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DBP) in human semen. Journal of Toxicology and Environmental Health, Part A: Current Issues 72(21-22):1463-1469.

HERO ID: 5557779

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Not much information was provided for semen collection. The source and storage condition was provided.
	Metric 2:	Analytical Methodology	High	Chromatographic analysis was performed using UPLC-MS/MS. LOD was provided.
	Metric 3:	Biomarker Selection	High	Biomarker (parent chemical or metabolite) is derived from exposure to the chemical of interest.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Samples were from Yonsei University, Korea
	Metric 5:	Currency	Medium	May and September in 2007
	Metric 6:	Spatial and Temporal Variability	High	Samples were from 99 healthy volunteers
	Metric 7:	Exposure Scenario	Medium	The data likely represent the relevant exposure scenario, unclear about the source of chemical.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data were not reported. Mean and range were reported in Table 3.
	Metric 9:	Quality Assurance	Medium	The study applied and documented quality assurance/quality control measures. Recovery values were above 90%.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study provided standard deviation for the data, and identified some uncertainties, as well as compared to other publications.

Overall Quality Determination High

Study Citation: Yang, J., Zhao, W., Wei, L., Zhang, Q., Zhao, Y., Hu, W., Wu, L., Li, X., Pavuluri, C. M., Pan, X., Sun, Y., Wang, Z., Liu, C. Q., Kawamura, K., Fu, P. (2020). Molecular and spatial distributions of dicarboxylic acids, oxocarboxylic acids, and alpha-dicarbonyls in marine aerosols from the South China Sea to the eastern Indian Ocean. Atmospheric Chemistry and Physics 20(11):6841-6860.

HERO ID: 6814078

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methods not reported such as sampler calibration
	Metric 2:	Analytical Methodology	High	Key analytical methods reported
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	South China Sea and eastern Indian Ocean
	Metric 5:	Currency	High	Samples collected in 2015
	Metric 6:	Spatial and Temporal Variability	Medium	>10 samples; no replicates
	Metric 7:	Exposure Scenario	Medium	Exposure source not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not reported
	Metric 9:	Quality Assurance	Low	QA not reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Gaps and limitations not reported

Overall Quality Determination Medium

Study Citation:	Teich, M., van Pinxteren, D., Herrmann, H. (2019). A one year study of functionalised medium-chain carboxylic acids in atmospheric particles at a rural site in Germany revealing seasonal trends and possible sources. Journal of Atmospheric Chemistry 76(2):115-132.
HERO ID:	6814470

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some methods not reported, such as sample storage conditions and sampler calibration
	Metric 2:	Analytical Methodology	Medium	Some analytical methods not reported, such as recovery samples
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Germany
	Metric 5:	Currency	Medium	Data collected in 2010
	Metric 6:	Spatial and Temporal Variability	High	>10 samples; replicates
	Metric 7:	Exposure Scenario	Medium	exposure source not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Raw data not provided
	Metric 9:	Quality Assurance	Low	Limited QA/QC reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Few gaps and limitations reported

Overall Quality Determination Medium

Study Citation:	van Drooge, B. L., Rivas, I., Querol, X., Sunyer, J., Grimalt, J. O. (2020). Organic air quality markers of indoor and outdoor PM2.5 aerosols in primary schools from Barcelona. International Journal of Environmental Research and Public Health 17(10):3685.
HERO ID:	6814514

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Duplicate sampling to consider seasonality, sampling period provided.
	Metric 2:	Analytical Methodology	Medium	Missing sampling information including LOD or LOQ not described but used.
	Metric 3:	Biomarker Selection	N/A	Biomarkers were not assessed nor relevant to this study.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Primary Schools from Barcelona.
	Metric 5:	Currency	Medium	Year of data collection is unclear; however, it is likely 2012-2013.
	Metric 6:	Spatial and Temporal Variability	High	Over 10 samples, replicates collected to account for seasonality.
	Metric 7:	Exposure Scenario	High	The exposure scenario assessed is relevant to indoor and ambient air pathways analyses for TSCA risk evaluation.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Multiple pieces of information not presented.
	Metric 9:	Quality Assurance	Medium	Though recoveries were discussed, replicates were not evident.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	While standard deviations were discussed, study lacked discussion of uncertainties or biases.

Overall Quality Determination Medium

Study Citation:	Sempere, R., Kawamura, K. (1994). COMPARATIVE DISTRIBUTIONS OF DICARBOXYLIC-ACIDS AND RELATED POLAR COMPOUNDS IN SNOW RAIN AND AEROSOLS FROM URBAN ATMOSPHERE. Atmospheric Environment 28(3):449-459.
HERO ID:	6815992

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	some criteria missing including sampling storage duration
	Metric 2:	Analytical Methodology	Low	No LOD reported
	Metric 3:	Biomarker Selection	N/A	NA - biomarker not needed for snow, rain, and aerosol samples
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Tokyo
	Metric 5:	Currency	Low	data collected in 1992
	Metric 6:	Spatial and Temporal Variability	Medium	medium number of samples and replicates
	Metric 7:	Exposure Scenario	High	Snow, rain, and aerosol in urban environments could be used for general population and environmental scenarios.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	High	Raw data in Table 3
	Metric 9:	Quality Assurance	Low	no QA/QC reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	no standard deviation or variance reported

Overall Quality Determination Medium

Study Citation:	Ren, G., Yan, X., Ma, Y., Qiao, L., Chen, Z., Xin, Y., Zhou, M.,in, Shi, Y., Zheng, K., Zhu, S., Huang, C., Li, L. (2020). Characteristics and source apportionment of PM2.5-bound saccharides and carboxylic acids in Central Shanghai, China. Atmospheric Research 237:104817.
HERO ID:	6816056

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some criteria not well reported, such as storage conditions and sampler calibration
	Metric 2:	Analytical Methodology	Low	LOD nor LOQ reported
	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	Central Shanghai, China
	Metric 5:	Currency	High	Data collected from Sept 2015 to Aug 2016
	Metric 6:	Spatial and Temporal Variability	High	Data collected over 4 seasons
	Metric 7:	Exposure Scenario	Medium	Exposure source not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Source of exposure not well characterized
	Metric 9:	Quality Assurance	Medium	Some QA/QC criteria not reported, such as storage recoveries
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Limited gaps and limitations reported

Overall Quality Determination Medium

Study Citation:	Kanellopoulos, P. G. A.,UCEAUKKAUVEAUKCAUSCAUBE (2020). Polar organic compounds in PM10 and PM2.5 atmospheric aerosols from a background Eastern Mediterranean site during the winter period: Secondary formation, distribution and source apportionment. Atmospheric Environment 237:117622.
HERO ID:	6821328

Domain	Metric		Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methods were not reported, such as sampler calibration.
	Metric 2:	Analytical Methodology	Medium	Key analytical methods were reported. LOD for PA might be located within the supplemental materials.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable for this study which measured the parent chemical within environmental media.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	This study was conducted in Cyprus.
	Metric 5:	Currency	Low	The sampling date is not specifically stated but is most likely between 2010-2017 based on results section.
	Metric 6:	Spatial and Temporal Variability	Medium	132 samples were collected, but it is unclear if there were replicates.
	Metric 7:	Exposure Scenario	Medium	The exposure source is not well characterized.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Summary statistics were provided. Individual points may be within supplemental material.
	Metric 9:	Quality Assurance	Medium	Not all quality assurance (QA) criteria were reported, such as control samples.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Few gaps and limitations were reported. There was not much variation in the location and dates of samples.

Overall Quality Determination Medium

Study Citation:	Wang, T. J. (2020). One-year characterization of organic aerosol markers in urban Beijing: Seasonal variation and spatiotemporal comparison. Science of the Total Environment 743:140689.
HERO ID:	6822255

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Some sampling methods not reported, such as sampler calibration
	Metric 2:	Analytical Methodology	High	All key analytical methods reported
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Beijing, China
	Metric 5:	Currency	High	Data collected from December 2014 to December 2015
	Metric 6:	Spatial and Temporal Variability	High	>10 samples (n=112); replicates
	Metric 7:	Exposure Scenario	Medium	Exposure sources not well characterized
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	raw data not provided
	Metric 9:	Quality Assurance	Medium	Most QA/QC metrics reported
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Few gaps and limitations reported

Overall Quality Determination High

Study Citation:	Agarwal, R., Shukla, K., Kumar, S., Aggarwal, S. G., Kawamura, K. (2020). Chemical composition of waste burning organic aerosols at landfill and urban sites in Delhi. Atmospheric Pollution Research 11(3):554-565.
HERO ID:	6824497

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Calibration of sampler is missing
	Metric 2:	Analytical Methodology	Medium	Detection limits are not reported
	Metric 3:	Biomarker Selection	N/A	Chemical is measured in outdoor air
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Delhi, India
	Metric 5:	Currency	Medium	December 2011 and October 2014 (see 2.1 Sampling)
	Metric 6:	Spatial and Temporal Variability	Medium	No replicate samples
	Metric 7:	Exposure Scenario	High	"Total suspended particles collected from an open waste burning landfill site and an urban site of Delhi, one of the most populated cities of Asia was studied."
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual data points are not reported.
	Metric 9:	Quality Assurance	Medium	Brief mention of quality assurance in Section 2.2. Chemical analyses "Field blank filters were treated the similar way for quality assurance."
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	Minimum and maximum concentrations are reported in Table 2. Limited discussion of key uncertainties.
Overall Quality Determination			**Medium**	

Study Citation:	Philips, E. M., Jaddoe, V. W. V., Deierlein, A., Asimakopoulos, A. G., Kannan, K., Steegers, E. A. P., Trasande, L. (2020). Exposures to phthalates and bisphenols in pregnancy and postpartum weight gain in a population-based longitudinal birth cohort. Environment International 144:106002.
HERO ID:	6957398

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Medium	Sample storage time was not specified.
	Metric 2:	Analytical Methodology	Medium	LOD was reported as a range for all phthalates.
	Metric 3:	Biomarker Selection	High	The biomarkers (metabolites of phthalates) are appropriate.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The study population is from Rotterdam, Netherlands. Urine samples were transported to New York for analysis.
	Metric 5:	Currency	Medium	Samples were collected from 2004 to 2005.
	Metric 6:	Spatial and Temporal Variability	Medium	Urine spot samples were collected.
	Metric 7:	Exposure Scenario	High	There is no clear exposure scenario, but this is a biomonitoring study among pregnant and postpartum women.
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	Individual raw data were not reported in the main study. However, in a large cohort study like this, providing raw data might not be feasible.
	Metric 9:	Quality Assurance	Low	Quality control measures were not discussed.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Medium	The study includes a discussion of its strengths and limitations. Characterization of variance only for maternal weight gain but not metabolite concentrations measured in urine.

Overall Quality Determination Medium

Study Citation:	Sol, C. M., Santos, S., Duijts, L., Asimakopoulos, A. G., Martinez-Moral, M. P., Kannan, K., Jaddoe, V. W. V., Trasande, L. (2020). Fetal phthalates and bisphenols and childhood lipid and glucose metabolism: A population-based prospective cohort study. Environment International 144:106063.
HERO ID:	6957607

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	Low	Sampling equipment and methods are only briefly mentioned, and missing details may have a substantial impact on results.
	Metric 2:	Analytical Methodology	Low	Analytical instrumentation and methods are cited to an external source and very little detail is provided. LOD is reported in supplementary information.
	Metric 3:	Biomarker Selection	Low	The monoester phthalate biomarker is a metabolite of multiple parent chemicals, not just the chemical of interest, and there is not a stated method to apportion the estimate to just the chemical of interest.
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	The Netherlands
	Metric 5:	Currency	Low	2004-2005
	Metric 6:	Spatial and Temporal Variability	Medium	Pooled urine spot samples from757 participants at three timepoints
	Metric 7:	Exposure Scenario	High	The exposure scenario of fetuses during gestation is highly relevant
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Low	Raw data are not reported; summary statistics include percentage below LOD, median, and percentiles (25, 75) of concentration.
	Metric 9:	Quality Assurance	Low	Quality assurance/quality control techniques and results were not directly discussed, but can be implied through the study's use of standard laboratory protocols
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	No characterization of variation of results was reported, and limitations/sources of uncertainty are only briefly discussed.

Overall Quality Determination Low

Study Citation:	Liu, H., Kawamura, K., Kunwar, B., Cao, J., Zhang, J., Zhan, C., Zheng, J., Yao, R., Liu, T., Xiao, W. (2019). Dicarboxylic acids and related compounds in fine particulate matter aerosols in Huangshi, central China. Journal of the Air and Waste Management Association 69(4):513-526.
HERO ID:	6968910

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology	High	Sampling method reported, such as sampling equipment, sample location, procedures and storage sample conditions.
	Metric 2:	Analytical Methodology	Low	Not all analytical methods reported. Detection or reporting limit not provided.
	Metric 3:	Biomarker Selection	N/A	This metric is not applicable because the study is testing for the parent chemical in an environmental media (air).
Domain 2: Representativeness				
	Metric 4:	Geographic Area	High	Huangshi, China
	Metric 5:	Currency	Medium	Timing of sample collection for monitoring data is consistent with current or recent exposures may be expected. Samples collected in 2012 and 2013.
	Metric 6:	Spatial and Temporal Variability	High	Sampling approach accurately captures variability of environmental contamination in population/scenario/media of interest. The study used a large sample size (n=61), replicate samples, and sampling occurred over a sufficient period of time (one year; March 2012 to February 2013) to characterize seasonal trends.
	Metric 7:	Exposure Scenario	High	The data represent the relevant exposure scenario (i.e., population/scenario/media of interest). The study describes the setting (location, climate, urban, rural etc.).
Domain 3: Accessibility/Clarity				
	Metric 8:	Reporting of Results	Medium	No supplemental or raw data reported, and therefore summary statistics cannot be reproduced. Number of samples, average, range, and median reported.
	Metric 9:	Quality Assurance	Medium	The study applied quality assurance/quality control measures; however, one or more pieces of QA/QC information is not described. Recoveries are on the low side and samples were corrected for recoveries and field blanks.
Domain 4: Variability and Uncertainty				
	Metric 10:	Variability and Uncertainty	Low	Limited gaps and limitations reported.

Overall Quality Determination Medium

Study Citation:	Tsai, Y. I., Wu, P. L., Hsu, Y. T., Yang, C. R. (2010). Anhydrosugar and sugar alcohol organic markers associated with carboxylic acids in particulate matter from incense burning. Atmospheric Environment 44(30):3708-3718.
HERO ID:	2612610

Domain		Metric	Rating	Comments
Domain 1: Reliability				
	Metric 1:	Sampling Methodology and Conditions	High	Sampling is described in section 2.2 and includes pertinent sampling information including sampling equipment and procedures. Sampling apparatus shown in Figure 1.
	Metric 2:	Analytical Methodology	High	Analytical methods are clearly and appropriately described in Section 2.3. MDL and recovery ratio for phthalic acid is listed in Table 2.
	Metric 3:	Biomarker Selection	N/A	Biomarkers of interest were not addressed in this reference.
Domain 2: Representative				
	Metric 4:	Testing Scenario	Medium	Testing conditions are likely to represent the relevant exposure scenario (incense burning) but was not tested under a broad range of conditions.
	Metric 5:	Sample Size and Variability	Medium	The sample size is reported in section 2.2: 6 samples for each type of incense were collected.
	Metric 6:	Temporality	Medium	Incense sticks were purchased from Taiwan prior to 2010 (date of publication); 5-15 years ago
Domain 3: Accessibility/Clarity				
	Metric 7:	Reporting of Results	Medium	Raw data is not reported therefore summary statistics cannot be reproduced. Emission factor for Phthalic acid is reported as a mean with associated SD is reported in Table 3.
	Metric 8:	Quality Assurance	Medium	Quality control measures were discussed in section 2.3. Recovery ratios are reported in Table 2.
Domain 4: Variability and Uncertainty				
	Metric 9:	Variability and Uncertainty	Medium	Experiment included two different types of incense and reported the coefficient of variation (pg 3711). There was little discussion on uncertainty.

Overall Quality Determination Medium

Table 40: Glossary of Select Terms for Data Evaluation

Term	Definition
7Q10	Lowest 7-day flow in a 10 year period
ADD	Average daily dose
ADR	Acute dose rate
AERMOD	American Meteorological Society (AMS)/EPA Regulatory Model
BAF	Bioaccumulation factor
BCF	Bioconcentration factor
CASRN	Chemical Abstracts Service Registry Number
CDC	Centers for Disease Control and Prevention (U.S.)
CDR	Chemical Data Reporting
CEM	Consumer Exposure Model
COU	Condition of use
DAD	Dermal absorbed dose
DI	Daily intake
DIY	Do-it-yourself
ECHO	The EPA Enforcement and Compliance History Online Database
IIOAC	Integrated indoor-outdoor air calculator
EPA	Environmental Protection Agency (U.S.)
GHS	Globally Harmonised System
HEC	Human equivalent concentration
HED	Human equivalent dose
HM	Harmonic mean
K_{OA}	Octanol:air coefficient
K_{OC}	Organic carbon:water partition coefficent
K_p	Dermal permeability coefficient
LADD	Lifetime average daily dose
MCCEM	Multi-Chamber Concentration and Exposure Model
NAICS	North American Industry Classification System
NHANES	National Health and Nutrition Examination Survey
NPDES	National Pollutant Discharge Elimination System
OCSPP	Office of Chemical Safety and Pollution Prevention
OES	Occupational exposure scenario
OPPT	Office of Pollution Prevention and Toxics
PESS	Potentially exposed or susceptible subpopulation(s)
POD	Point of departure
SDS	Safety Data Sheet
TDS	Technical Data Sheet
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
WWTP	Wastewater treatment plant