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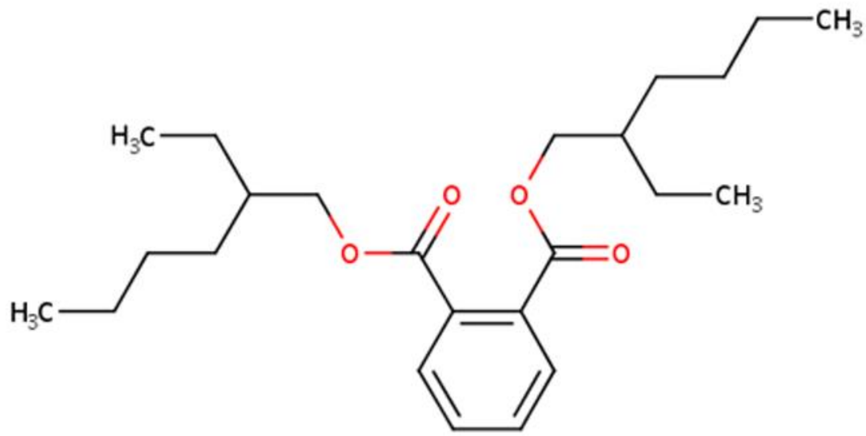
Environmental Protection Agency

Environmental Media Concentrations and General Population and Environmental Exposure Assessment for Diethylhexyl Phthalate (DEHP)

Technical Support Document for the Risk Evaluation

CASRN 117-81-7



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KEY ABBREVIATIONS AND ACRONYMS

7Q10	Lowest 7-day flow in a 10-year period
30Q5	Lowest 30-day average flow in a 5-year period
ADD	Average daily dose
ADME	Absorption, distribution, metabolization, and excretion
ADR	Acute dose rate
AERMOD	American Meteorological Society (AMS)/EPA Regulatory Model
BAF	Bioaccumulation factor
BSAF	Biota-sediment accumulation factor
BCF	Bioconcentration factor
CDC	Centers for Disease Control and Prevention (U.S.)
CEM	Consumer Exposure Model
COU	Condition of use
DAD	Dermal absorbed dose
DEHP	Diethylhexyl phthalate
DI	Daily intake
DMR	Discharge Monitoring Report
DOC	Dissolved organic carbon
dw	Dry weight
ECHO	EPA's Enforcement and Compliance History Online Database
E-FAST	Exposure and Fate Assessment Screening Tool
EPA	Environmental Protection Agency (U.S.) (or "the Agency")
EROM	Enhanced Runoff Method
ESD	Emission scenario document
F_{ue}	Fractional urinary excretion
GS	Generic scenario
IIOAC	Integrated Indoor-Outdoor Air Calculator
HEC	Human equivalent concentration
HED	Human equivalent dose
IR	Ingestion rate
K_{OA}	Octanol:air coefficient
K_{OC}	Organic carbon:water partition coefficient
K_{OW}	Octanol:water partition coefficient
K_p	Dermal permeability coefficient
LADD	Lifetime average daily dose
LOD	Limit of detection
MCNP	Mono-(carboxynonyl) phthalate
MECPP	Mono(2-ethyl-5-carboxypentyl) phthalate
MEHHP	Mono(2-ethyl-5-hydroxyhexyl) phthalate
MEHP	Mono(2-ethylhexyl) phthalate
MEOHP	Mono(2-ethyl-5-oxohexyl) phthalate
MOE	Margin of exposure
NAICS	North American Industry Classification System
NHANES	National Health and Nutrition Examination Survey
NHD	National Hydrography Dataset
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
POTW	Publicly owned treatment works
PSC	Point Source Calculator
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
STORET	EPA STOrage and RETrieval (STORET)
TMF	Trophic magnification factor
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TSD	Technical support document
UF	Uncertainty factor
ww	Wet weight
WWTP	Wastewater treatment plant

SUMMARY

DEHP – Environmental Media Concentrations and General Population and Environmental Exposure Assessment: Key Points

EPA evaluated the reasonably available information for various environmental media concentrations and estimated exposure using a conservative scenario as a screening level approach. The conservative, high-end exposure was assumed to result from the highest diethylhexyl phthalate (DEHP) releases associated with the corresponding Toxic Substances Control Act (TSCA) condition of use (COU) via different exposure pathways. The key points of this assessment are summarized below:

- EPA conducted a screening level assessment of general population and environmental exposure through air, water, and land (*e.g.*, soil, biosolids, groundwater).
    - For the land pathway, there are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs considered. However, based on high-quality physical and chemical property data, EPA determined that DEHP will have low persistence potential and mobility in soils. Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but are discussed qualitatively.
    - For the water pathway, DEHP in water releases is expected to predominantly partition into sediment and suspended particles in the water column. High-end, modeled total water column concentrations of DEHP exceeded solubility but were not as high as some monitored concentrations. However, many conservative assumptions were used to estimate the modeled high-end concentrations. Therefore, EPA is confident that the use of the modeled concentration to estimate DEHP risk in a screening-level assessment is protective.
    - For the ambient air pathway, the modeled DEHP concentrations in air are several orders of magnitude above any monitored concentration likely due to use of high-end releases and conservative meteorological data. Therefore, EPA is confident that the use of the modeled concentration to estimate DEHP risk is protective.
- Screening level risk estimates using high-end modeled water concentrations exceeded the benchmark for (1) incidental dermal contact, (2) incidental ingestion from swimming, (3) ingestion of drinking water, and (4) fish ingestion. The same is true using high-end, modeled air concentrations for inhalation of ambient air. Therefore, no further refinement was necessary for these pathways. Additionally, based on high-quality physical and chemical property data, exposures from land pathways are not expected to pose risk to the general population. EPA concludes that these exposure pathways are not of concern for the general population for DEHP.
- DEHP is not readily found in aquatic or terrestrial organisms and has low bioaccumulation and biomagnification potential. Therefore, DEHP has low potential for trophic transfer through food webs.

1 ENVIRONMENTAL MEDIA CONCENTRATION OVERVIEW

This assessment supports the *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025j). DEHP is the diester of phthalic acid and the branched-chain 2-ethylhexanol (CASRN 117-81-7). The primary use of DEHP is as a plasticizer in the production of polyvinyl chloride (PVC) plastics, where it is added to soften otherwise rigid polymers and promote flexibility.

This technical support document (TSD) describes the use of reasonably available information to estimate environmental concentrations of DEHP in different environmental media and the use of the estimated concentrations to evaluate exposure to the general population from releases associated with TSCA COUs. EPA evaluated the reasonably available information for releases of DEHP from facilities that use, manufacture, or process DEHP under industrial and/or commercial COUs as detailed in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e). Table 1-1 provides a crosswalk between COUs and occupational exposure scenarios (OESs). Table 1-2 shows the types of releases to the environment by OES.

Table 1-1. Crosswalk of Conditions of Use to Assessed Occupational Exposure Scenarios

COU			OES
Life Cycle Stage	**Category**	**Subcategory**	
Manufacture	Domestic manufacturing	Domestic manufacturing	Manufacture
	Importing	Importing	
Processing	Incorporation into article	Plasticizer in basic organic chemical manufacturing; plastics product manufacturing; rubber product manufacturing; miscellaneous manufacturing; PVC extruding	Rubber manufacturing
	Incorporation into formulation, mixture, or reaction product	Plasticizer in basic organic chemical manufacturing; custom compounding of purchased resins; miscellaneous manufacturing; paint and coating manufacturing; adhesive manufacturing; plastic material and resin manufacturing; synthetic rubber manufacturing; all other basic inorganic chemical manufacturing; wholesale and retail trade; services; ink, toner and colorant manufacturing	
Processing	Incorporation into article	Plasticizer in basic organic chemical manufacturing; plastics product manufacturing; rubber product manufacturing; miscellaneous manufacturing; PVC extruding	Plastic converting
Industrial Use	Other uses	Solid Rocket Motor Insulation and other aerospace applications Automotive articles	
Processing	Incorporation into formulation, mixture, or reaction product	Plasticizer in basic organic chemical manufacturing; custom compounding of purchased resins; miscellaneous manufacturing; paint and coating manufacturing; adhesive	Plastic compounding

COU			OES
Life Cycle Stage	**Category**	**Subcategory**	
		manufacturing; plastic material and resin manufacturing; synthetic rubber manufacturing; all other basic inorganic chemical manufacturing; wholesale and retail trade; services; ink, toner and colorant manufacturing	
Processing	Incorporation into formulation, mixture, or reaction product	Plasticizer in basic organic chemical manufacturing; custom compounding of purchased resins; miscellaneous manufacturing; paint and coating manufacturing; adhesive manufacturing; plastic material and resin manufacturing; synthetic rubber manufacturing; all other basic inorganic chemical manufacturing; wholesale and retail trade; services; ink, toner and colorant manufacturing	Incorporation into formulation, mixture, or reaction product
Processing	Other uses	Miscellaneous processing (cyclic crude and intermediate manufacturing; processing aid specific to hydraulic fracturing)	Incorporation into formulation, mixture, or reaction product
Manufacture	Importing	Importing	Import and repackaging
Processing	Repackaging	Repackaging in wholesale and retail trade and in paint and coating manufacturing	
Industrial Use	Construction, paint, electrical, and metal products	Paints and coatings	Application of paints, coatings, adhesives, and sealants
Commercial Use	Construction, paint, electrical, and metal products	Adhesives and sealants	
		Paints and coatings	
	Furnishing, cleaning, and treatment care products	All-purpose waxes and polishes	
Commercial Use	Furnishing, cleaning, and treatment care products	Fabric, textile, and leather products; furniture and furnishings	Textile finishing
	Furnishing, cleaning, and treatment care products	Fabric enhancer	
	Construction, paint, electrical, and metal products	Batteries and capacitors	Fabrication or use of final product or articles
		Construction and building materials covering large surface areas, including paper articles; metal articles; stone, plaster, cement, glass and ceramic articles	
		Machinery, mechanical appliances, electrical/electronic articles	
	Automotive, fuel, agriculture, and outdoor use products	Lawn and garden care products	

COU			OES
Life Cycle Stage	**Category**	**Subcategory**	
Commercial Use	Packaging, paper, plastic, toys, hobby products	Packaging (excluding food packaging) and other articles with routine direct contact during normal use, including paper articles; rubber articles; plastic articles (hard); plastic articles (soft)	
		Packaging (excluding food packaging), including paper articles	
		Toys, playground, and sporting equipment	Fabrication or use of final product or articles
Commercial Use	Furnishing, cleaning, and treatment care products	Floor coverings; Construction and building materials covering large surface areas including stone, plaster, cement, glass and ceramic articles fabrics, textiles, and apparel	
Commercial Use	Packaging, paper, plastic, toys, hobby products	Ink, toner and colorants	Use of dyes and pigments, and fixing agents
Industrial Use	Construction, paint, electrical, and metal products	Adhesives and Sealants	Application of paints, coatings, adhesives, and sealants (formulations for diffusion bonding)
Commercial Use	Other uses	Laboratory chemicals	Use of laboratory chemicals
Commercial Use	Other uses	Automotive articles	Use of automotive care products
Industrial Use	Other uses	Hydraulic fracturing	Use in hydraulic fracturing
Processing	Recycling	Recycling	Recycling
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal
Distribution in commerce	Distribution in commerce		Distribution in commerce

Table 1-2. Type of Release to the Environment by Occupational Exposure Scenario

OES[a]	Type of Discharge, Air Emission, or Transfer for Disposal
- Manufacturing[b] - Rubber manufacturing[b] - Plastics compounding[b] - Plastics converting[b] - Incorporation into formulation, mixture, or reaction product[b] - Repackaging[b] - Application of paints, coatings, adhesives, and sealants[b]	Fugitive air
	Stack air
	Direct discharges from facility to surface water typically with treatment These are reported according to National Pollutant Discharge Elimination System (NPDES) permit requirements via Discharge Monitoring Reports (DMR) captured in EPA's Enforcement and Compliance History Online (ECHO) database.
	Direct discharges from facility to surface water typically with treatment (reported in Toxics Release Inventory [TRI])
	Transfers to publicly owned treatment works (POTWs) of untreated or pretreated wastewater for further treatment before release (reported in TRI)
	Transfers to non-POTW of treated or pretreated wastewater that is transferred offsite to a non-POTW (*e.g.*, private or commercial wastewater treatment plant) for future treatment before release (reported in TRI)
	Land releases including but not limited to underground injection, Resource Conservation and Recovery Act (RCRA) Subtitle C landfills, land treatment, RCRA Subtitle C surface impoundments, other surface impoundments, and other land disposal methods
Textile finishing[b]	Fugitive air
	Stack air
	Direct discharges from facility to surface water typically with treatment (reported in DMR)
	Direct discharges from facility to surface water typically with treatment (reported in TRI)
	Transfers to POTW of untreated or pretreated wastewater for further treatment before release (reported in TRI)
	Transfers to non-POTW of treated or pretreated wastewater that is transferred offsite to a non-POTW (*e.g.*, private or commercial wastewater treatment plant) for future treatment before release [reported in TRI])
Fabrication of final products from articles[b]	Fugitive air
	Stack air
Use of dyes, pigments, and fixing agents[b]	Direct discharges from facility to surface water typically with treatment (reported in DMR)
Formulations for diffusion bonding[b]	Fugitive air
	Stack air
	Direct discharges from facility to surface water typically with treatment (reported in DMR)
Use of laboratory chemicals (liquid) [c]	Fugitive or stack air
	Wastewater, incineration, or landfill

OES[a]	Type of Discharge, Air Emission, or Transfer for Disposal
Use of laboratory chemicals (solid) [c]	Water, incineration, or landfill
	Air, water, incineration, or landfill
	Stack air
	Incineration or landfill
Use of automative care products[c]	Fugitive air
	POTW or landfill
Use in hydraulic fracturing[c]	Fugitive air
	Water, incineration, or landfill
	Surface water
	Soil
	Incineration or landfill
	Deep well injection
	Recycle
Recycling[b]	Fugitive air
	Stack air
Waste handing, disposal, and treatment	Fugitive air
	Stack air
	Direct discharges from facility to surface water typically with treatment (reported in DMR)
	Land releases including but not limited to underground injection, RCRA Subtitle C landfills, land treatment, RCRA Subtitle C surface impoundments, other surface impoundments, and other land disposal methods

[a] Table 1-1 provides the crosswalk of OES to COUs.
[b] Environmental releases for these OESs are based on reported data by facilities, typically from TRI or DMR (U.S. EPA, 2025e).
[c] No site-specific data for these OESs were available; environmental releases were modeled using generic scenarios (U.S. EPA, 2025e).

Although releases from all OESs were considered, EPA focused on estimating high-end concentrations of DEHP from the largest estimated releases for its screening level assessment of environmental and general population exposures. This means that the Agency considered the concentration of DEHP in a given environmental medium resulting from the OES that had the highest release compared to the other OESs. The OES resulting in the highest environmental concentration of DEHP varied by environmental media as shown in Table 2-1. Additionally, EPA relied on its fate assessment to determine which environmental pathways to consider. Details on the environmental partitioning and media assessment can be found in the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g). Briefly, based on DEHP's fate parameters (*e.g.*, Henry's Law constant, log K_{OC}, water solubility, fugacity modeling), EPA anticipates DEHP to be predominantly in surface water, soil, and sediment. However, because DEHP is released to the ambient air from industrial facilities and processes, inhalation of ambient air is a possible exposure pathway. EPA thus quantitatively assessed concentrations of DEHP in surface water, sediment, and ambient air. Soil concentrations of DEHP from land application of biosolids were not quantitatively assessed as DEHP was expected to have limited persistence potential and mobility in soils receiving biosolids. Additionally, DEHP in groundwater from landfills was not quantified because of its high hydrophobicity and high affinity for soil sorption making unlikely that DEHP will migrate from landfills via groundwater infiltration

Environmental exposures assessed using the predicted concentrations of DEHP are presented in Section 12. As DEHP fate and exposure from groundwater, biosolids, and landfills were not quantified, EPA performed a qualitative assessment for these land exposure scenarios (U.S. EPA, 2025g). Additionally, the Agency discusses the potential DEHP dietary exposures to aquatic and terrestrial organisms in the environment in Section 12. EPA did not conduct a quantitative analysis of DEHP trophic transfer because DEHP is expected to have low bioaccumulation potential, no apparent biomagnification potential, and thus low potential for uptake overall. For further information on the bioaccumulation and biomagnification of DEHP, please see the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g).

General population exposure is discussed using a risk screening approach detailed in Section 2. EPA used a margin of exposure (MOE) approach, as discussed in Section 2.2, using high-end exposure estimates (Section 2.1) to screen for potential non-cancer risks. The Agency assumed that if there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then that pathway was determined not to be a pathway of concern for general population exposure and was not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available, refinement of exposure estimates, and exposure estimates for additional subpopulations and COUs/OESs.

Table 1-3 summarizes the exposure pathways assessed for the general population. For DEHP, exposures to the general population via surface water, drinking water, fish ingestion, and ambient air were quantified, and modeled concentrations were compared to environmental monitoring data when possible. Exposures via the land pathway (*i.e.*, biosolids and landfills) were qualitatively assessed because DEHP is not expected to be persistent or mobile in soils. Concentrations of DEHP in soil following agricultural application of municipal biosolids were not identified during systematic review. Further description of the qualitative and quantitative assessments for each exposure pathway can be found in the sections linked in Table 1-3. As summarized in Table 1-3, biosolids application to soil, waste disposal into landfills and subsequent leaching to groundwater, surface water, drinking water, and ambient air are not pathways of concern for DEHP for highly exposed populations based on the OES that may result in the highest concentrations of DEHP in environmental media. Fish ingestion is not a pathway of concern for the general population, subsistence fishers, or tribal populations.

Table 1-3. Exposure Pathways Assessed for General Population Screening Level Assessment

OES[a]	Exposure Pathway	Exposure Route	Exposure Scenario	Pathway of Concern[b]
All	Biosolids (Section 3.1)	All scenarios were assessed qualitatively		No
All	Landfills (Section 3.2)	All scenarios were assessed qualitatively		No
Use of automotive care products; Plastic compounding	Surface water	Dermal	Dermal exposure to DEHP in surface water during swimming (Section 5.1.1)	No
		Oral	Incidental ingestion of DEHP in surface water during swimming (Section 5.1.2)	No
Use of automotive care products; Plastic compounding	Drinking water	Oral	Ingestion of drinking water sourced from surface water (Section 6.1.1)	No
Use of automotive care products; Plastic compounding	Fish ingestion	Oral	Ingestion of fish for general population (Section 7.1)	No
			Ingestion of fish for subsistence fishers (Section 7.2)	No[c]
			Ingestion of fish for tribal populations (Section 7.3)	No[c]
Application of paints, coatings, adhesives, and sealants	Ambient air	Inhalation	Inhalation of DEHP in ambient air resulting from industrial releases (Section 9)	No
		Oral	Ingestion from air to soil deposition resulting from industrial releases (Section 9)	No

[a] Table 1-1 provides a crosswalk of industrial and commercial COUs to OES.
[b] Using the MOE approach, an exposure pathway was determined to not be a pathway of concern if the MOE was equal to or exceeded the benchmark MOE of 30.
[c] Not a pathway of concern for OESs with reported releases. See Table 3-8 of the *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025i) for a full list of the OESs that have or do not have reported releases.

2 SCREENING LEVEL ASSESSMENT OVERVIEW

EPA began its DEHP exposure assessment using a screening level approach that relies on conservative assumptions. Conservative assumptions, including default input parameters for modeling environmental media concentrations, help to characterize exposure resulting from the high-end of the expected distribution. Most of the OESs presented in Table 1-1 report facility location data and releases in the TRI and DMR databases. When facility location- or scenario-specific information were unavailable, the Agency used generic EPA models and default input parameter values as described in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e). Details on the use of screening level analyses in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* (U.S. EPA, 2019b).

High-end exposure estimates used for screening level analyses were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. Additionally, individuals with the greatest intake rate of DEHP per body weight were considered to be those at the upper end of the exposure distribution. Taken together, these exposure estimates are conservative because they were determined using the highest environmental media concentrations and greatest intake rate of DEHP per kg of body weight. These exposure estimates are also protective of individuals having less exposure either due to lower intake rate or exposure to lower environmental media concentrations. This is explained further in Section 2.1.

For the general population screening level assessment, EPA used an MOE approach using high-end exposure estimates to determine whether exposure pathways were pathways of concern for potential non-cancer risks. Using the MOE approach, an exposure pathway associated with a COU was determined to not be a pathway of concern if the MOE was equal to or exceeded the benchmark MOE of 30. Further details of the MOE approach are described in Section 2.2.

If there is no risk for an individual identified as having the potential for the highest exposure associated with a COU, then that pathway was determined not to be a pathway of concern. If any pathways were identified as having potential for risk to the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling, additional subpopulations, and estimates for additional OES/COUs.

2.1 Estimating High-End Exposure

General population exposures occur when DEHP is released into the environment and the environmental media is then a pathway for exposure. As described in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e) and summarized in Table 1-2 of this assessment, releases of DEHP are expected to occur to air, water, and land. Figure 2-1 provides a graphic representation of where and in which media DEHP is expected to be found due to environmental releases and the corresponding route of exposure.

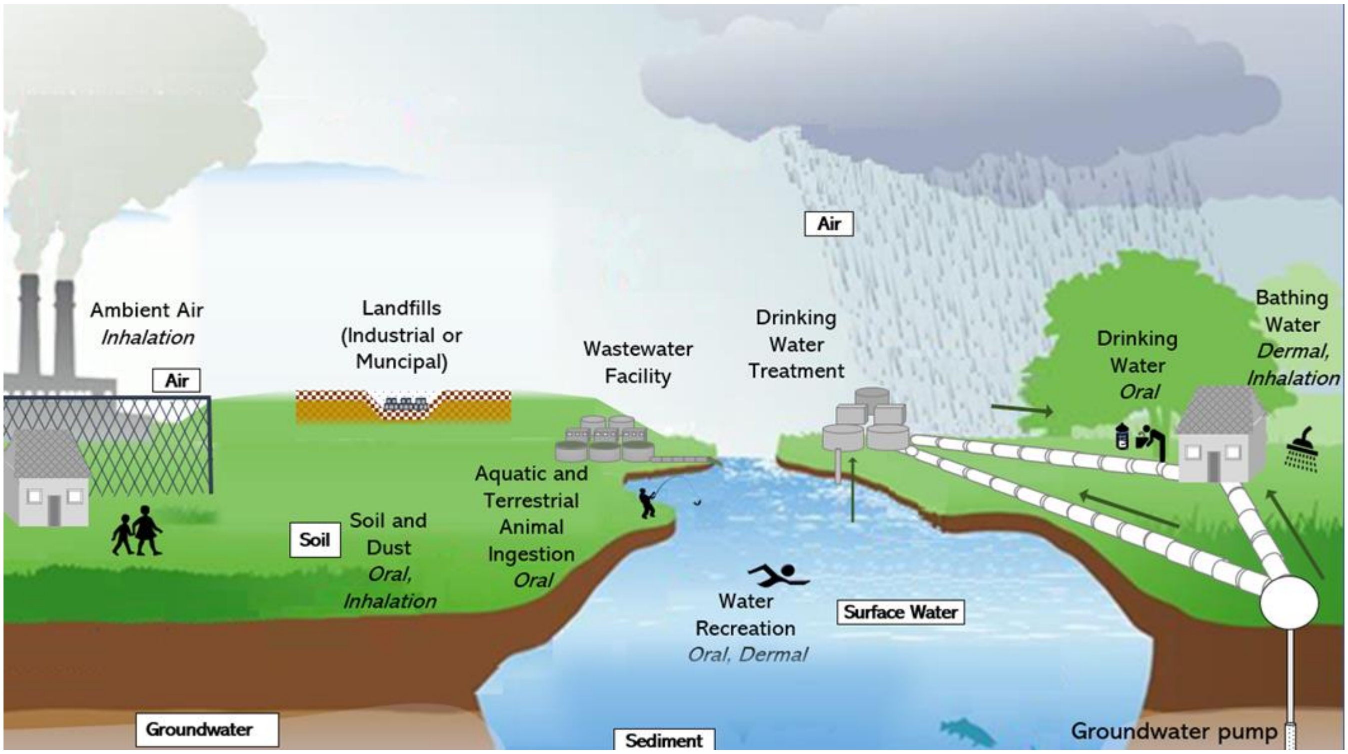


Figure 2-1. Potential Human Exposure Pathways for the General Population

The diagram presents the media (white text boxes) and routes of exposure (*italics* for oral, inhalation, or dermal) for the general population. Sources of drinking water from surface or water pipes are depicted with arrows.

For a screening level analysis, high-end exposures were estimated for each exposure pathway assessed. EPA's *Guidelines for Human Exposure Assessment* defined high-end exposure estimates as a "plausible estimate of individual exposure for those individuals at the upper end of an exposure distribution, the intent of which is to convey an estimate of exposure in the upper range of the distribution while avoiding estimates that are beyond the true distribution" (U.S. EPA, 2019b). If risk is not found for individuals with high-end exposure, no risk is anticipated for central tendency exposure, which is defined as "an estimate of individuals in the middle of the distribution."

Identifying individuals at the upper end of an exposure distribution included consideration of high-end exposure scenarios defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. Additionally, individuals with the greatest intake rate of DEHP per body weight were considered to be those at the upper end of the exposure. Intake rate and body weight are dependent on lifestage as shown in Appendix A.

Table 2-1 summarizes the high-end exposure scenarios that were considered in the screening level analysis including the lifestage assessed as the most potentially exposed population based on intake rate and body weight. Exposure scenarios were assessed quantitatively only when environmental media concentrations were quantified for the appropriate exposure scenario. Because DEHP environmental releases from biosolids and landfills (and therefore, resulting soil concentrations) were not quantified, exposure from soil or groundwater resulting from DEHP release to the environment via biosolids or landfills was not quantitatively assessed. Instead, the scenarios were assessed qualitatively for exposures potentially resulting from biosolids and landfills.

Table 2-1. Exposure Scenarios Assessed in Risk Screening for DEHP

OES(s)	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative)
All	Biosolids	All scenarios assessed qualitatively			Qualitative, Section 3.1
All	Landfills	All scenarios assessed qualitatively			Qualitative, Section 3.2
Use of automotive care products; Plastic compounding	Surface water	Dermal	Dermal exposure to DEHP in surface water during swimming	Adult, youth, and children	Quantitative, Section 5.1.1
		Oral	Incidental ingestion of DEHP in surface water during swimming	Adult, youth, and children	Quantitative, Section 5.1.2
Use of automotive care products; Plastic compounding	Drinking water	Oral	Ingestion of drinking water from surface water	Adult, youth, and children	Quantitative, Section 6.1.1
Use of automotive care products; Plastic compounding	Fish ingestion	Oral	Ingestion of fish for general population	Adult and children	Quantitative, Section 7.1
			Ingestion of fish for subsistence fishers	Adult	Quantitative, Section 7.2
			Ingestion of fish for tribal populations	Adult	Quantitative, Section 7.3
Application of paints, coatings, adhesives and sealants (stack) Plastic converting (fugitive)	Ambient air	Inhalation	Inhalation of DEHP in ambient air resulting from industrial releases	All	Quantitative, Section 9
		Oral	Ingestion from air to soil deposition from industrial releases	Infant and children (6 months to 12 years)	

As part of the general population exposure assessment, EPA considered fenceline populations in proximity to releasing facilities as part of the ambient air exposure assessment by using pre-screening methodology described in EPA's *TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022c). For other exposure pathways, EPA's screening method assessing high-end exposure scenarios used release data that reflect exposures expected to occur in proximity to releasing facilities, which would include fenceline populations.

Modeled surface water concentrations (Section 4.1) were used to estimate incidental dermal exposures (Section 5.1.1), incidental oral exposures (Section 5.1.2), oral drinking water exposures (Section 6.1.1), and fish ingestion exposure (Section 7) for the general population. Modeled ambient air concentrations (Section 8.1) were used to estimate inhalation exposures.

If any pathways were identified as an exposure pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available and exposure estimates for additional subpopulations and COUs.

2.2 Margin of Exposure Approach

EPA used an MOE approach using high-end exposure estimates to determine if the pathway analyzed is a pathway of concern. The MOE is the ratio of the non-cancer hazard value (or point of departure [POD]) divided by a human exposure dose. Acute, intermediate, and chronic MOEs for non-cancer inhalation and dermal risks were calculated using the following equation:

Equation 2-1. Margin of Exposure Calculation

$$MOE = \frac{Non-cancer\ Hazard\ Value\ (POD)}{Human\ Exposure}$$

Where:

MOE	=	Margin of exposure for acute, short-term, or chronic risk comparison (unitless)
$Non-cancer\ Hazard\ Value\ (POD)$	=	Human equivalent concentration (HEC, mg/m^3) or human equivalent dose (HED, in units of mg/kg-day)
$Human\ Exposure$	=	Exposure estimate (mg/m^3 or mg/kg-day)

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total uncertainty factor for each non-cancer POD. The MOE estimate is interpreted as a human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.*, the total uncertainty factor). On the other hand, for this screening level analysis, if the MOE estimate is equal to or exceeds the benchmark MOE, the exposure pathway is not analyzed further. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not "bright-line" indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization.

The non-cancer hazard values used to screen for risk are described in detail in the *Non-Cancer Human Health Hazard Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025h). Briefly, after considering hazard identification and evidence integration, dose-response evaluation, and weight of the scientific evidence of POD candidates, EPA chose one non-cancer POD for acute, intermediate, and chronic exposure scenarios (Table 2-2). Human equivalent concentrations (HECs) are based on daily continuous (24-hour) exposure and human equivalent doses (HEDs) are daily values.

Using the MOE approach in a screening level analysis, an exposure pathway associated with a COU was determined to not be a pathway of concern for non-cancer risk if the MOE was equal to or exceeded the benchmark MOE of 30.

Table 2-2. Non-Cancer Hazard Values Used to Estimate Risks

Exposure Scenario	Target Organ System	Species	Duration	POD (mg/kg-day)	Effect	HED [a] (mg/kg-day)	HEC [a] (mg/m^3) [ppm]	Benchmark MOE	Reference
Acute, intermediate, chronic	Development/ Reproductive	Rat	Continuous exposure for 3-generations	NOAEL = 4.8	↑ Total reproductive tract malformations in F1 and F2 males at 14 mg/kg-d	1.1	6.2 [0.39]	UF_A = 3 UF_H = 10 *Total UF = 30*	TherImmune Research Corporation (2004) Blystone et al. (2010)

HEC = human equivalent concentration; HED = human equivalent dose; MOE = margin of exposure; POD = point of departure; UF = uncertainty factor
[a] EPA used allometric body weight scaling to the ¾-power to derive the HED. Consistent with EPA guidance (U.S. EPA, 2011b), the interspecies uncertainty factor (UF_A), was reduced from 10 to 3 to account remaining uncertainty associated with interspecies differences in toxicodynamics. EPA used a default intraspecies (UF_H) of 10 to account for variation in sensitivity within human populations.

3 LAND PATHWAY

EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data to obtain concentrations of DEHP in terrestrial land pathways (*i.e.*, biosolids, wastewater sludge, agricultural soils, landfills, and landfill leachate). No monitoring data were available from a review of government regulatory and reporting databases related to soil, landfills, or biosolids (*e.g.*, California Environmental Data Exchange Network [CEDEN], Water Quality Portal [WQP]). Several academic experimental and field studies, however, have identified DEHP in various relevant compartments, including leachate, activated sludge, and biosolids. EPA cannot correlate monitoring levels with any releases associated with DEHP TSCA COUs. As such, the present assessment of DEHP exposure potential via land pathways is qualitative in nature relying on the fate and physical and chemical characteristics of DEHP. When possible, data from the existing literature including experimental and field data were used to support the qualitative assessment.

The monitoring studies and analysis presented in the following land pathway sections are for informational purposes and were not used as part of the analysis for quantifying exposure estimates or exposure risk. DEHP was not anticipated to pose a substantial risk of exposure for the general population through the biosolids or land pathways due to the low quantity of DEHP released and the high sorption causing significant retardation in either of the terrestrial system. As such, the assessments were qualitative in nature and were not used to quantitatively determine exposure estimates. The monitoring studies and application estimates presented here were not used as part of the analysis for quantifying exposure estimates and are included for informational and contextual purposes.

3.1 Biosolids

The term "biosolids" refers to treated sludge that meet the EPA pollutant and pathogen requirements for land application and surface disposal and can be beneficially recycled (40 CFR Part 503) (U.S. EPA, 1993). Biosolids generated during the treatment of industrial and municipal wastewater may be land applied to agricultural fields or pastures as fertilizer in either its dewatered form or as a water-biosolid slurry. Biosolids that are not applied to agricultural fields or pastures may be disposed of by incineration or landfill disposal. Landfill disposal will be discussed in further depth in Section 3.2. DEHP may be introduced to biosolids by the absorption or adsorption of DEHP to particulate or organic material during wastewater treatment. Wastewater treatment is expected to remove overt 90 percent of DEHP during wastewater treatment through sorption to biosolids (Berardi et al., 2019; Tran et al., 2014; Shao and Ma, 2009; Fauser et al., 2003; Marttinen et al., 2003). The STPWIN™ Model in EPI Suite™ predicts 94 percent DEHP removal in wastewater treatment with 93.21 percent of removal (out of 94% overall removal) resulting from sorption to activated sludge and solids (U.S. EPA, 2017).

Although DEHP is largely removed through sorption, some small fraction may be metabolized by the microbial community in activated sludge to form several metabolites that may remain in the sludge or stabilized biosolids. The known metabolites of DEHP identified in activated sludge and stabilized biosolids include 2-ethylhexyl phthalate (*i.e.*, monoester variant of DEHP), 2-ethylhexanol, 2-ethylhexanal, and 2-ethylhexonoic acid (Beauchesne et al., 2008). These metabolites can have similar toxicity and environmental fate profiles to DEHP with comparable persistence and partitioning behavior (Beauchesne et al., 2008).

DEHP has been identified in several U.S.- and international-based surveys of wastewater sludge and otherwise stabilized biosolids. The 2006 Targeted National Sewage Sludge Survey conducted by EPA identified DEHP in all 84 of 84 total samples collected from 74 facilities in 35 states. The concentrations of DEHP in dry sludge samples ranged from 657 to 310,000 ng/g (μg/kg) (U.S. EPA, 2009). A similar 2006 survey by the National Toxicology Program Center for the Evaluation of Risks to Human Reproduction found DEHP in sewage sludge samples ranging from 4.2×10^{-4} to 58.3 ng/g (NTP-CERHR, 2006) while a 2008 survey of Canadian wastewater plants identified DEHP in sludge sampling ranging from 15 to 346 ng/g (Beauchesne et al., 2008). A 2012 survey of North American wastewater plants (Canada and United States) identified DEHP in sludge at concentrations ranging from 60.4 to 43,200 ng/g dry weight (dw) (Ikonomou et al., 2012). All studies identified DEHP as the most common and abundant phthalate to be identified in any survey of wastewater plant biosolids (Ikonomou et al., 2012; U.S. EPA, 2009; Beauchesne et al., 2008; NTP-CERHR, 2006). Outside North America, DEHP has been identified in sludge at various concentrations across Europe (Finland, France, Germany, Greece, Spain, Switzerland), Asia (China, Taiwan), and Africa (Morocco, Nigeria) (Zhu et al., 2019b; Net et al., 2015; Meng et al., 2014; IARC, 2013; Beauchesne et al., 2008; ECJRC, 2008; Brandli et al., 2007).

There are currently no U.S.-based studies reporting DEHP concentration in biosolids or in soil following land application, nor has any TRI data been submitted reporting the land application or biosolids or sludges containing DEHP sludge and biosolids containing DEHP have not been reported for uses in surface land disposal or agricultural application. If DEHP containing sludge were used for agricultural or fertilizing applications, they are likely to be persistent in the top layers of incorporated soil with the shortest half-lives reported at 30 to several hundred days (Net et al., 2015). In a 2008 monitoring study of field applications in the European Union (EU) on biosolid applications of sludge containing DEHP, DEHP was persistent in the soil with continuing applications over 25 years and found to remain persistent in the topsoil in the 2 years after halting biosolids land applications (ECJRC, 2008). While DEHP did leach from the uppermost layers of soil deeper into the soil column, DEHP originating from agricultural application did not appear to have contacted nor contaminated any groundwater or surface water sources and instead remained sorbed to soil and organic media or was degraded aerobically (ECJRC, 2008).

Other sources of DEHP in biosolids-amended soils may include atmospheric deposition to soil. While long-range transport and deposition of DEHP in the atmosphere has not been directly monitored, a 2008 EU review noted an increase of DEHP in the topsoil in the years following the halting of land application of sludge to agricultural sites. A similar study evaluating the potential for DEHP to be taken up by crops demonstrated the largest concentration of DEHP on the surface of crop leaves resulting from localized volatilization and subsequent deposition of DEHP from soil and particulate onto the plants shoots and leaves (Müller and Kördel, 1993). The increase in DEHP concentrations was attributed to atmospheric deposition of DEHP released from nearby industrial sites (ECJRC, 2008). Wet and dry deposition of other phthalates, such as DEHP, have been similarly observed directly depositing onto agricultural sites (Zeng et al., 2010; Peters et al., 2008).

DEHP present in soil through the application of biosolids or otherwise introduced to topsoil has limited mobility within the soil column. Potential leaching of DEHP is limited due to the tendency of DEHP to sorb strongly to organic media and soil. Any leaching that does occur in the uppermost soil layers will sorb to soil lower in the column and show minimal potential to interact with groundwater systems. DEHP is not readily taken up by agricultural crop or cover crops planted in soils fertilized with biosolids. Such plants do not readily absorb DEHP from the soil nor do they incorporate DEHP into the roots, shoots, leaves, or fruiting bodies (Müller and Kördel, 1993). DEHP can be present on the surface of any plants growing in the vicinity, however, resulting from localized atmospheric deposition of DEHP transported by the wind or volatizing out of the top layer of soil. Although possible, no studies identified thus far in systematic review have reported that DEHP is susceptible to longer range atmospheric transport resulting in land application of DEHP containing biosolids beyond the immediate region of initial application.

Concentrations of DEHP in soil following agricultural application of municipal biosolids were not identified from TRI or the National Emissions Inventory (NEI) release data, nor were any monitoring studies identified during systematic review. As such, DEHP concentrations in soil were estimated using the concentrations identified in sludge, ranging from 657 to 310,000 ng/g (6.57×10^{-4} to 0.310 g/kg) (U.S. EPA, 2009). Biosolids application rates and frequencies were selected using EPA's recommendation to the public in *Land Application of Biosolids* (see Table 3-1 below) (U.S. EPA, 2000a). Annual application rates ranged from 2 to 100 tons of dry biosolids per application per acre with frequency ranging from three times a year to once every 5 years.

Table 3-1. Typical Biosolids Application Scenarios

Vegetation	Application Frequency ($year^{-1}$)	Application Rate (tons/acre)
Corn	1	5–10
Small grain	1–3	2–5
Soybeans	1	2–20
Hay	1–3	2–5
Forested land	0.2–0.5	5–100
Range land	0. 5–1	2–60
Reclamation sites	1	60–100
Source: *Land Application of Biosolids* (U.S. EPA, 2000a).		

Surface soil concentrations and incorporated concentrations were calculated from the minimum and maximum recommended application rates for each agricultural crop cover (Table 3-2). Minimum (657 ng/g) and maximum (310,000 ng/g) concentrations of DEHP in biosolids were selected from the observed concentrations in biosolids measured during the 2008 EPA National Sewage Survey (U.S. EPA, 2009). The 2008 survey of wastewater by the EPA was determined to have a high confidence level during systematic review. DEHP concentrations in sludge selected from the wastewater sludge monitoring study was not used to quantify exposures estimates in the DEHP risk evaluation document. The information instead provides general insight on the concentrations that may result if biosolids containing DEHP is applied to agricultural land at the recommended application rates at the observed concentrations.

Table 3-2. Estimated DEHP Soil Concentrations Following Application of Biosolids

Crop	Sludge Concentration (mg/kg) [a]	Application Rate (kg/acre) [b]	Frequency ($year^{-1}$) [b]	Surface Concentration (mg/m^2)	Topsoil Concentration (mg/kg) [c d]
Corn	0.66	5,080	1	0.83	0.003
Corn	0.66	10,161	1	1.66	0.007
Corn	310	5,080	1	389	1.56
Corn	310	10,161	1	778	3.13
Hay	0.66	2,032	1	0.33	0.001
Hay	0.66	5,080	3	2.49	0.010
Hay	310	2,032	1	156	0.63
Hay	310	5,080	3	1,167	4.69
Small grains	0.66	2,032	1	0.33	0.001
Small grains	0.66	5,080	3	2.49	0.010
Small grains	310	2,032	1	156	0.63
Small grains	310	5,080	3	1,170	4.69
Soybeans	0.66	5,080	1	0.83	0.003
Soybeans	0.66	20,321	1	3.31	0.013
Soybeans	310	5,080	1	389	1.56
Soybeans	310	20,321	1	1,560	6.25

[a] Source: *Targeted National Sewage Sludge Survey Sampling and Analysis Technical Report* (Data Quality: High Confidence) (U.S. EPA, 2009)
[b] Source: EPA Recommended Application Rates were taken from EPA 832-F-00-064, *Biosolids Technology Fact Sheet: Land Application of Biosolids* (U.S. EPA, 2000a).
[c] Recommended incorporation depth of 7 inches (18 cm) as outlined in 40 CFR Part 503
[d] An average topsoil bulk density value of 2,530 lb/yd^3 (1,500 kg/m^3) was selected from *NRCS Soil Quality Indicators* (USDA NRCS, 2008)

Using the generic application scenarios and biosolids concentrations collected from national surveys, the typical concentration of DEHP in biosolids can range by several orders of magnitude depending largely on the source material and method of application. The surface loading rate for spray or near surface injection applications ranges from 0.33 to 1,557 mg/m^2, while mixing applications (assuming a 7-inch tilling depth) may range from 0.0013 to 6.25 mg/m^3—depending on the application rate, frequency, and applied biosolids concentration.

Once in the soil, DEHP is expected to have a high affinity to particulates (log K_{OC} = 5.4) and organic media (log K_{OW} = 7.60), which would limit mobility from biosolids or biosolid amended soils. Similarly, high sorption to particulate and organics would likely lead to high retardation that would limit infiltration to and mobility within surrounding groundwater systems. DEHP is slightly soluble in water (0.003 mg/L) and has limited potential to leach from biosolids and infiltrate into deeper soil strata. DEHP is unlikely to migrate from potential biosolids-amended soils via groundwater infiltration because of its high hydrophobicity and a high affinity for soil sorption. DEHP has been detected in surface runoff originating from landfills containing DEHP (IARC, 2013) but its limited mobility and high sorption to soil suggests that infiltration of such stormwater runoff would be of minimal concern to deeper groundwater systems.

DEHP is readily biodegradable in soil with an aerobic half-life of 8.7 to 73 days in agricultural soils but can extend as long as 170 days in silty loam soils. Current standardized biodegradability studies indicate that DEHP (1) passes the OECD 10-day biodegradability test with 5 of 7 studies identified during systematic review, indicating 55 to 86 percent degradation over 28 to 29 days (NCBI, 2020; EC/HC, 2015; Stasinakis et al., 2008; Scholz et al., 1997); and (2) has an ultimate biodegradability in soil inoculated with activated sludge and wastewater, similar to the conditions that would be expected in soils amended with biosolids (SRC, 1983). In other unamended soils, DEHP has a longer aerobic half-life ranging from 33 to 468 days (Zhu et al., 2019a; He et al., 2018; Zhu et al., 2018; Carrara et al., 2011; Gejlsbjerg et al., 2001; Cartwright et al., 2000; Schmitzer et al., 1988). DEHP may be similarly degradable in anaerobic soils with an anaerobic half-life ranging from 8.7 days to 31 days in loams and as high as 170 days in silty sands (Yuan et al., 2011; Lindequist Madsen et al., 1999; Rüdel et al., 1993).

There is limited information available on the uptake and bioavailability of DEHP in land-applied soils. DEHP's solubility and sorption coefficients suggest that bioaccumulation and biomagnification will not be of significant concern for soil-dwelling organisms. Similarly, no studies were identified evaluating the bioaccumulation potential of DEHP. DEHP is not expected to have potential for significant bioaccumulation, biomagnification, or bioconcentration in exposed organisms based on the solubility (3×10^{-3} mg/L) and hydrophobicity (log K_{OW} = 7.60; log K_{OC} = 5.4). Studies evaluating the uptake of DEHP into crops planted in DEHP-containing soils did not find DEHP in any of the plant tissues (roots, shoots, leaves) resulting from the uptake via soil or water. Although DEHP has been found on the surface of the plants due to localized atmospheric transport and deposition, it is not readily absorbed by plants directly through the soil (Müller and Kördel, 1993). BAF and BCF were modeled using the BCFBAF™ model in EPI Suite™ with an estimated log BCF ranging from 2.086 to 2.267 (upper-lower trophic levels) and log BAF ranging from 3.017 to 4.24 (upper-lower trophic levels) (U.S. EPA, 2017).

There are limited measured data on concentrations of DEHP in biosolids or soils receiving biosolids, and there is uncertainty that concentrations used in this analysis are representative of all types of environmental releases. However, the high biodegradation rates and physical and chemical properties suggest that DEHP will have limited persistence potential and mobility in soils receiving biosolids.

3.1.1 Weight of Scientific Evidence Conclusions

There is considerable uncertainty in the applicability of using generic release scenarios and wastewater treatment plant modeling software to estimate concentrations of DEHP in biosolids. Additionally, there is uncertainty in the relevancy of the biosolids monitoring data to the COUs considered in this assessment. However, due to the high confidence in the biodegradation rates and physical and chemical data, there is robust confidence that DEHP in soils will not be mobile and will have low persistence potential. The existing literature suggests that DEHP present in biosolid amended soils will likely not be absorbed by any plants or crops growing in the soil. Although field and experimental data are limited, soil dwelling organisms may be exposed to DEHP through soils that have been amended with DEHP containing biosolids applied as fertilizers but are not expected to readily accumulate DEHP through ingestion or absorption.

3.2 Landfills

Landfills are a potential source of chemicals in the environment. DEHP may be deposited into landfills through various waste streams including consumer waste, residential waste, industrial waste, and municipal waste including dewatered wastewater biosolids. This qualitative assessment reviewed readily available information using EPA's systematic review process as well as transport and fate properties to understand potential exposures from landfills.

No studies were identified in systematic review evaluating the concentration of DEHP in waste entering landfills in the United States. A 1997 study of German refuse identified DEHP in residential refuse, with the highest concentration of DEHP present in composite materials (*e.g.*, plastic products) (7,862–26,352 µg/g) and textiles (374–2,035 µg/g) (Bauer and Herrmann, 1997). DEHP was found to be the most abundant phthalate in residential waste, comprising up to 91 percent of the total phthalate mass found in waste products (Bauer and Herrmann, 1997). According to TRI data, DEHP is regularly disposed of in landfills either as refuse or as biosolids submitted by wastewater facilities. Approximately 890,174 lb of DEHP have been disposed to 49 off-site landfills from 2017 to 2022 ranging from 61,113 to 299,013 lb annually (U.S. EPA, 2025e). RCRA Type C landfills received a smaller portion of DEHP, with 10 facilities receiving 14,783 lb of DEHP from 2017 to 2022 with contributions ranging from 301 to 3,979 lb annually (U.S. EPA, 2025e).

DEHP has been identified in several U.S.-based and international surveys of wastewater sludge, composted, and stabilized biosolids. The 2006 Targeted National Sewage Sludge survey conducted by EPA identified DEHP in all 84 total samples collected from 74 facilities in 35 states across the United States. The concentrations of DEHP in dry sludge samples ranged from 657 to 310,000 ng/g (µg/kg) (U.S. EPA, 2009). A similar 2006 survey by the National Toxicology Program Center for the Evaluation of Risks to Human Reproduction found DEHP in sewage sludge samples ranging from 4.2×10^{-4} to 58.3 ng/g (NTP-CERHR, 2006), whereas a 2008 survey of Canadian wastewater plants identified DEHP in sludge sampling ranging from 15 to 346 ng/g (Beauchesne et al., 2008). A 2012 survey of North American wastewater plants (Canada and United States) identified DEHP in sludge at concentrations ranging from 60.4 to 43,200 ng/g dw (Ikonomou et al., 2012). All studies identified DEHP as the most common and abundant phthalate to be identified in any survey of wastewater plant biosolids (Ikonomou et al., 2012; U.S. EPA, 2009; Beauchesne et al., 2008; NTP-CERHR, 2006). Outside of North America, DEHP has been identified in sludge at various concentrations across Europe (Finland, France, Germany, Greece, Spain, Switzerland), Asia (China, Taiwan), and Africa (Morocco, Nigeria) (Zhu et al., 2019b; Net et al., 2015; Meng et al., 2014; IARC, 2013; Beauchesne et al., 2008; ECJRC, 2008; Brandli et al., 2007).

To further understand potential transport and subsequent exposure from this setting, landfills can be divided into two zones: (1) "upper landfill" zones with normal environmental temperatures and pressures, where biotic processes are the predominant route of degradation for DEHP; and (2) "lower landfill" zones where elevated temperatures and pressures exist, and abiotic degradation is the predominant route of degradation. In the upper-landfill zone where oxygen can still be present in the subsurface, conditions may be favorable for aerobic biodegradation. However, photolysis is not considered to be a significant source of degradation in this zone. In the lower landfill zone, conditions are assumed to be anoxic, and temperatures present in this zone are likely to inhibit anaerobic biodegradation of DEHP. Temperatures in lower landfills may be as high as 70 °C; At temperatures at and above 60 °C, biotic processes are significantly inhibited and are likely to be completely inhibited at 70 °C (Huang et al., 2013). Hydrolysis may still degrade DEHP in the lower landfill even with the elevated temperatures. Photolysis, however, will only impact degradation on the outermost surface of the landfill where DEHP may be exposed to sunlight prior to daily capping. Once the daily cap has been applied, the lack of light penetration would prevent further photolysis.

DEHP is capable of leaching from bioreactors simulating landfill conditions using residential waste. The maximum recorded leaching potential is one gram of DEHP per ton of refuse in benchtop leaching studies (Bauer and Herrmann, 1997). DEHP has been measured in landfill leachate at concentrations ranging from 0.01 to 200 μg/L and in stormwater runoff from municipal landfills at concentrations ranging from 7 to 39 μg/L (IARC, 2013). DEHP is expected to have a high affinity to particulate (log K_{OC} = 5.4) and organic media (log K_{OW} = 7.60), which would cause significant retardation in groundwater and limit leaching to groundwater. DEHP is not expected to significantly migrate from landfills through groundwater infiltration because high hydrophobicity and high affinity for soil sorption is expected to retard or immobilize DEHP in the surrounding soil. Nearby surface waters, however, may be susceptible from surface water runoff which has picked up DEHP during overland flow if it is not captured before entering the receiving water body.

Although persistence in landfills has not been directly measured, DEHP can undergo abiotic degradation via carboxylic acid ester hydrolysis to form 2-ethylhexanol (major product) and 2-ethylhexyl phthalate (minor product) (U.S. EPA, 2017). Hydrolysis is not expected to be a significant degradation pathway in landfills with an estimated half-life of 36 years under standard environmental conditions (at pH 7 and 20 °C) (U.S. EPA, 2017). Temperature in lower landfills, however, often exceed 20 °C and are present in a complex leachate matrix. In such matrices, temperature, pressure, ionic strength, and chemical activity may all effect the hydrolysis rate of DEHP. With the very limited data available, the hydrolysis rate of DEHP cannot reliably be estimated in the complex conditions present in lower landfills. Chemical rates of reaction, in general, tend to increase as temperature, pressure, and chemical activity increase.

DEHP can be degraded biologically in the upper-landfill zone to form several different metabolites through aerobic respiration—including 2-ethylhexyl phthalate, 2-ethylhexanol, 2-ethylhexanal, and 2-ethylhexonoic acid (Beauchesne et al., 2008). In the lower-landfill zone, high temperatures (>60 °C) and low water content may partially or completely inhibit biological degradation (Huang et al., 2013). DEHP is readily degradable in aerobic, moist soils comparable to conditions similar to upper landfills with an aerobic half-life of 33 to 468 days (Zhu et al., 2019a; He et al., 2018; Zhu et al., 2018; Carrara et al., 2011; Gejlsbjerg et al., 2001; Cartwright et al., 2000; Schmitzer et al., 1988). DEHP is more similarly degraded under anaerobic conditions such as those that would exist in lower landfills with an anaerobic half-life reported at 8.7 to 170 days (Yuan et al., 2011; Lindequist Madsen et al., 1999; Rüdel et al., 1993). In landfills with high leachate production, DEHP can be more persistent with a half-life in anaerobic, saturated sediments ranging from 22.8 days to non-degradable in the most persistent cases (Lertsirisopon et al., 2006; Kao et al., 2005; Yuan et al., 2002; Painter and Jones, 1990; Johnson et al., 1984). However, areas saturated with leachate are likely in the lowest sections of the landfill, where temperatures exceed the habitable zones for most microorganisms capable of degrading DEHP (Huang et al., 2013).

DEHP's solubility and sorption coefficients suggest that bioaccumulation and biomagnification will not be of significant concern for soil-dwelling organisms adjacent to landfills. BAF and BCF were modeled using the BCFBAF™ model in EPI Suite™ with an estimated log BCF ranging from 2.086 to 2.267 (upper-lower trophic levels) and log BAF ranging from 3.017 to 4.24 (upper-lower trophic levels) (U.S. EPA, 2017). DEHP, however, is not expected to have potential for significant bioaccumulation, biomagnification, or bioconcentration in exposed organisms. Studies evaluating the uptake of DEHP into crops planted in DEHP containing soils found that DEHP was not found in any of the plant tissues (roots, shoots, leaves) resulting from the uptake via soil or water. Although DEHP has been found on the surface of the plants due to localized atmospheric transport and deposition, it is not readily absorbed by plants directly through the soil (Müller and Kördel, 1993).

3.2.1 Weight of Scientific Evidence Conclusions

There is uncertainty in the relevancy of the landfill leachate monitoring data to the COUs considered in this assessment. Based on the biodegradation and hydrolysis data for conditions relevant to landfills, there is high confidence that DEHP will be persistent in landfills. Overall, due to high-quality physical and chemical property data, there is robust confidence that DEHP is unlikely to be present in landfill leachates. The existing literature suggests that DEHP present in landfills will likely not be absorbed by any nearby plants. Although experimental data are limited, the available data supports the likelihood that soil dwelling organisms will be exposed to DEHP in amended soils but will not accumulate in landfills as a result of disposal of biosolids or refuse.

4 SURFACE WATER CONCENTRATION

EPA searched peer-reviewed literature, gray literature, and databases of environmental monitoring data to obtain concentrations of DEHP in ambient surface water and aquatic sediments. Although the available monitoring data were limited, DEHP was found in detectable concentrations in ambient surface waters, finished drinking water, and in aquatic sediments. In addition, industrial releases of DEHP to surface waters were either reported to EPA via TRI and DMR databases or estimated using generic scenarios (U.S. EPA, 2025e). The Agency modeled DEHP concentrations in surface water to assess the expected resulting environmental media concentrations from TSCA COUs presented in Table 1-1. Section 4.1 presents EPA-modeled surface water concentrations and modeled sediment concentrations; Section 4.2.1 includes a summary of monitoring concentrations for ambient surface water; and Section 4.2.2 includes monitoring concentrations for sediment found from the systematic review process.

Federal effluent limitation guidelines (ELGs) regulate the maximum allowable levels of concentrations achievable with treatment for certain chemicals across various industry sectors and processes. ELGs established in 40 CFR 414 and 40 CFR 437 for the point source category of Organic Chemicals, Plastics and Synthetic Fibers, and Centralized Waste Treatment limit effluent releases of DEHP to: 215 to 279 µg/L daily maximum concentration; and 95 to 158 µg/L maximum monthly average concentration. DEHP is also included in a Total Toxic Organics (TTO) ELG, which is a limit of the sum of multiple chemicals. Some of the processes included in OES evaluated in this assessment are subject to established ELGs, including Waste handling, treatment, and disposal; Rubber manufacturing; Application of paints and coatings; Manufacturing; Incorporation into formulation, mixture or reaction product. However, some of the other OES evaluated in this assessment, and certain processes within the OES listed here, fall outside of the category covered by these regulatory limits. EPA also has established ambient water quality criteria (AWQC) for DEHP, which protect the designated uses of waters. EPA's AWQC are not national regulatory limits but inform limits that States and authorized Tribes set for point source discharges regulated under the National Pollutant Discharge Elimination System (NPDES) program. As stated in the AWQC for DEHP (U.S. EPA, 2015b), for noncarcinogenic toxicological effects for consumption of water and organisms the AWQC is 50 µg/L while for consumptions of organisms only it is 60 µg/L. The human health AWQC for carcinogenic effects of DEHP is 0.32 µg/L for consumption of water and organisms and 0.37 µg/L for consumption of organisms only. EPA recommends the lower AWQC of 0.32 µg/L for consumption of water and organisms and 0.37 µg/L for consumption of organisms only for DEHP. Although the ELGs and AWQC may not directly represent releases associated with all OES, they provide helpful context to EPA's modeled results.

4.1 Modeling Approach for Estimating Concentrations in Surface Water

EPA conducted modeling using the EPA's Variable Volume Water Model (VVWM) in Point Source Calculator (PSC) tool (U.S. EPA, 2019c) to estimate surface water and sediment concentrations of DEHP resulting from TSCA COU releases. PSC inputs include physical and chemical properties of DEHP (*i.e.*, K_{OW}, K_{OC}, water column half-life, photolysis half-life, hydrolysis half-life, and benthic half-life) and reported or estimated DEHP releases to water (U.S. EPA, 2025e), which are used to predict receiving water column concentrations. PSC was also used to estimate DEHP concentrations in settled sediment in the benthic region of streams.

Site-specific parameters influence how partitioning occurs over time. For example, the concentration of suspended sediments, water depth, and weather patterns all influence how a chemical may partition between compartments. However, physical and chemical properties of the chemical itself have a major influence on partitioning and half-lives in aqueous environments. DEHP has a log K_{OC} of 5.4 indicating a high potential to sorb to suspended particles in the water column and settled sediment in the benthic environment (U.S. EPA, 2017).

Physical and chemical, and environmental fate properties selected by EPA for this assessment were used as inputs to the PSC model (Table 4-1). Selected values are described in detail in the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g).

Table 4-1. PSC Model Inputs (Chemical Parameters)

Parameter	Value[a]
K_{OC}	262,000 mL/g
Water Column Half-Life	10 days at 25 °C
Photolysis Half-Life	0.24375 days at 30° N latitude
Hydrolysis Half-Life	195 days at 25 °C
Benthic Half-Life	90 days at 25 °C
Molecular Weight	390.564 g/mol
Vapor Pressure	0.000000142 torr
Water Solubility	0.003 mg/L
Henry's Law Constant	0.000171 atm·m^3/mol
Heat of Henry	66,512 J/mol
Reference Temperature	25 °C

[a] For details on selected values, see *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g).

A common setup for the model environment and media parameters was applied consistently across all PSC runs. The standard EPA "farm pond" water body characteristics were used to parameterize the water column and sediment parameters (Table 4-2.), which is applied consistently as a conservative screening scenario. Standardized water body model cell geometry was also applied consistently across runs, with a standardized width of 5 m, length of 40 m, and depth of 1 m, representing a small section of the receiving stream. Only the release parameters (daily release amount and days of release) and the hydrologic flow rate were changed between model runs for this chemical to reflect facility-specific release conditions.

Table 4-2. Standard EPA "Farm Pond" Waterbody Characteristics for PSC Model Inputs

Parameter	Value
DFAC (represents the ratio of vertical path lengths to depth as defined in EPA's exposure analysis modeling system [EXAMS]) (U.S. EPA, 2019c))	1.19
Water Column Suspended Sediment	30 mg/L
Chlorophyll	0.005 mg/L
Water Column f_{oc} (fraction of organic carbon associated with suspended sediment)	0.04
Water Column Dissolved Organic Carbon (DOC)	5.0 mg/L
Water Column Biomass	0.4 mg/L
Benthic Depth	0.05 m

Parameter	Value
Benthic Porosity	0.50
Benthic Bulk Density	1.35 g/cm^3
Benthic f_{oc}	0.04
Benthic DOC	5.0 mg/L
Benthic Biomass	0.006 g/m^2
Mass Transfer Coefficient	0.00000001 m/s

A required input for the PSC model is the hydrologic flow rate of the receiving water body. For facilities reporting releases to TRI, relevant flow data from the associated receiving water body were collected. Databases that were queried to estimate a flow rate include EPA's ECHO that contains facilities with a National Pollutant Discharge Elimination System (NPDES) permit, National Hydrography Dataset Plus (NHDPlus), and NHDPlus V2.1 Flowline Network Enhanced Runoff Method (EROM) Flow. For facilities that did not report releases to TRI, EPA cannot identify the receiving water bodies and their location-specific hydrological flow data. Thus, the Agency generated a distribution of flow metrics by collecting flow data for facilities across North American Industry Classification System (NAICS) codes relevant to phthalate releases to surface water. The same databases were queried. This modeled distribution of hydrological flow data is specific to an industry sector rather than a facility but provides a reasonable estimate of the distribution of location-specific values. The complete methods for retrieving and processing flow data are detailed in Appendix B.

Different hydrological flow rates were used for different exposure scenarios. The 30Q5 flows (*i.e.*, the lowest 30-day average flow that occurs in a 5-year period) are used to estimate acute, incidental human exposure through swimming or recreational contact. The annual average flow represents long-term flow rates, but a harmonic mean provides a more conservative estimate and is preferred for assessing potential chronic human exposure via drinking water. The harmonic mean is also used for estimating human exposure through fish ingestion because it takes time for chemical concentrations to accumulate in fish. Lastly, for aquatic or ecological exposure, a 7Q10 flow (*i.e.*, the lowest 7-day average flow that occurs in a 10-year period) is used to estimate exceedances of concentrations of concerns for aquatic life (U.S. EPA, 2007). The regression equations for deriving the harmonic mean and 7Q10 flows are provided in Appendix B.

Receiving water body DEHP concentrations were estimated at the point of release (*i.e.*, in the immediate receiving water body receiving the effluent). For this conservative screening analysis, EPA utilized releases associated with the Use of automotive care products OES, which were modeled using a generic scenario. This OES was chosen as an appropriate OES for a screening level assessment based on it resulting in a conservatively high surface water concentration based on high volumes of releases paired with an assumption of a low flow (P50) in the receiving water body, with environmental concentrations exceeding those estimated in all other OES. Additionally, the generic release scenario for the Use of automotive care products OES estimates a combined release to POTW or landfill. Because the proportion of the release from Use of automotive care products OES to just surface water could not be determined from reasonably available information, EPA assumed that all of the release would be directly discharged to surface water, to represent an upper-bound of surface water concentrations. However, because the release was associated with a POTW there is a reasonable assumption of wastewater treatment.

Although Use of automotive care products OES was utilized for screening purposes, EPA prioritized use of actual release data from reporting facilities where overall confidence in the estimates would be higher. For estimating surface water concentrations from releases, the Agency prioritized the use of TRI annual release reports over DMR monitoring data, reviewing DMR period data as supporting information for the releases reported to TRI. Therefore, EPA estimated surface water concentrations from Plastic compounding OES that had release data collected from TRI and DMR databases. EPA's process for selecting the Use of automotive care products OES and Plastic compounding OES is detailed in Section 4.4 along with the confidence in using the surface water concentrations for the purpose of a screening level assessment. Table 4-3 below shows the surface water concentration modeled from the Plastic compounding and Use of automotive care products OES using the 7Q10 flow.

Table 4-3. Water and Benthic Sediment in the Receiving Waterbody, Applying 7Q10 Flow

OES	Number of Operating Days Per Year	Daily Release (kg/day)[a]	7Q10 Total Water Column Concentration (µg/L)	7Q10 Benthic Pore Water Concentration (µg/L)	7Q10 Benthic Sediment Concentration (µg/kg)
Use of automotive care products (generic scenario P50 flow)	260	0.37	217 [b]	112 [b]	1,180,000
Plastic compounding (TRI)	246	0.0148	16.0 [b]	7.98 [b]	83,800

[a] Details on operating days and daily releases are provided in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e)
[b] This value is above the water solubility limit for DEHP, which EPA estimates at 0.003 mg/L.

The OES with the highest total water column concentrations (Use of automotive care products) was additionally run under harmonic mean and 30Q5 flow conditions (Table 4-4). EPA traditionally applies a 7Q10 flow for ecological assessments, which represents a low-end flow condition. For chronic drinking water exposures, a harmonic mean flow estimate (a conservative average) is applied, and for incidental general population exposures and acute drinking water exposure, a 30Q5 low flow is applied to screen for risks to human health. The Use of automotive care products OES was appropriate for screening as the releases associated with it yielded the highest 30Q5 and harmonic mean concentrations. The 30Q5 and harmonic mean concentrations are also presented for the Plastic compounding OES as it is based on releases reported to TRI.

Table 4-4. PSC Modeling Results for Total Water Column Using Harmonic Mean Flow and 30Q5 Flow

Scenario	Release Estimate (kg/day) [a]	Harmonic Mean Flow (m^3/d)	30Q5 Flow (m^3/d)	Removal Efficiency Applied (%)	Harmonic Mean Concentration (µg/L)	30Q5 Concentration (µg/L)
Plastic compounding (TRI)	0.0148	3,170	1,050	0.00	4.11 [b]	10.3 [b]
Use of automotive care products (generic scenario P50 flow)	0.37	3,917	2,570	0.00	92.0 [b]	140 [b]

[a] Details on operating days and daily releases are provided in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e)
[b] This value is above the water solubility limit for DEHP, which EPA estimates at 0.003 mg/L.

4.2 Measured Concentrations

EPA identified monitoring studies through systematic review to provide context to modelling results. The monitoring studies presented here were not used as part of the analysis for quantifying exposure estimates. Measured concentrations of DEHP in surface water and sediment are presented in Section 4.2.1 and 4.2.2, respectively.

4.2.1 Measured Concentrations in Surface Water

Four U.S. studies that examined DEHP in surface water were identified (NWQMC, 2021; Elliott et al., 2017; Bargar et al., 2013; Liu et al., 2013) (Table 4-5). In March 2008 through June 2009, Liu et al. (2013) assessed the spatial distribution of phthalates in Lake Pontchartrain, Louisiana, before, during, and after opening of the Bonnet Carré Spillway that occurred April to May 2008. Forty-two freshwater samples were collected from the Bonnet Carré Spillway at six sites located about 1 mile apart. DEHP was detected in 24 percent of these samples with concentrations ranging from nondetect to 12 µg/L. Fifty-four samples were also collected from the central lake area at six sites located near Lake Maurepas to the Causeway Bridge, with one site near the Manchac Pass. DEHP was detected in 32 percent of these samples with concentrations up to 18.2 µg/L.

For the central lake area, the authors reported that concentrations of phthalates, including DEHP, were close to zero before opening of the spillway, increased significantly after opening of the spillway, and dropped back down to almost zero a year following the spillway opening. For the Bonnet Carré Spillway area, the authors reported that phthalate levels were high even before the spillway opened due to freshwater flows from the Mississippi River, but levels dropped close to zero a year following the spillway opening. Samples collected in June 2009 showed phthalate increases once again, likely from a combination of rain/stormwater, industrial discharges, and inputs from the Mississippi River (Liu et al., 2013).

A U.S. study conducted by Elliott et al. (2017) reported concentrations of DEHP in freshwater samples collected from 12 tributaries to the Laurentian Great Lakes. Sample sites represented a mix of uses from watersheds with relatively little human disturbance to watersheds with urban and agricultural land uses. DEHP was detected infrequently (1% of samples) with a maximum concentration of 8.6 µg/L found in the Raquette River in a sample collected below the Potsdam WWTP in New York.

A study conducted in St. John, U.S. Virgin Islands, reported concentrations of DEHP in sea water (Bargar et al., 2013). Marine waters from four sampling locations were collected from coral reefs of Virgin Islands National Park (Hawksnest Bay, Tektite Reef, and Whistling Cay) and Virgin Islands Coral Reef National Monument (Round Bay). Authors reported that Whistling Cay was selected because it is likely to have minimal tourism impact. DEHP was detected in Whistling Cay at an estimated concentration of 820 ng/L, and at concentrations below the method detection limit (<280 ng/L) at the other three sampling locations.

EPA STOrage and RETrieval (STORET) data were obtained through the Water Quality Portal (WQP) (NWQMC, 2021), which houses publicly available water quality data from the U.S. Geological Survey (USGS), EPA, and state, federal, Tribal, and local agencies. Since 2004, the maximum level in water (940 µg/L) came from a sample collected in Indiana in 2008; details related to this sample and its location are unclear.

Monitored surface water concentrations were sometimes above the water solubility of DEHP. That is because phthalate esters can form colloidal suspensions in water, leading to erroneously high measurements of DEHP's water solubility via methods such as slow-stir or shake flask (see the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g)). Therefore, review of analytical methods is important for determining the suitability of the monitoring data. The data from WQP (NWQMC, 2021) only provided information on the analytical instrument used to analyze the surface water, which leaves significant uncertainties for consideration in this assessment. EPA reviewed the second highest surface water concentration from Liu et al. (2013) and identified several uncertainties concerning the analytical methods used in this study as well. The water concentration was above the selected water solubility (3.0×10^{-3} mg/L), which suggests that the higher DEHP concentration captured may be as a result of colloidal suspension, partially attributed to the salinity of the water; sorption/association with dissolved organics; and sorption to particulate matter, that then desorbs during the solid-phase microextraction (SPME).

Table 4-5. Summary of Measured DEHP Concentrations in Surface Water

Reference	Sampling Location	DEHP Concentration	Sampling Notes	Study Quality Rating
Liu et al. (2013)	United States	Bonnet Carré Spillway (6 locations; n = 42) FOD: 24% <0.4–12 µg/L Central lake area (6 locations; n = 54) FOD: 32% <0.4–18.2 µg/L	Freshwater samples from Lake Pontchartrain, LA, before, during, and after opening of the Bonnet Carré Spillway that occurred April/May 2008, March 2008–June 2009	Medium
Elliott et al. (2017)	United States	FOD: 1% (n = 291) <2–8.6 µg/L	Freshwater samples from 12 tributaries to the Laurentian Great Lakes, 2013–2014	Medium
Bargar et al. (2013)	St. John, U.S. Virgin Islands	Hawksnest Bay, Round Bay, Tektite Reef <280 ng/L Whistling Cay 820 ng/L	Sea water samples around coral reefs of Virgin Islands National Park and Virgin Islands Coral Reef National Monument, 2010	Medium

Reference	Sampling Location	DEHP Concentration	Sampling Notes	Study Quality Rating
Water Quality Portal (WQP) (NWQMC, 2021) [a]	United States	Overall: ND–940 µg/L Maximum levels by media subdivision (µg/L): 940 (unspecified); 310 (groundwater); 150 (surface water); 20 (stormwater); 18 (wastewater)	U.S. STOrage and RETrieval (STORET) water quality data, 2004 and after	Medium
FOD = frequency of detection; ND = non-detect [a] Represents samples dated 2004 and after. Values where "result sample fraction" is "total," and "result status identifier" is "final." Results presented by media subdivision if media subdivision was specified. Results may be estimated or actual results.				

4.2.2 Measured Concentrations in Sediment

Two studies from the United States that examined DEHP in sediment were identified (Crane, 2019; Elliott et al., 2017) (Table 4-6). In the survey conducted by Crane et al. (2019), composite sediment samples from 15 urban stormwater ponds in the Minneapolis-St. Paul, MN metropolitan area were sampled in the fall of 2009. DEHP was detected in 60 percent of the samples at mean (±SD) concentration of 2.5 (±1.9) mg/kg dw, with the highest concentrations being in the stormwater pond sediments. The authors reported that DEHP was the only phthalate detected in 9 of the 15 ponds and acknowledged it is a common pollutant in urban stormwater.

Another U.S. study, Elliott et al. (2017), reported concentrations of DEHP in bottom sediment samples from 12 tributaries to the Laurentian Great Lakes collected in 2013 and 2014. As described above, sample sites represented a mix of uses from watersheds with relatively little human disturbance to watersheds with urban and agricultural land uses. A total of 80 sediment samples were collected, 77 of which were assessed for DEHP. DEHP was detected in 22 percent of samples at a maximum concentration of 2,650 µg/kg, with the highest levels found in samples from Saginaw, Oswegatchie, and Raquette.

EPA STORET sediment data (surface, subsurface, or unspecified submatrices) since 2004 were obtained through the WQP (NWQMC, 2021). The overall maximum level in sediment came from a sample collected in 2005 as part of EPA Region 6 Katrina Emergency Monitoring Data. Multiple DEHP detects greater than 100,000 µg/kg were found during 2004 to 2008 sampling activities at the EPA Region 10 Superfund Portland Harbor Site.

Table 4-6. Summary of Measured DEHP Concentrations in Sediment

Reference	Sampling Location	DEHP Concentration	Sampling Notes	Study Quality Rating
Crane (2019)	United States	FOD: 60% (n = 15) Mean (±SD): 2.5 (±1.9) mg/kg dw	Composite sediment samples from 15 urban stormwater ponds in the Minneapolis-St. Paul, MN metropolitan area, 2009	Medium
Elliott et al. (2017)	United States	FOD: 22% (n = 77) <165–2,650 µg/kg	Bottom sediment samples from 12	Medium

Reference	Sampling Location	DEHP Concentration	Sampling Notes	Study Quality Rating
			tributaries to the Laurentian Great Lakes, 2013–2014	
Water Quality Portal (WQP) (NWQMC, 2021)[a]	United States	Overall: ND–699,000 µg/kg Maximum levels by media subdivision (µg/kg): 699,000 (unspecified); 40,500 (surface); 6,700 (subsurface)	STOrage and RETrieval (STORET) sediment data, 2004 and after	Medium
FOD = frequency of detection; ND = non-detect; dw = dry weight [a] Represents samples dated 2004 and after and values where "result sample fraction" is "total" and "result status identifier" is "final." Results presented by media subdivision if media subdivision was specified. Results may be estimated or actual results.				

4.3 Evidence Integration for Surface Water and Sediment

4.3.1 Strengths, Limitations, and Sources of Uncertainty for Modeled and Monitored Surface Water Concentration

EPA conducted modeling with PSC to estimate concentrations of DEHP within surface water and sediment. PSC considers model inputs of physical and chemical properties of DEHP (*i.e.*, K_{OW}, K_{OC}, water column half-life, photolysis half-life, hydrolysis half-life, and benthic half-life) and allows EPA to estimate sediment concentrations. The use of vetted physical and chemical properties of DEHP increases confidence in the application of the PSC model. Only the chemical release amount, days-on of chemical release, and the receiving water body hydrologic flow were changed for each COU/OES. A standard EPA water body was used to represent a consistent and conservative receiving water body scenario.

The modeled data represent estimated surface water concentrations near actual facilities that are actively releasing DEHP to surface water, while the reported measured concentrations represent sampled ambient water concentrations of DEHP. Differences in magnitude between modeled and measured concentrations may be due to measured concentrations not being geographically or temporally close to known releases of DEHP. In addition, when modeling generic scenarios with PSC, EPA assumed all releases were directly discharged to surface waters without prior treatment, and that no releases were routed through publicly owned treatment works prior to release. EPA recognizes that this is a conservative assumption that results in no removal of DEHP prior to release to surface water. Direct releases to surface water reported via TRI and DMR were applied as the actual loading to surface water, including any onsite treatment prior to discharge.

Concentrations of DEHP within the sediment were estimated using the highest 2015 to 2020 annual releases and estimates of 7Q10 hydrologic flow data for the receiving water body that were derived from NHD-modeled EROM flow data. The 7Q10 flow represents the lowest 7-day flow in a 10-year period and is a conservative approach for examining a condition where a potential contaminate may be predicted to be elevated due to periodic low-flow conditions. Surrogate flow data collected via the EPA ECHO API (Application Programming Interface) and the NHDPlus V2.1 EROM flow database include self-reported hydrologic reach codes on NPDES permits and the best available flow estimations from the EROM flow data. The confidence in the flow values used, with respect to the universe of facilities for which data were pulled, should be considered moderate-to-robust. However, there is uncertainty in how representative the median flow rates are as applied to the facilities and COUs represented in the DEHP release modeling. Additionally, a regression-based calculation was applied to estimate flow statistics from NHD-acquired flow data, which introduces some additional uncertainty. EPA assumes that the results presented in this Section include a bias toward overestimation of resulting environmental concentrations due to conservative assumptions chosen because of the uncertainties.

4.4 Weight of Scientific Evidence Conclusions

For the screening level assessment, EPA utilized releases associated with the Use of automotive care products OES as it resulted in the highest surface water concentrations. EPA also utilized release associated with the Plastic compounding OES which were reported releases to TRI. EPA determined the surface water concentration associated with these OES represented conservative exposure scenarios appropriate to use in its screening level assessment to assess all other OESs and their associated COUs.

EPA utilized daily release information to estimate surface water concentrations for use in general population and environmental exposure assessment. As discussed in further detail in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e), EPA estimated a range for daily releases for each OES when possible. The Agency was not able to estimate site-specific releases for the final use of products or articles OES. Disposal sites handling post-consumer end-use DEHP were not quantifiable due to the wide and dispersed use of DEHP in PVC and other products. Pre-consumer waste handling, treatment, and disposal are assumed to be captured in upstream OES. Many OESs had releases estimated using release data from reporting facilities. EPA compiled release information using reported releases from TRI, DMR, and NEI, which were determined to have a high data quality rating through EPA's systematic review process and a weight of scientific evidence conclusion of moderate to robust across releases for the various OESs. One limitation noted was that it is uncertain the extent to which sites not captured in these databases release DEHP into the environment. Additionally, not all OESs are represented in these databases.

For OES that did not have reported release data, releases were estimated using generic scenarios and emission scenario documents. For releases that use GSs/ESDs, EPA concluded the weight of scientific conclusion was slight to moderate as described in *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e). To estimate surface water concentration, modeled releases were paired with a distribution of generic flows that best represented the OES assessed (Appendix B). Although a specific flow value could not be selected based on reasonably available data, EPA has slight to moderate confidence that using the flow distribution (P50, P75, P90), the surface water concentrations estimated represent possible environmental concentrations.

Three OESs (Use of laboratory chemicals, Use of automotive care products, and Use in hydraulic fracturing) had modeled releases from generic scenarios for the following type of discharge: surface water; water, incineration, or landfill; and POTW or Landfill. For the releases categorized as releasing to multiple media types, EPA could not differentiate the proportion of DEHP released only to surface water. For these generic scenario OESs, there was insufficient data precision to quantify estimated releases specifically to surface water. Therefore, EPA performed a conservative analysis in which the total estimated multimedia release amount was assumed to be discharged to surface water for the Use of laboratory chemicals Use of automotive care products OESs. For the Use in hydraulic fracturing OES, the surface water concentrations were lower than the high-end release associated with the Use of automotive care products applied for a screening level assessment. EPA has slight confidence in the estimated value of the surface water concentrations when making such an assumption. However, using a conservative assumption of releases all going to water alongside the assumptions of a low flow receiving waterbody and no wastewater treatment, EPA has robust confidence that the surface water concentrations estimated are appropriate for use in a screening evaluation.

Table 4-7 below identifies the data available for use in modeling surface water concentrations for each OES and EPA's confidence in the estimated surface water concentrations used for exposure assessment. For the screening level general population assessment, the Agency identified the OES (Use of automotive care products) that resulted in the highest surface water concentrations, highlighted in the table below, to assess exposure using 7Q10 (Table 4-3), HM, and30Q5 flow (Table 4-4). However, EPA also assessed surface water concentrations based on the Plastic compounding OES, which had releases reported to TRI. EPA prioritized use of actual release data from reporting facilities, where overall confidence in the estimates would be higher. For estimating concentrations from releases, the Agency prioritized the use of TRI annual release reports over DMR monitoring data, reviewing DMR period data as supporting information for the releases reported to TRI. Releases from facilities reporting via TRI Form A, which represents undefined releases to unspecified media types, less than 500 lb per year, were not directly modeled. For the purpose of the tiered approach taken for the general population analysis, environmental concentrations from potential releases to surface water from facilities reporting via TRI Form A were expected to be lower than the high-end concentrations applied for screening.

For facilities reporting releases to TRI, relevant flow data from the associated receiving water body were collected by querying multiple EPA databases and permit IDs under NPDES. The flow data include self-reported hydrologic reach codes on NPDES permits and the best available flow estimates from EPA and USGS databases. Other model inputs were derived from reasonably available literature collected and evaluated through EPA's systematic review process for TSCA risk evaluations. All monitoring and experimental data included in this analysis were from articles rated "medium" or "high" quality from this process.

Based on the weight of scientific evidence conclusions regarding confidence in the release estimates from facilities and the associated receiving water body and hydrologic flow information described in the preceding paragraphs, EPA proceeded with the use of TRI data for modeling surface water concentrations with greater confidence. In considering the various OESs for use in a screening assessment, EPA identified Use of automotive care product as appropriate for use as it resulted in a high-end surface water concentration. However, EPA also utilized the Plastic compounding OES as it resulted in a high-end surface water concentration based on reporting data for actual facilities. Additionally, release concentrations were estimated at the point of release in the receiving water body, as a conservative assumption to evaluate the upper end of potential exposure concentrations for a given release. Overall, EPA has robust confidence that the high-end estimated surface water concentration modeled using the Use of automotive care products and Plastic compounding OES are both appropriate to use in its screening level assessment of the general population surface water exposure pathway. The releases from all other OESs and their associated COUs, including OESs and COUs with releases that could not be quantified and those with releases modeled from generic scenarios, are expected to result in lower environmental concentrations in surface water.

Table 4-7. Summary of Weight of Scientific Evidence Associated with each OES

OES[a]	Water Release Data Type	Weight of Scientific Evidence
Manufacture	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DEHP. PSC inputs include physical and chemical properties of DEHP that received a high confidence rating and a reported DEHP release from TRI that received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Rubber manufacturing	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DEHP. PSC inputs include physical and chemical properties of DEHP that received a high confidence rating and a reported DEHP release from TRI that received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Plastic converting	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DEHP. PSC inputs include physical and chemical properties of DEHP that received a high confidence rating and a reported DEHP release from TRI that received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Plastic compounding[b]	TRI	EPA conducted modeling using the PSC tool to estimate surface water and sediment concentrations of DEHP. PSC inputs include physical and chemical properties of DEHP which received a high confidence rating and reported DEHP releases from TRI which received a moderate to robust rating. Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate to robust.
Incorporation into formulation, mixture, or reaction product	TRI	All reported releases to TRI within this OES were via Form A. Due to EPA's high confidence that such releases to surface water, if present, would not exceed the high-end releases applied for screening, no quantitative estimate of surface water release concentrations was conducted for this OES.
Repackaging	TRI	All reported releases to TRI within this OES were via Form A. Due to EPA's high confidence that such releases to surface water, if present, would not exceed the high-end releases applied for screening, no quantitative estimate of surface water release concentrations was conducted for this OES.
Application of paints, coatings, adhesives, and sealants	DMR	No reported releases to TRI, and review of DMR period data demonstrated lower release concentrations than high-end releases applied for screening. Due to limited annual data and low reported concentrations in effluent, no quantitative estimate of surface water release concentrations was conducted for this OES.
Textile finishing	TRI/DMR	One TRI facility reported no surface water discharge, and review of DMR period data demonstrated lower release concentrations than high-end releases applied for screening. Due to limited annual data and low reported concentrations in effluent, no quantitative estimate of surface water release concentrations was conducted for this OES.

OES[a]	Water Release Data Type	Weight of Scientific Evidence
Use of dyes and pigments, and fixing agents	DMR	No reported releases to TRI, and review of DMR period data demonstrated lower release concentrations than high-end releases applied for screening. Due to limited annual data and low reported concentrations in effluent, no quantitative estimate of surface water release concentrations was conducted for this OES.
Application of paints, coatings, adhesives, and sealants (formulations for diffusion bonding)	DMR	No reported releases to TRI, and review of DMR period data demonstrated lower release concentrations than high-end releases applied for screening. Due to limited annual data and low reported concentrations in effluent, no quantitative estimate of surface water release concentrations was conducted for this OES.
Use of laboratory chemicals	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA was unable to model releases to just surface water, EPA performed a conservative analysis in which the total estimated multimedia release amount was assumed to be discharged to surface water. For this scenario, the modeled release concentrations were less than the highest modeled releases applied for screening.
Use of automotive care products[c]	Generic Scenario (multimedia)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Because EPA was unable to model releases to just surface water, EPA performed a conservative analysis in which the total estimated multimedia release amount was assumed to be discharged to surface water. For this scenario, EPA included the resulting concentrations in the high-end screening analysis, which results in slight confidence in any subsequent risk identified, but EPA has robust confidence in the value being representative of an upper bound of potential exposure from these releases.
Use in hydraulic fracturing	Generic Scenario (water-specific)	No facilities reported releases for this OES, so EPA modeled releases using generic scenarios. Sufficient release data were available to model a surface water-specific release, and the resulting range of estimated concentrations were below the high-end modeled releases applied for screening.
Recycling	TRI	Within this OES, only one facility reported to TRI, claiming zero release to surface water. No quantitative estimate of surface water release concentrations was conducted for this OES.
Waste handling, treatment, and disposal	DMR	No reported releases to TRI, and review of DMR period data demonstrated lower release concentrations than high-end releases applied for screening. Due to limited annual data and low reported concentrations in effluent, no quantitative estimate of surface water release concentrations was conducted for this OES.

DMR = Discharge Monitoring Report; OES = occupational exposure scenario; PSC = Point Source Calculator; TRI = Toxics Release Inventory

[a] Table 1-1 provides a crosswalk of industrial and commercial COUs to OES.

[b] Plastic compounding OES selected as the most appropriate OES for use in screening level assessments based on high surface water concentrations resulting from facility releases.

[c] Use of automotive care products OES was chosen as OES most appropriate for screening-level assessment for exposure scenarios utilizing harmonic mean concentration.

5 SURFACE WATER EXPOSURE TO GENERAL POPULATION

Concentrations of DEHP in surface water resulting from TSCA COU releases can lead to different exposure scenarios including dermal exposure (Section 5.1.1) or incidental ingestion exposure (Section 5.1.2) to the general population swimming in affected waters. Additionally, DEHP surface water concentrations may impact drinking water exposure (Section 6) and fish ingestion exposure (Section 7).

For the purposes of a screening level assessment, exposure scenarios were assessed using the highest concentration of DEHP in surface water based on the (1) the maximum modeled concentration for the Use of automotive care products and the (2) maximum reported releases to water from TRI for Plastic compounding as estimated in Section 4.1 (Table 4-4) for various lifestages (*e.g.*, adult, youth, children).

5.1 Modeling Approach

5.1.1 Dermal Exposure

The general population may swim in surface waters (streams and lakes) that are affected by DEHP contamination. Modeled surface water concentrations estimated in Section 4.1 were used to estimate acute doses (ADR) from dermal exposure while swimming.

The following equations were used to calculate incidental dermal (swimming) doses for adults, youth, and children:

Equation 5-1. Acute Incidental Dermal Calculation

$$ADR = \frac{(SWC \times K_p \times SA \times ET \times CF1 \times CF2)}{BW}$$

Where:

ADR	=	Acute dose rate (mg/kg-day)
SWC	=	Surface water concentration (ppb or µg/L)
K_p	=	Permeability coefficient (cm/h)
SA	=	Skin surface area exposed (cm^2)
ET	=	Exposure time (h/day)
$CF1$	=	Conversion factor (1.0×10^{-3} mg/µg)
$CF2$	=	Conversion factor (1.0×10^{-3} L/cm^3)
BW	=	Body weight (kg)

A summary of inputs used for these exposure estimates are provided in Appendix A. EPA used the Consumer Exposure Model (CEM) (U.S. EPA, 2022b) to estimate the dermal permeability coefficient (K_p) of 0.0093 cm/h for DEHP.

Table 5-1 shows a summary of the estimates of ADRs due to dermal exposure while swimming for adults, youth, and children for the highest end release value from reported releases from TRI (Plastic compounding OES) and from modeled releases using generic scenarios (Use of automotive care products OES). The modeled concentrations are included without wastewater treatment.

Table 5-1. Dermal (Swimming) Doses[a] Across Lifestages

Scenario	Water Column Concentrations	Adult (21+ years)	Youth (11-15 years)	Child (6-10 years)
	30Q5 Conc. (µg/L)	ADR_{POT} (mg/kg-day)	ADR_{POT} (mg/kg-day)	ADR_{POT} (mg/kg-day)
Plastic compounding[b]	10.3	7.0E–05	5.4E–05	3.3E–05
Use of automotive care products[c]	140	9.5E–04	7.3E–04	4.4E–04
Highest monitored surface water (NWQMC, 2021)	150	1.0E–03	7.8E–04	4.7E–04

30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; POT = potential
[a] Doses calculated using Equation 5-1.
[b] Releases from this OES were water only releases reported to TRI
[c] Releases from this OES were modeled from a generic scenario and were not specific to water

5.1.2 Oral Ingestion Exposure

The general population may swim in surface waters (streams and lakes) that are affected by DEHP contamination. Modeled surface water concentrations estimated in Section 4.1 were used to estimate acute doses (ADR) due to ingestion exposure while swimming.

The following equations were used to calculate incidental oral (swimming) doses for adults, youth, and children using the Plastics compounding OES and Use of automotive care products OES that resulted in the highest modeled surface water concentrations:

Equation 5-2. Acute Incidental Ingestion Calculation

$$ADR = \frac{(SWC \times IR \times CF1)}{BW}$$

Where:

ADR = Acute dose rate (mg/kg-day)
SWC = Surface water concentration (ppb or µg/L)
IR = Daily ingestion rate (L/day)
$CF1$ = Conversion factor (1.0×10^{-3} mg/µg)
BW = Body weight (kg)

A summary of inputs utilized for these estimates are present in Appendix A.1.

Table 5-2. Incidental Ingestion Doses [a] (Swimming) Across Lifestages

Scenario	Water Column Concentrations	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
	30Q5 Conc. (µg/L)	ADR_{POT} (mg/kg-day)	ADR_{POT} (mg/kg-day)	ADR_{POT} (mg/kg-day)
Plastic compounding [b]	10.3	3.6E–05	5.51E–05	3.1E–05
Use of automotive care products [c]	140	4.8E–04	7.49E–04	4.2E–04
Highest monitored surface water (NWQMC, 2021)	150	5.2E–04	8.0E–04	4.5E–04

30Q5 = 30 consecutive days of lowest flow over a 5-year period; ADR = acute dose rate; POT = potential
[a] Doses calculated using Equation 5-2.
[b] Releases from this OES were water only releases reported to TRI
[c] Releases from this OES were modeled from a generic scenario and were not specific to water

5.2 Weight of Scientific Evidence Conclusions

There is uncertainty in the relevancy of the monitoring data to the modeled estimates presented in this evaluation. As stated in Section 4.4, there is robust confidence that the modeled concentrations represent a high-end exposure concentration, and that these concentrations are reasonably applied as a screening exposure for the general population.

Swimming Ingestion/Dermal Estimates

Two scenarios (youth being exposed dermally and through incidental ingestion while swimming in surface water) were assessed as high-end potential exposures to DEHP in surface waters. EPA's *Exposure Factors Handbook* provided detailed information on the youth skin surface areas and frequency of events for the various scenarios (U.S. EPA, 2011a). Non-diluted surface water concentrations were used when estimating dermal exposures to youth swimming in streams and lakes, as a conservative (protective) representation of the concentration in the receiving water body at the point of release. DEHP concentrations will further dilute and degrade with time and movement downstream. Therefore, EPA has robust confidence in these exposure estimates as a screening approach for incidental exposure.

6 DRINKING WATER EXPOSURE TO GENERAL POPULATION

Drinking water in the United States typically comes from surface water (*i.e.*, lakes, rivers, and reservoirs) and groundwater. The source water then flows to a treatment plant where it undergoes a series of water treatment steps before being distributed to homes and communities. Public drinking water systems often use a combination of treatment processes that include coagulation, flocculation, sedimentation, filtration, and disinfection to meet drinking water quality standards. The exact treatment processes used to meet drinking water quality standards differ between public water systems. As described in 3.2, DEHP is not expected to significantly migrate from landfills through groundwater infiltration because high hydrophobicity and high affinity for soil sorption is expected to retard or immobilize DEHP in the surrounding soil. Therefore, drinking water exposure in this assessment is focused on drinking water sourced from surface water.

6.1 Modeling Approach for Estimating Drinking Water Exposure

6.1.1 Drinking Water Ingestion

Modeled surface water concentrations estimated in Section 4.1 were used to estimate potential DEHP drinking water exposures. For this screening exercise, only the highest reported release from TRI and the highest modeled facility release using generic scenarios was included in the drinking water exposure analysis, alongside the highest monitored DEHP surface water concentration, and no further removal from drinking water treatment was applied. Drinking water doses were calculated using the following equations:

Equation 6-1. Acute Drinking Water Ingestion Calculation

$$ADR_{POT} = \frac{\left(SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times RD \times CF1\right)}{(BW \times AT)}$$

Where:

ADR_{POT}	=	Potential acute dose rate (mg/kg/day)
SWC	=	Surface water concentration (ppb or µg/L; 30Q5 conc for ADR, harmonic mean for ADD, LADD, LADC)
DWT	=	Removal during drinking water treatment (assumed to be 0% for this screening level analysis)
IR_{dw}	=	Drinking water intake rate (L/day)
RD	=	Release days (days/yr for ADD, LADD, and LADC; 1 day for ADR)
$CF1$	=	Conversion factor (1.0×10^{-3} mg/µg)
BW	=	Body weight (kg)
AT	=	Exposure duration (years for ADD, LADD, and LADC; 1 day for ADR)

Equation 6-2. Average Daily Drinking Water Ingestion Calculation

$$ADD_{POT} = \frac{\left(SWC \times \left(1 - \frac{DWT}{100}\right) \times IR_{dw} \times ED \times RD \times CF1\right)}{(BW \times AT \times CF2)}$$

Where:

ADD_{POT}	=	Potential average daily dose (mg/kg/day)
SWC	=	Surface water concentration (ppb or µg/L; 30Q5 conc for ADR, harmonic mean for ADD, LADD, LADC)
DWT	=	Removal during drinking water treatment (%)
IR_{dw}	=	Drinking water intake rate (L/day)
ED	=	Exposure duration (years for ADD, LADD, and LADC; 1 day for ADR)
RD	=	Release days (days/yr for ADD, LADD, and LADC; 1 day for ADR)
BW	=	Body weight (kg)
AT	=	Exposure duration (years for ADD, LADD, and LADC; 1 day for ADR)
$CF1$	=	Conversion factor (1.0×10^{-3} mg/µg)
$CF2$	=	Conversion factor (365 days/year)

The ADR and ADD from drinking water for chronic non-cancer were calculated using the 95th percentile ingestion rate for drinking water. A summary of inputs used for these exposure estimates are provided in Appendix A. Table 6-1 summarizes the drinking water doses for adults, infants, and toddlers. These estimates do not incorporate additional dilution beyond the point of discharge and in this case, it is assumed that the surface water outfall is located very close (within a few km) to the drinking water intake location. Applying dilution factors would decrease the concentration at the intake as well as the dose for all scenarios. Exposure estimates are low for all lifestages and scenarios, including for infants with the highest drinking water intake per body weight.

Table 6-1. Drinking Water Doses Across Lifestages

Scenario	**Water Column Concentrations**		**Adult (21+ years)**		**Infant (Birth to <1 year)**		**Toddler (1–5 years)**	
	30Q5 Conc. (µg/L)	**Harmonic Mean Conc. (µg/L)**	**ADR_{POT} (mg/kg-day)**	**ADD (mg/kg-day)**	**ADR_{POT} (mg/kg-day)**	**ADD (mg/kg-day)**	**ADR_{POT} (mg/kg-day)**	**ADD (mg/kg-day)**
Plastic compounding	10.3	4.11	4.1E–04	3.1E–05	1.5E–03	7.9E–05	5.2E–04	3.4E–05
Use of automotive care products (P50 flow)	140	92.9	5.6339E-03	7.28E-04	1.9767E-02	1.86E-03	7.0294E-03	7.97E-04
Highest monitored surface water (NWQMC, 2021)	150	150	6.0E–03	1.1E–03	2.1E–02	2.9E–03	7.5E–03	1.2E–03
ADD = average daily dose; ADR = acute dose rate; 30Q5 = lowest 30-day average flow in a 5-year period								

6.2 Measured Concentrations in Drinking Water

EPA identified monitoring studies through systematic review to provide context to modelling results. The monitoring study presented here was not used as part of the analysis for quantifying exposure estimates. Because a national maximum contaminant level (MCL) of 6 µg/L has been set for DEHP in drinking water distributed by public water systems, DEHP is monitored at drinking water facilities across the U.S. (U.S. EPA, 2025k). The EPA's Six-Year Review data from 2012-2019 includes 202,420 sample records from over 36,400 public water systems, ranging up to 52.2 µg/L DEHP detected in finished drinking water at a Pennsylvania facility sourcing surface water, and up to 130 µg/L at a Massachusetts groundwater facility. Drinking water quality data from 2011 to 2022 were obtained from the California Water Board (2022) for 55 counties in the state (Table 6-2). For the more than 1,900 active, inactive, or proposed water systems and facilities, DEHP was detected in less than 1 percent of samples. DEHP detections in those samples ranged from 0.2 to 61 µg/L. The highest level of DEHP was detected in a 2013 sample from an inactive Inland Empire Utilities Agency water system in San Bernardino County.

Table 6-2. Summary of Measured DEHP Concentrations in Drinking Water

Reference	Sampling Location	DEHP Concentration	Sampling Notes
(U.S. EPA, 2025k)	United States	FOD: 4% Overall: <0.6-130 µg/L Maximum levels by type (µg/L): 52.2 (finished drinking water sourced from surface water), 130 (finished drinking water sourced from groundwater)	202,420 DEHP sample records from over 36,400 public water systems, 2012-2019
CA Water Board (2022)	United States	FOD: 0.45% Overall: <0.2–61 µg/L Maximum levels by facility status (µg/L): 61 (inactive); 55 (active); 0.2 (proposed)	Over 27,000 DEHP sample records from over 1,900 public water systems, 2011–2022
FOD = frequency of detection			

6.3 Evidence Integration for Drinking Water

EPA estimates low potential exposure to DEHP via drinking water when considering expected treatment removal efficiencies, even under high-end release scenarios. This assessment assumes that concentrations at the point of intake for the drinking water system are equal to the concentrations in the receiving water body at the point of release, where treated effluent is being discharged from a facility. In reality, some distance between the point of release and a drinking water intake would be expected, providing space and time for additional reductions in water column concentrations via degradation, partitioning, and dilution. Some form of additional treatment would typically be expected for surface water at a drinking water treatment plant, including coagulation, flocculation, and sedimentation, and/or filtration. This treatment would likely result in even greater reductions in DEHP concentrations prior to releasing finished drinking water to customers. Lastly, of the available monitoring data in the United States for finished drinking water, DEHP was only detectable in 0.45 percent of samples, with the highest concentration reported at 61 µg/L, corroborating the expectation of very little exposure to the general population via treated drinking water.

6.4 Weight of Scientific Evidence Conclusions

EPA has moderate confidence in the surface water as drinking water exposures estimates. As described in Section 3.2, EPA did not assess drinking water estimates as a result of leaching from landfills to groundwater and subsequent migration to drinking water well.

7 FISH INGESTION EXPOSURE TO GENERAL POPULATION

To estimate exposure to humans from fish ingestion, EPA used three surface water concentrations in its assessment: (1) the water solubility limit of 3.0×10^{-3} mg/L (U.S. EPA, 2025g), (2) the maximum modeled concentration for the Use of automotive care products, and the (3) maximum reported releases to water from TRI for Plastic compounding. Incorporating multiple surface water concentrations accounts for the variation in fish tissue concentrations shown in Table 7-1. Note that modeled and reported surface water concentrations of DEHP correspond to total water column concentrations, which includes DEHP that is suspended in the water and DEHP sorbed to suspended sediment. DEHP can also form colloidal suspensions in water. As a result, the modeled concentrations can exceed the water solubility limit (U.S. EPA, 2025g).

Another important parameter in estimating human exposure to a chemical through fish ingestion is the bioaccumulation factor (BAF). BAF is preferred over the bioconcentration factor (BCF) because it considers the animal's uptake of a chemical from both diet and the water column. For DEHP, one high-quality study reporting BAF values for fish was identified during systematic review. Vethaak et al. (2005) reported a BAF value of 478.13 L/kg wet weight for bream (*Abramis brama*) (see *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g)).

Table 7-1 compares the fish tissue concentration calculated using empirical BAF and various surface water concentrations with the measured fish tissue concentrations obtained from literature. The measured concentrations identified through systematic review were only used to provide context to modeling results and not to quantify exposure estimates. Calculated fish tissue concentration using the water solubility limit was within the same order of magnitude as that using the TRI reported water releases for the Plastics compounding OES. Compared to the water solubility limit, the concentrations of DEHP in fish tissue based on a generic scenario for the Use of automotive care products OES varied by the flow rate (Table 7-1) and generally the modeled estimates for P50 and P75 flow rates are much higher than measured fish tissue concentrations while modeled estimates using P90 flow rates are similar to the measured fish tissue concentrations in the studies summarized in Table 7-1. It is important to note that no information is reasonably available to determine the proportion of releases to water for the Use of automotive care products OES. Therefore, EPA assumed all is discharged to water in its screening assessment. EPA also calculated DEHP concentrations in fish tissue using measured concentrations in surface water as a comparison with modeled results. The second highest measured DEHP concentration in surface water was used because of uncertainties associated with the maximum measured value (described in Section 7.4.1). That value is from Liu et al. (2013) (medium data quality rating) at 18.2 µg/L, or 1.82×10^{-2} mg/L. DEHP fish tissue concentration calculated with measured surface water concentration are slightly higher than those using the water solubility limit or the modeled surface water concentrations. However, the fish tissue concentration calculated from the measured surface water concentration was not used to quantify exposure. This is because of uncertainties with the studies, as well as monitoring data not allowing for source apportionment between TSCA and non-TSCA COUs (see Section 7.4.1 for details).

Table 7-1. Fish Tissue Concentrations Calculated from Modeled Surface Water Concentrations and Monitoring Data

Data Description and Source	Surface Water Concentration	Fish Tissue Concentration
Water solubility limit	3.0E–03 mg/L (EC/HC, 2017; NTP, 2000)	1.43 mg/kg ww
Maximum modeled and reported surface water concentrations	Use of automotive care products, HE (generic scenario for multimedia releases, without treatment) 9.29E–02, 2.23E–02, and 2.85E–3 mg/L for P50, P75, and P90 flow[b]	44.42, 10.66, 1.36 mg/kg ww for P50, P75, and P90 flow
	4.11E–03 mg/L for Plastic compounding (HE, TRI reported release)[b]	1.97 mg/kg ww
Second[a] highest measured concentration from Liu et al. (2013) (medium data quality rating)	1.82E–02 mg/L	8.70 mg/kg ww
Fish tissue monitoring data (wild-caught)[c] One Canadian study collected 12 fish samples in one species (McConnell, 2007)	N/A	5.8E–02 mg/kg ww
Fish tissue monitoring data (wild-caught)[c] One Chinese study collected 206 fish samples across 17 different species (Hu et al., 2020)		1.6E–02 to 1.573 mg/kg ww
Fish tissue monitoring data (wild-caught)[c] One Chinese study collected 69 fish samples across 3 species from 6 sampling sites (Cheng et al., 2018)		1.1E–01 to 1.05 mg/kg ww

HE = high-end, ww = wet weight
[a] The highest monitored surface was not used because no analytical methods were described, as further discussed in Section 7.4.1.
[b] Surface water concentrations of DEHP correspond to total water column concentrations, which include DEHP that is suspended in the water and DEHP sorbed to suspended sediment. DEHP can also form colloidal suspensions in water. As a result, the modeled concentrations can exceed the water solubility limit (U.S. EPA, 2025g).
[c] These studies identified through systematic review were not used as part of the analysis for quantifying exposure estimates; rather, they are provided here to contextualize modeling results. Study quality varied for each study and can be found in the *Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025a). Furthermore, concentrations reported as a dry weight were excluded from this table because insufficient information was provided to convert to a wet weight.

7.1 General Population Fish Ingestion Exposure

EPA estimated exposure from fish consumption using age-specific fish ingestion rates (Table_Apx A-2). Adults have the highest 50th percentile fish ingestion rate (IR) per kilogram of body weight for the general population, as shown in Table_Apx A-1. A young toddler between 1 and 2 years has the highest 90th percentile fish IR per kilogram of body weight. This section estimates exposure and risks for adults and toddlers 1 to 2 years who have the highest fish IR per kilogram of body weight among all lifestages in this screening level approach.

The ADR and ADD for non-cancer exposure estimates were calculated using the 90th percentile and central tendency IR, respectively. Exposure estimates via fish ingestion were calculated according to the following equation:

Equation 7-1. Fish Ingestion Calculation

$$ADR\ or\ ADD = \frac{(SWC \times BAF \times IR \times CF1 \times CF2 \times ED)}{AT}$$

Where:

ADR	=	Acute dose rate (mg/kg-day)
ADD	=	Average daily dose (mg/kg-day)
SWC	=	Surface water (dissolved) concentration (µg/L)
BAF	=	Bioaccumulation factor (L/kg wet weight)
IR	=	Fish ingestion rate (g/kg-day)
$CF1$	=	Conversion factor for mg/µg (1.0×10^{-3} mg/µg)
$CF2$	=	Conversion factor for kg/g (1.0×10^{-3} kg/g)
ED	=	Exposure duration (year)
AT	=	Averaging time (year)

The inputs to this equation can be found in the *Fish Ingestion Risk Calculator for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025c). The number of years within an age group (*i.e.*, 62 years for adults) was used for the exposure duration and averaging time to estimate non-cancer exposure. The exposures calculated using the water solubility limit, maximum surface water concentrations based on generic scenario and TRI release, and second highest monitored surface water concentration with an empirical BAF are presented in Table 7-2. Corresponding screening level risk estimates are shown in Appendix E.1. Fish ingestion is not expected to be a pathway of concern for the general population based on the conservative screening level risk estimates and using an upper-bound of exposure.

Table 7-2. General Population Fish Ingestion Doses by Surface Water Concentration

Surface Water Concentration and Scenario	Adult ADR (mg/kg–day)	Young Toddler ADR (mg/kg–day)	Adult ADD (mg/kg–day)
Water solubility limit (3.0E–03 mg/L)	3.98E–04	5.91E–04	9.04E–05
Use of automotive care products, HE - generic scenario for multimedia releases, without treatment (9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow)	1.23E–02 (P50 flow) 2.96E–03 (P75 flow) 3.78E–04 (P90 flow)	1.83E–02 (P50 flow) 4.39E–03 (P75 flow) 5.61E–04 (P90 flow)	2.80E–03 (P50 flow) 6.72E–04 (P75 flow) 8.58E–05 (P90 flow)
Plastic compounding - HE, TRI reported release (4.11E–03 mg/L)	5.45E–04	8.10E–04	1.24E–04
ADD = average daily dose; ADR = acute dose rate; HE = high-end, 95th percentile release; TRI = Toxics Release Inventory			

7.2 Subsistence Fish Ingestion Exposure

Subsistence fishers represent a potentially exposed or susceptible subpopulation(s) (PESS) group due to their greatly increased exposure via fish ingestion (average of 142.4 g/day of fish consumed compared to a 90th percentile of 22.2 g/day for the general population) (U.S. EPA, 2000b). The ingestion rate for subsistence fishers applies only to adults aged 16 to less than 70 years. EPA calculated exposure for subsistence fishers using Equation 7-1 and the same inputs as the general population, with the exception of the increased ingestion rate. EPA is unable to determine subsistence fishers' exposure estimates specific to younger lifestages based on lack of reasonably available information. Furthermore, unlike the general population fish ingestion rates, there is no central tendency or 90th percentile ingestion rate for subsistence fishers. The same value was used to estimate both the ADD and ADR.

The exposures calculated using the water solubility limit, maximum surface water concentrations based on generic scenario and TRI releases, and second highest monitored surface water concentration with an empirical BAF are in Table 7-3.

Screening-level risk estimates are an order of magnitude above benchmark using both the water solubility limit and surface water concentrations based on TRI reported releases for Plastic compounding (Appendix E.2). While the Use of automotive care products OES had a risk estimate of 14 at the P50 flow rate compared to a benchmark of 30, EPA has only slight confidence in this result. The modeled concentrations at P50 exceed the water solubility by one order of magnitude. That is because the generic scenarios used to estimate environmental releases does not proportion what fraction, if any, may be discharged to surface water. EPA assumed all is discharged to surface water in its screening-level assessment. However, because of the low confidence and high uncertainty inherent in assuming what fraction may be discharged to surface water, EPA is unable to refine its analysis. All OESs discharging to multiple media types are therefore not further considered.

Overall, based on screening-level risk estimates for the Plastic compounding OES, fish ingestion is not expected to be a pathway of concern for subsistence fishers for all OESs with reported releases (Appendix E.2).

Table 7-3. Adult Subsistence Fisher Doses by Surface Water Concentration

Surface Water Concentration and Scenario	Adult ADR/ADD (mg/kg–day)
Water solubility limit (3.0E–03 mg/L)	3.98E–04
Use of automotive care products, HE - generic scenario for multimedia releases, without treatment (9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow)	7.91E–02 (P50 flow) 1.90E–02 (P75 flow) 2.43E–03 (P90 flow)
Plastic compounding - HE, TRI reported release (4.11E–03 mg/L)	3.50E–03
ADD = average daily dose; ADR = acute dose rate; HE = high-end, 95th percentile release; TRI = Toxics Release Inventory	

7.3 Tribal Fish Ingestion Exposure

Tribal populations represent another PESS group. In the United States, there are a total of 574 federally recognized American Indian Tribes and Alaska Native Villages, and 63 state recognized tribes. Tribal cultures are inextricably linked to their lands, which provide all their needs from hunting, fishing, food gathering, and grazing horses to commerce, art, education, health care, and social systems. These services flow among natural resources in continuous interlocking cycles, creating a multi-dimensional relationship with the natural environment and forming the basis of *Tamanwit* (natural law) (Harper et al., 2012). Such an intricate connection to the land and the distinctive lifeways and cultures between individual tribes creates many unique exposure scenarios that can expose tribal members to higher doses of contaminants in the environment. EPA used the reasonably available information to quantitatively evaluate the tribal fish ingestion pathway for DEHP but lacks reasonably available data to assess other exposure scenarios unique to tribal populations.

U.S. EPA (2011a) (Chapter 10, Table 10-6) summarizes relevant studies on current tribal-specific fish ingestion rates that covered 11 tribes and 94 Alaskan communities. The highest central tendency value (a mean) ingestion rate per kilogram of body weight is reported in a 1997 survey of adult members (16+ years) of the Suquamish Tribe in Washington. Adults from the Suquamish Tribe reported a mean ingestion rate of 2.7 g/kg-day, or 216 g/day assuming an adult body weight of 80 kg. In comparison, the ingestion rates for adult subsistence fishers and the general population are 142.2 and 22.2 g/day, respectively. A total of 92 adults responded to the survey funded by the Agency for Toxic Substances and Disease Registry (ATSDR) through a grant to the Washington State Department of Health, of which 44 percent reported consuming less fish/seafood today compared to 20 years ago. One reason for the decline is restricted harvesting caused by increased pollution and habitat degradation (Duncan, 2000).

In addition to the current mean fish ingestion rate, EPA reviewed literature and surveys to identify a high-end (*i.e.*, 90th or 95th percentile) current fish ingestion rate. The surveys asked participants to estimate their daily fish consumption over the course of a year by meal size and meal frequency. The highest 95th percentile fish and shellfish ingestion rate was 874 g/day, or 10.9 g/kg-day assuming a body weight of 80 kg, for male adults (18+ years) of the Shoshone-Bannock Tribes in Idaho (Polissar et al., 2016). The 95th percentile ingestion rate for males and females combined was similar at 10.1 g/kg-day. The Suquamish Tribe also reported similar high-end (90th percentile) current ingestion rates for adults ranging from 8.56 to 9.73 g/kg-day (Duncan, 2000). Estimated high-end fish ingestion rates were lower for other tribes in Alaska, the Pacific Northwest, Great Lakes region, and northeastern North America. To evaluate a current high-end exposure scenario, EPA used the highest 95th percentile ingestion rate of 10.9 g/kg-day.

Because current fish consumption rates are suppressed by contamination, degradation, or loss of access, EPA reviewed existing literature for ingestion rates that reflect heritage rates. Heritage ingestion rates refer to typical fish ingestion prior to non-indigenous settlement on tribal fisheries resources, as well as changes in culture and lifeways (U.S. EPA, 2016a). Heritage ingestion rates were identified for four tribes, all located in the Pacific Northwest. The highest heritage ingestion rate was reported for the Kootenai Tribe in Idaho at 1,646 g/day, or 20.6 g/kg-day assuming an adult body weight of 80 kg (Ridolfi, 2016; Northcote, 1973). Northcote (1973) conducted a comprehensive review and evaluation of ethnographic literature, historical accounts, harvest records, archaeological and ecological information, as well as other studies of heritage consumption. The heritage ingestion rate is estimated for Kootenai members living in the vicinity of Kootenay Lake in British Columbia, Canada; the Kootenai Tribe once occupied territories in parts of Montana, Idaho, and British Columbia. It is based on a 2,500 calorie per day diet, assuming 75 percent of the total caloric intake comes from fish which may overestimate fish intake. However, the higher ingestion rate also accounted for salmon fat loss during migration to spawning locations by using a lower caloric value for whole raw fish. Northcote (1973) assumed a caloric content of 113.0 cal/100 g wet weight. In comparison, the U.S. Department of Agriculture’s Agricultural Research Service (1963) estimates a caloric content for fish sold in the United States to range from 142 to 242 cal/100 g of fish.

EPA calculated exposure via fish consumption for tribes using Equation 7-1 and the same inputs as the general population, with the exception of the ingestion rate. Three ingestion rates were used: 216 g/day

(2.7 g/kg-day) for a central tendency current tribal fish ingestion rate; 874 g/day (10.9 g/kg-day) as a high-end current tribal fish ingestion rate; and 1,646 g/day (20.58 g/kg-day) for heritage consumption. Similar to subsistence fishers, EPA used the same ingestion rate to estimate both the ADD and ADR. The heritage ingestion rate is assumed to be applicable to adults. For current ingestion rates, U.S. EPA (2011a) provides values specific to younger lifestages, but adults still consume higher amounts of fish per kilogram of body weight. An exception is for the Squaxin Island Tribe in Washington that reported an ingestion rate of 2.9 g/kg-day for children under 5 years. That ingestion rate for children is nearly the same as the adult ingestion rate of 2.7 g/kg-day for the Suquamish Tribe. As a result, exposure estimates based on current ingestion rates (IR) focused on adults (Table 7-4).

Table 7-4 presents multiple exposure estimates for the tribal populations. Conservative exposure estimates based on the water solubility limit and maximum water concentrations-based TRI releases resulted in screening level risk estimates above benchmarks for all but at the heritage consumption rate (Appendix E.3). However, because no available information can substantiate if these rates reflect current consumption patterns, EPA did not consider them further in this assessment. Additionally, screening-level risk estimates are below benchmark for the Use of automotive care products at the P50 and P75 flow rates (Appendix E.2). As discussed in Section 7.2 for subsistence fishers, EPA has only slight confidence in these risk estimates because the generic scenarios used to estimate environmental releases does not proportion what fraction, if any, may be discharged to surface water. The modeled concentrations at P50 and P75 flow rate also exceed the water solubility by up to one order of magnitude. Without further information, EPA is unable to refine its analysis because of the resultant slight confidence and high uncertainty in assuming what fraction may be released to water. EPA did not further consider all OESs discharging to multiple media types.

Overall, based on screening-level risk estimates for the Plastic compounding OES, fish ingestion is not expected to be a pathway of concern for tribal populations for all OESs with reported releases (Appendix E.2).

Table 7-4. Adult Tribal Fish Ingestion Doses by Surface Water Concentration

Surface Water Concentration and Scenario	ADR/ADD (mg/kg-day)		
	Current Mean IR	Current Tribal IR, 95th Percentile	Heritage IR
Water solubility limit (3.0E–03 mg/L)	3.87E–03	1.56E–02	2.95E–02
Use of automotive care products, HE (generic scenario for multimedia releases, without treatment) 9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow	1.20E–01 (P50 flow) 2.88E–02 (P75 flow) 3.68E–03 (P90 flow)	4.84E–01 (P50 flow) 1.16E–01 (P75 flow) 1.49E–02 (P90 flow)	9.14E–01 (P50 flow) 2.19E–01 (P75 flow) 2.80E–02 (P90 flow)
4.11E–03 mg/L for Plastic compounding (HE, TRI reported release)	5.31E–03	2.14E–02	4.04E–02
ADD = average daily dose; ADR = acute dose rate; HE = high-end, 95th percentile release; TRI = Toxics Release Inventory; IR = ingestion rate			

7.4 Weight of Scientific Evidence Conclusions

7.4.1 Strength, Limitations, Assumptions, and Key Sources of Uncertainty

To account for the variability in fish consumption across the United States, fish intake estimates were considered for general population, subsistence fishers, and tribal populations. DEHP concentrations in fish tissue calculated from modeled surface water concentrations were up to two orders of magnitude or more above measured fish tissue values. An OES that discharges to multiple environmental media including water resulted in the highest DEHP concentrations in surface water, and risk estimates were below the benchmark for subsistence fisher and tribal populations at select flow rates (see Appendix E). However, information on the proportion of the release going to each of the media types, including surface water, is unknown. EPA cannot determine how much, if any, is released to surface water for OESs with multimedia discharges. EPA therefore is not able to characterize the risk from fish ingestion for OESs discharging to multiple environmental media due to the slight confidence and high uncertainty in the modeled surface water concentrations and exposure estimates. For OESs that have reported releases to either TRI or DMR, fish ingestion is not expected to be a pathway of concern because screening level risk estimates all exceeded benchmark.

Monitored surface water concentrations were sometimes above the highest modeled surface water concentration based on the Use of automotive care products OES. That is because phthalate esters can form colloidal suspensions in water, leading to erroneously high measurements of DEHP's water solubility via methods such as slow-stir or shake flask (see the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g)). Therefore, review of analytical methods is important for determining the suitability of the monitoring data. The data from WQP (NWQMC, 2021) only provided information on the analytical instrument used to analyze the surface water, which leaves significant uncertainties for consideration in this assessment. EPA reviewed the second highest surface water concentration from Liu et al. (2013) and identified several uncertainties concerning the analytical methods used in this study as well. The water concentration was above the selected water solubility (3.0×10^{-3} mg/L), which suggests that the higher DEHP concentration captured may be as a result of colloidal suspension, partially attributed to the salinity of the water; sorption/association with dissolved organics; and sorption to particulate matter, that then desorbs during the solid-phase microextraction (SPME). Furthermore, there is uncertainty about the bioavailability of DEHP associated with the colloidal suspensions. It is possible that the particles cannot be absorbed if they become too large. Despite the uncertainties in Liu et al. (2013), its surface water data were within the range of DEHP's water solubility but still higher than surface water concentrations based on reported and modeled releases. Monitoring data does not allow for source apportionment, thus the contribution of specific TSCA COUs to the overall concentration in an environmental media cannot be determined and EPA did not incorporate them into this screening-level analysis.

Lastly, it is critical to note that DEHP is expected to have low potential for bioaccumulation, biomagnification, and uptake by aquatic organisms because of its low water solubility and preferential sorption to organic matter that limits its bioavailability (Section 12). This is supported by the empirical BAF value of 478.13 L/kg for bream (*Abramis brama*). Additionally, trophic dilution of DEHP from lower to higher trophic levels within the food-web is expected to occur within the aquatic ecosystem (Section 12.4).

8 AMBIENT AIR CONCENTRATION

EPA considers both modeled and monitored concentrations in the ambient air for this ambient air exposure assessment for DEHP. The Agency's modeling estimates both short-term and long-term concentrations in ambient air as well as dry, wet, and total deposition rates. EPA considers monitoring data from published literature for additional insight into ambient air concentrations of DEHP.

8.1 Approach for Estimating Concentrations in and Deposition from Ambient Air

EPA used previously peer-reviewed methodology for fenceline communities (U.S. EPA, 2022c) to evaluate exposures and deposition via the ambient air pathway for this assessment. This methodology uses the Integrated Indoor/Outdoor Air Calculator (IIOAC) Model to estimate daily-average and annual-average concentrations of DEHP in the ambient air at three distances (*e.g.*, 100; 100–1,000, and 1,000 ms) from the releasing facility. IIOAC also estimates dry, wet, and total deposition rates of DEHP from the ambient air to other media (*e.g.*, water and land) at those same distances. IIOAC is a spreadsheet-based tool that estimates outdoor air concentrations and deposition rates using pre-run results from a suite of dispersion scenarios in a variety of meteorological and land-use settings within EPA's American Meteorological Society/EPA Regulatory Model (AERMOD). Additional information on IIOAC can be found in the user guide (U.S. EPA, 2019d).

EPA uses the maximum daily releases of DEHP across all OES/COUs as direct inputs to the IIOAC model. The Agency considered three different datasets for DEHP releases including EPA estimated releases based on production volumes of DEHP from facilities that manufacture, process, repackage, or dispose of DEHP (U.S. EPA, 2025e), releases reported to TRI by industry (2017–2022 reporting years), and releases reported to NEI (U.S. EPA, 2025e) (2017 and 2020 reporting years).

The maximum daily release value for fugitive releases for DEHP was 8.85 kg/site-day. This value was reported to the 2020 NEI dataset and categorized under the Plastic converting OES as fugitive releases. The maximum daily release value for stack releases for DEHP was 36.23 kg/site-day. This value was reported to the 2017 NEI dataset and categorized under the Application of paints, coatings, adhesives, and sealants OES as stack releases. Although the maximum releases for each release type are from different facilities in different locations and different OES, for this assessment EPA assumes the releases occurred from the same location at the same time under the same OES to determine a "total exposure" to DEHP from both release types. This approach may overestimate ambient concentrations of DEHP at the distances evaluate since exposures to each release type at the distances evaluated cannot occur at a single location at the same time.

8.1.1 Release and Exposure Scenarios Evaluated

The release and exposure scenarios evaluated for this analysis are summarized below:

- Release: Maximum Daily Release (kg/site-day)
- Release Dataset: TRI
- Release Type: Stack and Fugitive
- Release Pattern: Consecutive
- Distances Evaluated: 100, 100 to 1,000, and 1,000 m
- Meteorological Station (selected to represent high-end meteorologic data based on a sensitivity analysis of the 14 meteorological stations included within the IIOAC Model which tended to

result in high-end (more conservative) concentrations):
  - South (Coastal): Surface and Upper Air Stations at Lake Charles, Louisiana
- Operating Scenario: 365 and 296 days per year; 24 h/day
- Topography: Urban and Rural
- Particle Size:
  - Coarse (PM_{10}): Particulate matter with an aerodynamic diameter of 10 microns
  - Fine ($PM_{2.5}$): Particulate matter with an aerodynamic diameter of 2.5 microns

EPA used default release input parameters integrated within the IIOAC Model for both stack and fugitive releases along with a user-defined length and width for fugitive releases as listed in Table 8-1.

Table 8-1. IIOAC Input Parameters for Stack and Fugitive Air Releases

Stack Release Parameters	Value
Stack height (m)	10
Stack diameter (m)	2
Exit velocity (m/sec)	5
Exit temperature (K)	300
Fugitive Release Parameters	**Value**
Length (m)	10
Width (m)	10
Angle (degrees)	0
Release height (m)	3.05

8.1.2 IIOAC Model Output Values

The IIOAC Model provides multiple output values (see *Ambient Air Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025b)). A description of select outputs relied upon in this assessment are provided below. These outputs were relied upon because they represent a more conservative exposure scenario where modeled concentrations are expected to be higher, thus more protective of exposed populations and ensuring potential high-end exposures are not missed during screening for the ambient air pathway.

Fenceline Average: represents the daily-average and annual-average concentrations at 100-meter distance from a releasing facility.

High-End, Daily-Average: represents the 95th percentile daily average of all modeled hourly concentrations across the entire distribution of modeled concentrations at 100 m.

High-End, Annual Average: 95th percentile annual-average concentration across the entire distribution of modeled concentrations at 100 m.

High-End, Annual Average Deposition Rate: 95th percentile annual-average deposition rate across the entire distribution of modeled deposition rates at 100 m.

8.1.3 Modeled Results from IIOAC

All results for each scenario described in Section 8.1.1 are included in the *Ambient Air Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025b). EPA utilized the highest estimated concentrations across all modeled scenarios to evaluate exposures and deposition rates near a releasing facility. This exposure scenario represents a national level exposure estimate inclusive of sensitive and locally impacted populations who live next to a releasing facility.

The IIOAC Model provides source apportioned concentrations and deposition rates (fugitive and stack) based on the respective releases. To evaluate exposures and total deposition rates for this ambient air assessment, EPA assumes the fugitive and stack releases occur simultaneously throughout the day and year. Therefore, the total concentration and deposition rate used to evaluate exposures and derive risk estimates in this ambient air assessment is the sum of the separately modeled fugitive and stack concentrations and total deposition rates at 100 m from a releasing facility. The source apportioned concentrations and the total concentrations for the scenario used are provided in Table 8-2.

Table 8-2. Source Apportioned and Total Daily-Average and Annual-Average IIOAC-Modeled Concentrations at 100 m from Releasing Facility

Source Type	Daily-Average Concentration[a] (µg/m^3)	Annual-Average Concentration[a] (µg/m^3)
Fugitive	16.31	15.86
Stack	6.92	2.64
Total	23.23	18.50
[a] The daily and annual average concentrations are the same because DEHP is assumed to be released 365 days per year.		

The source apportioned wet and dry deposition rates and the total deposition rates for the scenario used in the *Environmental Hazard Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025d) are provided in Table 8-3

Table 8-3. Source Apportioned and Total Annual-Average IIOAC-Modeled Wet, Dry, and Total Deposition Rates at 100 m from Releasing Facility

Source Type	Total Annual-Average Deposition Rates (g/m^2)		
	Total	Wet	Dry
Fugitive	2.66E–04	2.63E–04	3.83E-06
Stack	2.12E–04	2.05E–04	1.26E–05
Total	4.78E-04	4.68E–04	1.65E–05

8.2 Measured Concentrations in Ambient Air

EPA reviewed published literature as described in the *Systematic Review Protocol for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025l) to identify studies where ambient air concentrations of DEHP were measured. The monitoring studies identified were not used as part of the analysis for quantifying exposure estimates. Rather, they were used to provide context for modeled concentrations.

EPA identified a Chinese study (Zhu et al., 2016), which measured concentrations of several phthalates including DEHP. A simple plot of the measured concentrations is provided in Appendix F. This study received an overall data quality rating of medium under EPA's systematic review.

EPA also identified a single U.S. study where DEHP concentrations were measured at three New York City air sampling stations (Bove et al., 1978). Findings from this study are also summarized in Appendix F.

Measured concentrations of DEHP in these two studies were low, generally in the ng/m^3 range. How these data do or do not reflect conditions in the United States (in relation to the foreign study) or TSCA COUs (in relation to both the international and U.S. study) is unknown, limiting the utility of these data to this assessment.

Uncertainties associated with monitoring data from other countries limit their applicability to this risk assessment. It is unknown how these data do or do not reflect conditions in the United States or TSCA COUs. Information needed to link the monitoring data to foreign industrial processes and crosswalk those to TSCA COUs is not available. The proximity of the monitoring site to a releasing facility associated with a TSCA COU is also unknown. Furthermore, regulations of emissions standards often vary between the United States and foreign countries.

EPA also reviewed EPA's Ambient Monitoring Technology Information Center database but did not find any monitored DEHP concentrations in ambient air (U.S. EPA, 2022a).

8.3 Evidence Integration

EPA relied on the IIOAC-modeled concentrations and deposition rates to characterize human and ecological exposures for the ambient air exposure assessment. Modeled DEHP ambient air concentrations were estimated using the maximum daily ambient air releases, conservative meteorological data, and a distance of 100 m from a releasing facility. The modeled concentrations are higher than measured concentrations (Section 8.1 and 8.2). Caution is needed when interpreting such a comparison, however, because modeled concentrations are near a releasing facility (100 m away), and it is unknown if the sampling sites are located at a similar distance from a site. Additionally, measured concentrations represent all sources (TSCA and other sources) contributing DEHP to the ambient air, while modeled concentrations are specific to TSCA sources.

8.4 Strengths, Limitations, and Sources of Uncertainty for Modeled Air Concentrations

The approach and methodology used in this ambient air exposure assessment replicates previously peer reviewed approaches and methods, as well as incorporates recommendations provided during peer review of other ambient air exposure assessments.

A strength of the IIOAC modelling includes use of environmental release data from multiple databases across multiple years (including data that are required by law to be reported by industry). These databases undergo repeatable quality assurance and quality control reviews (U.S. EPA, 2025e). These release data are used as direct inputs to EPA's peer-reviewed IIOAC Model to estimate concentrations at several distances from releasing facilities where individuals may reside for many years. The specific maximum release value used for this assessment came from the NEI release datasets and was the highest value across multiple datasets considered.

The IIOAC Model also has limitations in what inputs can and cannot be changed. Because it is based on pre-run scenarios within AERMOD, default input parameters (*e.g.,* stack characteristics and 2011–2015 meteorological data) are already predefined. Site-specific information like building dimensions, stack heights, elevation, and land use cannot be changed in IIOAC and therefore presents a limitation on the modeled results for DEHP. This is in addition to the data gap EPA has on certain parameters like building dimensions, stack heights, and release elevation since such information has not been provided by industry to EPA for consideration which creates additional limitations on using other models to their full potential. Furthermore, IIOAC does not consider the presence or location of residential areas relative to the 100 m distance from releasing facilities, the size of the facility, and the release point within a facility. For larger facilities, 100 m from a release point may still fall within the facility property where individuals within the general population are unlikely to live or frequent. In contrast, for smaller facilities, there may be individuals within the general population living 100 m away from the release point and therefore could be exposed continuously. However, most individuals may not stay within their residences 24 hours per day, 7 days per week throughout the year.

The use of estimated annual release data and number of operating days to calculate daily average releases assumes operations are continuous and releases are the same for each day of operation. This can underestimate short-term or daily exposure and deposition rates because results may miss actual peak releases (and associated exposures) if higher and lower releases occur on different days.

As described in Section 8.1, for this ambient air assessment EPA assumes the maximum daily fugitive and stack releases occurred from the same location, at the same time, under the same OES, at the same distance from the releasing facility to determine a “total exposure” to DEHP from both release types. This assumption provides a conservative assumption for each individual release type (fugitive or stack) and “total exposure” ensuring possible exposure pathways are not missed and is health protective for this screening analysis. However, since the reported releases occur from two different facilities in different locations and under different OES, the results are not additive as they cannot occur at the same time. None-the-less, EPA still provides a total exposure and deposition rate from both release types as if they occurred from the same facility, at the same time, under the same OES, at the same distance for this screening level assessment. This provides low confidence in the exposure scenario (cannot occur at same time under assumptions modeled) and an overestimate of ambient concentrations and deposition rates at the evaluated distances. However, if results indicate the total exposure or deposition rate under this scenario still does not indicate an exposure or risk concern, EPA has high confidence that exposure to and deposition rates of DEHP via the ambient air pathway do not pose an exposure or risk concern and no further analysis is needed. If results indicated an exposure or risk concern, the Agency would have low confidence in the results and refine the analysis to be more representative of a real exposure scenario (*e.g.,* only determine exposures and derive risk estimates based on a single facility reporting both release types).

8.5 Weight of Scientific Evidence Conclusions

EPA has low confidence in the exposure scenario modeled for this assessment since the maximum daily fugitive and stack releases occur from different facilities, but EPA treats both release types as if they occur from the same facility, at the same time, under the same OES, and at the same distance from the releasing facility, adding modeled results together to estimate a “total exposure.” EPA has moderate confidence in the IIOAC-modeled results used to characterize exposures and deposition rates since EPA used conservative inputs, considers a series of exposure scenarios under varying operating scenarios, multiple particle sizes, is based on previously peer reviewed methodology, and incorporates recommendations received during previous peer review and public comment. Despite the limitations and uncertainties described in Section 8.3, this screening level analysis presents an upper-bound value from which exposures can be characterized and risk estimates derived. The conservative inputs and assumptions lead to overestimation of exposure and deposition rates, providing a high confidence the exposure estimates are health protective.

9 AMBIENT AIR EXPOSURE TO GENERAL POPULATION

9.1 Exposure Calculations

Modeled ambient air concentration outputs from IIOAC need to be converted to estimates of exposures to derive risk estimates. For this exposure assessment, EPA assumes the general population evaluated is continuously exposed (*i.e.*, 24 hours per day, 365/296 days per year) to outdoor ambient air concentrations. Therefore, daily average modeled ambient air concentrations are equivalent to daily average exposure concentrations, and annual average modeled ambient air concentrations are equivalent to annual average exposure concentrations used to derive risk estimates (Section 8.1.3). Calculations for general population exposure to ambient air via inhalation and ingestion from air to soil deposition for lifestages expected to be highly exposed based on exposure factors can be found in *Ambient Air Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025b)

9.2 Overall Findings

Based on the results from the analysis of the maximum estimated release and high-end exposure concentrations presented in this document and the *Non-Cancer Human Health Risk Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f), EPA does not expect an inhalation risk from ambient air nor ingestion from air to soil deposition to result from exposures to DEHP from industrial releases. Because no exposures of concern were identified at the maximum release scenario, EPA does not expect a different finding for smaller releases and therefore additional or more detailed analyses for exposure to DEHP through inhalation of ambient air or ingestion from air to soil deposition are not necessary.

10 HUMAN MILK EXPOSURE

Infants are potentially susceptible for various reasons including their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes. Reasonably available information from oral studies of experimental animal models (*i.e.*, rats and mice) also indicates that DEHP is a developmental and reproductive toxicant (U.S. EPA, 2025d). EPA considered exposure (Section 10.1) and hazard (Section 10.3) information, as well as pharmacokinetic models (Section 10.2), to determine the most scientifically supportable appropriate approach to evaluate infant exposure to DEHP from human milk ingestion. The Agency concluded that the most appropriate approach is to use human health hazard values that are based on fetal and infant effects following maternal exposure during gestation and lactation. In other words, infant exposure and risk estimates from maternal exposure are expected to be protective of nursing infants as well.

10.1 Biomonitoring Information

DEHP has the potential to accumulate in human milk because of its small mass (390.56 Daltons or g/mol) and lipophilicity (log K_{OW} = 7.60). EPA identified 13 biomonitoring studies through systematic review from reasonably available information that investigated if DEHP or its metabolites (Table 10-1) were present in human milk. Two studies are from the United States, one from Canada, and the rest from seven other high-income countries around the world. A summary of the studies is provided in Figure 10-1. They provide evidence of DEHP or its metabolites in human milk and were not used as part of the analysis for quantifying exposure estimates. Study quality can be found in the *Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025a). Table 10-1 provides a list of the measured metabolites and their acronyms. None of the studies characterized if any of the study participants may be occupationally exposed to DEHP.

Table 10-1. Metabolites Measured in Biomonitoring Studies and Their Acronyms

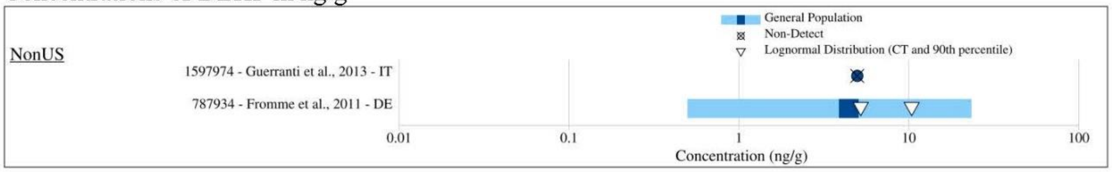
Acronym	Full Chemical Name
MEHP	Mono(2-ethylhexyl) phthalate
MEOHP	Mono(2-ethyl-5-oxohexyl) phthalate
MEHHP	Mono(2-ethyl-5-hydroxyhexyl) phthalate
MECPP	Mono(2-ethyl-5-carboxypentyl) phthalate

One U.S. study detected three metabolites of DEHP (MEHP, MEOHP, MEHHP) in all 23 samples from the Mother’s Milk Bank in California. Concentrations of the metabolites ranged from 1.63 to 2,540.94 ng/g. Median concentrations were 15.62, 45.62, and 124.44 ng/g for MEHP, MEOHP, and MEHHP, respectively (Hartle et al., 2018). A second U.S. study monitored 33 lactating North Carolinian women under the EPA’s Methods Advancement for Milk Analysis study. The detection frequency for all the measured metabolites was below 13 percent. The concentrations of DEHP’s oxidative metabolites (MECPP, MEHHP, and MEOHP) in human milk ranged from 0.1 to 0.4 µg/L. Overall, the concentrations detected were low (Hines et al., 2009).

Eleven non-U.S. studies detected a combination of DEHP or its metabolites in human milk. A Canadian study by Zhu et al. (2006) reported a maximum DEHP concentration of 2,920 ng/g lipid weight, with a mean and median of 222 and 116 ng/g, respectively among 86 samples. Except for a single sample with a DEHP concentration in human milk of 2,920 ng/g, all samples had concentrations below 1,000 ng/g (Zhu et al., 2006). The 10 remaining studies from Europe and Asia measured concentrations that ranged from below the limit of detection (LOD) to 23.5 ng/g for lipid weight and below the LOD to 1,410 μg/L for wet weight. For wet weight concentrations, the 95th percentile concentrations did not exceed 75 μg/L among the 10 studies, and six of them reported non-detectable levels for one or more of the compounds measured (Kim et al., 2020; Kim et al., 2018; Guerranti et al., 2013; Zimmermann et al., 2012; Fromme et al., 2011; Lin et al., 2011; Schlumpf et al., 2010; Latini et al., 2009; Hogberg et al., 2008; Main et al., 2006).

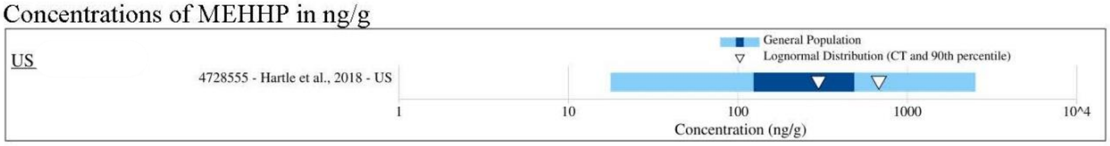
These studies provide evidence of DEHP and its metabolites in human milk and were not used to quantify exposure estimates. Study quality varied for each study and can be found in the *Data Quality Evaluation Information for General Population, Consumer, and Environmental Exposure for Diethylhexyl Phthalate* (DEHP) (U.S. EPA, 2025a).

Concentrations of DEHP in ng/g

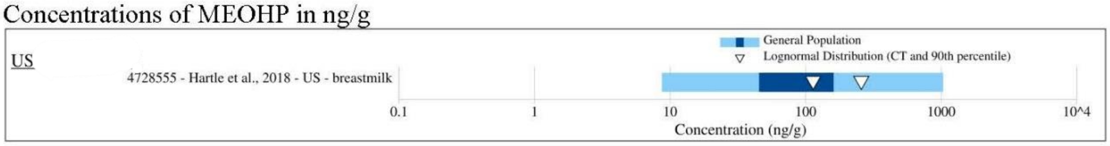


Concentrations of MEHP in ng/g

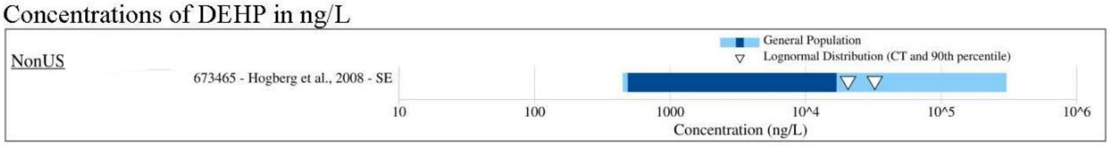
Concentrations of MEHHP in ng/g



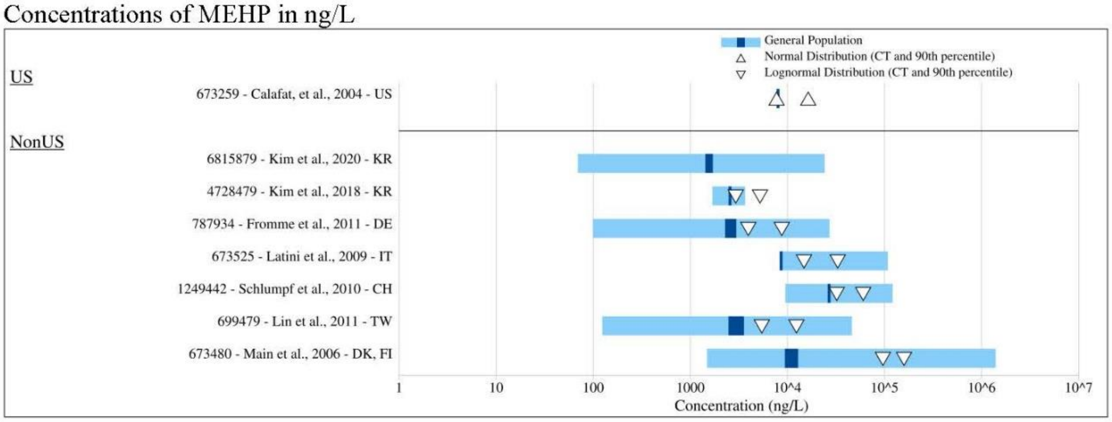
Concentrations of MEOHP in ng/g



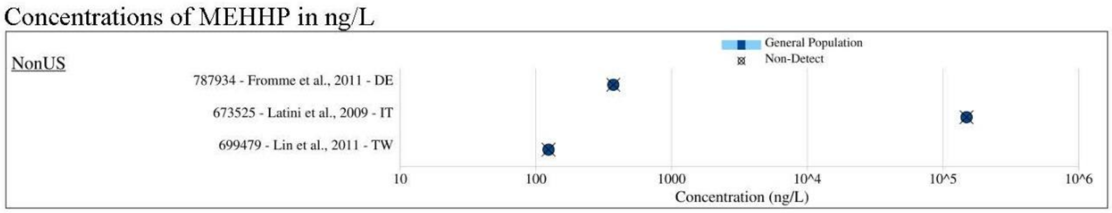
Concentrations of DEHP in ng/L



Concentrations of MEHP in ng/L



continued



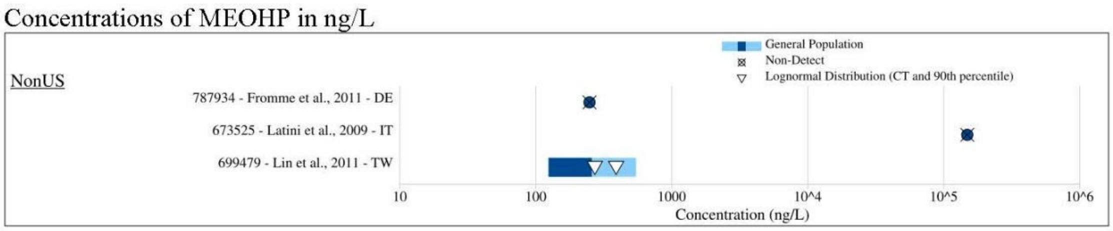


Figure 10-1. Concentrations of DEHP or its Metabolites in Human Milk in Either Lipid (ng/g) or Wet (ng/L) Weight

Biomonitoring data from the United States and/or Canada are most representative of U.S. general population exposures. However, of the three U.S. and Canadian studies identified during the systematic review process, limitations in the sampling methodology for two of them introduce uncertainties regarding the use of their data in this risk evaluation. Due to study design, study participants did not fast prior to milk collection in either the California study by Hartle et al. (2018) or the Canadian study by Zhu et al. (2006). DEHP can be found in a variety of food due to it use during processing and packaging (ATSDR, 2002). As such, DEHP levels in the mothers' milk detected in these two studies could be partially attributed to consumption of DEHP-contaminated food. Zhu et al. (2006) also measured exclusively DEHP and none of its metabolites. While participants in this study were asked to hand-express, the ubiquity of phthalate esters like DEHP in the environment (*e.g.*, in sampling equipment, laboratory reagents, and analytical apparatus) can lead to external contamination of the human milk sample (Koch and Calafat, 2009). Hartle et al. (2018) measured DEHP's hydrolytic and oxidative metabolites. However, samples originated from a milk bank that did not provide details on the collection process or efforts to minimize external contamination. Milk samples were presumably expressed manually or with a pump, and DEHP's use in medical devices could result in leaching of the chemical into the milk. In addition, the milk bank's use of storage bags could also cause contamination because DEHP can migrate from the plastic storage bags to the milk (Fan et al., 2020). Two non-U.S./Canadian studies measured concentrations of DEHP or MEHP as a lipid weight in human milk. The reported concentrations were below the limit of detection or up to three orders of magnitude lower than those in Hartle et al. (2018) and Zhu et al. (2006).

A U.S. study from North Carolina (Hines et al., 2009) addressed the limitations of the above studies by asking participants to fast prior to milk collection, and by providing collection and storage supplies that were tested and known to be phthalate-free. The study reported the concentrations of three DEHP metabolites at less than 1 µg/L, which is similar to results from seven studies from other high-income countries that measured concentrations of less than 4 µg/L for one or more metabolite. A few other studies from high-income countries detected concentrations greater than 100 µg/L; however, they reported potential contamination during collection and storage and use of breast pumps (Main et al., 2006) or identified likely outliers in their data (Hogberg et al., 2008). The similarity in results between the North Carolina study and those from several other high-income countries, as well as its control for potential food exposures and contamination from equipment increases EPA's confidence in placing greatest weight on results from (Hines et al., 2009).

It is important to note that biomonitoring data do not distinguish between exposure routes or pathways and does not allow for source apportionment. While they provide important empirical evidence that human milk ingestion is a potential exposure pathway for nursing infants, EPA cannot isolate the contribution of specific TSCA uses to the measured levels in human milk. There is no evidence in any of the studies that the measured levels of DEHP or their metabolites can be attributed solely or partially to TSCA uses. Other possible sources of exposure include food packaging and processing and medical devices (*i.e.*, breast pump) that are not regulated by TSCA. The use of biomonitoring data to characterize a nursing infant's exposure to DEHP represents an aggregate exposure from all DEHP sources and pathways which may contribute to the presence of DEHP in human milk, including both TSCA and non-TSCA uses. In other words, biomonitoring data reflect total infant exposure through human milk ingestion, and the contribution of specific TSCA COUs to overall exposure cannot be determined.

10.2 Modeling Information

EPA explored the potential to model DEHP concentrations in human milk resulting from specific sources of maternal exposures, with the aim of providing quantitative estimates of COU-specific milk exposures and risks. The Agency identified a pharmacokinetic model described in Kapraun et al. (2022) as the best available model to estimate transfer of lipophilic chemicals from mothers to infants during gestation and lactation, hereafter referred to as the Kapraun Model. The only chemical-specific parameter required by the Kapraun model is the elimination half-life in the animal species of interest.

EPA considered the model input data available for DEHP and concluded that uncertainties in establishing an appropriate half-life value precludes using the model to quantify lactational transfer and exposure from TSCA COUs. The parent DEHP has been detected in urine (Kessler et al., 2012; Koo and Lee, 2007; Koch et al., 2004). However, measurement of DEHP in organs, tissues, and other matrices is prone to error and contamination from sampling materials because of its rapid hydrolysis (Koch and Calafat, 2009). DEHP is rapidly hydrolyzed to its primary monoester metabolite, MEHP, which undergoes further oxidation reactions to produce multiple secondary metabolites (see the toxicokinetics summary in the *Non-cancer Human Health Hazard Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f). Although MEHP is specific to DEHP, its longer alkyl side chain of 10 carbons reduces its aqueous solubility, and less than 10 percent of MEHP is detectable in urine (Koch and Calafat, 2009). Half-life measurements in urine are thus inappropriate for use in estimating human milk concentrations.

DEHP metabolites measured in matrices besides urine may serve as more sensitive biomarkers of exposure to DEHP. However, half-life values may vary by tissue matrix. Half-lives have been reported to be one to two orders of magnitudes longer in epididymal fat than in plasma, liver, or other less fatty tissues for DEHP after controlling for dose and exposure route in rats (Domínguez-Romero and Scheringer, 2019; Oishi and Hiraga, 1982). No half-life values were identified in mammary glands or milk, but it may be similar to other more lipophilic matrices than in urine or blood. Although some of DEHP's secondary metabolites can be considered specific biomarkers (Wang et al., 2019), a limitation is the lack of studies elucidating the toxic moiety of DEHP.

Instead, exposure estimates for workers, consumers, and the general population were compared against the hazard values designed to be protective of infants and expressed in terms of maternal exposure levels throughout gestation and lactation.

10.3 Hazard Information

EPA determined that the critical effect following DEHP exposure is male reproductive tract malformations (testes, epididymis, seminal vesicles, prostate). The human health hazard values used in this assessment are based on a reproductive toxicity study following continuous maternal exposure for three generations. They are also supported by co-critical studies that initiated maternal dosing at implantation and continued throughout gestation, lactation, and weaning (see *Non-cancer Human Health Risk Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f)). Although no studies have evaluated only lactational exposure from quantified levels of DEHP in milk, the human health hazard values are based on studies that cover the lactational period. Because these values designed to be protective of infants are expressed in terms of maternal exposure levels and hazard values to assess direct exposures to infants are unavailable, EPA concluded that further characterization of infant exposure through human milk ingestion would be uninformative.

10.4 Weight of Scientific Evidence Conclusions

EPA considered infant exposure to DEHP through human milk because the available biomonitoring data demonstrate that DEHP can be present in human milk, and hazard data demonstrate that the developing male reproductive system may be particularly susceptible to the effects of DEHP. EPA explored the potential to model milk concentrations and concluded that there is insufficient information (*e.g.*, sensitive and specific half-life data) available to support modeling of the milk pathway. However, the Agency also concluded that modeling is not needed to adequately evaluate risks associated with exposure through milk. This is because the POD used in this assessment is based on male reproductive effects resulting from maternal exposures throughout sensitive phases of development in multigenerational studies. EPA therefore has confidence that the risk estimates calculated based on maternal exposures are protective of a nursing infant.

11 URINARY BIOMONITORING

The use of human biomonitoring data is an important tool for determining total dose (or aggregate exposure) to a chemical for real world populations. Reverse dosimetry uses biomonitoring data, as shown in Figure 11-1, to estimate an external exposure or intake dose to a chemical responsible for the measured biomarker (U.S. EPA, 2019b). Intake doses estimated using reverse dosimetry are not source apportionable and are therefore not directly comparable to the exposure estimates presented throughout this document associated with specific COUs. However, the total intake dose estimated from reverse dosimetry can help contextualize the exposure estimates from TSCA COUs as being potentially underestimated or overestimated. This section discusses urinary biomonitoring data that provide total exposure from all sources for different life stages.

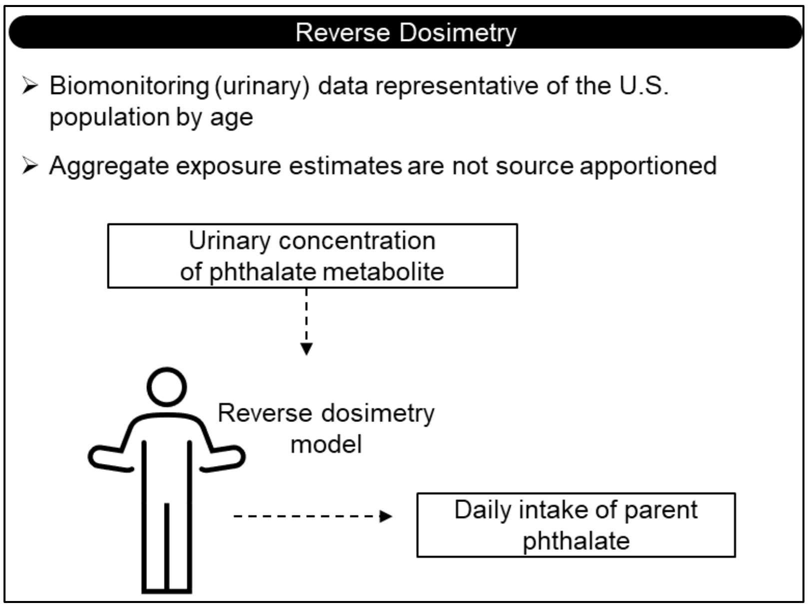


Figure 11-1. Reverse Dosimetry Approach for Estimating Daily Intake

11.1 Approach for Analyzing Biomonitoring Data

The U.S. Centers for Disease Control and Prevention's (CDC) National Health and Nutrition Examination Survey (NHANES) dataset provides a relatively recent (data available from 2017–2018) and robust source of urinary biomonitoring data that is considered a national, statistically representative sample of the non-institutionalized, U.S. civilian population. Phthalates have elimination half-lives on the order of several hours and are quickly excreted from the body in urine and to some extent feces (ATSDR, 2022; EC/HC, 2015). Therefore, the presence of phthalate metabolites in NHANES urinary biomonitoring data indicates recent phthalate exposure.

NHANES reports urinary concentrations for 15 phthalate metabolites specific to individual phthalate diesters. Four metabolites of DEHP, MEHP, MEHHP, MECPP, and MEOHP have been reported in the NHANES data. Sampling details can be found in Appendix G. Urinary concentrations of DEHP metabolites were quantified for different lifestages. The lifestages assessed included: women of reproductive age (16–49 years), adults (16+ years), adolescents (11 to <16 years), children (6 to <11 years), and toddlers (3 to <6 years) when data were available. Urinary concentrations of DEHP metabolites were analyzed for all available NHANES survey years to examine the temporal trend of DEHP exposure. However, intake doses using reverse dosimetry were calculated for the most recent NHANES cycle (2017–2018) as being most representative of current exposures.

NHANES uses a multi-stage, stratified, clustered sampling design that intentionally oversamples certain demographic groups; to account for this, all data was analyzed using the survey weights provided by NHANES and analyzed using weighted procedures in SAS and SUDAAN statistical software. Median and 95th percentile concentrations were calculated in SAS and reported for lifestages of interest. Median and 95th percentile concentrations are provided in Table_Apx G-2. DEHP metabolite trends were analyzed over time with PROC DESCRIPT using SAS-callable SUDAAN.

11.1.1 Temporal Trend of MEHP

Figure 11-2 through Figure 11-7 show urinary MEHP concentrations plotted over time for the various populations to visualize the temporal exposure trends. All data used for the temporal exposure trends are provided in Table_Apx G-2. Overall, MEHP urinary concentrations have decreased over time for all lifestages.

Median urinary MEHP concentrations decreased significantly among all children under age 16 ($p < 0.001$) (Figure 11-5), as well as among children aged 3 to less than 6 years ($p < 0.001$) (Figure 11-2), 6 to less than 11 years ($p < 0.001$) (Figure 11-3), and 11 to less than 16 years ($p < 0.001$) (Figure 11-4). There were also significant decreases in median urinary MEHP concentrations for all male children ($p < 0.001$) and female children ($p < 0.001$) under age 16. Decreases in 95th percentile urinary MEHP concentrations were seen for all children under age 16 ($p < 0.001$), as well as among children aged 3 to less than 6 years ($p < 0.001$), 6 to less than 11 years ($p < 0.001$), and 11 to less than 16 years ($p < 0.001$). 95th percentile urinary MEHP concentrations decreased significantly for all male children ($p < 0.001$) and female children (p < 0.001) under age 16.

Among adults, 50th percentile MEHP urinary concentrations ($p < 0.001$) and 95th percentile MEHP urinary concentrations ($p < 0.001$) significantly decreased over time from 1999 to 2018 (Figure 11-6). A significant decrease in MEHP concentrations was also seen among adult males (50th percentile: $p < 0.001$, 95th percentile: $p < 0.001$). Among female adults, 50th percentile MEHP urinary concentrations ($p < 0.001$) and 95th percentile MEHP urinary concentrations ($p < 0.001$) also decreased over time. Among women of reproductive age, there were statistically significant decreases in 50th percentile ($p < 0.001$) and 95th percentile ($p < 0.001$) MEHP urinary concentrations over time (Figure 11-7).

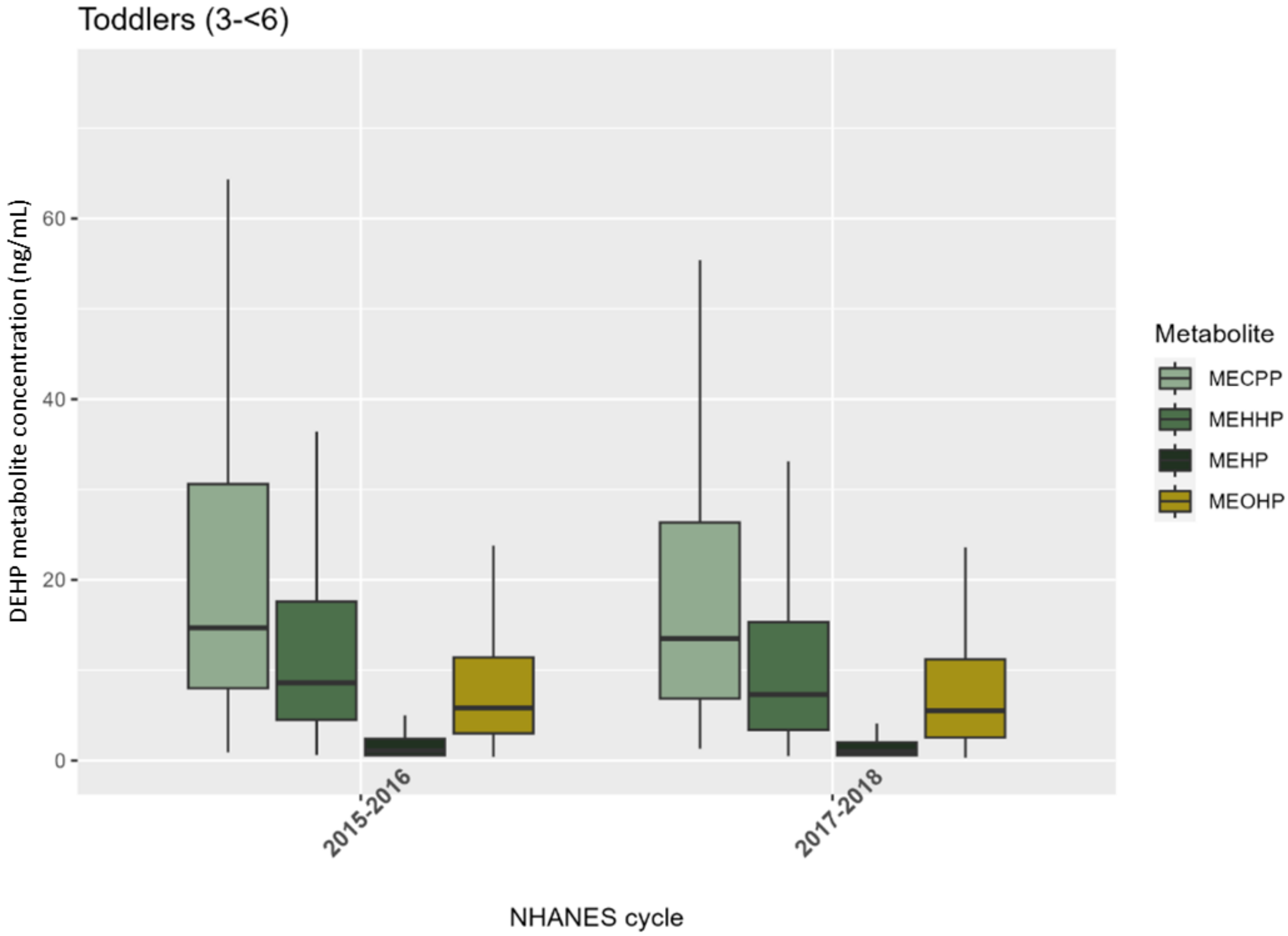


Figure 11-2. Urinary DEHP Metabolite Concentrations for Toddlers (3 to <6 Years)

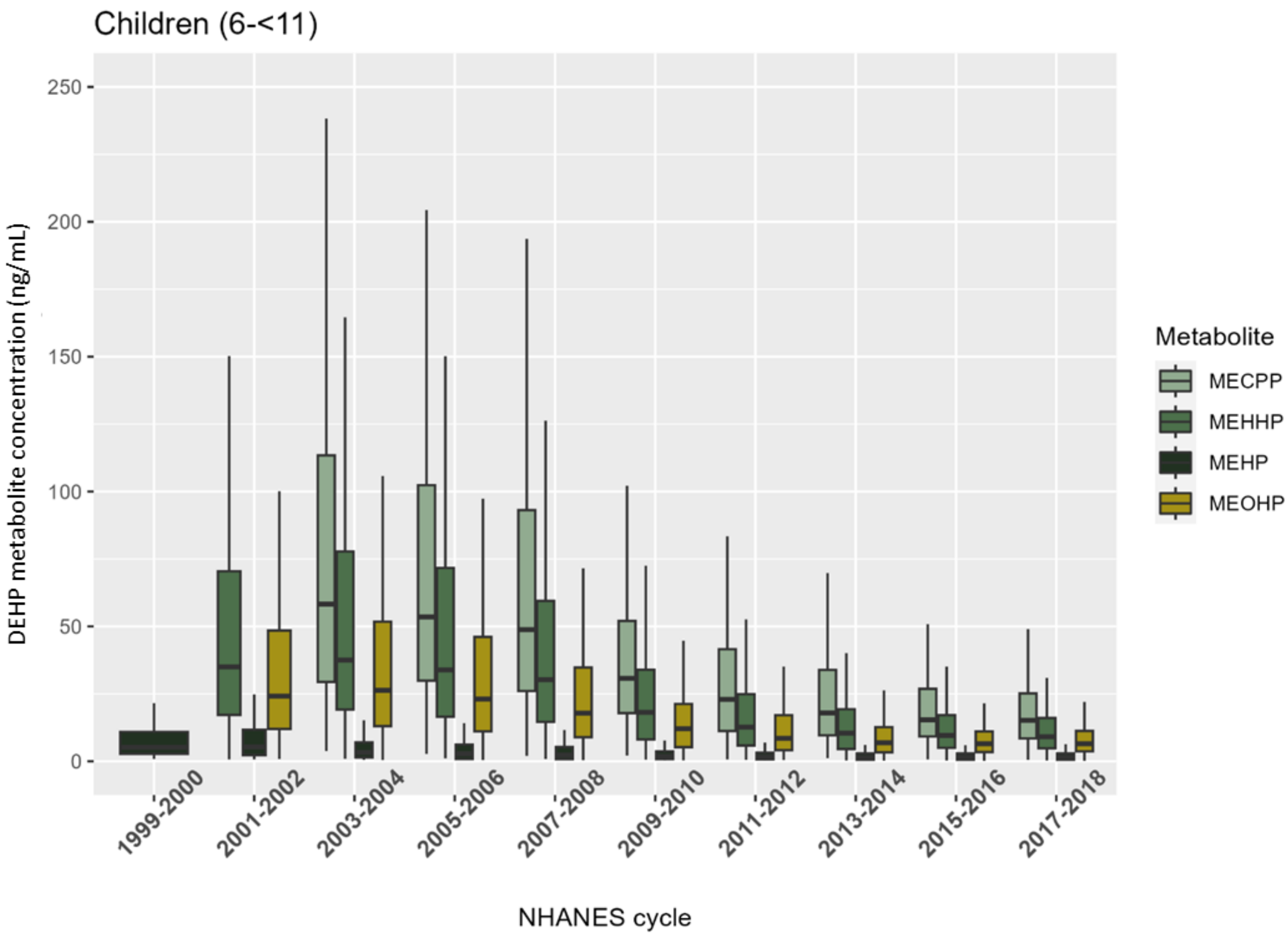


Figure 11-3. Urinary DEHP Metabolite Concentrations for Children (6 to <11 Years)

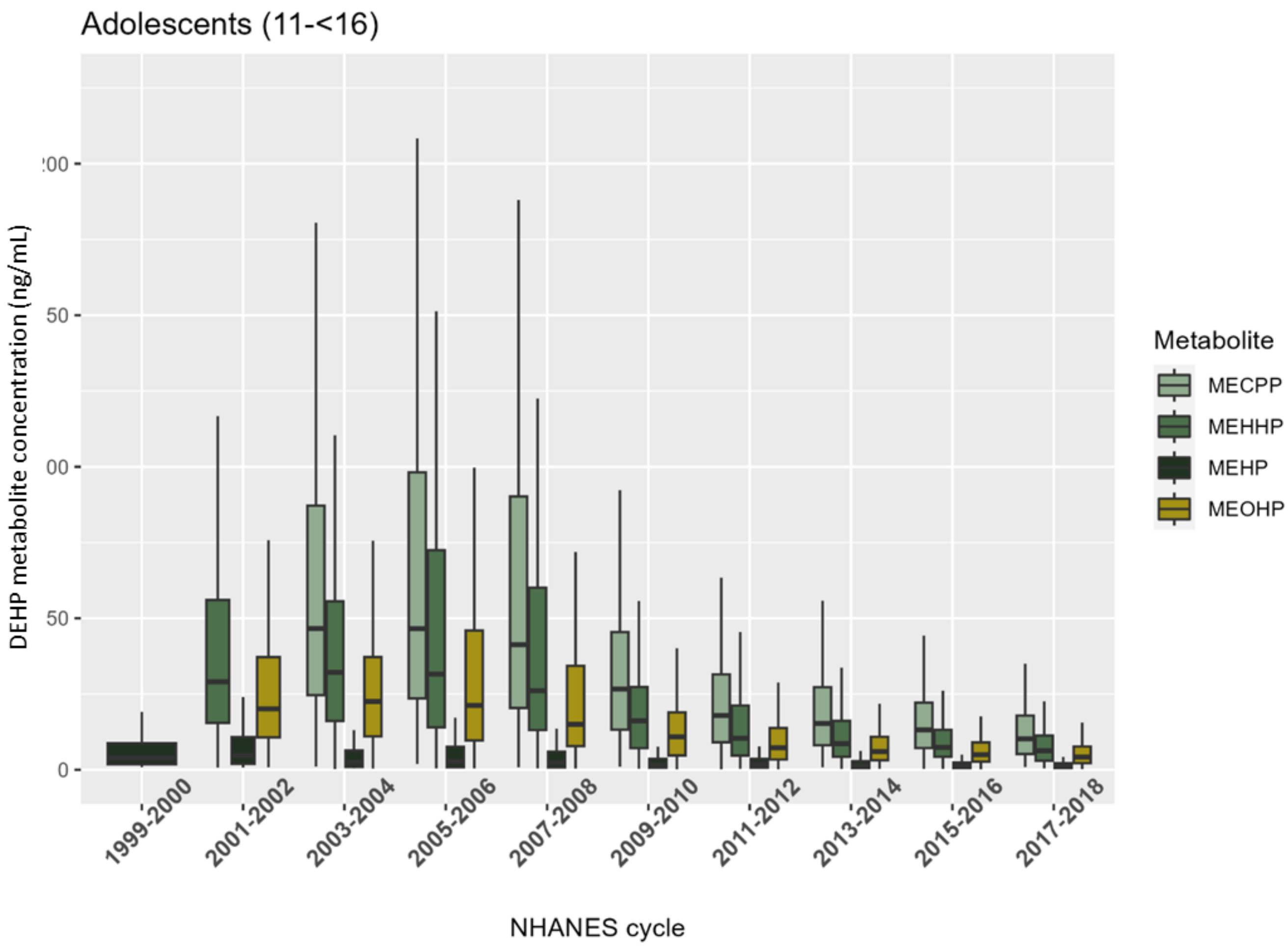


Figure 11-4. Urinary DEHP Metabolite Concentrations for Adolescents (11 to <16 Years)

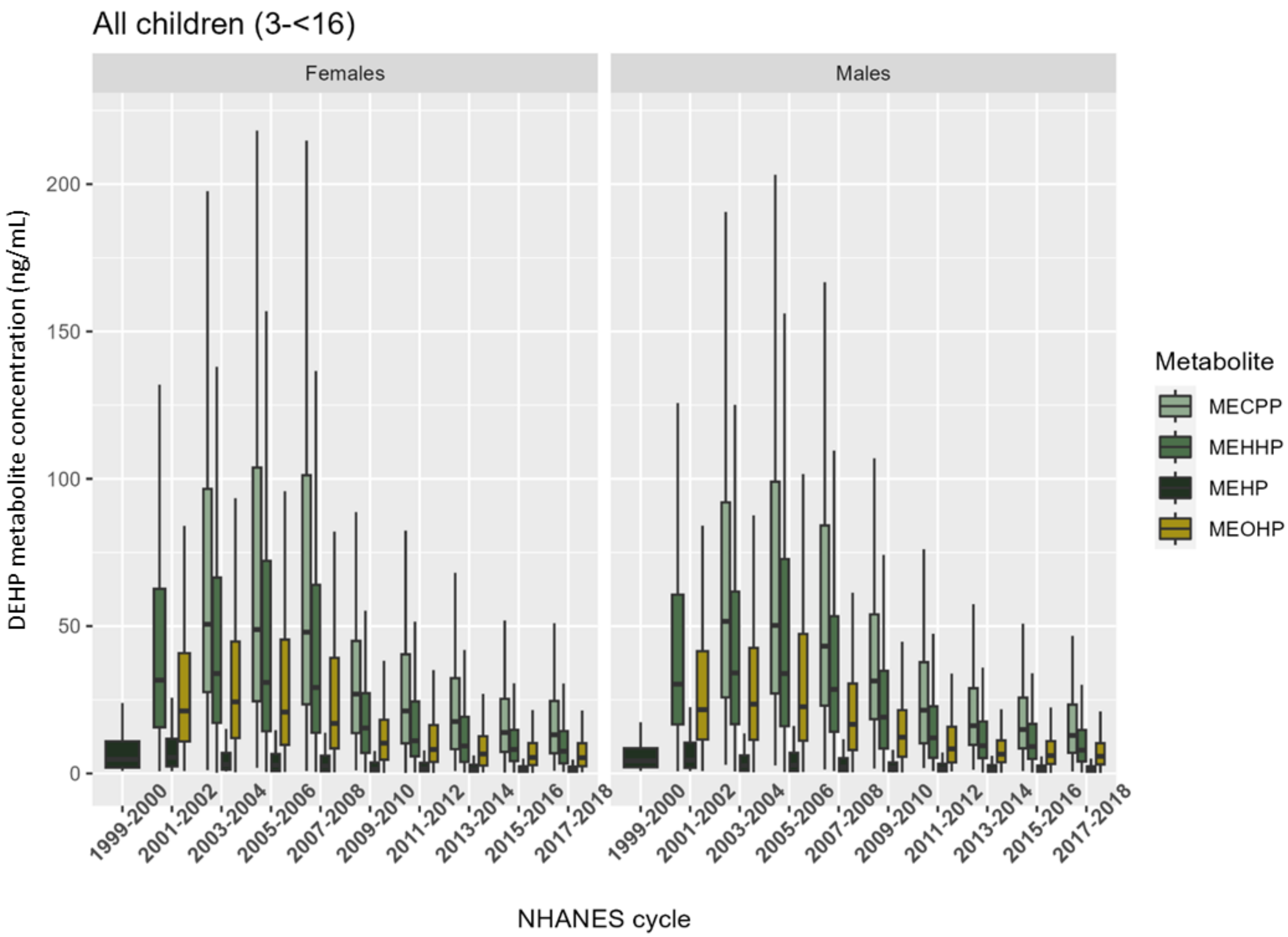


Figure 11-5. Urinary DEHP Metabolite Concentrations for All Children (3 to <16 Years), by Sex

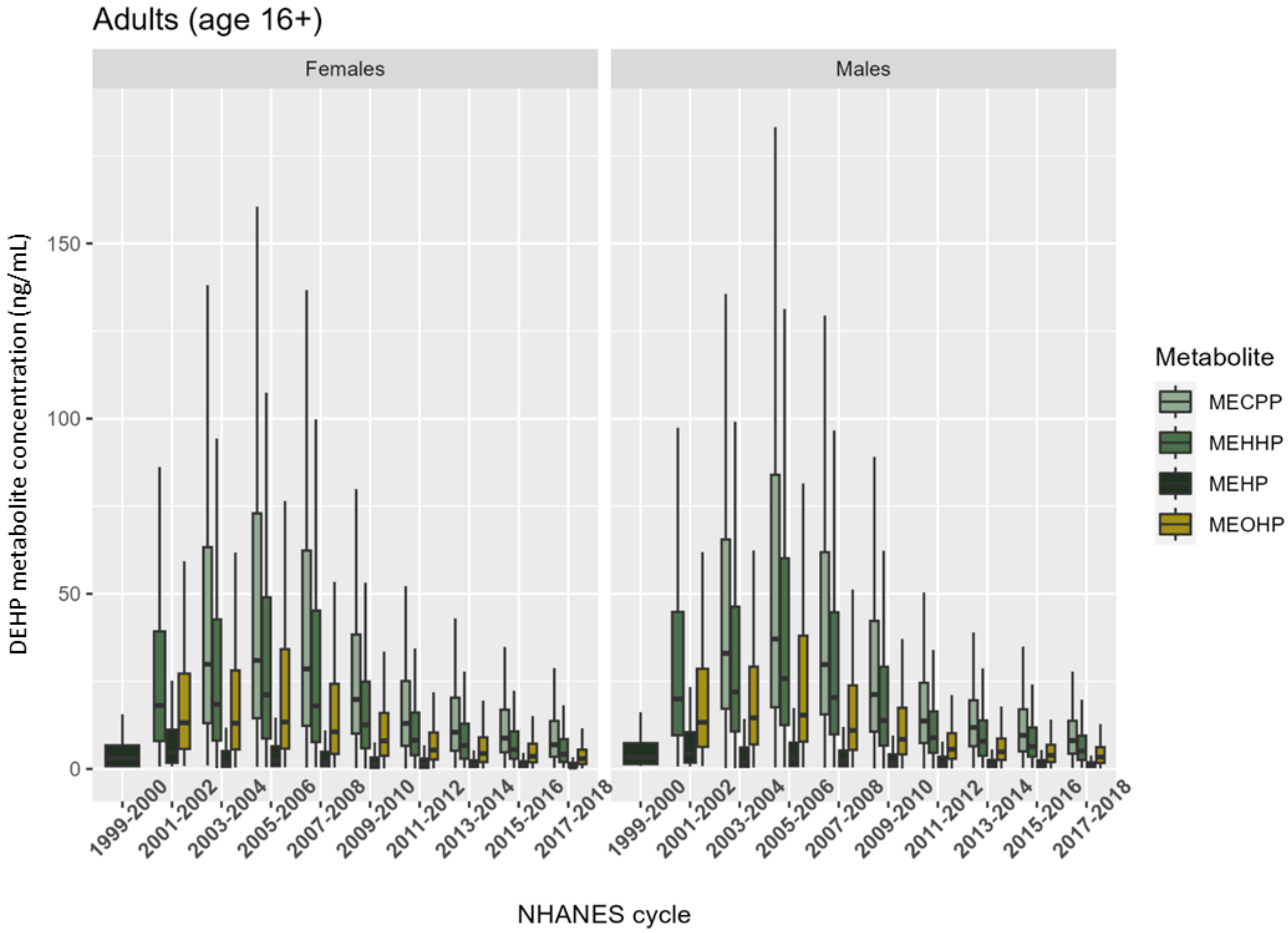


Figure 11-6. Urinary DEHP Metabolite Concentrations for Adults (16+ Years), by Sex

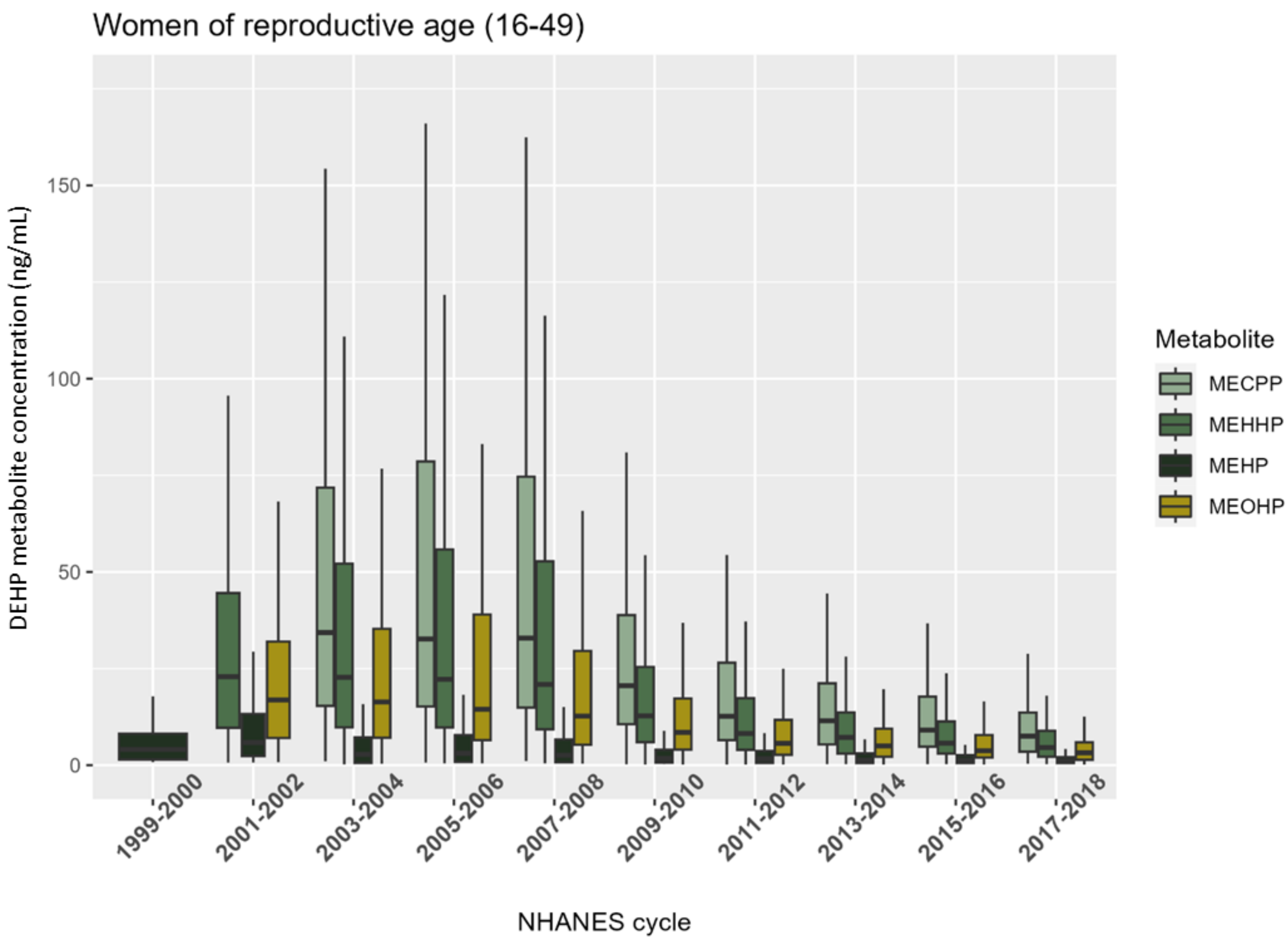


Figure 11-7. Urinary DEHP Metabolite Concentrations for Women of Reproductive Age (16–49 Years)

11.1.2 Temporal Trends of MEHHP

Figure 11-2 through Figure 11-7 show urinary MEHHP concentrations plotted over time for the various populations to visualize the temporal exposure trends. All data used for the temporal exposure trends are provided in Table_Apx G-2. Overall, median and 95th percentile MEHHP concentrations have decreased over time for all lifestages.

Statistically significant decreases in median and 95th percentile urinary MEHHP concentrations were observed among all children under age 16 ($p < 0.001$) (Figure 11-5), as well as among children aged 3 to less than 6 years ($p < 0.001$) (Figure 11-2), 6 to less than 11 years ($p < 0.001$) (Figure 11-3), and 11 to less than 16 years ($p < 0.001$) (Figure 11-4). Median and 95th percentile urinary MEHHP concentrations also decreased significantly for all male children ($p < 0.001$) and female children ($p < 0.001$) under age 16, all male adults ($p < 0.001$) and all female adults ($p < 0.001$).

From 2001 to 2018, 50th and 95th percentile MEHP urinary concentrations decreased significantly among all adults ($p < 0.001$), as well as among adult males ($p < 0.001$), and among adult females ($p < 0.01$) (Figure 11-6). Among women of reproductive age, there were statistically significant decreases in 50th percentile ($p < 0.001$) and 95th percentile ($p < 0.001$) MEHHP urinary concentrations over time (Figure 11-7).

11.1.3 Temporal Trends of MEOHP

Figure 11-2 through Figure 11-7 show urinary MEOHP concentrations plotted over time for the various populations to visualize the temporal exposure trends. All data used for the temporal exposure trends are provided in Table_Apx G-2. Overall, median and 95th percentile MEOHP concentrations have decreased over time for all lifestages.

There were statistically significant decreases in median and 95th percentile urinary MEOHP concentrations among all children under age 16 ($p < 0.001$) (Figure 11-5), including among children aged 3 to less than 6 years ($p < 0.001$) (Figure 11-2), 6 to less than 11 years ($p < 0.001$) (Figure 11-3), and 11 to less than 16 years ($p < 0.001$) (Figure 11-4). Decreases in median and 95th percentile urinary MEOHP concentrations were observed for all male children ($p < 0.001$) and female children ($p < 0.001$) under age 16.

From 2001 to 2018, 50th and 95th percentile MEOHP urinary concentrations decreased significantly for all adults ($p < 0.001$), as well as for adult males ($p < 0.001$), and adult females ($p < 0.001$) (Figure 11-6). Among women of reproductive age, there were statistically significant decreases in 50th percentile ($p < 0.001$) and 95th percentile ($p < 0.001$) MEOHP urinary concentrations over time (Figure 11-7).

11.1.4 Temporal Trends of MECPP

Figure 11-2 through Figure 11-7 show urinary MECPP concentrations plotted for the 2003–2018 NHANES cycles. All data used for the temporal exposure trends are provided in Table_Apx G-2. Overall, median and 95th percentile MECPP concentrations have decreased over time for all lifestages.

Among all children under age 16, median and 95th percentile urinary MECPP concentrations decreased significantly ($p < 0.001$) (Figure 11-5), as well as for children aged 3 to less than 6 years ($p < 0.001$) (Figure 11-2), 6 to less than 11 years ($p < 0.001$) (Figure 11-3), and 11 to less than 16 years ($p < 0.001$) (Figure 11-4). Median urinary MECPP concentrations decreased significantly for all male ($p < 0.001$) and female ($p < 0.001$) children under age 16.

From 1999 to 2018, 50th and 95th percentile MECPP urinary concentrations decreased significantly for all adults ($p < 0.001$) as well as for adult males ($p < 0.001$), and adult females ($p < 0.001$) (Figure 11-6). From 2003 to 2018, 95th percentile MECPP urinary concentrations decreased significantly for all adults ($p < 0.001$) as well as for adult males ($p < 0.001$) and females ($p < 0.001$). Among women of reproductive age, there were statistically significant decreases in 50th percentile MECPP urinary concentrations over time ($p < 0.001$) and 95th percentile MECCP urinary concentrations over time ($p < 0.001$) (Figure 11-7).

11.1.5 Daily Intake of DEHP from NHANES

Using DEHP metabolite concentrations measured in the most recently available sampling cycle (2017–2018), EPA estimated the daily intake of DEHP through reverse dosimetry. Reverse dosimetry approaches that incorporate basic pharmacokinetic information are available for phthalates (Koch et al., 2007; Koch et al., 2003; David, 2000) and have been used in previous phthalate risk assessments conducted by U.S. CPSC (2014) and Health Canada (ECCC/HC, 2020) to estimate daily intake values for exposure assessment. For phthalates, reverse dosimetry can be used to estimate a daily intake (DI) value for a parent phthalate diester based on phthalate monoester metabolites measured in human urine using Equation 11-1 (Koch et al., 2007). For DEHP, the phthalate monoester metabolites are MEHP, MEHHP, MEOHP, and MECPP.

Equation 11-1. Calculating the Daily Intake Value from Urinary Biomonitoring Data

$$Phthalate\ DI = \frac{(\mathrm{UE}_{Sum} \times \mathrm{CE})}{\mathrm{Fue}_{sum}} \times MW_{Parent}$$

Where:

$Phthalate\ DI$	=	Daily intake (µg/kg-day) value for the parent phthalate diester
UE_{sum}	=	Sum molar concentration of urinary metabolites associated with the parent phthalate diester (µmol/g)
CE	=	Creatinine excretion rate normalized by body weight (mg/kg-day). CE can be estimated from the urinary creatinine values reported in biomonitoring studies (*i.e.*, NHANES) using the equations of Mage et al. (2008) based on age, gender, height, and race, as was done by Health Canada (2020) and U.S. CPSC (2014).
Fue_{sum}	=	Summed molar fraction of urinary metabolites. The molar fraction describes the molar ratio between the amount of metabolite excreted in urine and the amount of parent compound taken up. F_{ue} values used for daily intake value calculations are shown in Table 11-1.
MW_{parent}	=	Molecular weight of the parent phthalate diester (g/mol)

Table 11-1. F_{ue} Values Used for the Calculation of Daily Intake Values by DEHP

Metabolite	F_{ue} [a]	F_{ue} Sum	Reference	Study Population
MEHP	0.062	0.453	Anderson et al. (2011)	n = 10 men (20–42 years of age) and 10 women (18–77 years of age)
MEHHP	0.149			
MEOHP	0.109			
MECPP	0.132			

[a] F_{ue} values are presented on a molar basis and were estimated by study authors based on metabolite excretion over a 24-hour period.

Daily intake values were calculated for each participant from NHANES. A creatinine excretion rate for each participant was calculated using equations provided by Mage et al. (2008). The applied equation is dependent on the participant's age, height, race, and sex to accommodate variances in urinary excretion rates. Creatinine excretion rate equations were only reported for people who are non-Hispanic Black and non-Hispanic White, so the creatinine excretion rate for participants of other races were calculated using the equation for non-Hispanic White adults or children, in accordance with the approach used by U.S. CPSC (2015). Daily intake values for DEHP are reported in Table 11-2.

Table 11-2. Daily Intake Values for DEHP Based on Urinary Biomonitoring from the 2017–2018 NHANES Cycle

Demographic	50th Percentile Daily Intake Value (Median [95% CI]) (µg/kg-day)	95th Percentile Daily Intake Value (Median [95% CI]) (µg/kg-day)
All	1.07 (0.96–1.18)	4.5 (3.86–5.15)
Females	1.1 (0.98–1.23)	4.22 (3.54–4.91)
Males	1.07 (0.91–1.23)	4.62 (3.71–5.53)
White non-Hispanic	1.11 (0.94–1.28)	3.74 (2.89–4.59)
Black non-Hispanic	0.84 (0.65–1.03)	4.1 (3.52–4.67)
Mexican-American	0.91 (0.75–1.07)	5.45 (3.67–7.23)
Other	1.18 (1.01–1.36)	5.34 (3.25–7.43)
Above poverty level	1.29 (1.06–1.51)	5.89 (4.34–7.43)
Below poverty level	1.04 (0.91–1.16)	3.79 (3.17–4.42)
Toddlers (3 to <6 years)	2.11 (1.86–2.35)	6.41 (5.13–7.69)
Children (6 to <11 years)	1.32 (1.12–1.52)	4.62 (3.55–5.69)
Adolescents (12 to <16 years)	0.69 (0.52–0.85)	2.05 (–5.34 to 9.43)
Adults (16+ years)	0.54 (0.4–0.68)	1.78 (–0.23 to 3.79)
Male toddlers (3 to <6 years)	2.11 (1.85–2.38)	6.44 (4.68–8.2)
Male children (6 to <11 years)	1.24 (0.98–1.51)	4.68 (3.32–6.04)
Male adolescent (12 to <16 years)	0.66 (0.56–0.76)	2.51[a]
Male adults (16+ years)	0.54 (0.29–0.79)	2.17[a]
Female toddlers (3 to <6 years)	2 (1.68–2.31)	6.17 (3.81–8.52)
Female children (6 to <11 years)	1.38 (1.11–1.65)	4.35 (2.46–6.23)
Female adolescents (12 to <16 years)	0.74 (0.5–0.98)	1.58[a]
Women of reproductive age (16–49 years)	0.53 (0.36–0.71)	1.48 (–1.55 to 4.52)
Female adults (16+ years)	0.53 (0.36–0.71)	1.48 (–1.55 to 4.52)

[a] 95% confidence intervals (CI) could not be calculated due to small sample size or a standard error of zero

The calculated DI values in this analysis are similar to those reported by the U.S. CPSC (2014) and Health Canada (2020). The daily intake values in the present analysis are calculated with all available NHANES data between 1999 and 2018, while the CPSC report only contains estimates for MEHP, MEOHP, and MEHHP calculated with data from the 2005 to 2006 NHANES cycle, and the Health Canada analysis used data from the Canadian Health Measures Survey on MEHP, MEOHP, and MEHHP from the 2007 to 2009 cycle. Due to the significant decrease in DEHP concentrations over time, the daily intake values calculated by EPA are lower than those reported in phthalate assessments using older data.

Daily intake values in the U.S. CPSC (2014) report were estimated for adults aged 15 to 45 years, while the present analysis reports results for adults aged 16 years and older, as well as for women of reproductive age (16–49 years). U.S. CPSC reports a median daily intake value for adults aged 15 to 45 years as 3.8 µg/kg-day and a 95th percentile daily intake value of 45.2 µg/kg-day.

The Health Canada (2020) assessment reports median and 95th percentile daily intake values for male children aged 6 to 11 as 3 and 12 µg/kg-day, respectively, and as 2.3 and 8.1 µg/kg-day respectively for female children aged year 6 to 11. Among males aged 12 to 19 years, the median daily intake value was

1.4 µg-kg/day, and the 95th percentile was 5.6 µg-kg/day, and the median daily intake value among females aged 12 to 19 years was 1.2 µg-kg/day, and the 95th percentile was 4 µg/kg-day. The reported median and 95th percentile daily intake values for adults (age 20–49) were 1.4 and 5.6 µg-kg/day for males and 1.2 and 4 µg/kg-day for females.

As described earlier, reverse dosimetry modeling does not distinguish between routes or pathways of exposure, but it does not allow for source apportionment (*i.e.*, exposure from TSCA COUs cannot be isolated). Therefore, general population exposure estimates from exposure to ambient air, surface water, and soil are not directly comparable. However, in contrast to the general population exposures estimated for a screening level analysis with the NHANES biomonitoring data, many of the acute dose rates or average daily doses from a single exposure scenario are similar in magnitude to the total daily intake values estimated using NHANES. Taken together with results from U.S. CPSC (2014) stating that DEHP exposure comes primarily from diet for women, infants, toddlers, and children and that the outdoor environment does not contribute to DEHP exposures, *general population exposures via ambient air, surface water, and drinking water quantified in this assessment are likely overestimates.*

11.2 Limitations and Uncertainties of Reverse Dosimetry Approach

Controlled human exposure studies have been conducted and provide estimates of the urinary molar excretion factor (*i.e.*, the F_{ue}) to support use of a reverse dosimetry approach. These studies most frequently involve oral administration of an isotope-labelled (*e.g.*, deuterium or carbon-13) phthalate diester to a healthy human volunteer and then urinary excretion of monoester metabolites is monitored over 24 to 48 hours. F_{ue} values estimated from these studies have been used by both U.S. CPSC (2014) and Health Canada (2020) to estimate phthalate daily intake values using urinary biomonitoring data.

Use of reverse dosimetry and urinary biomonitoring data to estimate daily intake of phthalates is consistent with approaches employed by both U.S. CPSC (2014) and Health Canada (2020). However, there are challenges and sources of uncertainty associated with the use of reverse dosimetry approaches. U.S. CPSC considered several sources of uncertainty associated with use of human urinary biomonitoring data to estimate daily intake values and conducted a semi-quantitative evaluation of uncertainties to determine the overall effect on daily intake estimates (see Section 4.1.3 of (U.S. CPSC, 2014)). Identified sources of uncertainty include the following: (1) analytical variability in urinary metabolite measurements; (2) human variability in phthalate metabolism and its effect on metabolite conversion factors (*i.e.*, the F_{ue}); (3) temporal variability in urinary phthalate metabolite levels; (4) variability in urinary phthalate metabolite levels due to fasting prior to sample collection; (5) variability due to rapid elimination kinetics and spot samples; and (6) creatinine correction models for estimating daily intake values.

In addition to some of the limitations and uncertainties discussed above and outlined by U.S. CPSC (2014), the short half-lives of phthalates can be a challenge when using a reverse dosimetry approach. Phthalates have elimination half-lives on the order of several hours and are quickly excreted from the body in urine and to some extent feces (ATSDR, 2022; EC/HC, 2015). Therefore, spot urine samples, as collected through NHANES and many other biomonitoring studies, are representative of relatively recent exposures. Spot urine samples were used by both Health Canada (2020) and U.S. CPSC (2014) to estimate daily intake values. However, due to the short half-lives of phthalates, a single spot sample may not be representative of average urinary concentrations that are collected over a longer term or calculated using pooled samples (Shin et al., 2019; Aylward et al., 2016). Multiple spot samples provide a better characterization of exposure, with multiple 24-hour samples potentially leading to better characterization, but are less feasible to collect for large studies (Shin et al., 2019). Due to rapid elimination kinetics, U.S. CPSC concluded that spot urine samples collected at a short time (2–4 hours) since last exposure may overestimate human exposure, while samples collected at a longer time (>14 hours) since last exposure may underestimate exposure (see Section 4.1.3 of (U.S. CPSC, 2014) for further discussion).

11.3 Weight of Scientific Evidence Conclusions

For the urinary biomonitoring data, despite the uncertainties discussed in Section 11.2, overall U.S. CPSC (2014) concluded that factors that might lead to an overestimation of daily intake seem to be well balanced by factors that might lead to an underestimation of daily intake. Therefore, reverse dosimetry approaches "provide a reliable and robust measure of estimating the overall phthalate exposure." Given a similar approach and estimated daily intake values, EPA has robust confidence in the estimated daily intake values calculated using reverse dosimetry on NHANES biomonitoring data. Again, reverse dosimetry modeling does not distinguish between routes or pathways of exposure and does not allow for source apportionment (*i.e.,* exposure from TSCA COUs cannot be isolated), but EPA has robust confidence in the use of its total daily intake value calculated using NHANES to contextualize the exposure estimates from TSCA COUs as being overestimated as described in Section 11.1.5.

12 ENVIRONMENTAL BIOMONITORING AND TROPHIC TRANSFER

Trophic transfer is the process by which chemical contaminants can be taken up by organisms through dietary and media exposures and be transferred from one trophic level to another. EPA has assessed the available studies related to the biomonitoring of DEHP and collected in accordance with the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances* (U.S. EPA, 2021b) and *Systematic Review Protocol for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025l). Chemicals can be transferred from contaminated media and diet to biological tissue and accumulate throughout an organisms' lifespan (bioaccumulation) if they are not readily excreted or metabolized. Through dietary consumption of prey, a chemical can subsequently be transferred from one trophic level to another. If biomagnification occurs, higher trophic level predators will contain greater body burdens of a contaminant compared to lower trophic level organisms. EPA reviewed the descriptions of DEHP content in biotic tissue via biomonitoring studies and provides qualitative descriptions of the potential dietary exposures to aquatic and terrestrial organisms via feeding (trophic) relationships.

12.1 Aquatic Environmental Biomonitoring

Studies on DEHP concentrations in aquatic species within the pool of reasonably available information were coupled with larger investigations on dialkyl phthalate esters (DPE). Measured DEHP concentrations stemmed from studies examining phthalate ester concentrations in aquatic ecosystems. Multiple aquatic species had DEHP wet weight concentrations reported and/or calculated from a total of 15 studies. Examination of the highest geometric mean DEHP wet weight concentrations at each trophic level are presented here from primary producers to tertiary consumers including fishes and avian taxa.

DEHP wet weight concentrations were reported for two primary producers from aquatic ecosystems (Chi, 2009; McConnell, 2007). In Vancouver, British Columbia, Canada, green algae (*Prasiola meridionalis*) from the urban False Creek Harbor had a geometric mean whole body DEHP concentration of 0.26 mg/kg ww (McConnell, 2007). This was slightly lower than the average DEHP concentration found in the vascular aquatic plant, *Potamogeton crispus*, that was collected from Northern China's Haihe River in the urban portion of Tianjin. The plant was measured from its above ground tissue at approximately 0.46 mg/kg ww (Chi, 2009).

DEHP wet weight concentrations have been reported and/or calculated for 14 species of primary consumers (*e.g.*, crustaceans, mollusks, invertebrates, and herbivorous finfish) (Hu et al., 2016; Sánchez-Avila et al., 2013; Blair et al., 2009; McConnell, 2007; Giam et al., 1978). The hepatopancreas of the dungeness crab (*Cancer magister*) from the urban False Creek Harbor in Vancouver, British Columbia, Canada had a geometric mean DEHP concentration at 0.045 mg/kg ww (McConnell, 2007). For six mollusk species, the highest geometric mean DEHP concentrations ranged from approximately 0.024 mg/kg ww in blue mussel homogenate from the urban False Creek Harbor in Vancouver, British Columbia, Canada, to 0.067 mg/kg ww within the whole body of the Mediterranean mussel (*Mytilus galloprovincialis*) collected from coastal waters in Northern Spain that receive urban and industrial waste in addition to having active ports (Sánchez-Avila et al., 2013; Blair et al., 2009). The great blue spotted mudskipper (*Boleophthalmus pectinirostris*), an herbivorous finfish, from the Ningbo coastal city in the Yangtze River Delta had an average DEHP concentration at approximately 0.13 mg/kg ww in homogenized organs (Hu et al., 2016). As a collective, primary consumers had geometric mean DEHP concentrations ranging from approximately 0.024 to 0.13 mg/kg ww (Hu et al., 2016; Blair et al., 2009).

Omnivorous finfish are secondary and tertiary consumers with DEHP wet weight concentrations reported and/or calculated for 11 species (Lucas and Polidoro, 2019; Hu et al., 2016; Jarosová et al., 2012; McConnell, 2007; Camanzo et al., 1987; De Vault, 1985; Giam et al., 1978; U.S. EPA, 1974). Homogenized organs of the flathead grey mullet (*Mugil cephalus*) from the Taizhou coastal city in the Yangtze River Delta had the highest average DEHP concentration at 1.077 mg/kg ww (Hu et al., 2016). The second highest concentrations within the reasonably available literature were from De Vault (1985) with the Great Lakes Monitoring Program. De Vault (1985) collected fishes from 1980 to 1981 and reported DEHP concentrations within whole common carp (*Cyprinus carpio*) collected from eight rivers within Wisconsin and one river in Ohio with a geometric mean concentration of 0.987 mg/kg ww. The shiner perch (*Cymatogaster aggregata*) from the urban False Creek Harbor in Vancouver, British Columbia, Canada, had the lowest geometric mean DEHP concentration in its whole body at 0.043 mg/kg ww (McConnell, 2007).

Piscivorous finfish are secondary and tertiary consumers. DEHP wet weight concentrations were reported and/or calculated for 44 piscivorous species (Lucas and Polidoro, 2019; Hu et al., 2016; Evenset et al., 2009; Cousins et al., 2007; McConnell, 2007; Peijnenburg and Struijs, 2006; Camanzo et al., 1987; De Vault, 1985; Giam et al., 1978; U.S. EPA, 1974). The silver pomfret (*Pampus argenteus*) from the industrial coastal city of Shanghai near the Yangtze River Delta had the highest average DEHP concentration in homogenized organs at 1.941 mg/kg ww (Hu et al., 2016). The second highest concentrations within the reasonably available literature from carnivorous fishes were from De Vault (1985) and the Great Lakes Monitoring Program reporting a geometric mean concentrations of 1.23 mg/kg ww within northern pike (*Esox lucius*) collected from one river in Wisconsin and one in Ohio. Authors reported a fish identified as the tidewater goby (*Eucyclogobius newberryi*) from the coastal city Zhoushan, China, near the Yangtze River Delta had the lowest DEHP concentrations at 0.0039 mg/kg ww (Hu et al., 2016). In addition, bream and roach finfish, a piscivore and an omnivore, from a mix of contaminated and non-contaminated sites throughout the Netherlands were homogenized and had a geometric mean DEHP concentration at 0.0018 mg/kg ww (Peijnenburg and Struijs, 2006).

Aquatic avian species are part of the upper trophic level in aquatic ecosystems, and DEHP wet weight concentrations were reported and/or calculated for four avian species from Svalbard, Norway (Huber et al., 2015; Evenset et al., 2009). The common eider (*Somateria mollissima*) from Kongsfjorden and the kittiwakes (*Rissa tridactyla*) from Kongsfjorden and Liefdefjorden had similar geometric means in their liver at 0.10 and approximately 0.11 mg/kg ww, respectively (Evenset et al., 2009). Mackintosh (2004) reported DEHP concentrations within liver tissue of a marine avian species, surf scooter (*Melanitta perspicillata*), from the urban False Creek Harbor in Vancouver, British Columbia, Canada, at a mean of 0.005 mg/kg ww. A comprehensive study on environmental pollutants within egg samples was conducted on seabird species within coastal Norway (Huber et al., 2015). Concentrations of DEHP recorded within pooled eggs of the European herring gull (*Larus argentatus*) ranged from 0.011 to 0.024 mg/kg ww and 0.003 to 0.042 mg/kg ww in European shag eggs (*Phalacrocorax aristotelis*) (Huber et al., 2015).

Additional biomonitoring studies have reported the concentrations of DEHP within components of eggs in oviparous aquatic animals. DEHP was measured in thirty sea turtle (*Caretta caretta*) eggs (shell, yolk, and albumin) from the Marine Protected Area of the Pelagie Islands in the Mediterranean Sea (Savoca et al., 2021). The eggs were collected from four different nests around the islands. The maximum eggshell, yolk, and albumen content of DEHP was 0.206, 0.276, and 0.052 mg/kg, respectively. Another study examined DEHP in Audouin’s gull eggs (*Larus audouinia*) from four breeding colonies in coastal Spain (Oró-Nolla et al., 2024). In this study, DEHP was not detected in the eggs and the study authors suggested it may be because the minimum detection limit (MDL) was high (9.455 mg/kg wet weight) due to blank contribution from background sources of DEHP. The study authors also indicated that some fish species can metabolize the chemical (Oró-Nolla et al., 2024). Concentrations of various phthalates were measured in 13 European herring gull (*Larus argentatus*) eggs collected from seven nests at 3 semi-urban sites in Cornwall, UK (Allen et al., 2021). According to the report, only one of the 13 eggs contained measurable amounts of DEHP, and that DEHP concentration at ~ 0.416 mg/kg yolk. The DEHP metabolite, MEHP, was only detected in one egg sample but was reported at a concentration below the MDL, which was not reported and not available within supplementary information. Another DEHP metabolite, MEOHP, was either not detected or was also detected within eggs at concentrations below the MDL. The authors indicated that phthalate ingestion and subsequent deposition in gull eggs may be variable over macro and microgeographic scales possibly due to local differences in exposure and foraging preferences (Allen et al., 2021).

12.2 Terrestrial Environmental Biomonitoring

Measured DEHP concentrations stemmed from studies examining phthalate ester levels in terrestrial ecosystems with DEHP dry weight concentrations quantified and reported from a total of three studies represented by terrestrial plants, invertebrates, and bird eggs.

DEHP dry weight concentrations were only reported for one primary producer from terrestrial ecosystems (Barroso et al., 2019). The bitter orange plant (*Citrus aurantium*) had average DEHP concentrations in its leaves ranging from 0.14 to approximately 0.53 mg/kg dry matter, which were sampled from an urban park and industrial constructs in Seville City, Spain, respectively (Barroso et al., 2019). DEHP dry weight concentrations have been reported for only one terrestrial invertebrate species (Kinney et al., 2010). Whole body earthworm samples had average DEHP concentrations ranging from approximately 0.15 to 0.29 mg/kg dw, which were measured from hayfields and pastures with a history of biosolid amendment (Kinney et al., 2010).

Schwarz et al. (2016) collected samples from failed peregrine falcon (*Falco peregrinus*) eggs within Germany as part of a large survey of pollutants within eggs. Concentrations of DEHP within peregrine falcon eggs were reported as “traces of DEHP” with no concentration reported within the study (LOD = 0.001 mg/kg dw).

12.3 Absorption, Distribution, Metabolization, and Excretion (ADME)

Chemicals are capable of being absorbed by finfish via oral and epithelial exposure routes. Oral exposure occurs when finfish consume a contaminated food item or incidental ingestion of sediment that is then absorbed within the gastrointestinal tract, which is dependent on feed rate and assimilation efficiency (Katagi, 2020; Larisch and Goss, 2018). For epithelial exposure, gills surfaces absorb chemicals that are present in the surrounding water column, and the absorption depends on respiratory rate, up-take efficiency, and chemical-specific blood transport limit (Katagi, 2020; Larisch and Goss, 2018). Oral and epithelial exposure are the major routes for chemical absorption (Arnot et al., 2009). Epithelial exposure specifically related to dermal exposure has been modeled with rainbow trout and channel catfish and determined to contribute less than 10 percent of initial uptake for the tested chemicals (*e.g.*, hexachloroethane, pentachloroethane, 1,1,2,2-tetrachloroethane) (Nichols et al., 1996).

Phthalate ester chemicals and their ADME in finfish are of interest to help determine if bioaccumulation occurs with these plasticizers. In the case of DEHP, it is initially and rapidly metabolized to MEHP, which is the major metabolite upon metabolic transformation. MEHP glucuronide, phthalic acid, and phthalic acid glucuronide are also produced in small concentrations (Barron et al., 1995; Barron, 1986; Melancon and Lech, 1976; Stalling et al., 1973). MEHP had the highest radioactivity in the bile of rainbow trout (*Oncorhynchus mykiss*) from 53.9 to 58.0 percent, measured 12 hours after 400 µg ^{14}C-DEHP/kg was up taken intravascularly (Barron et al., 1995). During the same exposure period, concentrations of DEHP were low at 0.02 percent after 12 hours (Barron et al., 1995). MEHP glucuronide was reported as the dominant metabolite in the bile of rainbow trout that were exposed to 2,900 dpm/µg of ^{14}C-DEHP for 24 to 36 hours via water. The low relative concentration of DEHP was reported approximately 1 percent, likely due to the gills serving to metabolize DEHP before possible distribution to compartment of the body (Barron et al., 1995; Melancon and Lech, 1976). On a whole-body basis, MEHP also had the highest composition in channel catfish (*Ictalurus punctatus*) at 66 percent after a 24-hour exposure to 1 µg/L of DEHP, while DEHP was low at 14 percent (Stalling et al., 1973). DEHP is susceptible to biotransformation and the significant biotransformation of DEHP impacts bioaccumulation and biomagnification potential (Burkhard et al., 2012). Thus, the rapid biotransformation of DEHP in finfish prevents it from accumulating, which supports the qualitative trophic transfer analysis for DEHP.

In birds, mash containing DEHP at 0 and 0.5g/100g (5000 mg DEHP/kg diet) feed was fed to twenty 10-month-old White Leghorn hens (10 each) ad libitum for 25 days (Ishida et al., 1982). Eggs laid on every fifth day during the 25 days administration and on the seventh day after administration period were also collected for DEHP analysis. The study authors did not report the weight of the birds, growth, or the mass of food consumed daily so a calculation of the oral dose for this study was not possible. The DEHP concentrations of liver, kidney, adipose tissue, muscle, feather, and egg yolk were investigated. Hens were killed on the fifth day (four each), 25th day (four each) of treatment administration and on the seventh day following the administration period (2 each). During a five-day period, DEHP was detected only within the liver and the feathers but was detected within all tissue types collected after 25-days of feeding. DEHP concentration in feathers was 179.2 to 397.6 mg/kg and in adipose tissues was 11.4 to 16.7 mg/kg. As the levels of DEHP in livers did not vary markedly during the administration period, it was assumed that the disappearance of DEHP from the liver reaches an equilibrium within five days and may be eliminated. In a second experiment, hens were fed 2000 mg DEHP/kg feed, and eggs were examined every five days during the study and seven days after the end of the study. Similar to the first experiment within (Ishida et al., 1982), authors did not report feed intake, weight of birds, or growth to derive an oral dose from this ad libitum feeding study. Concentrations in the egg were 20.1-24.3 mg DEHP/kg egg on Days 15-25, and declined to 4.5 mg/kg (81.5%) seven days after hens were taken off test diets (Ishida et al., 1982).

A detailed review of ADME within mammals from reasonably available literature is presented in Section 2 in the *Non-Cancer Human Health Hazard Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025f).

12.4 Trophic Transfer

Due to its physical and chemical properties, environmental fate, and exposure parameters, DEHP is not expected to persist in surface water, groundwater, or air. Based on its solubility (3.0×10^{-3} mg/L) and organic carbon:water adsorption coefficient (log K_{OC} = 5.41–5.95), DEHP readily sorbs to organic matter such as sediment and suspended solids, suggesting limited bioavailability. Biodegradation studies within water demonstrate consistency in reporting DEHP is readily biodegradable. Furthermore, with a half-life on the order of days to weeks and biodegradation within aerobic and anaerobic sediments DEHP is expected to have a half-life on the order of months to a year. While DEHP is anticipated to not persist within air with a half-life of 5.85 hours, the octanol:air partition coefficient (log K_{OA}) of 10.76 estimated from EPI Suite™ (U.S. EPA, 2017) indicates adsorption to organic carbon within airborne particles with limited atmospheric oxidation. Within aerobic and anaerobic soils, DEHP is expected to have a half-life on the order of months, which is largely influenced by temperature and soil composition.

Investigations on DEHP consistently present evidence that DEHP has low bioaccumulation potential and exhibits trophic dilution within aquatic ecosystems. Bioaccumulation endpoints for DEHP presented within reasonably available literature include laboratory and field investigations with empirical endpoints such as BCF, BAF, biota-sediment accumulation factor (BSAF), and trophic magnification factor (TMF). Overall BCF among studies indicate low values (*i.e.*, <1,000) for fishes and invertebrates such as decapod crustaceans and bivalves with the highest BCF for fishes from sheepshead minnow (*Cyprinodon variegatus*) at 637 L/kg ww, and highest BCF within invertebrates from midge larvae (*Chironomus plumosus*) at 408 L/kg ww (Karara and Hayton, 1989; Streufert et al., 1980). Although one study presents BAF values above 1,000 for crucian carp (*Carassius carassius*) and skygager (*Erythroculter hypselonotus*), further details indicate that authors present these data on desiccated muscle tissue (1 g) resulting in values presented as L/kg dry weight as opposed to reporting L/kg wet weight (Lee et al., 2019). Lee et al. (2019) did not report proximate composition details such as moisture content for these muscle tissue samples and the presentation of dry weight BAF values likely inflates this bioaccumulation metric for these two fishes.

Vethaak et al. (2005) determined surface water and bream muscle tissue concentration of DEHP from collections made throughout the Netherlands resulting in an empirical BAF of 478.13 L/kg ww. The data landscape on BSAF values indicates variability among the reasonably available literature on fishes ranging from 0.02 in African pike (*Hepsetus odoe)* (Adeogun et al., 2015) to 40.9 within Greenback mullet (*Liza subviridis*) (Huang et al., 2008) as reported within the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g). Burkhart et al. (2012) similarly identified large variation among fish BSAF values within DEHP, indicating that the observed variance among studies could likely be the result of overestimation of this measure from contamination of field collected tissues. A comprehensive study on trophic transfer for several dialkyl phthalate esters examined DEHP within 18 marine species across approximately 4 trophic levels determining a TMF (reported as a "Food-Web Magnification Factor) of 0.34 demonstrating trophic dilution for this phthalate (Mackintosh et al., 2004). Lipid equivalent concentrations of DEHP significantly decreased with increasing trophic position and nitrogen stable isotope ($\delta^{15}N$) in the food web, indicating trophic dilution.

The landscape of information indicating low DEHP bioaccumulation potential within terrestrial ecosystems is supported by studies on vascular plants and earthworms (*Eisenia foetida*). BCF values are available for nine vascular plants with the highest values of 157.6 and 100 for pondweed and alfalfa (*Medicago sativa*), respectively (Chi and Gao, 2015; Ma et al., 2012). Four other studies conducted on vascular plants, such as lettuce (*Lactuca sativa*), strawberry (*Fragaria x ananassa*), tomato (*Solanum lycopersicum*), wheat (*Triticum aestivum*), and maize (*Zea mays*), within reasonably available literature resulted in BCF values at or below 1. Within earthworms, a low BCF value is reported at 0.2 from the European Union (ECJRC, 2003), which is consistent with reported BSAF values between 0.073 to 0.244 for earthworms from Hu et al. (2005).

Past examinations of individual metrics for bioaccumulation and concentration potential for DEHP are informative; however, Burkhart et al. (2012) detailed results of a holistic approach that examines the landscape of these metrics in combination with other important factors. The approach demonstrated within Burkhart et al. (2012) eliminates differences in numerical scales and units among bioaccumulation endpoints (BCF, BAF, BSAF, TMF) and converts these data to "dimensionless fugacity ratios." Specifically, this normalizes endpoints such as BCF, BAF, and BSAF from both laboratory and field examinations using the partition coefficients related to the reference phase of interest. The resulting fugacity ratios can be organized among bioaccumulation metric and can be further organized by study type (*i.e.*, field and laboratory studies) in addition to division among taxon types (*i.e.*, fish, mollusks, decapod crustaceans, annelids, etc.) when available. Burkhart et al. (2012) used DEHP as a case study reporting visualizations of plots for bioaccumulation endpoint fugacity ratios and demonstrated limited bioaccumulation and trophic transfer but also revealed that lower invertebrates potentially have a more limited biotransformation capacity for DEHP as compared to higher invertebrate and vertebrate taxa. These plots also showed the variance among fish BSAF ratios within field studies, as previously discussed within the current section, which the authors attributed to overestimation from sample extraction and analysis. The case study presented within Burkhart et al. (2012) further supports the weight of evidence that DEHP does not biomagnify, partially due to the crucial role of biotransformation resulting in trophic dilution across trophic levels.

EPA conducted qualitative assessments of the chemical and physical properties, fate, and exposure of DEHP and preliminarily determined that DEHP does not biomagnify and is characterized as demonstrating trophic dilution. Thus, EPA did not conduct a quantitative modeling analysis of the trophic transfer of DEHP through food webs. See the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g) for detailed information on bioaccumulation, biomagnification, and trophic transfer of DEHP.

12.5 Weight of Scientific Evidence Conclusions

EPA has robust confidence that DEHP has limited bioaccumulation and bioconcentration potential based on its physical, chemical, and fate properties, biotransformation, and the empirical metrics of bioaccumulation metrics. Based on the conclusions on the physical and chemical as well as fate and transport properties of DEHP presented in the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g) and reasonably available literature on biotransformation, biomonitoring data, and bioaccumulation data; EPA conducted a qualitative assessment trophic transfer in biota. The conclusion that DEHP does not biomagnify is supported by the estimated BCF, BAF, BSAF, and TMF values and studies specifically centered on the characteristics of trophic transfer of DEHP and other phthalates.

13 CONCLUSION OF GENERAL POPULATION AND ENVIRONMENTAL EXPOSURE

13.1 Environmental Exposure Conclusions

DEHP is expected to be released to the environment via air, water, and biosolids to landfills as detailed within the environmental release assessment presented in the *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate* (U.S. EPA, 2025e). Environmental media concentrations were quantified in ambient air, soil from ambient air deposition, biosolids, surface water, and sediment. Further details on the environmental partitioning and media assessment can be found in the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g).

For the land pathway, there are uncertainties in the relevance of limited monitoring data for biosolids and landfill leachate to the COUs considered. However, based on high-quality physical and chemical property data, EPA determined that DEHP has low persistence potential and mobility in soils. Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via biosolids applications were not quantified but are discussed qualitatively. Modeled soil DEHP concentrations from air deposition to soil (Table 8-3) and modeled DEHP in biosolids-amended soils from OESs (Table 3-2) with the resulting highest concentrations to soil are assessed quantitatively with hazard thresholds (U.S. EPA, 2025d) for relevant soil dwelling organisms and plants within the DEHP Environmental Risk Characterization section (U.S. EPA, 2025i).

For the water pathway, relevant flow data from the associated receiving water body were collected for facilities reporting to TRI. The ECHO database was accessed via API and queried for facilities regulated under the Clean Water Act. All available NPDES permit IDs were retrieved from the facilities returned by the query. In addition to the hydrologic flow data retrieved from the NHDPlus database, information about the facility effluent rate was collected, as available, from the ECHO API. From the distribution of resulting receiving water body flow rates across the pooled flow data of all relevant NAICS codes, the median 7Q10 flow rate was selected to be applied as a conservative low-flow condition across the modeled releases (Section 4.1). Quantified release estimates to surface water were evaluated with PSC modeling. For each COU with surface water releases, the highest estimated release to surface water was modeled. Releases were evaluated for resulting environmental media concentrations at the point of release (*i.e.*, in the immediate receiving water body receiving the effluent). Due to uncertainty about the prevalence of wastewater treatment from DEHP-releasing facilities, all releases are assumed initially to be released to surface water without treatment. The resulting surface water, pore water, and benthic sediment concentrations are presented in Table 4-3 and will be utilized within the environmental risk characterization for DEHP for quantitative risk characterization.

Based on the conclusions on the physical and chemical and fate and transport properties of DEHP presented in the *Physical Chemistry, Fate, and Transport Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025g) and reasonably available literature on biotransformation, biomonitoring data, and bioaccumulation data; EPA conducted a qualitative assessment trophic transfer in biota. The Agency has robust confidence that DEHP has limited bioaccumulation and bioconcentration potential based on physical chemical and fate properties, biotransformation, and empirical metrics of bioaccumulation metrics presented in Section 12.

13.2 Weight of Scientific Evidence Conclusions for Environmental Exposure Conclusions

The weight of scientific evidence supporting the exposure estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for biosolids (Section 3.1.1), landfills (Section 3.2.1), surface water (Section 4.4), ambient air (Section 8.4), and environmental biomonitoring and trophic transfer (Section 12.5). EPA summarized its weight of scientific evidence using confidence descriptors as follows: robust, moderate, slight, or indeterminate confidence. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, and uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

For its quantitative assessment, EPA modeled exposure due to various exposure scenarios resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose of conducting a screening level analysis as demonstrated within the land pathway for modeled concentrations of DEHP in biosolids-amended soils at relevant COUs and air to soil deposition of DEHP (Section 3.1). Within the water pathway, the release resulting in the highest environmental concentrations are presented in Section 4.1. When available, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends. Differences in magnitude between modeled and measured concentrations (Section 4.2) may be due to measured concentrations not being geographically or temporally close to known releasers of DEHP. The modeled concentrations in the surface water and sediment exceeded the highest values available from monitoring studies by an order of magnitude. This confirms EPA’s expectation that modeled concentrations presented here are potentially an overestimation to be applied as a screening evaluation. EPA has robust confidence that DEHP has limited bioaccumulation and bioconcentration potential based on its physical, chemical, and fate properties, biotransformation, and the empirical metrics of bioaccumulation metrics.

13.3 General Population Screening Conclusions

The general population can be exposed to DEHP from various exposure pathways. As shown in Table 2-1, exposures to the general population via surface water, drinking water, fish ingestion, and ambient air were quantified using a conservative high-end scenario screening approach whereas exposures via the land pathway (*i.e.*, biosolids and landfills) were qualitatively assessed. Using the high-end estimates of environmental media concentrations summarized in Table 13-1, general population exposures were estimated for the lifestage that would be most exposed based on intake rate and body weight. The high-end exposure estimates were then used to calculate MOEs for purposes of risk screening in Appendix C, Appendix D, and Appendix E.

Table 13-1. Summary of High-End DEHP Concentrations in Various Environmental Media from Environmental Releases

OES(s) [a]	Release Media	Environmental Media	DEHP Concentration
Plastic compounding	Water	Surface water (30Q5)	10.3 µg/L
		Surface water (harmonic mean)	4.11 µg/L
Use of automotive care products	Water	Surface water (30Q5)	140 µg/L
		Surface water (harmonic mean)	92.9 µg/L
Application of paints, coatings, adhesives, and sealants (stack) Plastic converting (fugitive)	Ambient air	Daily-averaged total (fugitive and stack, 100 m)	23.23 µg/m^3
		Annual-averaged total (fugitive and stack, 100 m)	18.50 µg/m^3
[a] Table 1-1 provides the crosswalk of OES to COUs			

Table 13-2 summarizes the conclusions for the exposure pathways and lifestages that were assessed for the general population. EPA conducted a quantitative evaluation for the following: incidental dermal and incidental ingestion from swimming in surface water, drinking water ingestion, fish ingestion, and ambient air. Biosolids and landfills were assessed qualitatively in Sections 3.1 and 3.2, respectively. Results indicate that no pathways were of concern for DEHP for the highest exposed populations for the maximum release associated with Use of laboratory chemicals OES.

Table 13-2. Risk Screen for High-End Exposure Scenarios for Highest Exposed Populations

OES[a]	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Pathway of Concern[b]
All	Biosolids (Section 3.1)	All scenarios were assessed qualitatively			No
All	Landfills (Section 3.2)	All scenarios were assessed qualitatively			No
Use of automotive care products; Plastics compounding	Surface water	Dermal	Dermal exposure to DEHP in surface water during swimming (Section 5.1.1)	Adult (21+ years)	No
		Oral	Incidental ingestion of DEHP in surface water during swimming (Section 5.1.2)	Youth (11–15 years)	No
Use of automotive care products; Plastics compounding	Drinking water	Oral	Ingestion of drinking water sourced from surface water (Section 6.1.1)	Infant (<1 year)	No
Use of automotive care products; Plastic compounding	Fish ingestion	Oral	Ingestion of fish for general population (Section 7.1)	Adult (21+ years)	No
			Ingestion of fish for subsistence fishers (Section 7.2)	Adult (21+ years)	No[c]
			Ingestion of fish for tribal populations (Section 7.3)	Adult (21+ years)	No[c]

OES[a]	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Pathway of Concern[b]
Application of paints, coatings, adhesives, and sealants (stack) Plastic converting (fugitive)	Ambient air	Inhalation	Inhalation of DEHP in ambient air resulting from industrial releases (Section 9)	All	No
		Oral	Ingestion of soil from air to soil deposition resulting from industrial releases (Section 9)	Infant and children (6 months to 12 years)	No

[a] Table 1-1 provides a crosswalk of industrial and commercial COUs to OES.
[b] Using the MOE approach as a risk screening tool, an exposure pathway was determined to not be a pathway of concern if the MOE was equal to or exceeded the benchmark MOE of 30.
[c] Not a pathway of concern for OESs with reported releases. See Table 3-8 of the *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025i) for a full list of the OESs that have or do not have reported releases.

13.4 Weight of Scientific Evidence Conclusions for General Population Screening Conclusions

The weight of scientific evidence supporting the exposure estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for biosolids (Section 3.1.1), landfills (Section 3.2.1), surface water (Section 4.3.1), drinking water (Section 6.4), fish ingestion (Section 7.4.1), ambient air (Section 8.4), human milk (Section 10), and urinary biomonitoring (Section 11.3). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate confidence descriptors. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

EPA determined robust confidence in its qualitative assessment of biosolids (Section 3.1.1) and landfills (Section 3.2.1). For its quantitative assessment, the Agency modeled exposure due to various exposure scenarios resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose of a screening level analysis. When available, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends. For its quantitative exposure assessment of surface water (Section 5.2), drinking water (Section 6.4), ambient air (Section 8.5), human milk (Section 10), and urinary biomonitoring (Section 11.3), EPA has robust confidence that the screening level analysis was appropriately conservative to determine that no environmental pathway has the potential for non-cancer risks to the general population. The Agency has moderate confidence in the absolute values of the estimated environmental media concentrations based on facility release data, but robust confidence in exposure estimates capturing high-end exposure scenarios given the many conservative assumptions which yielded modeled values similar in magnitude to total daily intake values calculated from NHANES biomonitoring data. Furthermore, risk estimates for high-end exposure scenarios were still consistently above the benchmarks, adding to confidence that non-cancer risks are not expected except for the fish ingestion pathway (Section 7.4) for certain populations which is discussed in detail in *Risk Evaluation for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025j).

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APPENDICES

Appendix A EXPOSURE FACTORS

Table_Apx A-1. Body Weight by Age Group

Age Group[a]	Mean Body Weight (kg)[b]
Infant (<1 year)	7.83
Young toddler (1 to <2 years)	11.4
Toddler (2 to <3 years)	13.8
Small child (3 to <6 years)	18.6
Child (6 to <11 years)	31.8
Teen (11 to <16 years)	56.8
Adult (16+ years)	80.0

[a] Age group weighted average
[b] See Table 8-1 of U.S. EPA (2011a)

Table_Apx A-2. Fish Ingestion Rates by Age Group

Age Group	Fish Ingestion Rate (g/kg-day) [a]	
	50th Percentile	90th Percentile
Infant (<1 year) [b]	N/A	N/A
Young toddler (1 to <2 years) [b]	0.053	0.412
Toddler (2 to <3 years) [b]	0.043	0.341
Small child (3 to <6 years) [b]	0.038	0.312
Child (6 to <11 years) [b]	0.035	0.242
Teen (11 to <16 years) [b]	0.019	0.146
Adult (16+ years) [c]	0.063	0.277
Subsistence fisher (adult) [d]	1.78	

[a] Age group-weighted average using body weight from Table_Apx A-1
[b] See Table 20a of U.S. EPA (2014)
[c] See Table 9a of U.S. EPA (2014)
[d] U.S. EPA (2000b)

Table_Apx A-3. Recommended Default Values for Common Exposure Factors

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
ED	Exposure duration (hours/day)	8	24	
EF	Exposure frequency (days/year)	250	365	
EY	Exposure years (years)	40	Varies for Adult (chronic non-cancer) 78 → (Lifetime) 1 → Infant (birth to <1 year) 5 → Toddler (1–5 years) 5 → Child (6–10 years) 5 → Youth (11–15 years) 5 → Youth (16–20 years)	Number of years in age group. Note: These age bins may vary for different measurements and sources
AT	Averaging time non-cancer	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	Equal to total exposure duration or 365 days/yr × EY; whichever is greater	See pg. 6–23 of Risk assessment guidance for superfund, volume I: Human health evaluation manual (Part A). (U.S. EPA, 1989)
	Averaging time cancer	78 years (28,470 days)	78 years (28,470 days)	See Table 18-1 of the *Exposure Factors Handbook* (U.S. EPA, 2011a)
BW	Body weight (kg)	80	80 → Adult 7.83 → Infant (birth to <1 year) 16.2 → Toddler (1–5 years) 31.8 → Child (6–10 years) 56.8 → Youth (11–15 years) 71.6 → Youth (16–20 years) 65.9 → Adolescent woman of childbearing age (16 to <21) – apply to all developmental exposure scenarios	See Table 8-1 of the *Exposure Factors Handbook* (U.S. EPA, 2011a) (Refer to Figure 31 for age-specific BW) Note: These age bins may vary for different measurements and sources See Table 8-5 of the *Exposure Factors Handbook* (U.S. EPA, 2011a)
$IR_{dw\text{-}acute}$	Drinking water ingestion rate (L/day) – acute	3.219 Adult	3.219 → Adult 1.106 → Infant (birth to <1 year) 0.813 →Toddler (1–5 years) 1.258 → Child (6–10 years) 1.761 → Youth (11–15 years) 2.214 → Youth (16–20 years)	See Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years) (U.S. EPA, 2011a)
$IR_{dw\text{-}chronic}$	Drinking water ingestion rate (L/day) – chronic	0.880 Adult	0.880 → Adult 0.220 → Infant (birth to <1 year) 0.195 → Toddler (1–5 years) 0.294 → Child (6–10 years) 0.315 → Youth (11–15 years) 0.436 → Youth (16–20 years)	Chapter 3 of the *Exposure Factors Handbook* (U.S. EPA, 2011a), Table 3-9 per capita mean values; weighted averages for adults (years 21–49 and 50+), for toddlers (years 1–2, 2–3, and 3 to <6).

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
IR_{inc}	Incidental water ingestion rate (L/hr)		0.025 → Adult 0.05 → Child (6 to < 16 years)	Evaluation of Swimmer Exposures Using the SWIMODEL Algorithms and Assumptions (U.S. EPA, 2015a)
IR_{fish}	Fish ingestion rate (g/day)		22 → Adult	Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (U.S. EPA, 2014) This represents the 90th percentile consumption rate of fish and shellfish from inland and nearshore waters for the U.S. adult population 21 years of age and older, based on NHANES data from 2003–2010
IR_{soil}	Soil ingestion rate (mg/day)	50 Indoor workers 100 Outdoor workers	100 → Infant (<6 months) 200 → Infant to Youth (6 months to <12 years) 100 → Youth to adult (12+ years) 1,000 → Soil pica infant to youth (1 to <12 years) 50,000 → Geophagy (all ages)	U.S. EPA Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (1991) Chapter 5 of the *Exposure Factors Handbook* (U.S. EPA, 2011a), Table 5-1, Upper percentile daily soil and dust ingestion
SA_{water}	Skin surface area exposed (cm^2) used for incidental water dermal contact		19,500 → Adult 7,600 → Child (3 to <6 years) 10,800 → Child (6 to <11 years) 15,900 → Youth (11 to <16 years)	Chapter 7 of the *Exposure Factors Handbook* (U.S. EPA, 2011a), Table 7-1, Recommended Mean Values for Total Body Surface Area, for Children (sexes combined) and Adults by Sex
K_p	Permeability constant (cm/hr) used for incidental water dermal contact		0.001 Or calculated using K_p equation with chemical specific K_{OW} and MW (see exposure formulas)	EPA Dermal Exposure Assessment: Principles and Applications (U.S. EPA, 1992), Table 5-7, "Predicted K_p Estimates for Common Pollutants"
SA_{soil}	Skin surface area exposed (cm^2) used for soil dermal contact	3,300 Adult	5,800 → Adult 2,700 → Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure (U.S. EPA, 2004)

Symbol	Definition	Recommended Default Value	Recommended Default Value	Source
		Occupational	Residential	
AF_{soil}	Adherence factor (mg/cm^2) used for soil dermal contact	0.2 Adult	0.07 → Adult 0.2 → Child	EPA Risk Assessment Guidance for Superfund RAGS Part E for Dermal Exposure (U.S. EPA, 2004)

Table_Apx A-4. Mean and Upper Milk Ingestion Rates by Age

Age Group	Milk Ingestion (mL/kg day)	
	Mean	Upper (95th Percentile)
Birth to <1 month	150	220
1 to <3 month	140	190
3 to <6 month	110	150
6 to <12 month	83	130
Birth to <1 year	104.8	152.5
[a] Values converted from Table 15-1 of U.S. EPA (2011a) using the density of human milk of 1.03 g/mL		

A.1 Surface Water Exposure Activity Parameters

Table_Apx A-5. Incidental Dermal (Swimming) Modeling Parameters

Input	Description (Units)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)	Notes	Reference
BW	Body weight (kg)	80	56.8	31.8	Mean body weight. Chapter 8 of the *Exposure Factors Handbook*, Table 8-1	U.S. EPA (2021a)
SA	Skin surface area exposed (cm^2)	19,500	15,900	10,800	U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL)	U.S. EPA (2015a)
ET	Exposure time (hr/day)	3	2	1	High-end default short-term duration from U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL)	U.S. EPA (2015a)
ED	Exposure duration (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
AT	Averaging time (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
K_p	Permeability coefficient (cm/hr)	0.0071 cm/h			CEM estimate aqueous K_p	U.S. EPA (2022b)

Table_Apx A-6. Incidental Oral Ingestion (Swimming) Modeling Parameters

Input	Description (Units)	Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)	Notes	Reference
IR_{inc}	Ingestion rate (L/hr)	0.092	0.152	0.096	Upper percentile ingestion while swimming. Chapter 3 of the *Exposure Factors Handbook*, Table 3-7.	U.S. EPA (2019a)
BW	Body weight (kg)	80	56.8	31.8	Mean body weight. Chapter 8 of the *Exposure Factors Handbook*, Table 8-1.	U.S. EPA (2021a)
ET	Exposure time (hr/day)	3	2	1	High-end default short-term duration from U.S. EPA Swimmer Exposure Assessment Model (SWIMODEL); based on competitive swimmers in the age class	U.S. EPA (2015a)
$IR_{inc\text{-}daily}$	Incidental daily ingestion rate (L/day)	0.276	0.304	0.096	Calculation: ingestion rate × exposure time	
IR/BW	Weighted incidental daily ingestion rate (L/kg-day)	0.0035	0.0054	0.0030	Calculation: ingestion rate/body weight	
ED	Exposure duration (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
AT	Averaging time (years for ADD)	57	5	5	Number of years in age group,	U.S. EPA (2021a)
CF1	Conversion factor (mg/µg)		1.00E−03			
CF2	Conversion factor (days/year)		365			

Appendix B ESTIMATING HYDROLOGICAL FLOW DATA FOR SURFACE WATER MODELING

Due to a lack of available data about facilities releasing DEHP to surface water under some OES, generic release scenarios were modeled for those OES. To develop relevant receiving waterbody flow distributions to pair with the estimated releases, for each OES relying on generic scenarios, a distribution of flow metrics was generated by collecting flow data for facilities across aligning with relevant North American Industry Classification System (NAICS) codes associated with the respective OES. An example of relevant NAICS codes assigned to the Use of automotive care products OES is provided in Table_Apx B-1. The full table of NAICS codes assigned to OESs is included in *Environmental Release and Occupational Exposure Assessment for Diethylhexyl Phthalate (DEHP)* (U.S. EPA, 2025e).

Table_Apx B-1. Example of NAICS codes selected to identify relevant facilities with discharges to surface water and derive OES-specific receiving waterbody flow distributions

OES	NAICS
Use of automotive care products	811111 – General Automotive Repair 811121 – Automotive Body, Paint, and Interior Repair and Maintenance 811191 – Automotive Oil Change and Lubrication Shops 811192 – Car Washes 811198 – All Other Automotive Repair and Maintenance

EPA's Enforcement and Compliance History Online (ECHO) database was accessed via the API (https://echo.epa.gov/tools/web-services; accessed December 18, 2025) and queried for facilities regulated under the Clean Water Act within the relevant NAICS codes for each OES. All available National Pollutant Discharge Elimination System (NPDES) permit IDs were retrieved from the facilities returned by the query. It is important to note that while these NAICS codes cover the relevant sectors of industry within which this particular use of DEHP can be found, the pool of facilities from which receiving waterbody data are collected are not necessarily all discharging DEHP.

The Discharge Monitoring Report (DMR) REST service was then queried via the ECHO API (https://echo.epa.gov/tools/web-services/facility-search-water; accessed December 18, 2025) to return the NHDPlus reach code associated with the receiving waterbody for each available facility's NPDES permit. Modeled flow metrics were then extracted for the retrieved reach codes from the NHDPlus V2.1 Flowline Network EROM flow database (U.S. EPA, 2016b). For each OES, all the receiving waterbody and flow information for each unique facility was pooled together from each respective NAICS code. After the further processing described below to derive the flow statistics for each receiving waterbody in the OES-specific distribution, selected percentiles (P50, P75, and P90) were used to model potential ranges of receiving waterbody concentrations. For example, the P50 7Q10 flow for the Use of automotive care products OES represents the P50 value from all 7Q10 flows derived from facility permit and NHDPlus data for that OES. It can also be thought of as the 7Q10 flow for the median waterbody receiving effluent within those NAICS codes.

The EROM database (U.S. EPA, 2016b). provides modeled monthly average flows for each month of the year. While the EROM flow database represents averages across a 30-year time period, the lowest of the monthly average flows was selected as a substitute for the 30Q5 flow used in modeling, as both approximate the lowest observed monthly flow at a given location. The substitute 30Q5 flow was then plugged into the regression equation used by EPA's Exposure and Fate Assessment Screening Tool (EFAST) (U.S. EPA, 2007) to convert between these flow metrics and solved for the 7Q10 using Equation_Apx B-1. In previous assessments, the EPA has selected the 7Q10 flow as a representative low-flow scenario for biological impacts due to effluent in streams, while the harmonic mean represents a more average flow for assessing chronic drinking water exposure.

Equation_Apx B-1. Calculating the 7Q10 Flow

$$7Q10 = \frac{\left(0.409\frac{cfs}{MLD} \times \frac{30Q5}{1.782}\right)^{1.0352}}{0.409\frac{cfs}{MLD}}$$

Where:

$7Q10$	=	Modeled 7Q10 flow, in million liters per day (MLD)
$30Q5$	=	Lowest monthly average flow from NHD, in MLD

Further, the harmonic mean (HM) flow was calculated using Equation_Apx B-2, derived from the relevant EFAST regression (U.S. EPA, 2007).

Equation_Apx B-2. Calculating the Harmonic Mean Flow

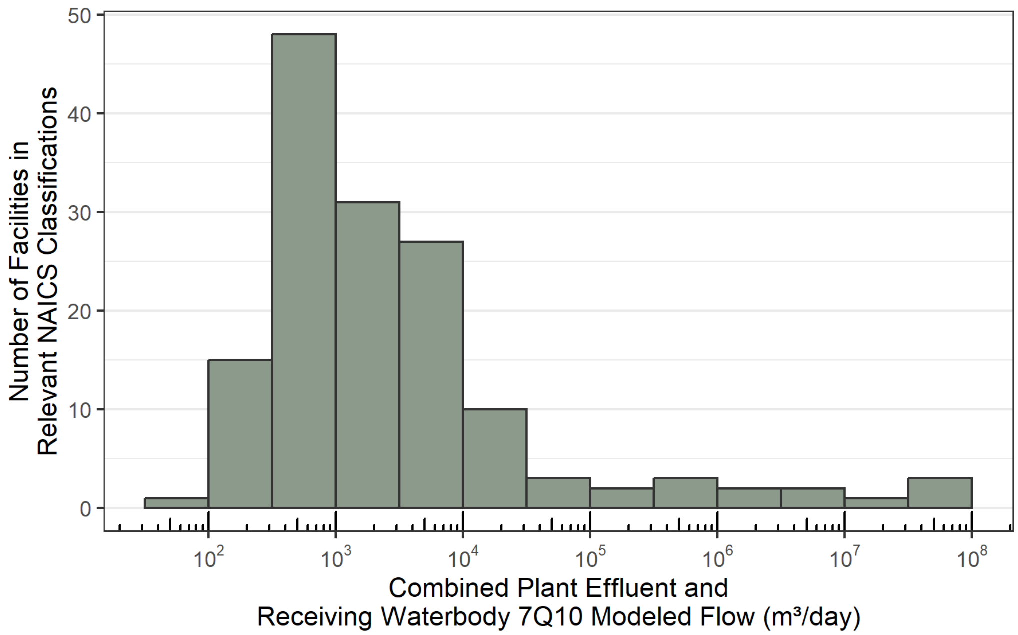
$$HM = 1.194 \times \frac{\left(0.409\frac{cfs}{MLD} \times AM\right)^{0.473} \times \left(0.409\frac{cfs}{MLD} \times 7Q10\right)^{0.552}}{0.409\frac{cfs}{MLD}}$$

Where:

HM	=	Modeled harmonic mean flow, in MLD
AM	=	Annual average flow from NHD, in MLD
$7Q10$	=	Modeled 7Q10 flow from the previous equation, in MLD

In addition to the individual releasing facilities that report to TRI and DMR that were queried for permit and flow data, a generic flow distribution was developed to apply to the generic scenarios for OES without release data from reporting facilities. A distribution of flow metrics was generated by collecting flow data for facilities across one North American Industry Classification System (NAICS) code associated with DEHP-releasing facilities (Figure_Apx B-1). The ECHO database was similarly queried for all available permit and receiving water body information within the NAICS code, then processed in the same way to retrieve and generate flow metrics.

In addition to the hydrologic flow data retrieved from the NHDPlus database, information about the facility effluent rate was collected, as available, from the ECHO API. A minimum effluent flow rate of six cubic feet per second, derived from the average reported effluent flow rate across facilities, was applied. The receiving water body 7Q10 flow was then calculated as the sum of the hydrologic 7Q10 flow estimated from regression and the facility effluent flow. From the distribution of resulting receiving water body flow rates across the pooled flow data of all relevant NAICS codes, the median 7Q10 flow rate was selected to be applied as a conservative low flow condition across the modeled releases (Figure_Apx B-1). Additional refined analyses were conducted for the scenarios resulting in the greatest environmental concentrations by applying the 75th and 90th percentile (P75 and P90, respectively) flow metrics from the distribution to represent a more complete range of potential flow rates. (Figure_Apx B-1). When comparing generic scenario releases and flow percentiles to known releases from facilities within relevant phthalate COUs and their respective receiving waterbodies, EPA was unable to constrain the analysis to a single flow percentile, as the P50, P75, and P90 flows are derived from relevant facilities and each condition is plausible.



Figure_Apx B-1. Distribution of Receiving Waterbody 7Q10 Modeled Flow for Facilities with Relevant NAICS Classifications

Table_Apx B-2. Flow Statistics Applied for Generic Release to Surface Water Scenarios

OES	Number of Facilities	Number of NAICS Codes	Flow Statistic	Percentile Flows (m³/day)		
				P50	P75	P90
Use of automotive care products	148	5	HM	3,917	16,555	129,618
			7Q10	1,455	5,451	58,387
			30Q5	2,570	9,390	93,338

For other OES that did not rely on generic scenarios, individual facilities reported their releases to the EPA TRI and DMR systems. For such OES, the actual releasing facilities and their respective receiving waterbody details were looked up using the ECHO API and NHDPlus V2.1 approach described above.

The specific flow statistics (7Q10, 30Q5, HM) for those site-specific receiving waterbodies were applied, rather than generic distributions, and therefore selecting of percentiles was not a necessary step for these facilities.

Quantified release estimates to surface water were evaluated with PSC modeling, applying the receiving waterbody flows retrieved from the NHDPlus. For each COU with surface water releases of wastewater effluent, the highest estimated release to surface water was modeled. The total days of release associated with the highest OES surface water releases was applied as continuous days of release per year (for example, a scenario with 250 days of release per year was modeled as 250 consecutive days of release, followed by 115 days of no release, per year). Estimates from PSC were evaluated for the highest resulting concentrations in an averaging window equal to the total days of release (for example, a scenario with 250 days of release was evaluated for the highest 250-day average concentration), using the averaging calculations within PSC.

Appendix C GENERAL POPULATION SURFACE WATER RISK SCREENING RESULTS

C.1 Incidental Dermal Exposure (Swimming)

Based on the estimated dermal doses in Table 5-1, EPA screened for risk to adults, youth, and children. Table_Apx C-1 summarizes the acute MOEs based on the dermal doses. Using the total acute dose based on the highest modeled 95th percentile, the MOEs exceed the benchmark of 30 (U.S. EPA, 2025h). *Based on the conservative modeling parameters for surface water concentration and exposure factors parameters, risk for non-cancer health effects for dermal absorption through swimming is not expected.*

Table_Apx C-1. Risk Screen for Modeled Incidental Dermal (Swimming) Doses for Adults, Youths, and Children from Modeling and Monitoring Results (Benchmark MOE = 30)

Scenario	Water Column Concentrations		Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
	30Q5 Conc. (µg/L)	Harmonic Mean Conc. (µg/L)	Acute MOE	Acute MOE	Acute MOE
Plastic compounding	10.3	4.11	16,000	21,000	34,000
Use of automotive care products	140	92.9	1,155	1,509	2,488
Highest monitored surface water (NWQMC, 2021)	150	150	1,078	1,408	2,322

C.2 Incidental Ingestion Exposure

Based on the estimated incidental ingestion doses in Table 5-2, EPA screened for risk to adults, youth, and children. Table_Apx C-2 summarizes the acute MOEs based on the incidental ingestion doses. Using the total acute dose based on the highest modeled 95th percentile, the MOEs exceed the benchmark of 30 (U.S. EPA, 2025h). *Based on the conservative modeling parameters for surface water concentration and exposure factors parameters, risk for non-cancer health effects for incidental ingestion through swimming is not expected.*

Table_Apx C-2. Risk Screen for Modeling Incidental Ingestion Doses for Adults, Youths, and Children from Modeling and Monitoring Results (Benchmark MOE = 30)

Scenario	Water Column Concentrations		Adult (21+ years)	Youth (11–15 years)	Child (6–10 years)
	30Q5 Conc. (µg/L)	Harmonic Mean Conc. (µg/L)	Acute MOE	Acute MOE	Acute MOE
Plastic compounding	10.3	4.11	31,000	20,000	35,000
Use of automotive care products	140	92.9	2,277	1,468	2,603
Highest monitored surface water (NWQMC, 2021)	150	150	2,126	1,370	2,429

Appendix D GENERAL POPULATION DRINKING WATER RISK SCREENING RESULTS

Based on the estimated drinking water doses in Table 6-1, EPA screened for risk to adults, youth, and children. Table_Apx D-1 summarizes the acute and chronic MOEs based on the drinking water doses. Using the total acute and chronic dose based on the highest modeled 95th percentile, the MOEs exceed the benchmark of 30 (U.S. EPA, 2025h). *Based on the conservative modeling parameters for drinking water concentration and exposure factors parameters, risk for non-cancer health effects for drinking water ingestion is not expected.*

Table_Apx D-1. Risk Screen for Modeled Drinking Water Exposure for Adults, Toddlers, and Infants from Modeling and Monitoring Results (Benchmark MOE = 30)

Scenario	Water Column Concentrations		Adult (21+ years)		Infant (Birth to <1 year)		Toddler (1–5 years)	
	30Q5 Conc. (µg/L)	Harmonic Mean Conc. (µg/L)	Acute MOE	Chronic MOE	Acute MOE	Chronic MOE	Acute MOE	Chronic MOE
Plastic compounding *without wastewater treatment*	10.3	4.11	2,654	36,000	756	14,000	2,127	32,000
Use of automotive care products (P50 flow)	140	92.9	195	1,512	56	592	156	1,381
Highest monitored surface water (NWQMC, 2021)	150	150	182	974	52	381	146	889

Appendix E FISH INGESTION RISK SCREENING RESULTS

E.1 General Population

Table_Apx E-1. Risk Estimates for Fish Ingestion Exposure for General Population (Benchmark MOE = 30)

	Acute Non-Cancer MOE UFs = 30		Adult Chronic Non-Cancer MOE
	Adult	Young Toddler	
Water solubility limit (3.0E–03 mg/L)	2,764	1,861	12,173
Use of automotive care products, HE (generic scenario for multimedia releases, without treatment) 9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow[a]	89 (P50 flow) 372 (P75 flow) 2,909 (P90 flow)	60 (P50 flow) 250 (P75 flow) 1,959 (P90 flow)	393 (P50 flow) 1,638 (P75 flow) 12,813 (P90 flow)
4.11E–03 mg/L for Plastic compounding (HE, TRI reported release)	2,017	1,359	8,885
MOE = margin of exposure; UF = uncertainty factor; HE = high-end [a] This OES resulted in the highest maximum modeled surface water concentration across all OESs.			

E.2 Subsistence Fishers

Table_Apx E-2. Risk Estimates for Fish Ingestion Exposure for Subsistence Fishers (Benchmark MOE = 30)

Surface Water Concentration and Scenario	Acute and Chronic Non-Cancer MOE
Water solubility limit (3.0E–03 mg/L)	431
Use of automotive care products, HE (generic scenario for multimedia releases, without treatment) 9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow [a]	14 (P50 flow) 58 (P75 flow) 454 (P90 flow)
4.11E–03 mg/L for Plastic compounding (HE, TRI reported release)	314
MOE = margin of exposure, UF = uncertainty factor; HE = high-end, 95th percentile [a] This OES resulted in the highest maximum modeled surface water concentration across all OESs.	

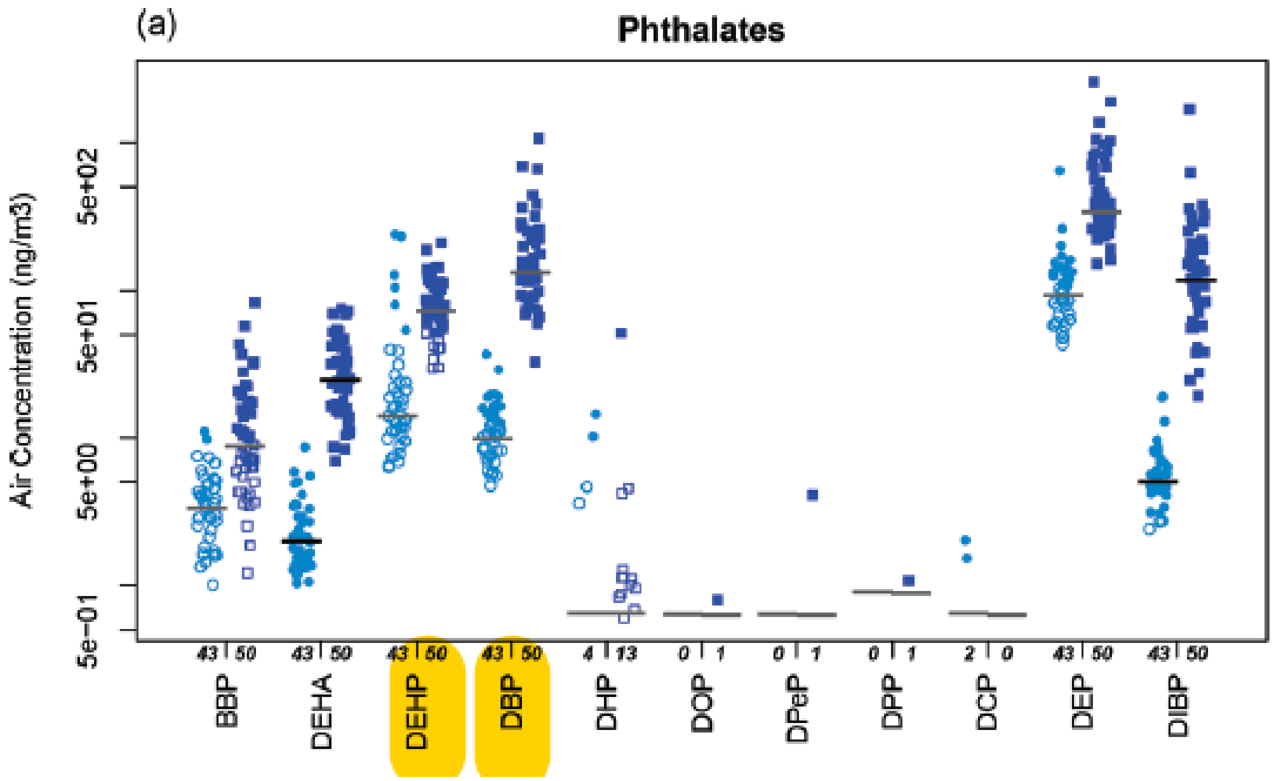
E.3 Tribal Populations

Table_Apx E-3. Risk Estimates for Fish Ingestion Exposure for Tribal Populations (Benchmark MOE = 30)

Surface Water Concentration and Scenario	Acute and Chronic Non-Cancer MOE		
	Current Mean IR	Current Tribal IR, 95th Percentile	Heritage IR
Water solubility limit (3.0E–03 mg/L)	284	70	37
Use of automotive care products, HE (generic scenario for multimedia releases, without treatment) 9.29E–02, 2.23 E–02, 2.85E–03 for P50, P75, and P90 flow [a]	9 (P50 flow) 38 (P75 flow) 299 (P90 flow)	2 (P50 flow) 9 (P75 flow) 74 (P90 flow)	1 (P50 flow) 5 (P75 flow) 39 (P90 flow)
4.11E–03 mg/L for Plastic compounding (HE, TRI reported release)	207	51	27
MOE = margin of exposure; UF = uncertainty factor; HE = high-end, 95th percentile; IR = ingestion rate [a] This OES resulted in the highest maximum modeled surface water concentration across all OESs.			

Appendix F AMBIENT AIR MONITORING STUDY SUMMARY

China Study ([Zhu et al., 2016](#))
Chinese study saying cancer risks 3.51×10^{-8} to 9.75×10^{-11}, well below 1×10^{-6}.



Figure_Apx F-1. Ambient air concentrations of phthalate esters as measured by Zhu et al.

Although the phthalates DEHP, DIBP, and DBP are typically considered indoor contaminants from plastics and consumer goods, the concentration difference between outdoor air in urban/industrial and rural communities suggests some industrial or transportation sources as well.

New York City Study ([Bove et al., 1978](#))
Airborne DBP concentrations at three New York City air sampling stations were 3.73, 5.69, and 3.28 ng/m^3.

Airborne DEHP concentrations at three NYC air sampling stations were 10.20, 16.79, and 14.20 ng/m^3.

Appendix G URINARY BIOMONITORING METHODOLOGY AND RESULTS

EPA analyzed urinary biomonitoring data from the CDC's NHANES, which reports urinary concentrations for 15 phthalate metabolites specific to individual phthalate diesters. Four metabolites of DEHP, mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), mono(2-ethyl-5-carboxypentyl) phthalate (MECPP), and mono(2-ethyl-5-oxohexyl) phthalate (MEOHP) have been reported in the NHANES data.

MEHP has been reported in NHANES beginning with the 1999 cycle and measured in 26,740 members of the general public, including 7,331 children under 16 years and 19,409 adults aged 16 years and over. MEHHP was added starting in the 2001 to 2002 NHANES cycle and has been measured in 24,199 participants, including 6,617 children and 17,852 adults. MEOHP was added starting in the 2001 to 2002 NHANES cycle and has been measured in 24,199 participants, including 6,617 children and 17,582 adults. Most recently, NHANES began reporting concentrations of MECPP, which has been measured in 21,417 participants, including 5,839 children and 15,578 adults.

Metabolites of DEHP were quantified in urinary samples from a one-third subsample of all participants aged 6 and older. Beginning with the 2005 to 2006 cycle of NHANES, all participants between 3 and 5 years were eligible for DEHP metabolite urinary analysis. Urinary DEHP metabolite concentrations were quantified using high performance liquid chromatography-electrospray ionization-tandem mass spectrometry. The LOD for each cycle on NHANES are provided in Table_Apx G-1. Values below the LOD were replaced by the lower limit of detection divided by the square root of 2 (NCHS, 2021).

Table_Apx G-1. Limit of Detection of Urinary DEHP Metabolites by NHANES Cycle

NHANES Cycle	MEHP	MEHHP	MECPP	MEOHP
1999–2000	0.86	–	–	–
2001–2002	0.86	–	–	–
2003–2004	0.90	0.32	0.25	0.45
2005–2006	1.2	0.7	0.6	0.7
2007–2008	1.2	0.7	0.6	0.7
2009–2010	0.5	0.2	0.2	0.2
2011–2012	0.5	0.2	0.2	0.2
2013–2014	0.8	0.4	0.4	0.2
2015–2016	0.8	0.4	0.4	0.2
2017–2018	0.8	0.4	0.4	0.2

Table_Apx G-2. Summary of Urinary DEHP Metabolite Concentrations (ng/mL) from all NHANES Cycles Between 1999–2018

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2017–2018	MECPP	Adults	All adults	1,896	1,896 (99.74%)	7.6 (5.8–9.8)	33.4 (21.9–44.6)	7.3 (6.9–7.6)	36.59 (29.9–41.06)
2017–2018	MECPP	Adults	At or above poverty level	467	467 (99.57%)	7.6 (5.7–10)	33.3 (21.3–46.3)	7.02 (6.71–7.41)	30.46 (27.45–35.6)
2017–2018	MECPP	Adults	Below poverty level	337	337 (99.7%)	7.8 (5.3–11.4)	33.4 (17–41)	9.4 (7.88–11.74)	50 (41.11–65.47)
2017–2018	MECPP	Adults	Black non-Hispanic	438	438 (100%)	9.1 (7–11.1)	47.8 (20.2–103.7)	6.5 (5.79–6.94)	31.56 (25.07–37.49)
2017–2018	MECPP	Adults	Females	952	952 (99.79%)	6.8 (4.9–9)	28.1 (21.4–41.9)	8.95 (7.78–10.38)	39.39 (32.78–49.27)
2017–2018	MECPP	Adults	Males	944	944 (99.68%)	7.6 (5.8–9.9)	33.4 (21.9–45.1)	6.43 (6.07–6.9)	31.61 (27.2–37.37)
2017–2018	MECPP	Adults	Mexican American	278	278 (100%)	7.9 (6.4–10.8)	45.2 (28.4–95.4)	9.05 (7.43–12.25)	53.52 (41.14–78.65)
2017–2018	MECPP	Adults	Other	532	532 (99.44%)	6.7 (4.1–8.1)	31 (20.3–44)	8.17 (7.27–9.22)	45.66 (35–58.99)
2017–2018	MECPP	Adults	Unknown income	840	840 (99.88%)	7.4 (5.1–11.1)	35.9 (14.6–51.3)	7.23 (5.68–8.94)	37.48 (18.83–63.33)
2017–2018	MECPP	Adults	White non-Hispanic	648	648 (99.69%)	7.7 (5.1–10.3)	23.7 (16.9–44.6)	6.99 (6.48–7.41)	29.11 (24.71–37.48)
2017–2018	MECPP	Children	Adolescents (11 to <16 years)	213	213 (100%)	3.8 (3–4.4)	18.3 (12.6–23.1)	3.61 (2.64–4.47)	13.14 (8–18.54)
2017–2018	MECPP	Children	Adolescents (11 to <16 years)	213	213 (100%)	3.8 (3–4.4)	18.3 (12.6–23.1)	3.61 (2.64–4.47)	26.05 (18.1–36.92)
2017–2018	MECPP	Children	Adolescents (11 to <16 years)	213	213 (100%)	3.8 (3–4.4)	18.3 (12.6–23.1)	7.64 (6.48–9.36)	13.14 (8–18.54)
2017–2018	MECPP	Children	Adolescents (11 to <16 years)	213	213 (100%)	3.8 (3–4.4)	18.3 (12.6–23.1)	7.64 (6.48–9.36)	26.05 (18.1–36.92)
2017–2018	MECPP	Children	All children	866	866 (100%)	10.6 (9.8–12.3)	52.9 (44.6–61.9)	10.95 (9.78–12.3)	45.37 (33.57–57.25)
2017–2018	MECPP	Children	At or above poverty level	231	231 (100%)	10.1 (8.8–11.4)	47.1 (42.5–61.9)	10.37 (8.7–12.32)	36.62 (29.55–50.33)
2017–2018	MECPP	Children	Below poverty level	234	234 (100%)	13.9 (10.2–18.3)	48.4 (36.5–62.6)	13.44 (11.46–17)	56.37 (39.39–88)
2017–2018	MECPP	Children	Black non-Hispanic	207	207 (100%)	14.6 (10–19)	41.5 (29.6–46.7)	8.13 (7.02–10.38)	32.94 (19.71–58.65)
2017–2018	MECPP	Children	Children (6 to <11 years)	274	274 (100%)	6.1 (5.3–6.9)	27.8 (19.8–40.7)	17.61 (14.67–20.66)	26.11 (18.99–35.52)
2017–2018	MECPP	Children	Children (6 to <11 years)	274	274 (100%)	6.1 (5.3–6.9)	27.8 (19.8–40.7)	17.61 (14.67–20.66)	72.94 (49.68–92.68)
2017–2018	MECPP	Children	Children (6 to <11 years)	274	274 (100%)	6.1 (5.3–6.9)	27.8 (19.8–40.7)	7.71 (5.8–8.95)	26.11 (18.99–35.52)
2017–2018	MECPP	Children	Children (6 to <11 years)	274	274 (100%)	6.1 (5.3–6.9)	27.8 (19.8–40.7)	7.71 (5.8–8.95)	72.94 (49.68–92.68)
2017–2018	MECPP	Children	Females	447	447 (100%)	10.3 (8.1–14.6)	47.6 (40.7–60.1)	12.3 (10.37–14.55)	48.82 (32.2–62.58)
2017–2018	MECPP	Children	Males	419	419 (100%)	10.8 (10.1–13.1)	60.9 (42.5–62.1)	9.69 (8.15–11.36)	39.06 (33.1–59.15)
2017–2018	MECPP	Children	Mexican American	139	139 (100%)	8.9 (6.9–12.9)	59.6 (29.6–140.5)	11.13 (8.15–13.46)	74.74 (34.02–129.04)
2017–2018	MECPP	Children	Other	262	262 (100%)	11.2 (9.2–12.3)	62.4 (33.5–126.7)	10.98 (8.43–15.62)	57.25 (29.63–235.19)
2017–2018	MECPP	Children	Toddlers (3 to <6 years)	379	379 (100%)	3.8 (2.9–4.2)	18.4 (6.2–73.8)	1.77 (1.46–3.57)	23.57 (11.74–36.62)
2017–2018	MECPP	Children	Toddlers (3 to <6 years)	379	379 (100%)	3.8 (2.9–4.2)	18.4 (6.2–73.8)	1.77 (1.46–3.57)	8.42 (5–17.32)
2017–2018	MECPP	Children	Toddlers (3 to <6 years)	379	379 (100%)	3.8 (2.9–4.2)	18.4 (6.2–73.8)	4.17 (3.11–9.66)	23.57 (11.74–36.62)
2017–2018	MECPP	Children	Toddlers (3 to <6 years)	379	379 (100%)	3.8 (2.9–4.2)	18.4 (6.2–73.8)	4.17 (3.11–9.66)	8.42 (5–17.32)
2017–2018	MECPP	Children	Unknown income	316	316 (100%)	11.2 (6.9–14.5)	65.2 (20.9–165.9)	11.51 (6.38–20.74)	63.09 (20.74–125.45)
2017–2018	MECPP	Children	White non-Hispanic	258	258 (100%)	10.3 (8.8–14)	48 (38.1–61.9)	11.46 (9.95–14)	34.04 (28.96–55.43)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2017–2018	MECPP	WRA	All women of reproductive age	496	496 (100%)	6.8 (4.9–9)	28.1 (21.4–41.9)	19.53 (15.1–24.16)	62.58 (48.67–125.45)
2017–2018	MECPP	WRA	At or above poverty level	112	112 (100%)	6.4 (4.8–8.6)	23.3 (17–38.2)	18.2 (10.81–24.5)	59.59 (32.78–129.04)
2017–2018	MECPP	WRA	Below poverty level	124	124 (100%)	6.5 (3.8–9.8)	28.5 (16.9–43.2)	20.7 (13.44–32.34)	55.43 (32.94–235.19)
2017–2018	MECPP	WRA	Black non-Hispanic	109	109 (100%)	11 (5.9–15.1)	41.9 (26.7–58.6)	12 (6.83–20.44)	32.94 (18.63–62.58)
2017–2018	MECPP	WRA	Mexican American	86	86 (100%)	6.8 (3.4–12.2)	35.9 (14.2–72.3)	19.89 (9.78–48.67)	125.45 (20.69–129.04)
2017–2018	MECPP	WRA	Other	150	150 (100%)	6.8 (4.6–9.9)	27.3 (16.9–164.4)	20.66 (16.03–36.4)	99.39 (31.45–316.59)
2017–2018	MECPP	WRA	Unknown income	199	199 (100%)	11 (7.8–19.7)	58.6 (21.4–80.1)	16.32 (4.24–125.45)	92.68 (4.24–125.45)
2017–2018	MECPP	WRA	White non-Hispanic	151	151 (100%)	6.3 (4.8–8.4)	23.1 (12.9–34.8)	20 (9.95–28.96)	55.43 (26.15–98.78)
2017–2018	MEHHP	Adults	All adults	1,896	1,896 (98.63%)	4.9 (3.9–6.1)	24.4 (17–31.2)	4.64 (4.32–4.89)	21.7 (18.97–25.45)
2017–2018	MEHHP	Adults	At or above poverty level	467	467 (98.72%)	4.7 (3.6–6.3)	26.1 (16.8–49.9)	4.6 (4.29–4.85)	19.18 (18.08–22.38)
2017–2018	MEHHP	Adults	Below poverty level	337	337 (98.81%)	4.9 (3.3–6.8)	16.7 (12.9–29)	5.99 (4.93–7.27)	33.21 (22.5–49.82)
2017–2018	MEHHP	Adults	Black non-Hispanic	438	438 (99.09%)	6.1 (5.4–7.9)	23.6 (15.9–52.5)	4.43 (4.11–4.89)	23.26 (18.06–30.28)
2017–2018	MEHHP	Adults	Females	952	952 (98.53%)	4.3 (3.2–5.5)	19.4 (16.4–22.9)	5.45 (4.8–6.36)	24.53 (20.29–30)
2017–2018	MEHHP	Adults	Males	944	944 (98.73%)	4.9 (3.7–6.3)	24.4 (17–31.2)	4.24 (3.87–4.62)	20.25 (18.35–23.47)
2017–2018	MEHHP	Adults	Mexican American	278	278 (98.92%)	5.4 (3.2–8.7)	25.6 (15.6–45.1)	5.97 (4.43–7.59)	33.48 (23.92–47.88)
2017–2018	MEHHP	Adults	Other	532	532 (97.93%)	4.4 (3.4–5.3)	22.5 (15.8–31.2)	5.28 (4.38–5.83)	25.33 (20.42–33.95)
2017–2018	MEHHP	Adults	Unknown income	840	840 (98.57%)	5.2 (3.3–7)	25.6 (7.3–34.6)	4.11 (3.36–5.09)	20.55 (18.24–26.67)
2017–2018	MEHHP	Adults	White non-Hispanic	648	648 (98.77%)	4.7 (3.4–7)	23.1 (11.8–49.9)	4.37 (4.09–4.81)	18.68 (15.19–22.97)
2017–2018	MEHHP	Children	Adolescents (11 to <16 years)	213	213 (100%)	5.4 (4–6.4)	26.6 (19.4–31.1)	4.94 (3.89–6.46)	17.62 (12.46–23.15)
2017–2018	MEHHP	Children	All children	866	866 (99.88%)	6.6 (6–7.5)	30.9 (26.6–38.3)	6.48 (5.74–7.94)	28.19 (20.96–32.14)
2017–2018	MEHHP	Children	At or above poverty level	231	231 (100%)	6.3 (5.5–7.5)	28.9 (25.1–33.7)	6.29 (5.3–7.69)	25.06 (18.09–30)
2017–2018	MEHHP	Children	Below poverty level	234	234 (100%)	7.9 (5.4–10.4)	29 (24.4–51.1)	8.43 (5.76–10)	32.76 (19.57–50)
2017–2018	MEHHP	Children	Black non-Hispanic	207	207 (100%)	9.9 (8.6–11.9)	28.9 (22.6–41.6)	6.21 (5.11–7.81)	22.34 (13.95–31.74)
2017–2018	MEHHP	Children	Children (6 to <11 years)	274	274 (99.64%)	8.7 (7.4–9.8)	38.8 (29.8–62.9)	10 (8.37–13.28)	37.31 (29.9–50)
2017–2018	MEHHP	Children	Females	447	447 (100%)	6.3 (5.4–7.6)	29.8 (23.5–33.7)	8.12 (6.09–9.1)	28.72 (20.96–37.31)
2017–2018	MEHHP	Children	Males	419	419 (99.76%)	6.8 (5.8–8.5)	36.4 (26.6–44.1)	5.83 (5.19–7.2)	25.81 (20.82–31.74)
2017–2018	MEHHP	Children	Mexican American	139	139 (100%)	6 (4.5–8.2)	38.8 (18.7–104.8)	6.82 (4.32–10.52)	40.32 (25.81–65.1)
2017–2018	MEHHP	Children	Other	262	262 (99.62%)	6.6 (5.5–7.6)	42.6 (20.4–66.7)	6.69 (5.83–8.52)	29.44 (17.35–133.64)
2017–2018	MEHHP	Children	Toddlers (3 to <6 years)	379	379 (100%)	5.5 (3.4–8.5)	26.3 (8.5–126.8)	2.56 (2.12–5.57)	15.26 (8.53–29.77)
2017–2018	MEHHP	Children	Unknown income	316	316 (99.68%)	6.8 (3.6–10.7)	62.9 (11.1–104.8)	8.5 (3.73–11.91)	40.32 (19.09–93.57)
2017–2018	MEHHP	Children	White non-Hispanic	258	258 (100%)	6.1 (5.2–7.5)	29.8 (20.7–38.3)	6.48 (5.5–9.05)	25.06 (18.22–29.77)
2017–2018	MEHHP	WRA	All women of reproductive age	496	496 (98.79%)	4.3 (3.2–5.5)	19.4 (16.4–22.9)	9.83 (7.35–13.33)	37.31 (29.12–65.1)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2017–2018	MEHHP	WRA	At or above poverty level	112	112 (99.11%)	4 (3.2–5.4)	17.2 (12.9–22.2)	9.07 (6.33–12.43)	30.24 (26.36–65.1)
2017–2018	MEHHP	WRA	Below poverty level	124	124 (99.19%)	4.2 (2.3–7.3)	20.4 (12–25.5)	11.72 (10–17.03)	37.31 (22.34–139.81)
2017–2018	MEHHP	WRA	Black non-Hispanic	109	109 (99.08%)	7.8 (4.7–9.2)	29.5 (22.9–48.7)	8.21 (4.17–13.57)	29.12 (10.49–30.48)
2017–2018	MEHHP	WRA	Mexican American	86	86 (100%)	3.9 (2.8–7.6)	21.9 (9.7–35.1)	13.28 (5.25–37.31)	65.1 (14.19–93.57)
2017–2018	MEHHP	WRA	Other	150	150 (98.67%)	4.1 (2.8–5.5)	21.1 (11.1–102.1)	11.2 (8.28–17.27)	64.12 (16.43–139.81)
2017–2018	MEHHP	WRA	Unknown income	199	199 (98.99%)	6.4 (4.6–10.6)	26.3 (11.5–48.7)	10.26 (1.82–93.57)	47.88 (1.82–93.57)
2017–2018	MEHHP	WRA	White non-Hispanic	151	151 (98.01%)	3.8 (2.8–4.8)	12.7 (8.7–21.6)	8.54 (3.87–18.27)	28.72 (12.43–32.14)
2017–2018	MEHP	Adults	All adults	1,896	1,896 (53.06%)	0.9 (0.57–1.1)	6.1 (5–8.6)	1.07 (0.98–1.16)	5.18 (4.38–5.98)
2017–2018	MEHP	Adults	At or above poverty level	467	467 (53.75%)	0.57 (0.57–0.57)	8.3 (5–11.6)	1.04 (0.93–1.17)	4.64 (3.88–5.53)
2017–2018	MEHP	Adults	Below poverty level	337	337 (58.75%)	1.1 (0.57–1.3)	4.8 (3–5.5)	1.24 (1.15–1.5)	6.62 (4.75–6.9)
2017–2018	MEHP	Adults	Black non-Hispanic	438	438 (58.68%)	1.2 (1–1.4)	5.2 (3.5–14.2)	0.98 (0.79–1.1)	4.67 (3.45–5.7)
2017–2018	MEHP	Adults	Females	952	952 (48.63%)	0.8 (0.57–1)	5.5 (4.1–6.6)	1.24 (1.12–1.43)	6.38 (3.89–10)
2017–2018	MEHP	Adults	Males	944	944 (57.52%)	0.8 (0.57–1.1)	6.2 (5–9.2)	0.95 (0.86–1.05)	4.57 (3.88–5.18)
2017–2018	MEHP	Adults	Mexican American	278	278 (57.91%)	1.4 (0.57–2.1)	10.75 (4.3–11.8)	1.38 (1.06–1.63)	7.66 (5.7–8.79)
2017–2018	MEHP	Adults	Other	532	532 (56.02%)	1 (0.9–1.5)	6.05 (4.3–10.8)	1.33 (1.19–1.58)	8.14 (5.56–11.67)
2017–2018	MEHP	Adults	Unknown income	840	840 (50.48%)	1.2 (0.57–1.8)	5.9 (2.5–14.3)	1.01 (0.75–1.24)	6.99 (3–11.34)
2017–2018	MEHP	Adults	White non-Hispanic	648	648 (44.75%)	0.57 (0.57–0.57)	5.5 (3.7–18)	1 (0.88–1.11)	3.85 (3.49–5)
2017–2018	MEHP	Children	Adolescents (11 to <16 years)	213	213 (60.09%)	1 (0.57–1.4)	8.8 (7.3–10.4)	1.24 (0.93–1.52)	4.43 (2.81–11.67)
2017–2018	MEHP	Children	Adolescents (11 to <16 years)	213	213 (60.09%)	1 (0.57–1.4)	8.8 (7.3–10.4)	1.24 (0.93–1.52)	7.64 (6.48–9.36)
2017–2018	MEHP	Children	All children	866	866 (63.16%)	1.2 (1–1.5)	5.8 (4.2–7.1)	1.42 (1.19–1.58)	6.79 (4.24–10.08)
2017–2018	MEHP	Children	At or above poverty level	231	231 (62.77%)	1 (0.8–1.4)	4.8 (4.1–7.1)	1.4 (1.14–1.53)	6.79 (3.69–11.67)
2017–2018	MEHP	Children	Below poverty level	234	234 (65.81%)	1.1 (0.57–1.7)	6 (3.7–8.5)	1.45 (1.01–1.88)	6.67 (4.31–10.08)
2017–2018	MEHP	Children	Black non-Hispanic	207	207 (74.4%)	1.7 (1.3–2.1)	6.1 (4–7.1)	1.34 (1.11–1.5)	4.07 (3.33–5.94)
2017–2018	MEHP	Children	Children (6 to <11 years)	274	274 (74.09%)	1.3 (1.1–1.5)	15.8 (12.3–18.6)	1.6 (1.41–2.2)	17.61 (14.67–20.66)
2017–2018	MEHP	Children	Children (6 to <11 years)	274	274 (74.09%)	1.3 (1.1–1.5)	15.8 (12.3–18.6)	1.6 (1.41–2.2)	7.16 (4.89–10.39)
2017–2018	MEHP	Children	Females	447	447 (61.07%)	1.1 (0.57–1.5)	6.4 (4.2–7.3)	1.54 (1.26–2.19)	7.18 (3.7–11.67)
2017–2018	MEHP	Children	Males	419	419 (65.39%)	1.2 (0.9–1.5)	5.6 (4–10.2)	1.25 (0.94–1.48)	4.73 (3.83–6.79)
2017–2018	MEHP	Children	Mexican American	139	139 (66.19%)	1.2 (0.57–1.5)	6.9 (3.7–12.7)	1.52 (1.08–2.17)	7.16 (4.63–11.34)
2017–2018	MEHP	Children	Other	262	262 (64.89%)	1.1 (0.8–1.5)	7 (4.3–13.4)	1.43 (1–2.13)	10.39 (2.68–21.98)
2017–2018	MEHP	Children	Toddlers (3 to <6 years)	379	379 (56.99%)	1.2 (0.57–2.1)	9.45 (6.4–10.8)	0.7 (0.42–1.21)	3.43 (1.68–3.76)
2017–2018	MEHP	Children	Toddlers (3 to <6 years)	379	379 (56.99%)	1.2 (0.57–2.1)	9.45 (6.4–10.8)	0.7 (0.42–1.21)	4.17 (3.11–9.66)
2017–2018	MEHP	Children	Unknown income	316	316 (60.76%)	1.8 (1.1–2.3)	10.2 (3.6–27.7)	1.56 (1.06–3.18)	6.99 (3.43–21.98)
2017–2018	MEHP	Children	White non-Hispanic	258	258 (50.78%)	1 (0.57–1.3)	4.2 (3.2–7.3)	1.4 (1.01–1.58)	4.14 (3.5–6.76)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2017–2018	MEHP	WRA	All women of reproductive age	496	496 (58.87%)	0.8 (0.57–1)	5.5 (4.1–6.6)	1.55 (1.43–2.48)	7.18 (4.07–10)
2017–2018	MEHP	WRA	At or above poverty level	112	112 (61.61%)	0.8 (0.57–0.9)	3.7 (2.8–5.9)	1.49 (1.22–2.2)	7.16 (3.69–10.58)
2017–2018	MEHP	WRA	Below poverty level	124	124 (59.68%)	1.1 (0.57–1.4)	6.45 (3.1–7.1)	2.48 (1.54–3.62)	6.67 (3.62–16.85)
2017–2018	MEHP	WRA	Black non-Hispanic	109	109 (69.72%)	2 (1.1–2.6)	7.7 (6.3–9.1)	1.68 (0.71–3.61)	5.7 (2.65–5.94)
2017–2018	MEHP	WRA	Mexican American	86	86 (62.79%)	1.3 (0.57–2)	7.6 (2.8–9.9)	2.42 (0.63–10.58)	10.58 (2.59–11.34)
2017–2018	MEHP	WRA	Other	150	150 (56%)	0.9 (0.57–1.3)	5.9 (3–10.8)	2.68 (0.98–3.69)	7.6 (3.62–16.85)
2017–2018	MEHP	WRA	Unknown income	199	199 (55.28%)	2.1 (0.9–3.2)	12.3 (4.2–14.3)	1.38 (0.39–11.34)	6.99 (0.39–11.34)
2017–2018	MEHP	WRA	White non-Hispanic	151	151 (51.66%)	0.8 (0.57–0.9)	2.5 (1.7–4.8)	1.46 (0.81–3.7)	4.89 (1.49–7.18)
2017–2018	MEOHP	Adults	All adults	1,896	1,896 (98.84%)	3.1 (2.4–3.8)	15.3 (11.6–19)	3.05 (2.88–3.24)	15.15 (13.57–17.6)
2017–2018	MEOHP	Adults	At or above poverty level	467	467 (98.5%)	2.9 (2.3–3.9)	16.4 (10.9–24.9)	3.03 (2.83–3.24)	13.57 (12.34–15.15)
2017–2018	MEOHP	Adults	Below poverty level	337	337 (98.81%)	3.1 (1.8–4.2)	12.6 (9–16)	3.64 (3.13–4.57)	22.31 (16–34)
2017–2018	MEOHP	Adults	Black non-Hispanic	438	438 (98.86%)	4.1 (3.4–4.4)	17.5 (10.2–35.5)	2.71 (2.52–2.92)	14.85 (10.43–18.46)
2017–2018	MEOHP	Adults	Females	952	952 (98.74%)	2.9 (2.3–3.7)	13 (10.7–17)	3.77 (3.33–3.94)	17.69 (13.13–20.29)
2017–2018	MEOHP	Adults	Males	944	944 (98.94%)	3.1 (2.4–3.9)	15.1 (11.6–20.2)	2.67 (2.47–2.88)	14.36 (12.46–15.82)
2017–2018	MEOHP	Adults	Mexican American	278	278 (99.64%)	3.6 (2.2–6.2)	17.6 (9.5–31.4)	4.03 (2.78–5.1)	23.85 (16.29–29.64)
2017–2018	MEOHP	Adults	Other	532	532 (97.93%)	2.8 (2.1–3.5)	13.1 (9–18.8)	3.45 (2.94–3.88)	16.92 (14–24.44)
2017–2018	MEOHP	Adults	Unknown income	840	840 (99.05%)	3.5 (2.4–4.3)	14.1 (4.7–22.8)	2.48 (2.02–3.68)	17.62 (8.86–27.56)
2017–2018	MEOHP	Adults	White non-Hispanic	648	648 (99.23%)	2.9 (2–4.1)	14.2 (7.6–30.9)	3.01 (2.73–3.13)	13.57 (11.19–17.38)
2017–2018	MEOHP	Children	Adolescents (11 to <16 years)	213	213 (100%)	41.5 (27.5–44.8)	8.8 (7.3–10.4)	3.61 (2.64–4.47)	13.14 (8–18.54)
2017–2018	MEOHP	Children	Adolescents (11 to <16 years)	213	213 (100%)	41.5 (27.5–44.8)	8.8 (7.3–10.4)	3.61 (2.64–4.47)	17.62 (12.46–23.15)
2017–2018	MEOHP	Children	Adolescents (11 to <16 years)	213	213 (100%)	41.5 (27.5–44.8)	8.8 (7.3–10.4)	4.94 (3.89–6.46)	13.14 (8–18.54)
2017–2018	MEOHP	Children	Adolescents (11 to <16 years)	213	213 (100%)	41.5 (27.5–44.8)	8.8 (7.3–10.4)	4.94 (3.89–6.46)	17.62 (12.46–23.15)
2017–2018	MEOHP	Children	All children	866	866 (99.88%)	4.9 (4.2–5.7)	22.8 (18.4–25.4)	4.65 (4.17–5.4)	18.33 (15.82–23.33)
2017–2018	MEOHP	Children	At or above poverty level	231	231 (100%)	4.4 (3.9–5.4)	22.6 (17.9–25.4)	4.37 (3.64–5.18)	17.32 (13.8–18.54)
2017–2018	MEOHP	Children	Below poverty level	234	234 (100%)	5.9 (4.2–7.5)	21.4 (16–33.3)	6 (4.57–7.43)	22.06 (14.31–36.18)
2017–2018	MEOHP	Children	Black non-Hispanic	207	207 (100%)	6.8 (5.2–7.5)	18.3 (14.9–20.1)	3.89 (3.27–5.37)	15.32 (9.64–20.94)
2017–2018	MEOHP	Children	Children (6 to <11 years)	274	274 (99.64%)	61.2 (49–77.2)	15.8 (12.3–18.6)	10 (8.37–13.28)	26.11 (18.99–35.52)
2017–2018	MEOHP	Children	Children (6 to <11 years)	274	274 (99.64%)	61.2 (49–77.2)	15.8 (12.3–18.6)	10 (8.37–13.28)	37.31 (29.9–50)
2017–2018	MEOHP	Children	Children (6 to <11 years)	274	274 (99.64%)	61.2 (49–77.2)	15.8 (12.3–18.6)	7.71 (5.8–8.95)	26.11 (18.99–35.52)
2017–2018	MEOHP	Children	Children (6 to <11 years)	274	274 (99.64%)	61.2 (49–77.2)	15.8 (12.3–18.6)	7.71 (5.8–8.95)	37.31 (29.9–50)
2017–2018	MEOHP	Children	Females	447	447 (100%)	4.9 (3.5–5.8)	21.4 (17.9–23.2)	5.72 (4.44–6.54)	18.54 (14.4–26.11)
2017–2018	MEOHP	Children	Males	419	419 (99.76%)	5 (4.2–5.9)	25.4 (18.4–28.7)	4.09 (3.61–4.77)	17.85 (15.11–25.6)
2017–2018	MEOHP	Children	Mexican American	139	139 (100%)	4.2 (3.1–5.2)	26.7 (14.2–72.1)	4.48 (2.78–6.43)	29.33 (20–48.27)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2017–2018	MEOHP	Children	Other	262	262 (99.62%)	4.8 (3.8–5.6)	26.55 (15–45.7)	4.57 (4.17–5.49)	22.65 (12.91–92.5)
2017–2018	MEOHP	Children	Toddlers (3 to <6 years)	379	379 (100%)	38.2 (16.8–156)	9.45 (6.4–10.8)	1.77 (1.46–3.57)	15.26 (8.53–29.77)
2017–2018	MEOHP	Children	Toddlers (3 to <6 years)	379	379 (100%)	38.2 (16.8–156)	9.45 (6.4–10.8)	1.77 (1.46–3.57)	8.42 (5–17.32)
2017–2018	MEOHP	Children	Toddlers (3 to <6 years)	379	379 (100%)	38.2 (16.8–156)	9.45 (6.4–10.8)	2.56 (2.12–5.57)	15.26 (8.53–29.77)
2017–2018	MEOHP	Children	Toddlers (3 to <6 years)	379	379 (100%)	38.2 (16.8–156)	9.45 (6.4–10.8)	2.56 (2.12–5.57)	8.42 (5–17.32)
2017–2018	MEOHP	Children	Unknown income	316	316 (99.68%)	5.6 (2.4–8.8)	43 (8.8–72.1)	5.67 (2.73–8.89)	27.56 (12.07–64.38)
2017–2018	MEOHP	Children	White non-Hispanic	258	258 (100%)	4.6 (3.9–5.7)	22.7 (14.7–25.4)	4.69 (3.61–6.54)	17.38 (14.31–18.54)
2017–2018	MEOHP	WRA	All women of reproductive age	496	496 (98.79%)	2.9 (2.3–3.7)	13 (10.7–17)	7.71 (5.8–9.15)	27.56 (17.97–48.27)
2017–2018	MEOHP	WRA	At or above poverty level	112	112 (98.21%)	2.8 (2.2–3.5)	10.7 (8.7–17)	7.68 (4.25–9.5)	18.39 (17.38–48.27)
2017–2018	MEOHP	WRA	Below poverty level	124	124 (99.19%)	3.1 (1.4–4.3)	11.2 (7.6–18.5)	7.83 (7–13.04)	29.33 (12.7–98.43)
2017–2018	MEOHP	WRA	Black non-Hispanic	109	109 (99.08%)	5.3 (3.3–6.6)	19 (14.5–31.5)	5.48 (2.56–10.2)	17.65 (7.83–18.39)
2017–2018	MEOHP	WRA	Mexican American	86	86 (100%)	3.3 (2.3–4.5)	15.3 (6.1–24.9)	9.77 (3.33–27.56)	48.27 (10.32–64.38)
2017–2018	MEOHP	WRA	Other	150	150 (98%)	3.1 (1.8–4.2)	14 (7.2–54.8)	9.1 (6.31–13.61)	33.67 (12.7–98.43)
2017–2018	MEOHP	WRA	Unknown income	199	199 (99.5%)	4.5 (3.7–8.2)	17.6 (8.4–31.5)	7.7 (1.21–64.38)	27.56 (1.21–64.38)
2017–2018	MEOHP	WRA	White non-Hispanic	151	151 (98.68%)	2.5 (2.1–3.1)	10.5 (6.1–11.8)	7.78 (3.03–17.38)	17.69 (9.5–26.11)
2015–2016	MECPP	Adults	All adults	1,880	1,880 (99.73%)	8.7 (6.7–10.5)	38.8 (26.4–53.2)	8.59 (7.76–9.6)	40.25 (35.61–46.53)
2015–2016	MECPP	Adults	At or above poverty level	461	461 (99.78%)	8.3 (6.4–11.2)	37.4 (26.1–47.9)	8.21 (7.45–9.24)	35.83 (31–44.09)
2015–2016	MECPP	Adults	Below poverty level	399	399 (99.75%)	9.1 (7.6–10.3)	43.7 (18.1–59.6)	10.24 (9.33–11.67)	57.69 (46.92–66.86)
2015–2016	MECPP	Adults	Black non-Hispanic	427	427 (99.53%)	10.3 (7.6–13.1)	45.6 (19.6–130.7)	8.23 (7.04–9.6)	49.24 (37.69–59.6)
2015–2016	MECPP	Adults	Females	984	984 (99.8%)	8 (6.8–10.3)	44.8 (31.4–64.1)	10.63 (9.03–12.03)	43.64 (37.69–58.11)
2015–2016	MECPP	Adults	Males	896	896 (99.67%)	8.7 (6.7–10.6)	38.1 (26.4–49.6)	7.62 (6.79–8.72)	35.85 (30.77–46.92)
2015–2016	MECPP	Adults	Mexican American	342	342 (99.71%)	8.5 (6.6–9.2)	32 (22.1–53.2)	10.86 (9.69–12.59)	51.35 (43.18–65.65)
2015–2016	MECPP	Adults	Other	540	540 (99.81%)	9.9 (6.8–12.8)	38.1 (31.8–49.6)	9.84 (8.37–11.78)	49.45 (40.11–60.16)
2015–2016	MECPP	Adults	Unknown income	833	833 (99.76%)	9.7 (5–19.7)	53.2 (19.7–76.8)	8.57 (7.22–12.1)	46.53 (43.68–68.02)
2015–2016	MECPP	Adults	White non-Hispanic	571	571 (99.82%)	7.8 (5.3–11.4)	40.6 (22.2–56.2)	7.96 (7.35–9.09)	35.44 (26.46–46.53)
2015–2016	MECPP	Children	Adolescents (11 to <16 years)	284	284 (99.65%)	4.6 (3.8–5.4)	16.6 (13.5–19.2)	3.53 (3.07–4.05)	10.59 (8.96–14.3)
2015–2016	MECPP	Children	Adolescents (11 to <16 years)	284	284 (99.65%)	4.6 (3.8–5.4)	16.6 (13.5–19.2)	3.53 (3.07–4.05)	29.19 (20.97–35.71)
2015–2016	MECPP	Children	Adolescents (11 to <16 years)	284	284 (99.65%)	4.6 (3.8–5.4)	16.6 (13.5–19.2)	8.1 (7.17–9.8)	10.59 (8.96–14.3)
2015–2016	MECPP	Children	Adolescents (11 to <16 years)	284	284 (99.65%)	4.6 (3.8–5.4)	16.6 (13.5–19.2)	8.1 (7.17–9.8)	29.19 (20.97–35.71)
2015–2016	MECPP	Children	All children	1,095	1,095 (99.91%)	12.3 (11.4–13.5)	50.8 (42.4–60)	11.72 (10.33–13.52)	48.91 (36.84–58.3)
2015–2016	MECPP	Children	At or above poverty level	282	282 (100%)	12.1 (11–13.5)	46.8 (29.6–57.6)	10.86 (9.05–12.45)	43.7 (33.08–57.05)
2015–2016	MECPP	Children	Below poverty level	329	329 (100%)	14.3 (11.1–19.9)	65.6 (46.9–80.6)	15.67 (12.53–18.21)	65.4 (35.28–91.31)
2015–2016	MECPP	Children	Black non-Hispanic	271	271 (100%)	14.2 (11.6–16.5)	65 (44.3–111.4)	12.29 (9.23–15.71)	52.78 (35.11–91.31)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2015–2016	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.1 (5.1–6.8)	26.7 (21.5–34.1)	18.66 (17.14–20.34)	23.88 (20.63–30.76)
2015–2016	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.1 (5.1–6.8)	26.7 (21.5–34.1)	18.66 (17.14–20.34)	62.49 (57.03–82.42)
2015–2016	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.1 (5.1–6.8)	26.7 (21.5–34.1)	7.78 (6.9–8.48)	23.88 (20.63–30.76)
2015–2016	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.1 (5.1–6.8)	26.7 (21.5–34.1)	7.78 (6.9–8.48)	62.49 (57.03–82.42)
2015–2016	MECPP	Children	Females	517	517 (99.81%)	12.3 (10.8–14.3)	47.7 (38.8–59.4)	12.45 (10.68–15.71)	53.37 (35.61–58.3)
2015–2016	MECPP	Children	Males	578	578 (100%)	12.2 (11.2–13.7)	53.1 (39.3–70.3)	11.1 (9.17–13.26)	47.91 (34.58–58.41)
2015–2016	MECPP	Children	Mexican American	253	253 (100%)	14.3 (11.8–16.1)	59.4 (39.4–87.8)	15.68 (13.87–16.92)	60.71 (43.64–91.3)
2015–2016	MECPP	Children	Other	280	280 (100%)	13.2 (11.4–15)	55.5 (38.4–79.2)	12.24 (10.07–15.96)	52.81 (40.11–63)
2015–2016	MECPP	Children	Toddlers (3 to <6 years)	465	465 (100%)	3.9 (2.7–6.1)	9.1 (9–10.6)	2.47 (1.87–2.94)	12.27 (10.45–15.29)
2015–2016	MECPP	Children	Toddlers (3 to <6 years)	465	465 (100%)	3.9 (2.7–6.1)	9.1 (9–10.6)	2.47 (1.87–2.94)	6.04 (4.74–12.08)
2015–2016	MECPP	Children	Toddlers (3 to <6 years)	465	465 (100%)	3.9 (2.7–6.1)	9.1 (9–10.6)	6 (4.57–7.48)	12.27 (10.45–15.29)
2015–2016	MECPP	Children	Toddlers (3 to <6 years)	465	465 (100%)	3.9 (2.7–6.1)	9.1 (9–10.6)	6 (4.57–7.48)	6.04 (4.74–12.08)
2015–2016	MECPP	Children	Unknown income	388	388 (99.74%)	13.7 (10.6–19.1)	42.7 (26.9–275.4)	14.72 (9.6–20.61)	46.95 (38.2–235.38)
2015–2016	MECPP	Children	White non-Hispanic	291	291 (99.66%)	11.6 (10.5–13.5)	46.3 (24.6–57.6)	10.53 (8.65–12.25)	35.61 (27–58.3)
2015–2016	MECPP	WRA	All women of reproductive age	564	564 (99.82%)	8 (6.8–10.3)	44.8 (31.4–64.1)	17.7 (15.96–21.15)	57.69 (40.2–78.89)
2015–2016	MECPP	WRA	At or above poverty level	134	134 (99.25%)	7.4 (6.5–9.4)	31.9 (22.8–47.6)	16.92 (14.96–17.75)	53.97 (33.57–72.73)
2015–2016	MECPP	WRA	Below poverty level	132	132 (100%)	11.9 (8.8–15.8)	68.2 (44.8–199.8)	22.69 (18.29–29.38)	80 (28.78–139.11)
2015–2016	MECPP	WRA	Black non-Hispanic	143	143 (100%)	10.1 (6.5–17.5)	72.3 (27.5–106.4)	18.29 (14.92–25.2)	82.42 (29.38–164.65)
2015–2016	MECPP	WRA	Mexican American	112	112 (100%)	11.4 (6–16.9)	38.8 (25.9–199.8)	20.38 (16–27.29)	51.19 (32.14–71.84)
2015–2016	MECPP	WRA	Other	160	160 (99.38%)	6.3 (4.7–8.8)	47.4 (21.1–102)	20.61 (15.96–30.26)	53.37 (31–235.38)
2015–2016	MECPP	WRA	Unknown income	251	251 (100%)	9.2 (2.9–20.9)	33.7 (13.7–53.2)	20.61 (8.5–235.38)	63.82 (8.5–235.38)
2015–2016	MECPP	WRA	White non-Hispanic	149	149 (100%)	7.6 (6–12.7)	33.7 (20–64.1)	16.6 (13.81–19.56)	57.69 (24–80)
2015–2016	MEHHP	Adults	All adults	1,880	1,880 (99.41%)	5.6 (4.9–6.9)	25.1 (21.2–29.7)	5.59 (5.26–5.93)	27.27 (21.75–30.43)
2015–2016	MEHHP	Adults	At or above poverty level	461	461 (99.78%)	5.4 (4.5–6.9)	23.3 (19.5–27.6)	5.4 (5.11–5.76)	22.73 (19.23–28.95)
2015–2016	MEHHP	Adults	Below poverty level	399	399 (99.5%)	6.2 (5.3–7.8)	27 (12.7–52.9)	6.63 (5.65–7.68)	34.62 (30–40.61)
2015–2016	MEHHP	Adults	Black non-Hispanic	427	427 (99.3%)	7.2 (5.9–9.2)	33.9 (15.8–74.9)	5.82 (5.21–6.43)	33.29 (26.1–40.61)
2015–2016	MEHHP	Adults	Females	984	984 (99.8%)	5.4 (4.6–6.5)	27.9 (22–39.3)	6.35 (5.81–6.98)	30 (22.09–34.76)
2015–2016	MEHHP	Adults	Males	896	896 (99%)	5.6 (4.9–7.1)	24.1 (20.5–29.7)	5.14 (4.65–5.63)	23.94 (18.33–33.27)
2015–2016	MEHHP	Adults	Mexican American	342	342 (99.42%)	5.6 (4.6–6.6)	22.65 (16.6–27.8)	7.3 (6.33–8.33)	34.29 (27.45–40.89)
2015–2016	MEHHP	Adults	Other	540	540 (99.26%)	5.9 (4.7–7.2)	26.4 (21.6–29.9)	6.14 (5.32–6.98)	32.09 (24.85–38.21)
2015–2016	MEHHP	Adults	Unknown income	833	833 (99.16%)	8.4 (4.6–11.9)	64.4 (11.9–77.5)	6 (5.23–7.71)	27.73 (14.46–67.2)
2015–2016	MEHHP	Adults	White non-Hispanic	571	571 (99.65%)	5.3 (4.2–6.9)	23.4 (16.5–32.4)	5.35 (4.9–5.63)	22.61 (18–30)
2015–2016	MEHHP	Children	Adolescents (11 to <16 years)	284	284 (99.3%)	6.6 (5.3–8.1)	25.3 (18.6–29)	5.43 (4.8–6.02)	16.29 (12.57–19.08)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2015–2016	MEHHP	Children	All children	1,095	1,095 (99.73%)	7.5 (6.4–8.5)	30.1 (25.3–36.5)	7.1 (6.27–8.14)	30.43 (22.86–36.04)
2015–2016	MEHHP	Children	At or above poverty level	282	282 (100%)	7.2 (6.2–8.1)	29 (20.8–36.4)	6.8 (6.01–7.7)	28.47 (19.29–36.27)
2015–2016	MEHHP	Children	Below poverty level	329	329 (99.7%)	8.7 (6.2–11.1)	35.1 (27.5–53.6)	9.09 (7.03–10.23)	34.9 (24.43–43.53)
2015–2016	MEHHP	Children	Black non-Hispanic	271	271 (100%)	9.4 (7.9–11.1)	52 (30.1–66.9)	8.85 (6.67–10.69)	36.27 (23.94–60)
2015–2016	MEHHP	Children	Children (6 to <11 years)	346	346 (99.71%)	8.7 (7.3–9.9)	40.8 (32.3–55.8)	10.91 (10.09–12.27)	36.92 (32.24–47.44)
2015–2016	MEHHP	Children	Females	517	517 (99.81%)	7 (5.5–8.8)	29 (20.2–36.4)	7.33 (6.39–8.97)	30.43 (21.32–36.04)
2015–2016	MEHHP	Children	Males	578	578 (99.65%)	7.8 (6.8–8.7)	30.3 (23.2–47.9)	7 (6.02–7.86)	29.12 (20.94–38.63)
2015–2016	MEHHP	Children	Mexican American	253	253 (99.6%)	7.8 (6.4–9.8)	34 (23.3–58.7)	9.34 (7.47–10.76)	34.9 (23.33–46.25)
2015–2016	MEHHP	Children	Other	280	280 (100%)	8.1 (6.2–9.8)	33.9 (22.6–44.9)	7.78 (5.91–9.29)	32.09 (23.51–38.96)
2015–2016	MEHHP	Children	Toddlers (3 to <6 years)	465	465 (100%)	6.3 (4.8–8.9)	14.3 (11.6–14.8)	4.15 (2.81–4.81)	9.2 (7.4–28.98)
2015–2016	MEHHP	Children	Unknown income	388	388 (99.48%)	7.9 (6.1–10.6)	27.6 (20–118.2)	9.38 (6.34–11.68)	29.41 (18–101.03)
2015–2016	MEHHP	Children	White non-Hispanic	291	291 (99.31%)	6.7 (5.4–8.1)	25.3 (16.9–31.7)	6.47 (5.76–7.66)	20.71 (18–36.04)
2015–2016	MEHHP	WRA	All women of reproductive age	564	564 (99.65%)	5.4 (4.6–6.5)	27.9 (22–39.3)	11.31 (10.38–12.31)	35.1 (24.33–44.44)
2015–2016	MEHHP	WRA	At or above poverty level	134	134 (99.25%)	4.9 (4.2–5.7)	21.7 (16.1–28.4)	10.38 (8.91–11.67)	32.6 (21.75–44.44)
2015–2016	MEHHP	WRA	Below poverty level	132	132 (100%)	8 (4.1–11.4)	53.6 (39.3–65.6)	13.1 (10.95–15.37)	43.53 (16.23–72.28)
2015–2016	MEHHP	WRA	Black non-Hispanic	143	143 (99.3%)	6.4 (4.1–10.2)	62.7 (18.8–70.3)	13.33 (10.77–17.86)	60 (19.12–83.54)
2015–2016	MEHHP	WRA	Mexican American	112	112 (100%)	4.9 (3.1–10.7)	28.4 (19.6–65.6)	12.57 (9.87–15.36)	34.9 (23.33–36.92)
2015–2016	MEHHP	WRA	Other	160	160 (99.38%)	4.3 (2.9–5.8)	31.4 (12.1–64.6)	12.48 (9.26–15.75)	32.24 (18.2–101.03)
2015–2016	MEHHP	WRA	Unknown income	251	251 (99.6%)	3.7 (2.2–13.2)	23.2 (13.2–64.4)	15.82 (2.5–101.03)	29.41 (2.5–101.03)
2015–2016	MEHHP	WRA	White non-Hispanic	149	149 (100%)	5.4 (3.7–7.1)	23.5 (15.1–52.2)	10 (7.33–12.68)	36.04 (17.45–44.44)
2015–2016	MEHP	Adults	All adults	1,880	1,880 (60.69%)	1.1 (0.9–1.3)	6.9 (5.4–8.7)	1.18 (1.11–1.3)	5.56 (4.71–6.51)
2015–2016	MEHP	Adults	At or above poverty level	461	461 (64.64%)	1.1 (0.9–1.3)	6.3 (5.1–8.3)	1.15 (1.05–1.27)	5 (4.47–5.93)
2015–2016	MEHP	Adults	Below poverty level	399	399 (60.15%)	0.9 (0.57–1.7)	8.7 (4.8–23.4)	1.32 (1.11–1.5)	8 (5.21–12.32)
2015–2016	MEHP	Adults	Black non-Hispanic	427	427 (65.34%)	1.7 (0.9–2.4)	8.2 (4.6–13.9)	1.18 (1.06–1.37)	6.95 (5.09–8.96)
2015–2016	MEHP	Adults	Females	984	984 (59.15%)	1.2 (1–1.5)	7.6 (4.9–10.1)	1.32 (1.12–1.47)	6.54 (4.62–8.14)
2015–2016	MEHP	Adults	Males	896	896 (62.39%)	1 (0.9–1.3)	7 (5.4–8.8)	1.14 (1.02–1.28)	4.83 (4.23–6)
2015–2016	MEHP	Adults	Mexican American	342	342 (61.4%)	1.2 (0.57–1.7)	5.7 (3.9–9)	1.47 (1.38–1.57)	5.24 (4.83–5.93)
2015–2016	MEHP	Adults	Other	540	540 (63.15%)	1.3 (0.57–2.1)	7.1 (5.9–8.8)	1.46 (1.25–1.61)	6.2 (5.25–7.13)
2015–2016	MEHP	Adults	Unknown income	833	833 (58.1%)	1.4 (0.57–2.8)	9.7 (3.1–9.7)	1.3 (0.94–1.73)	5.9 (4.27–12.6)
2015–2016	MEHP	Adults	White non-Hispanic	571	571 (54.47%)	1 (0.57–1.1)	5.1 (3.7–13.2)	1.11 (1–1.18)	4.79 (4.19–6.54)
2015–2016	MEHP	Children	Adolescents (11 to <16 years)	284	284 (64.08%)	0.9 (0.57–1.1)	11.2 (8.9–14.3)	0.97 (0.85–1.14)	4.07 (2.9–5.43)
2015–2016	MEHP	Children	Adolescents (11 to <16 years)	284	284 (64.08%)	0.9 (0.57–1.1)	11.2 (8.9–14.3)	0.97 (0.85–1.14)	8.1 (7.17–9.8)
2015–2016	MEHP	Children	All children	1,095	1,095 (65.02%)	1.1 (0.9–1.2)	4.9 (4.3–6.2)	1.28 (1.12–1.47)	5.09 (4.47–6.27)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2015–2016	MEHP	Children	At or above poverty level	282	282 (64.89%)	1 (0.8–1.3)	4.7 (4.1–5)	1.18 (1–1.46)	4.67 (3.9–6.27)
2015–2016	MEHP	Children	Below poverty level	329	329 (61.4%)	1.2 (0.8–1.6)	7.6 (5.6–8.8)	1.58 (1.28–1.84)	7.08 (4.72–8.46)
2015–2016	MEHP	Children	Black non-Hispanic	271	271 (70.48%)	1.6 (1–2.2)	7.1 (4.6–19.4)	1.37 (1.16–1.75)	6.95 (4.22–15.28)
2015–2016	MEHP	Children	Children (6 to <11 years)	346	346 (69.08%)	1.2 (1–1.7)	13.8 (12.5–16.3)	1.88 (1.62–2.27)	18.66 (17.14–20.34)
2015–2016	MEHP	Children	Children (6 to <11 years)	346	346 (69.08%)	1.2 (1–1.7)	13.8 (12.5–16.3)	1.88 (1.62–2.27)	6.25 (5.18–9.53)
2015–2016	MEHP	Children	Females	517	517 (62.28%)	1.1 (0.8–1.3)	4.5 (3.6–5.6)	1.33 (1.12–1.43)	5.18 (4.38–8.14)
2015–2016	MEHP	Children	Males	578	578 (67.47%)	1.1 (0.8–1.3)	5.4 (4.6–7.2)	1.25 (1.02–1.54)	5.07 (4.05–6.95)
2015–2016	MEHP	Children	Mexican American	253	253 (60.47%)	1.2 (1–1.5)	5.7 (3.9–7.2)	1.55 (1.4–1.8)	5.24 (4.45–7)
2015–2016	MEHP	Children	Other	280	280 (65%)	1.3 (1.1–1.8)	5 (4.2–6.9)	1.58 (1.12–1.85)	5.42 (3.9–8.62)
2015–2016	MEHP	Children	Toddlers (3 to <6 years)	465	465 (62.58%)	0.8 (0.57–1.5)	11.1 (7.6–13.3)	0.56 (0.34–1.09)	2.44 (1.21–4.29)
2015–2016	MEHP	Children	Toddlers (3 to <6 years)	465	465 (62.58%)	0.8 (0.57–1.5)	11.1 (7.6–13.3)	0.56 (0.34–1.09)	6 (4.57–7.48)
2015–2016	MEHP	Children	Unknown income	388	388 (67.01%)	1.5 (0.57–2.4)	5.2 (3.2–19.4)	1.75 (1.15–2.85)	5.61 (3.6–15.28)
2015–2016	MEHP	Children	White non-Hispanic	291	291 (63.92%)	0.9 (0.57–1.2)	4.3 (3.5–5)	1.14 (0.81–1.45)	4.47 (3.16–8.1)
2015–2016	MEHP	WRA	All women of reproductive age	564	564 (64.54%)	1.2 (1–1.5)	7.6 (4.9–10.1)	2.04 (1.62–2.28)	6.11 (4.51–8.62)
2015–2016	MEHP	WRA	At or above poverty level	134	134 (64.93%)	1.1 (0.9–1.4)	6.2 (4.6–8.8)	1.73 (1.38–2.27)	5.21 (4.38–8.62)
2015–2016	MEHP	WRA	Below poverty level	132	132 (66.67%)	1.6 (0.57–2.4)	10.8 (3–30)	2.19 (1.43–2.55)	7.38 (3.81–9.62)
2015–2016	MEHP	WRA	Black non-Hispanic	143	143 (68.53%)	1.8 (1.2–2.1)	9.3 (5–30)	1.78 (1.58–2.43)	7.88 (2.55–15.28)
2015–2016	MEHP	WRA	Mexican American	112	112 (68.75%)	1.4 (0.57–2.6)	8.6 (4.9–14.5)	2.04 (1.43–2.85)	4.9 (2.96–6.27)
2015–2016	MEHP	WRA	Other	160	160 (64.38%)	1.2 (0.57–1.8)	7.4 (3.7–15.6)	2.48 (1.96–3.23)	6.63 (4.34–10.51)
2015–2016	MEHP	WRA	Unknown income	251	251 (63.75%)	1.8 (0.57–2.6)	7.6 (2.9–16.4)	3.33 (1–15.28)	5.61 (1–15.28)
2015–2016	MEHP	WRA	White non-Hispanic	149	149 (57.72%)	1.2 (0.9–1.6)	5 (3.8–10.1)	1.62 (1.06–2.5)	4.18 (3–11.11)
2015–2016	MEOHP	Adults	All adults	1,880	1,880 (99.31%)	3.4 (2.8–4)	15 (11.6–19.8)	3.46 (3.2–3.78)	17.38 (14.15–19.62)
2015–2016	MEOHP	Adults	At or above poverty level	461	461 (99.78%)	3.5 (2.7–4.2)	13.9 (11–18.8)	3.36 (3.08–3.64)	15.59 (12.44–18.85)
2015–2016	MEOHP	Adults	Below poverty level	399	399 (99.5%)	3.6 (3–4.1)	15.2 (8.8–32.6)	4.27 (3.2–5.21)	22.5 (17.54–25.47)
2015–2016	MEOHP	Adults	Black non-Hispanic	427	427 (99.06%)	4.1 (3.5–5.3)	15.6 (12.7–32.1)	3.45 (3.13–3.93)	21.16 (16.81–25.48)
2015–2016	MEOHP	Adults	Females	984	984 (99.49%)	3.5 (2.8–4.2)	18 (14.7–24.5)	4.22 (3.75–4.67)	18.94 (15.7–23)
2015–2016	MEOHP	Adults	Males	896	896 (99.11%)	3.4 (2.8–4.1)	14 (11–19)	3.18 (2.87–3.46)	14.82 (12.75–18.76)
2015–2016	MEOHP	Adults	Mexican American	342	342 (99.12%)	3.1 (2.7–4)	11.6 (9.6–18.3)	4.51 (3.85–5)	20.22 (15.71–27)
2015–2016	MEOHP	Adults	Other	540	540 (99.26%)	3.7 (2.7–5)	17 (11.4–20.5)	3.75 (3.08–4.19)	20 (15.67–23.58)
2015–2016	MEOHP	Adults	Unknown income	833	833 (99.16%)	3.6 (2.6–7.7)	43.8 (7.7–43.8)	3.88 (2.66–4.98)	18.5 (13.76–33.33)
2015–2016	MEOHP	Adults	White non-Hispanic	571	571 (99.65%)	3.3 (2.7–4.1)	11.6 (10.6–19.8)	3.33 (2.99–3.62)	14.82 (12.12–19)
2015–2016	MEOHP	Children	Adolescents (11 to <16 years)	284	284 (99.3%)	41.4 (29.7–46.8)	11.2 (8.9–14.3)	3.53 (3.07–4.05)	10.59 (8.96–14.3)
2015–2016	MEOHP	Children	Adolescents (11 to <16 years)	284	284 (99.3%)	41.4 (29.7–46.8)	11.2 (8.9–14.3)	3.53 (3.07–4.05)	16.29 (12.57–19.08)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2015–2016	MEOHP	Children	Adolescents (11 to <16 years)	284	284 (99.3%)	41.4 (29.7–46.8)	11.2 (8.9–14.3)	5.43 (4.8–6.02)	10.59 (8.96–14.3)
2015–2016	MEOHP	Children	Adolescents (11 to <16 years)	284	284 (99.3%)	41.4 (29.7–46.8)	11.2 (8.9–14.3)	5.43 (4.8–6.02)	16.29 (12.57–19.08)
2015–2016	MEOHP	Children	All children	1,095	1,095 (99.73%)	5.2 (4.5–5.7)	20.7 (16.7–24.5)	4.96 (4.25–5.41)	20.63 (15–23.55)
2015–2016	MEOHP	Children	At or above poverty level	282	282 (100%)	5.1 (4.3–5.7)	19.3 (15.4–24.5)	4.63 (3.79–5.41)	18.06 (13–23.58)
2015–2016	MEOHP	Children	Below poverty level	329	329 (99.7%)	5.7 (4.4–6.8)	23.1 (19.7–34.4)	5.68 (4.91–6.76)	22.21 (17.25–31.75)
2015–2016	MEOHP	Children	Black non-Hispanic	271	271 (100%)	5.9 (5.3–7.3)	28.7 (20.9–44.6)	5.24 (4.37–6.84)	21.34 (17.16–39.75)
2015–2016	MEOHP	Children	Children (6 to <11 years)	346	346 (99.71%)	65 (54.8–80.6)	13.8 (12.5–16.3)	10.91 (10.09–12.27)	23.88 (20.63–30.76)
2015–2016	MEOHP	Children	Children (6 to <11 years)	346	346 (99.71%)	65 (54.8–80.6)	13.8 (12.5–16.3)	10.91 (10.09–12.27)	36.92 (32.24–47.44)
2015–2016	MEOHP	Children	Children (6 to <11 years)	346	346 (99.71%)	65 (54.8–80.6)	13.8 (12.5–16.3)	7.78 (6.9–8.48)	23.88 (20.63–30.76)
2015–2016	MEOHP	Children	Children (6 to <11 years)	346	346 (99.71%)	65 (54.8–80.6)	13.8 (12.5–16.3)	7.78 (6.9–8.48)	36.92 (32.24–47.44)
2015–2016	MEOHP	Children	Females	517	517 (99.81%)	5 (4.1–5.8)	20.8 (15.9–24.5)	5.29 (4.39–6.06)	20.24 (15–24.26)
2015–2016	MEOHP	Children	Males	578	578 (99.65%)	5.2 (4.5–6)	19.7 (15.8–29.2)	4.74 (3.9–5.41)	20.63 (13.18–23.55)
2015–2016	MEOHP	Children	Mexican American	253	253 (99.6%)	5.3 (4.6–6.3)	20.7 (15.8–41.3)	5.85 (5.07–7.33)	19.68 (14–30.76)
2015–2016	MEOHP	Children	Other	280	280 (100%)	5.1 (4.3–5.7)	20.7 (15.2–24)	4.94 (3.97–5.65)	18.95 (15.67–24.42)
2015–2016	MEOHP	Children	Toddlers (3 to <6 years)	465	465 (100%)	19.6 (13.6–156.8)	11.1 (7.6–13.3)	2.47 (1.87–2.94)	6.04 (4.74–12.08)
2015–2016	MEOHP	Children	Toddlers (3 to <6 years)	465	465 (100%)	19.6 (13.6–156.8)	11.1 (7.6–13.3)	2.47 (1.87–2.94)	9.2 (7.4–28.98)
2015–2016	MEOHP	Children	Toddlers (3 to <6 years)	465	465 (100%)	19.6 (13.6–156.8)	11.1 (7.6–13.3)	4.15 (2.81–4.81)	6.04 (4.74–12.08)
2015–2016	MEOHP	Children	Toddlers (3 to <6 years)	465	465 (100%)	19.6 (13.6–156.8)	11.1 (7.6–13.3)	4.15 (2.81–4.81)	9.2 (7.4–28.98)
2015–2016	MEOHP	Children	Unknown income	388	388 (99.48%)	5.3 (3.9–7.3)	17.6 (15–106.1)	5.71 (3.64–10.63)	19.77 (13–90.68)
2015–2016	MEOHP	Children	White non-Hispanic	291	291 (99.31%)	4.6 (3.9–5.7)	19.1 (11.4–24.5)	4.53 (3.53–5.43)	15.08 (12.4–23.88)
2015–2016	MEOHP	WRA	All women of reproductive age	564	564 (99.29%)	3.5 (2.8–4.2)	18 (14.7–24.5)	7.7 (6.63–8.84)	24.26 (17.54–30.33)
2015–2016	MEOHP	WRA	At or above poverty level	134	134 (99.25%)	3.4 (2.8–4.2)	13.9 (11.2–20.3)	7.26 (6.15–8.3)	22.87 (14.56–26.79)
2015–2016	MEOHP	WRA	Below poverty level	132	132 (100%)	5.1 (3.4–7.5)	33.1 (8.2–49.8)	8.62 (6.52–10.99)	28.82 (10.99–43.54)
2015–2016	MEOHP	WRA	Black non-Hispanic	143	143 (99.3%)	4.3 (3–6)	28.4 (12.6–41.9)	8.79 (6.92–10.94)	39.7 (12.2–66.85)
2015–2016	MEOHP	WRA	Mexican American	112	112 (99.11%)	3.3 (2.3–5.6)	15.7 (11.7–49.8)	7.69 (6.15–10.51)	18.94 (11.58–26.79)
2015–2016	MEOHP	WRA	Other	160	160 (98.75%)	2.8 (1.5–3.5)	18.7 (9.2–39)	7.7 (5.45–10.75)	21.92 (15.49–90.68)
2015–2016	MEOHP	WRA	Unknown income	251	251 (98.8%)	2.9 (0.9–8.5)	15.7 (7–36.2)	10.77 (1.5–90.68)	20.24 (1.5–90.68)
2015–2016	MEOHP	WRA	White non-Hispanic	149	149 (100%)	4 (2.7–5.4)	15.2 (10.1–33.7)	6.73 (5.98–8.87)	24.26 (13–30.33)
2013–2014	MECPP	Adults	All adults	2,040	2,040 (99.71%)	11.7 (10.5–12.9)	50.6 (37.8–67.1)	10.14 (9.31–10.95)	41.18 (35.83–46.39)
2013–2014	MECPP	Adults	At or above poverty level	484	484 (99.79%)	11.4 (9.9–12.9)	50.65 (34.4–67.8)	10 (8.95–10.85)	38.68 (34.12–44.72)
2013–2014	MECPP	Adults	Below poverty level	454	454 (100%)	12.8 (11.3–15)	50.8 (26.6–80.8)	11.94 (10.26–13.83)	58.19 (40.26–67.5)
2013–2014	MECPP	Adults	Black non-Hispanic	442	442 (99.77%)	13.2 (9.2–16.4)	61.7 (36–97)	8.19 (7.32–9.2)	36.67 (28.93–41.65)
2013–2014	MECPP	Adults	Females	1,076	1,076 (99.72%)	10.95 (8.5–13.9)	49.7 (38.8–60.1)	12.37 (10.52–14.91)	49.78 (36.97–67.6)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2013–2014	MECPP	Adults	Males	964	964 (99.69%)	11.6 (10.5–12.9)	50.7 (40.1–67.9)	9.04 (8.18–9.88)	36.94 (33.77–41.86)
2013–2014	MECPP	Adults	Mexican American	282	282 (100%)	11.7 (8.3–13.4)	52.6 (24.7–67.9)	12.39 (10.72–14.81)	55.93 (48.4–66.72)
2013–2014	MECPP	Adults	Other	496	496 (99.4%)	12.6 (11.5–14.4)	52.7 (37–68.4)	11.92 (10.24–13)	49.48 (36.15–67.39)
2013–2014	MECPP	Adults	Unknown income	921	921 (99.46%)	13.1 (7.8–15.2)	48 (23.4–67.9)	9.58 (8.16–10.74)	41.93 (27.07–51.05)
2013–2014	MECPP	Adults	White non-Hispanic	820	820 (99.76%)	11.3 (9.9–13)	47.6 (26.3–80.8)	10 (8.89–10.94)	36.97 (30.74–49.22)
2013–2014	MECPP	Children	Adolescents (11 to <16 years)	299	299 (100%)	5.5 (4.2–7.5)	24.2 (17.6–43.2)	12.25 (10.57–14)	17.23 (12.19–31.53)
2013–2014	MECPP	Children	Adolescents (11 to <16 years)	299	299 (100%)	5.5 (4.2–7.5)	24.2 (17.6–43.2)	12.25 (10.57–14)	40.74 (28.61–78.25)
2013–2014	MECPP	Children	Adolescents (11 to <16 years)	299	299 (100%)	5.5 (4.2–7.5)	24.2 (17.6–43.2)	4.61 (4.13–5.44)	17.23 (12.19–31.53)
2013–2014	MECPP	Children	Adolescents (11 to <16 years)	299	299 (100%)	5.5 (4.2–7.5)	24.2 (17.6–43.2)	4.61 (4.13–5.44)	40.74 (28.61–78.25)
2013–2014	MECPP	Children	All children	645	645 (100%)	15.4 (13.1–18.7)	63.8 (54.3–83.4)	15.43 (13.91–17.81)	67.6 (45.66–109.64)
2013–2014	MECPP	Children	At or above poverty level	171	171 (100%)	15.4 (12.8–19.8)	64.6 (50.7–86.5)	15.09 (13.56–17.89)	67.13 (40.74–110.69)
2013–2014	MECPP	Children	Below poverty level	212	212 (100%)	16.4 (14.4–19.3)	78.9 (42.8–105.3)	15.51 (13.29–19.38)	68.82 (58.19–119.68)
2013–2014	MECPP	Children	Black non-Hispanic	167	167 (100%)	16.2 (13.5–20.4)	67.8 (43.2–123)	13.05 (11.67–15.67)	49.45 (37.05–71.08)
2013–2014	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.5 (4.6–8.5)	30 (22.5–40.2)	22 (18.95–25.44)	36.17 (24.67–59.18)
2013–2014	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.5 (4.6–8.5)	30 (22.5–40.2)	22 (18.95–25.44)	85.27 (67.13–156.95)
2013–2014	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.5 (4.6–8.5)	30 (22.5–40.2)	7.99 (6.5–9.9)	36.17 (24.67–59.18)
2013–2014	MECPP	Children	Children (6 to <11 years)	346	346 (100%)	6.5 (4.6–8.5)	30 (22.5–40.2)	7.99 (6.5–9.9)	85.27 (67.13–156.95)
2013–2014	MECPP	Children	Females	324	324 (100%)	18.9 (13.8–22.2)	83.4 (56.8–132.9)	17.23 (14.3–21.35)	78.25 (48.4–180.45)
2013–2014	MECPP	Children	Males	321	321 (100%)	14.4 (11.6–16.4)	52.6 (38–71.9)	14.44 (11.97–16.53)	50 (40.84–60.69)
2013–2014	MECPP	Children	Mexican American	156	156 (100%)	18 (16.7–22.2)	69.3 (51.6–140)	18.38 (15.85–22)	63.05 (39.49–250.12)
2013–2014	MECPP	Children	Other	155	155 (100%)	15.6 (12.5–19.7)	105.3 (52–173.4)	16.24 (12.28–19.88)	106.17 (54.05–165.09)
2013–2014	MECPP	Children	Unknown income	213	213 (100%)	10.9 (8.3–24.4)	61.9 (24.7–173.4)	15.17 (9.05–25.95)	54.05 (37.96–279.68)
2013–2014	MECPP	Children	White non-Hispanic	167	167 (100%)	13.8 (10.8–19.9)	61.9 (46.8–86.5)	14.68 (11.97–18.35)	67.6 (34.32–124.19)
2013–2014	MECPP	WRA	All women of reproductive age	599	599 (99.67%)	10.95 (8.5–13.9)	49.7 (38.8–60.1)	25.9 (19.22–31.75)	124.19 (67.13–180.45)
2013–2014	MECPP	WRA	At or above poverty level	135	135 (100%)	10.2 (8.4–13.4)	47.2 (35.5–75.4)	24.59 (17.96–30.99)	156.95 (74.13–250.12)
2013–2014	MECPP	WRA	Below poverty level	175	175 (100%)	12.7 (7.4–14.6)	50.8 (36.2–74.2)	25.95 (19.77–35.33)	119.68 (39.4–165.09)
2013–2014	MECPP	WRA	Black non-Hispanic	133	133 (100%)	14.5 (9.3–20)	58.5 (37.8–82.6)	14.21 (10.42–22.44)	58.93 (17.44–156.95)
2013–2014	MECPP	WRA	Mexican American	90	90 (100%)	12 (6.5–13.4)	52.6 (14.7–246.6)	27.46 (16.7–48.4)	87.82 (40.2–250.12)
2013–2014	MECPP	WRA	Other	169	169 (98.82%)	9.8 (6.4–13.8)	50.6 (19.3–261.8)	22.47 (17.96–32.39)	165.09 (53.19–390.14)
2013–2014	MECPP	WRA	Unknown income	244	244 (99.18%)	12.8 (6.3–17.2)	38.8 (38.7–225.7)	25.95 (7.16–48.4)	45.85 (7.16–48.4)
2013–2014	MECPP	WRA	White non-Hispanic	207	207 (100%)	10.3 (7.6–15.5)	40.2 (31.9–51.7)	30.99 (20–34.42)	124.19 (36.36–180.45)
2013–2014	MEHHP	Adults	All adults	2,040	2,040 (99.31%)	7.8 (6.9–8.6)	31.2 (26.5–38.4)	6.11 (5.6–6.84)	26 (22.3–31.18)
2013–2014	MEHHP	Adults	At or above poverty level	484	484 (99.38%)	7.4 (6.5–8.5)	29.4 (26.6–35.5)	6.06 (5.53–6.67)	23.78 (20.38–29.08)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2013–2014	MEHHP	Adults	Below poverty level	454	454 (99.34%)	8.5 (7.5–10.7)	35.2 (19.6–86.1)	7.33 (6.4–8.1)	32.57 (24.29–49.1)
2013–2014	MEHHP	Adults	Black non-Hispanic	442	442 (99.77%)	10 (7.7–12.3)	48.5 (29.4–66.8)	5.71 (5–6.44)	24.79 (19.88–33.51)
2013–2014	MEHHP	Adults	Females	1,076	1,076 (99.26%)	6.7 (4.8–8.1)	31.3 (24.9–40.8)	7.4 (6.54–9.05)	31.53 (22.91–44.16)
2013–2014	MEHHP	Adults	Males	964	964 (99.38%)	7.9 (6.9–8.6)	31.2 (25.3–38.4)	5.67 (5.26–6.11)	22.3 (19.84–26.09)
2013–2014	MEHHP	Adults	Mexican American	282	282 (98.94%)	6.9 (4.6–8.9)	36.3 (15.3–46.4)	7.33 (6.44–8.42)	35.31 (27.01–54.88)
2013–2014	MEHHP	Adults	Other	496	496 (98.59%)	8.2 (6.8–9.3)	38.4 (23.9–47.8)	6.67 (5.32–7.9)	30.59 (22.04–41.88)
2013–2014	MEHHP	Adults	Unknown income	921	921 (99.24%)	7.2 (4.9–11.3)	38.4 (21.7–77.7)	5.64 (4.87–7.39)	26.25 (19.7–35.31)
2013–2014	MEHHP	Adults	White non-Hispanic	820	820 (99.63%)	7.4 (6.3–8.4)	26.7 (23.7–31.2)	6.03 (5.45–6.8)	22.91 (20.1–29.08)
2013–2014	MEHHP	Children	Adolescents (11 to <16 years)	299	299 (99.33%)	7.4 (5.9–11.4)	36.9 (25.8–60.5)	6.36 (5.56–7.94)	25 (17.39–52.21)
2013–2014	MEHHP	Children	All children	645	645 (99.22%)	8.3 (6.7–10.6)	40.6 (31.8–58)	8.27 (7.18–9.44)	40.27 (31.13–68.65)
2013–2014	MEHHP	Children	At or above poverty level	171	171 (99.42%)	7.9 (6.3–10.7)	38.8 (31.2–60.5)	8.04 (6.67–9.44)	41.96 (25–97.8)
2013–2014	MEHHP	Children	Below poverty level	212	212 (100%)	9 (7.1–11.8)	44.8 (28.1–55.4)	9.71 (7.69–11.03)	38.13 (31.13–61.67)
2013–2014	MEHHP	Children	Black non-Hispanic	167	167 (100%)	10.4 (8.5–14.3)	48.5 (31.9–66.8)	8.59 (6.85–10.41)	31.18 (25.13–47.87)
2013–2014	MEHHP	Children	Children (6 to <11 years)	346	346 (99.13%)	9.1 (6.9–13)	43 (35.9–64.9)	12.08 (9.41–15.21)	57.02 (37.23–109.28)
2013–2014	MEHHP	Children	Females	324	324 (99.38%)	9.1 (7–12.8)	43 (34.7–76.5)	9.46 (7.4–12.2)	48.18 (24.65–130)
2013–2014	MEHHP	Children	Males	321	321 (99.07%)	7.3 (6.4–9.9)	33.7 (25.9–44.8)	7.48 (6.07–8.97)	31.54 (25.26–37.23)
2013–2014	MEHHP	Children	Mexican American	156	156 (99.36%)	10.5 (8.7–12.9)	37.9 (28.1–146.1)	10.59 (9.53–11.68)	49.17 (24.79–117.98)
2013–2014	MEHHP	Children	Other	155	155 (98.71%)	8.6 (5.9–12.8)	59.5 (31.4–100.2)	7.89 (5.96–10.87)	46.83 (30.59–97.8)
2013–2014	MEHHP	Children	Unknown income	213	213 (98.59%)	7.3 (4–10.1)	43 (13.4–118.2)	7.5 (5.08–12.05)	37.31 (19.34–190.65)
2013–2014	MEHHP	Children	White non-Hispanic	167	167 (98.8%)	7.1 (5.5–10.6)	36.4 (27–60.5)	7.48 (6.14–9.2)	35.81 (19.26–130)
2013–2014	MEHHP	WRA	All women of reproductive age	599	599 (99%)	6.7 (4.8–8.1)	31.3 (24.9–40.8)	13.5 (11.34–16.83)	74.19 (42.66–130)
2013–2014	MEHHP	WRA	At or above poverty level	135	135 (99.26%)	6.7 (4.5–7.6)	26.8 (23.7–37.6)	13.2 (10.08–16.74)	117.98 (41.96–133.69)
2013–2014	MEHHP	WRA	Below poverty level	175	175 (98.86%)	6.9 (4.5–9.5)	30.8 (20–101.1)	14.57 (9.62–20.46)	34.62 (22.29–86.38)
2013–2014	MEHHP	WRA	Black non-Hispanic	133	133 (100%)	10.2 (8.2–12.9)	40.8 (32.7–113.9)	9.73 (6.84–12.79)	24 (12.79–133.69)
2013–2014	MEHHP	WRA	Mexican American	90	90 (98.89%)	6.7 (4–9.2)	28.1 (12–143.3)	16.25 (9.53–23.5)	34.62 (23.43–117.98)
2013–2014	MEHHP	WRA	Other	169	169 (97.04%)	4.7 (3–6.9)	31.9 (16.9–113.7)	12.67 (6.67–19.34)	97.8 (22.04–250.68)
2013–2014	MEHHP	WRA	Unknown income	244	244 (98.77%)	6.9 (3–17.7)	36.3 (14.7–149)	12.63 (2.93–31.85)	31.85 (2.93–31.85)
2013–2014	MEHHP	WRA	White non-Hispanic	207	207 (100%)	6.5 (4.1–7.7)	26.7 (23.6–36.3)	14.21 (12.2–22.29)	73.56 (34.34–130)
2013–2014	MEHP	Adults	All adults	2,040	2,040 (61.13%)	1.4 (1.2–1.6)	5.7 (5.3–6.8)	1.16 (1.06–1.27)	5 (4.3–5.53)
2013–2014	MEHP	Adults	At or above poverty level	484	484 (61.16%)	1.4 (1.1–1.6)	5.7 (4.5–6.6)	1.14 (1.06–1.23)	4.66 (4.09–5.83)
2013–2014	MEHP	Adults	Below poverty level	454	454 (66.74%)	1.5 (1.1–2.1)	6.7 (5–18.2)	1.31 (1.01–1.73)	5.09 (4.17–6.94)
2013–2014	MEHP	Adults	Black non-Hispanic	442	442 (70.36%)	1.7 (1.4–2.3)	10.5 (6.5–15.8)	1.06 (0.92–1.23)	4.71 (3.63–5.98)
2013–2014	MEHP	Adults	Females	1,076	1,076 (57.53%)	1.1 (0.9–1.3)	7.5 (6.5–9.2)	1.5 (1.27–1.77)	5.77 (4.47–9.9)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2013–2014	MEHP	Adults	Males	964	964 (65.15%)	1.3 (1.1–1.6)	5.7 (4.6–6.7)	1.03 (0.95–1.12)	4.29 (3.94–5.06)
2013–2014	MEHP	Adults	Mexican American	282	282 (66.31%)	1.5 (1.1–1.8)	6.7 (4.4–7.1)	1.35 (1.16–1.73)	6.61 (4.58–8.13)
2013–2014	MEHP	Adults	Other	496	496 (61.09%)	1.55 (1.1–1.9)	6.7 (5–11.7)	1.36 (1.23–1.54)	5.98 (4.81–7.45)
2013–2014	MEHP	Adults	Unknown income	921	921 (57.87%)	1.1 (1–1.5)	6.4 (4.4–11.7)	1.11 (0.93–1.3)	5.53 (4.21–7.1)
2013–2014	MEHP	Adults	White non-Hispanic	820	820 (54.39%)	1.2 (0.9–1.5)	4.5 (3.4–5.7)	1.1 (1–1.21)	4.44 (3.94–5.7)
2013–2014	MEHP	Children	Adolescents (11 to <16 years)	299	299 (68.9%)	1.2 (0.9–1.6)	13.8 (11–18.2)	1.24 (1.11–1.43)	12.25 (10.57–14)
2013–2014	MEHP	Children	Adolescents (11 to <16 years)	299	299 (68.9%)	1.2 (0.9–1.6)	13.8 (11–18.2)	1.24 (1.11–1.43)	4.71 (3.35–8.32)
2013–2014	MEHP	Children	All children	645	645 (66.51%)	1.2 (1–1.4)	8.2 (5.5–10.4)	1.4 (1.24–1.57)	6.77 (4.49–8.87)
2013–2014	MEHP	Children	At or above poverty level	171	171 (69.59%)	1.2 (1–1.5)	7.9 (4.9–11)	1.35 (1.2–1.58)	6.61 (4.3–10.89)
2013–2014	MEHP	Children	Below poverty level	212	212 (67.45%)	1.1 (0.9–1.2)	6.1 (5.4–8.8)	1.36 (1.18–1.67)	6.24 (3.81–10)
2013–2014	MEHP	Children	Black non-Hispanic	167	167 (70.66%)	1.5 (0.9–2.4)	7.3 (5.8–9.8)	1.5 (1.25–1.67)	5.16 (3.8–6.54)
2013–2014	MEHP	Children	Children (6 to <11 years)	346	346 (64.45%)	1.1 (0.9–1.2)	17.3 (13.2–23.1)	1.73 (1.48–2.04)	22 (18.95–25.44)
2013–2014	MEHP	Children	Children (6 to <11 years)	346	346 (64.45%)	1.1 (0.9–1.2)	17.3 (13.2–23.1)	1.73 (1.48–2.04)	7.88 (6.03–12.07)
2013–2014	MEHP	Children	Females	324	324 (66.36%)	1.3 (0.9–1.7)	10.3 (6.9–11.4)	1.65 (1.46–1.88)	8.29 (4.21–14.14)
2013–2014	MEHP	Children	Males	321	321 (66.67%)	1 (0.9–1.3)	5.8 (4.4–8.4)	1.23 (1–1.43)	5.9 (4.02–7.86)
2013–2014	MEHP	Children	Mexican American	156	156 (71.79%)	1.4 (1.1–2)	8.5 (4.4–25.5)	1.52 (1.24–1.88)	7.86 (3.62–27.73)
2013–2014	MEHP	Children	Other	155	155 (64.52%)	1.6 (1.1–2.1)	6.9 (5.2–12.1)	1.46 (1.27–1.83)	6.45 (5.6–8.63)
2013–2014	MEHP	Children	Unknown income	213	213 (62.91%)	1.3 (0.57–2.2)	10.4 (3.1–10.9)	1.53 (1.11–2.46)	7.1 (4.21–19)
2013–2014	MEHP	Children	White non-Hispanic	167	167 (59.28%)	0.9 (0.57–1.1)	7.5 (4.3–10.7)	1.28 (1.08–1.54)	7 (4.07–10.89)
2013–2014	MEHP	WRA	All women of reproductive age	599	599 (63.44%)	1.1 (0.9–1.3)	7.5 (6.5–9.2)	2 (1.5–2.34)	8.29 (6.3–12.07)
2013–2014	MEHP	WRA	At or above poverty level	135	135 (60%)	1.2 (1–1.5)	6.5 (4.7–8)	1.77 (1.46–2.38)	7.88 (4.19–10.61)
2013–2014	MEHP	WRA	Below poverty level	175	175 (67.43%)	1.2 (0.57–1.4)	9.2 (4.2–17.6)	2.11 (1.46–2.6)	11.76 (3.27–22.59)
2013–2014	MEHP	WRA	Black non-Hispanic	133	133 (71.43%)	2.1 (1.3–3.1)	10.6 (7.9–21)	1.25 (0.77–2.96)	4.55 (1.87–7.03)
2013–2014	MEHP	WRA	Mexican American	90	90 (66.67%)	1.4 (0.57–2)	8.4 (4.2–14.9)	2.32 (1.36–2.89)	6.77 (3.27–27.73)
2013–2014	MEHP	WRA	Other	169	169 (57.99%)	1.2 (0.57–1.8)	9.2 (3.5–50.5)	1.78 (1.33–3.8)	10.61 (5.6–62.97)
2013–2014	MEHP	WRA	Unknown income	244	244 (61.48%)	1.6 (0.57–4.4)	7.8 (3.8–53.1)	1.63 (0.49–27.73)	5.53 (0.49–27.73)
2013–2014	MEHP	WRA	White non-Hispanic	207	207 (61.35%)	1 (0.8–1.2)	6 (4.1–7.1)	1.78 (0.88–3.13)	7.88 (3.13–11.76)
2013–2014	MEOHP	Adults	All adults	2,040	2,040 (99.36%)	4.9 (4.2–5.4)	19.1 (16–20.2)	3.98 (3.71–4.38)	16.45 (13.8–18.73)
2013–2014	MEOHP	Adults	At or above poverty level	484	484 (99.38%)	4.7 (3.9–5.3)	19.2 (16.1–20.1)	3.91 (3.64–4.24)	15.11 (12.66–17.37)
2013–2014	MEOHP	Adults	Below poverty level	454	454 (99.78%)	5.5 (4.8–6.2)	19.7 (11.9–51.7)	4.49 (4.07–5)	20.97 (17.24–24.76)
2013–2014	MEOHP	Adults	Black non-Hispanic	442	442 (99.77%)	6.3 (5.1–7.3)	29.6 (19.9–34.3)	3.71 (3.37–4.21)	14.84 (12.49–18.57)
2013–2014	MEOHP	Adults	Females	1,076	1,076 (99.44%)	4.8 (3.9–5.8)	19.5 (16–25.5)	5 (4.22–5.8)	20.13 (14.95–29.51)
2013–2014	MEOHP	Adults	Males	964	964 (99.27%)	4.8 (4.2–5.4)	19.1 (15.3–20.2)	3.7 (3.46–3.91)	14.06 (11.59–16.88)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2013–2014	MEOHP	Adults	Mexican American	282	282 (98.94%)	4.3 (2.8–5.3)	19.7 (7.7–26.5)	4.59 (4.22–5.33)	20.7 (16.88–33.69)
2013–2014	MEOHP	Adults	Other	496	496 (98.99%)	5 (4.5–5.9)	18.2 (13.9–26.7)	4.17 (3.33–4.83)	18.63 (13.51–24.38)
2013–2014	MEOHP	Adults	Unknown income	921	921 (99.13%)	4.9 (3.7–7)	26.3 (10.1–38.8)	3.73 (3.2–4.6)	16.84 (10.53–21.38)
2013–2014	MEOHP	Adults	White non-Hispanic	820	820 (99.51%)	4.6 (4–5.3)	18 (13.3–20.1)	3.9 (3.63–4.34)	15.03 (12.5–18)
2013–2014	MEOHP	Children	Adolescents (11 to <16 years)	299	299 (100%)	64.6 (40.4–107.2)	13.8 (11–18.2)	4.61 (4.13–5.44)	17.23 (12.19–31.53)
2013–2014	MEOHP	Children	Adolescents (11 to <16 years)	299	299 (100%)	64.6 (40.4–107.2)	13.8 (11–18.2)	4.61 (4.13–5.44)	25 (17.39–52.21)
2013–2014	MEOHP	Children	Adolescents (11 to <16 years)	299	299 (100%)	64.6 (40.4–107.2)	13.8 (11–18.2)	6.36 (5.56–7.94)	17.23 (12.19–31.53)
2013–2014	MEOHP	Children	Adolescents (11 to <16 years)	299	299 (100%)	64.6 (40.4–107.2)	13.8 (11–18.2)	6.36 (5.56–7.94)	25 (17.39–52.21)
2013–2014	MEOHP	Children	All children	645	645 (100%)	5.9 (4.8–7)	26.4 (21.5–34.3)	5.73 (5.12–6.52)	25.34 (18.78–37.41)
2013–2014	MEOHP	Children	At or above poverty level	171	171 (100%)	5.8 (4.7–7.4)	24.5 (19.8–31.9)	5.56 (4.74–6.41)	27.26 (17–53.3)
2013–2014	MEOHP	Children	Below poverty level	212	212 (100%)	6 (4.6–7.7)	28.5 (18.5–34.6)	6.36 (5.2–7.27)	25.15 (18.69–37.14)
2013–2014	MEOHP	Children	Black non-Hispanic	167	167 (100%)	7.6 (5.9–9.2)	28 (19.5–33.7)	5.6 (4.7–6.76)	18.22 (14.06–25.34)
2013–2014	MEOHP	Children	Children (6 to <11 years)	346	346 (100%)	71.8 (57.4–98.4)	17.3 (13.2–23.1)	12.08 (9.41–15.21)	36.17 (24.67–59.18)
2013–2014	MEOHP	Children	Children (6 to <11 years)	346	346 (100%)	71.8 (57.4–98.4)	17.3 (13.2–23.1)	12.08 (9.41–15.21)	57.02 (37.23–109.28)
2013–2014	MEOHP	Children	Children (6 to <11 years)	346	346 (100%)	71.8 (57.4–98.4)	17.3 (13.2–23.1)	7.99 (6.5–9.9)	36.17 (24.67–59.18)
2013–2014	MEOHP	Children	Children (6 to <11 years)	346	346 (100%)	71.8 (57.4–98.4)	17.3 (13.2–23.1)	7.99 (6.5–9.9)	57.02 (37.23–109.28)
2013–2014	MEOHP	Children	Females	324	324 (100%)	6.6 (5.1–8.3)	30 (22.7–43.2)	6.64 (5.61–7.44)	34.39 (17.23–80.69)
2013–2014	MEOHP	Children	Males	321	321 (100%)	5.4 (4.6–6.6)	23.3 (16.7–29.6)	5.23 (4.59–6.15)	19.02 (17–22.8)
2013–2014	MEOHP	Children	Mexican American	156	156 (100%)	6.6 (5.7–8.3)	29.4 (19–83.7)	7.08 (5.64–8.51)	28.94 (16.18–73.64)
2013–2014	MEOHP	Children	Other	155	155 (100%)	5.5 (4.4–7.7)	28.5 (20.8–54.2)	5.56 (4.25–7.18)	27.07 (18.39–57.44)
2013–2014	MEOHP	Children	Unknown income	213	213 (100%)	5.6 (2.7–7.5)	30 (10.9–66.1)	6.07 (3.49–9.55)	23.24 (10.53–106.61)
2013–2014	MEOHP	Children	White non-Hispanic	167	167 (100%)	5 (4.1–6.9)	24.1 (16.8–32.7)	5.45 (4.59–6.22)	27.26 (13.85–70.45)
2013–2014	MEOHP	WRA	All women of reproductive age	599	599 (99.33%)	4.8 (3.9–5.8)	19.5 (16–25.5)	9.23 (7.08–10.86)	48.75 (28.94–70.45)
2013–2014	MEOHP	WRA	At or above poverty level	135	135 (100%)	4.8 (3.7–5.8)	19 (14.3–22.9)	8.43 (6.03–10.86)	70.45 (27.26–83.83)
2013–2014	MEOHP	WRA	Below poverty level	175	175 (100%)	5.6 (3.4–6.7)	17.7 (15.3–24.1)	9.29 (7.44–11.39)	24.55 (14.82–54.19)
2013–2014	MEOHP	WRA	Black non-Hispanic	133	133 (99.25%)	6.3 (5.1–8.1)	22.6 (17.3–64)	6.07 (4.18–9.07)	14.67 (9.07–83.83)
2013–2014	MEOHP	WRA	Mexican American	90	90 (100%)	5.1 (2.2–6.8)	19.7 (9–79.1)	10.45 (7.08–15.37)	24.55 (14.82–73.64)
2013–2014	MEOHP	WRA	Other	169	169 (98.22%)	3.6 (2.4–5.6)	19.5 (11.7–61.6)	8 (4.73–12.1)	59.18 (21.06–119.32)
2013–2014	MEOHP	WRA	Unknown income	244	244 (98.36%)	6.2 (1.6–23.7)	23.7 (14.4–90.4)	10.39 (3.14–22.22)	22.22 (3.14–22.22)
2013–2014	MEOHP	WRA	White non-Hispanic	207	207 (100%)	4.6 (3.3–6.3)	18 (14.2–23.7)	10.73 (6.22–12.1)	48.75 (22.22–70.45)
2011–2012	MECPP	Adults	All adults	1,894	1,894 (99.68%)	14.8 (13–16.7)	84.1 (58.9–109.5)	13.86 (12.86–15.03)	60.08 (54.95–69.66)
2011–2012	MECPP	Adults	At or above poverty level	449	449 (99.78%)	15.4 (13.6–17)	94.1 (58.9–152)	13.83 (12.84–14.71)	59.64 (54.31–70.71)
2011–2012	MECPP	Adults	Below poverty level	441	441 (99.77%)	13.2 (9.2–23.9)	72.2 (42.5–126.8)	14.59 (11.8–16.43)	72.5 (55.56–80.91)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2011–2012	MECPP	Adults	Black non-Hispanic	499	499 (99.2%)	16.4 (14–21.2)	79.4 (63.7–104)	11.27 (10.15–13.45)	50.36 (37.91–72.5)
2011–2012	MECPP	Adults	Females	933	933 (99.68%)	11.7 (9.9–13.3)	76.8 (62.7–84.6)	17.23 (14.96–20.38)	69.66 (54.95–88.33)
2011–2012	MECPP	Adults	Mexican American	186	186 (100%)	13.7 (9.9–18.7)	76.8 (42.7–1548.4)	15.34 (11.94–19.8)	78.27 (46.84–110.66)
2011–2012	MECPP	Adults	Other	545	545 (99.82%)	11.2 (9.6–13.7)	74 (59.8–227.3)	14.85 (13–16.25)	80.91 (61.52–100.55)
2011–2012	MECPP	Adults	Unknown income	821	821 (99.51%)	12.9 (10.9–20.1)	37.1 (16.8–44.9)	13.72 (12.88–15.94)	40.87 (37.1–54.31)
2011–2012	MECPP	Adults	White non-Hispanic	664	664 (99.85%)	15.7 (12.5–18.7)	91.7 (43.5–152)	13.82 (12.51–15.43)	57 (42.86–69.66)
2011–2012	MECPP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	7.2 (5.1–10.1)	45.9 (26.6–79.9)	14.84 (12.35–16.84)	33.59 (27.36–54.57)
2011–2012	MECPP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	7.2 (5.1–10.1)	45.9 (26.6–79.9)	14.84 (12.35–16.84)	92.9 (48.46–169.43)
2011–2012	MECPP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	7.2 (5.1–10.1)	45.9 (26.6–79.9)	5.83 (5.23–7.1)	33.59 (27.36–54.57)
2011–2012	MECPP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	7.2 (5.1–10.1)	45.9 (26.6–79.9)	5.83 (5.23–7.1)	92.9 (48.46–169.43)
2011–2012	MECPP	Children	All children	595	595 (99.83%)	18.2 (14.6–22.5)	94.8 (69.9–134.7)	20.4 (16.74–22.73)	88.33 (71.3–95.13)
2011–2012	MECPP	Children	At or above poverty level	154	154 (99.35%)	17.2 (12.8–21.4)	94.8 (65.4–134.7)	18.95 (15.75–22)	75.45 (67.5–92.9)
2011–2012	MECPP	Children	Below poverty level	195	195 (100%)	22.8 (16.8–27.5)	87.9 (69.2–151.9)	24.47 (20.76–28.2)	114.85 (59.02–207.35)
2011–2012	MECPP	Children	Black non-Hispanic	166	166 (100%)	24.3 (20.4–28)	96.7 (66.9–169.2)	20.1 (15.12–23.37)	75.89 (50.36–112.59)
2011–2012	MECPP	Children	Children (6 to <11 years)	330	330 (100%)	7.9 (6.5–10)	31.4 (27.9–37.5)	10.88 (9.34–12.5)	35.27 (26.36–42.84)
2011–2012	MECPP	Children	Children (6 to <11 years)	330	330 (100%)	7.9 (6.5–10)	31.4 (27.9–37.5)	10.88 (9.34–12.5)	78.83 (71.3–109.19)
2011–2012	MECPP	Children	Children (6 to <11 years)	330	330 (100%)	7.9 (6.5–10)	31.4 (27.9–37.5)	27.78 (23.64–32.77)	35.27 (26.36–42.84)
2011–2012	MECPP	Children	Children (6 to <11 years)	330	330 (100%)	7.9 (6.5–10)	31.4 (27.9–37.5)	27.78 (23.64–32.77)	78.83 (71.3–109.19)
2011–2012	MECPP	Children	Females	297	297 (99.66%)	20.8 (14.1–25.4)	101.4 (68.5–134.7)	21.1 (17.03–27.78)	92.9 (63.46–109.19)
2011–2012	MECPP	Children	Males	298	298 (100%)	17 (14.6–21.3)	76.8 (59.4–152)	18.02 (15.5–21.84)	72 (56.67–139.69)
2011–2012	MECPP	Children	Mexican American	130	130 (100%)	16.3 (14.6–19.2)	82.35 (56.6–184.8)	19.65 (15.74–25.33)	84.42 (57.04–277.59)
2011–2012	MECPP	Children	Other	150	150 (100%)	20.4 (15–22.4)	100.1 (63.2–146.5)	20.86 (17.65–26.67)	95.13 (69.31–125.26)
2011–2012	MECPP	Children	Unknown income	208	208 (100%)	18.4 (10.9–31.5)	97.7 (51.4–184.8)	17.77 (12.05–35.8)	100.55 (36.82–125.26)
2011–2012	MECPP	Children	White non-Hispanic	149	149 (99.33%)	16.4 (10.9–23.1)	81.5 (60.4–152)	20.47 (15.5–24.25)	89.47 (60.08–109.19)
2011–2012	MECPP	WRA	All women of reproductive age	536	536 (99.81%)	11.7 (9.9–13.3)	76.8 (62.7–84.6)	29.47 (22.04–36.46)	94 (70.7–116.67)
2011–2012	MECPP	WRA	At or above poverty level	119	119 (100%)	10.4 (8.8–13.2)	75.2 (48.4–88.9)	27.14 (18.82–37.08)	84.52 (63.46–109.19)
2011–2012	MECPP	WRA	Below poverty level	150	150 (99.33%)	16.2 (12.2–24.7)	72.6 (52.1–143.8)	34.17 (26.02–37.15)	88.45 (45.93–410.54)
2011–2012	MECPP	WRA	Black non-Hispanic	135	135 (99.26%)	15.6 (11.6–22.2)	116.8 (61–176.9)	26.38 (19.76–36.86)	71.43 (44.91–94)
2011–2012	MECPP	WRA	Mexican American	53	53 (100%)	14.9 (7.2–30.4)	72.2 (33.1–507.2)	31.18 (20–46.84)	107.92 (46.84–410.54)
2011–2012	MECPP	WRA	Other	169	169 (100%)	10.8 (7.8–17.7)	77.4 (53.2–399.2)	34.17 (26.67–44.35)	90.26 (65.29–125.26)
2011–2012	MECPP	WRA	Unknown income	225	225 (100%)	12.6 (4–26.5)	507.2 (15.7–507.2)	40.87 (6.94–125.26)	110.66 (6.94–125.26)
2011–2012	MECPP	WRA	White non-Hispanic	179	179 (100%)	10.6 (8.7–12.9)	52.1 (36.9–93.6)	28.02 (18.11–41.02)	84.4 (41.02–116.67)
2011–2012	MEHHP	Adults	All adults	1,894	1,894 (99.68%)	10 (8.3–11.2)	59.2 (38.9–84.6)	8.46 (7.88–9.23)	39.35 (32.92–49.57)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2011–2012	MEHHP	Adults	At or above poverty level	449	449 (99.78%)	10.1 (7.8–11.5)	60.5 (40.6–116.3)	8.21 (7.73–8.89)	39.14 (31.5–50.17)
2011–2012	MEHHP	Adults	Below poverty level	441	441 (100%)	8.8 (5.5–12.7)	49 (30.6–102.5)	9.23 (7.65–10)	43.19 (34.01–57.36)
2011–2012	MEHHP	Adults	Black non-Hispanic	499	499 (99.6%)	11.3 (10.2–13.2)	61.3 (37.5–100.3)	7.98 (7.06–8.89)	43.19 (27.95–53.79)
2011–2012	MEHHP	Adults	Females	933	933 (99.68%)	6.9 (5.8–8.2)	47.9 (38.4–54.1)	10.38 (9–11.95)	41.32 (34.83–55.36)
2011–2012	MEHHP	Adults	Males	961	961 (99.69%)	10 (8.1–11.3)	60.2 (38.8–86.2)	7.8 (7.18–8.21)	37.22 (29.55–50.17)
2011–2012	MEHHP	Adults	Mexican American	186	186 (100%)	9.6 (5.7–13.4)	45.8 (29.9–1186.6)	8.74 (6.42–12.49)	41 (26.45–131.01)
2011–2012	MEHHP	Adults	Other	545	545 (99.45%)	6.9 (5.6–9.4)	67.9 (43.8–116.3)	8.81 (7.79–10)	46.32 (35.76–79.25)
2011–2012	MEHHP	Adults	Unknown income	821	821 (99.39%)	11.1 (6.9–15.2)	24.2 (13.4–33.2)	9.65 (7.33–12.02)	29.24 (24.2–47.03)
2011–2012	MEHHP	Adults	White non-Hispanic	664	664 (99.85%)	10.3 (8–11.8)	45 (30.6–118.9)	8.39 (7.67–9.54)	35.5 (28.08–50.17)
2011–2012	MEHHP	Children	Adolescents (11 to <16 years)	265	265 (100%)	10.1 (7.2–13)	99.7 (46.2–136.4)	8.49 (7.29–10.18)	68.83 (36.3–102.86)
2011–2012	MEHHP	Children	All children	595	595 (100%)	10.7 (9.1–12.7)	67.5 (46.6–99.8)	11.11 (9.35–12.98)	60.36 (47.57–68.83)
2011–2012	MEHHP	Children	At or above poverty level	154	154 (100%)	10.3 (7.2–11.9)	68.4 (40.2–100.3)	10.47 (8.67–13)	58.06 (42.95–68.83)
2011–2012	MEHHP	Children	Below poverty level	195	195 (100%)	12 (9.5–15.8)	58.8 (43.1–106.6)	12.43 (10.25–15)	70.57 (32.9–143.64)
2011–2012	MEHHP	Children	Black non-Hispanic	166	166 (100%)	14.9 (12.7–18.1)	69.3 (51.8–130.2)	12.19 (9.5–14.83)	57.5 (42.57–92.83)
2011–2012	MEHHP	Children	Children (6 to <11 years)	330	330 (100%)	11.8 (10–14.7)	47.4 (40.2–62.7)	16.2 (13.85–18.91)	56.67 (42.95–75.14)
2011–2012	MEHHP	Children	Females	297	297 (100%)	10.7 (8.8–14.4)	69.3 (46.3–99.8)	12.49 (10.83–15.05)	68.83 (37.69–81.36)
2011–2012	MEHHP	Children	Males	298	298 (100%)	10.7 (7.8–12.2)	51.7 (36–130.2)	9.5 (8.55–12.19)	58.06 (34.52–85.69)
2011–2012	MEHHP	Children	Mexican American	130	130 (100%)	9.8 (7–12.7)	52 (29.5–202.3)	10.18 (8.36–13.83)	59.37 (30–104.28)
2011–2012	MEHHP	Children	Other	150	150 (100%)	10 (7.8–11.9)	70.9 (35.6–106.6)	10.25 (8.94–12.01)	58.38 (41.32–83.59)
2011–2012	MEHHP	Children	Unknown income	208	208 (100%)	11.7 (6.1–18.8)	69.3 (30.6–100.8)	14.92 (6.84–22.38)	59.4 (22.38–83.59)
2011–2012	MEHHP	Children	White non-Hispanic	149	149 (100%)	10.2 (6.6–13.1)	55.4 (36–105.4)	11.26 (8.7–13.97)	58.06 (37.69–75.14)
2011–2012	MEHHP	WRA	All women of reproductive age	536	536 (99.81%)	6.9 (5.8–8.2)	47.9 (38.4–54.1)	18.7 (13.85–19.69)	59.4 (41–81.36)
2011–2012	MEHHP	WRA	At or above poverty level	119	119 (100%)	6.4 (5.2–8)	46.35 (34.4–51.9)	16.79 (10–23.08)	44.36 (29.39–75.14)
2011–2012	MEHHP	WRA	Below poverty level	150	150 (100%)	9.7 (7–16.1)	54.1 (34.5–159.7)	19.69 (17.18–25.81)	56.67 (30.78–114.32)
2011–2012	MEHHP	WRA	Black non-Hispanic	135	135 (100%)	11.9 (7.1–17.6)	60.5 (38.4–118.1)	15.65 (10.88–25.81)	62.5 (27.4–92.83)
2011–2012	MEHHP	WRA	Mexican American	53	53 (100%)	8.8 (5.3–21.5)	44.2 (32.1–260.2)	18.7 (10–28.78)	53.37 (28.33–114.32)
2011–2012	MEHHP	WRA	Other	169	169 (99.41%)	7.6 (4.7–13.2)	46.4 (31–416.3)	18.89 (12.37–27.69)	83.59 (33.24–90)
2011–2012	MEHHP	WRA	Unknown income	225	225 (99.56%)	7.3 (2.7–20.2)	260.2 (13.2–260.2)	18.77 (3.42–83.59)	60.36 (3.42–83.59)
2011–2012	MEHHP	WRA	White non-Hispanic	179	179 (100%)	5.6 (4.6–7.8)	34.5 (22.9–51.9)	18.26 (8.58–24.8)	42.95 (19.23–75.14)
2011–2012	MEHP	Adults	All adults	1,894	1,894 (75.45%)	1.9 (1.5–2.2)	11.3 (8.6–14.1)	1.4 (1.27–1.57)	7.95 (6.14–8.94)
2011–2012	MEHP	Adults	At or above poverty level	449	449 (77.06%)	1.8 (1.5–2.2)	11.8 (8.1–24.3)	1.4 (1.27–1.54)	8.24 (5.83–9.69)
2011–2012	MEHP	Adults	Below poverty level	441	441 (73.47%)	1.2 (0.8–2.4)	12 (8.1–15)	1.4 (1.27–1.6)	7.79 (5.08–10)
2011–2012	MEHP	Adults	Black non-Hispanic	499	499 (80.76%)	2.6 (2–3)	14.4 (10.2–25.3)	1.35 (1.2–1.58)	7.33 (5.29–8.84)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2011–2012	MEHP	Adults	Females	933	933 (72.24%)	1.6 (1.3–2.1)	9.7 (8.3–14.1)	1.43 (1.21–1.67)	8.18 (5–15)
2011–2012	MEHP	Adults	Males	961	961 (78.56%)	1.9 (1.5–2.2)	11.3 (8.9–16.2)	1.36 (1.21–1.58)	7.19 (6.16–8.79)
2011–2012	MEHP	Adults	Mexican American	186	186 (74.73%)	1.6 (0.7–2.7)	12.7 (6.4–125.2)	1.46 (1.07–2)	9.03 (5.29–15.8)
2011–2012	MEHP	Adults	Other	545	545 (78.35%)	1.7 (1.2–2.2)	15 (10.1–29.5)	1.66 (1.4–1.94)	10.38 (7.79–15.17)
2011–2012	MEHP	Adults	Unknown income	821	821 (74.79%)	1.6 (0.7–3.1)	6.2 (5.2–14.9)	1.3 (0.89–2.01)	5.57 (4.27–6.74)
2011–2012	MEHP	Adults	White non-Hispanic	664	664 (69.28%)	1.7 (1.1–2.2)	10 (6.3–21.1)	1.35 (1.13–1.59)	6.25 (5.19–8.75)
2011–2012	MEHP	Children	Adolescents (11 to <16 years)	265	265 (81.51%)	1.4 (0.9–2.5)	16.9 (13.2–22.5)	1.67 (1.36–1.94)	10.29 (4.39–13.66)
2011–2012	MEHP	Children	Adolescents (11 to <16 years)	265	265 (81.51%)	1.4 (0.9–2.5)	16.9 (13.2–22.5)	1.67 (1.36–1.94)	14.84 (12.35–16.84)
2011–2012	MEHP	Children	All children	595	595 (80.84%)	1.5 (1.1–1.9)	10.3 (7.2–13.9)	1.82 (1.62–2.04)	8.48 (5.89–11.07)
2011–2012	MEHP	Children	At or above poverty level	154	154 (81.17%)	1.4 (1–2.1)	10.5 (6.6–14.3)	1.79 (1.47–2.06)	7.35 (5.26–11.07)
2011–2012	MEHP	Children	Below poverty level	195	195 (83.59%)	1.4 (0.9–2.1)	10 (7.2–12.7)	1.86 (1.71–2.06)	9.08 (4.07–15.8)
2011–2012	MEHP	Children	Black non-Hispanic	166	166 (94.58%)	2.6 (2–2.9)	10.5 (9.5–18.3)	1.97 (1.8–2.34)	8.06 (5.5–12.29)
2011–2012	MEHP	Children	Children (6 to <11 years)	330	330 (80.3%)	1.5 (1.2–1.7)	22.2 (16.8–24.1)	2.17 (1.75–2.61)	27.78 (23.64–32.77)
2011–2012	MEHP	Children	Children (6 to <11 years)	330	330 (80.3%)	1.5 (1.2–1.7)	22.2 (16.8–24.1)	2.17 (1.75–2.61)	7.12 (5.89–8.17)
2011–2012	MEHP	Children	Females	297	297 (80.47%)	1.4 (1–2)	9.5 (6.6–14.3)	1.84 (1.67–2.04)	8.17 (5–15.8)
2011–2012	MEHP	Children	Males	298	298 (81.21%)	1.4 (1–2.1)	10.5 (6.6–13.2)	1.8 (1.47–2.06)	8.24 (5.15–11.07)
2011–2012	MEHP	Children	Mexican American	130	130 (70%)	1 (0.8–1.7)	7.7 (5.7–12.2)	1.55 (1.18–2.17)	7.62 (5.67–20.31)
2011–2012	MEHP	Children	Other	150	150 (80%)	1.4 (0.9–1.7)	11.6 (8.7–17.8)	1.75 (1.4–2.06)	10.49 (6.12–13.98)
2011–2012	MEHP	Children	Unknown income	208	208 (78.37%)	2.3 (0.5–4.5)	8 (4.5–18.3)	2.46 (0.62–4.79)	5.74 (4.79–15.64)
2011–2012	MEHP	Children	White non-Hispanic	149	149 (75.84%)	1.4 (0.8–2.2)	9 (4.4–14.3)	1.83 (1.46–2.32)	7.15 (4.79–10.29)
2011–2012	MEHP	WRA	All women of reproductive age	536	536 (75.93%)	1.6 (1.3–2.1)	9.7 (8.3–14.1)	2.04 (1.71–2.82)	6.92 (5.19–9.07)
2011–2012	MEHP	WRA	At or above poverty level	119	119 (77.31%)	1.4 (0.8–2.1)	9.6 (6.6–23.8)	1.96 (1.35–3.89)	5.89 (5.19–7.62)
2011–2012	MEHP	WRA	Below poverty level	150	150 (78%)	2 (1.6–2.5)	11.5 (7.6–25.3)	2.05 (1.43–2.83)	8.17 (3.53–13.78)
2011–2012	MEHP	WRA	Black non-Hispanic	135	135 (83.7%)	2.2 (1.3–3.1)	24.1 (9.7–25.3)	2.45 (1.46–4.64)	7.33 (4.93–15.64)
2011–2012	MEHP	WRA	Mexican American	53	53 (84.91%)	1.8 (0.9–5.3)	11.5 (6.3–64.2)	2.17 (1.31–4.31)	7.62 (3.53–13.78)
2011–2012	MEHP	WRA	Other	169	169 (76.92%)	2 (1.6–2.6)	12.7 (8–94.3)	2.03 (1.33–2.75)	8.17 (4.81–17.01)
2011–2012	MEHP	WRA	Unknown income	225	225 (73.33%)	1.4 (0.35–3.2)	64.2 (1.8–64.2)	2.7 (0.16–15.64)	15.64 (0.16–15.64)
2011–2012	MEHP	WRA	White non-Hispanic	179	179 (66.48%)	1.25 (0.9–1.8)	6.6 (4.9–8.8)	1.79 (1.21–3.89)	5.26 (4.06–6.92)
2011–2012	MEOHP	Adults	All adults	1,894	1,894 (99.58%)	5.7 (4.9–6.5)	34.2 (21.2–45.5)	5.33 (4.94–5.75)	24.09 (20.8–28.44)
2011–2012	MEOHP	Adults	At or above poverty level	449	449 (100%)	5.7 (4.6–6.7)	35.2 (21.2–56.8)	5.18 (4.83–5.63)	24.08 (19.21–28.44)
2011–2012	MEOHP	Adults	Below poverty level	441	441 (99.55%)	5.4 (3.8–7.2)	29.6 (16.2–65.2)	5.6 (5–6.2)	28.04 (21–36.82)
2011–2012	MEOHP	Adults	Black non-Hispanic	499	499 (99.8%)	7.1 (6.3–7.6)	38.7 (23.4–55)	4.97 (4.52–5.51)	26.36 (17.21–36.02)
2011–2012	MEOHP	Adults	Females	933	933 (99.46%)	4.7 (4–5.8)	31.9 (25–46.6)	6.67 (5.96–7.25)	24.95 (21–32.05)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2011–2012	MEOHP	Adults	Males	961	961 (99.69%)	5.8 (5.1–6.8)	33.8 (21.2–45.5)	4.86 (4.49–5.12)	22.51 (18.05–29.71)
2011–2012	MEOHP	Adults	Mexican American	186	186 (100%)	5.5 (3.5–8.2)	29.5 (16.6–528.7)	5.76 (4.34–7.73)	24.09 (16.25–60.82)
2011–2012	MEOHP	Adults	Other	545	545 (99.27%)	4.6 (3.7–6.2)	36.3 (24.9–56.5)	5.66 (4.86–6.35)	32.57 (23.46–41.95)
2011–2012	MEOHP	Adults	Unknown income	821	821 (99.39%)	6.7 (3.8–10.3)	15 (13.9–19.8)	5.71 (4.71–7.36)	16.43 (14.7–32.81)
2011–2012	MEOHP	Adults	White non-Hispanic	664	664 (99.55%)	5.8 (4.9–7.3)	26.5 (17.7–56.8)	5.26 (4.85–5.83)	22.86 (16.59–28.5)
2011–2012	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	112.2 (60.4–152)	16.9 (13.2–22.5)	5.83 (5.23–7.1)	33.59 (27.36–54.57)
2011–2012	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	112.2 (60.4–152)	16.9 (13.2–22.5)	5.83 (5.23–7.1)	68.83 (36.3–102.86)
2011–2012	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	112.2 (60.4–152)	16.9 (13.2–22.5)	8.49 (7.29–10.18)	33.59 (27.36–54.57)
2011–2012	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	112.2 (60.4–152)	16.9 (13.2–22.5)	8.49 (7.29–10.18)	68.83 (36.3–102.86)
2011–2012	MEOHP	Children	All children	595	595 (99.83%)	7.2 (5.7–8.9)	39.3 (29.8–46.8)	7.35 (6.5–8.52)	33.33 (31.38–42.22)
2011–2012	MEOHP	Children	At or above poverty level	154	154 (100%)	7.2 (5.2–9.1)	39.3 (27.9–48)	7.14 (6.16–8.06)	32.2 (25.64–33.59)
2011–2012	MEOHP	Children	Below poverty level	195	195 (100%)	8.1 (6–11.3)	39.8 (26.8–56.9)	8.71 (7.33–11.03)	46.11 (21.86–79.08)
2011–2012	MEOHP	Children	Black non-Hispanic	166	166 (100%)	9.6 (8.3–11.8)	45.9 (31.4–81.6)	7.74 (6.27–9.26)	36.02 (23.89–79.08)
2011–2012	MEOHP	Children	Children (6 to <11 years)	330	330 (100%)	80 (63.7–95.8)	22.2 (16.8–24.1)	10.88 (9.34–12.5)	35.27 (26.36–42.84)
2011–2012	MEOHP	Children	Children (6 to <11 years)	330	330 (100%)	80 (63.7–95.8)	22.2 (16.8–24.1)	10.88 (9.34–12.5)	56.67 (42.95–75.14)
2011–2012	MEOHP	Children	Children (6 to <11 years)	330	330 (100%)	80 (63.7–95.8)	22.2 (16.8–24.1)	16.2 (13.85–18.91)	35.27 (26.36–42.84)
2011–2012	MEOHP	Children	Children (6 to <11 years)	330	330 (100%)	80 (63.7–95.8)	22.2 (16.8–24.1)	16.2 (13.85–18.91)	56.67 (42.95–75.14)
2011–2012	MEOHP	Children	Females	297	297 (99.66%)	7.6 (6–10.5)	39.4 (29–46.8)	8.54 (7.08–10)	33.21 (27.36–46.22)
2011–2012	MEOHP	Children	Males	298	298 (100%)	7.1 (5.5–8.7)	32.7 (23.4–79.9)	6.78 (5.83–7.78)	33.33 (24.12–52.67)
2011–2012	MEOHP	Children	Mexican American	130	130 (100%)	6.2 (4.6–9.1)	32.7 (18.5–117.1)	7 (5.9–8.87)	34.46 (19.01–60)
2011–2012	MEOHP	Children	Other	150	150 (100%)	6.3 (5.1–8.6)	39.8 (25.4–56.9)	7.24 (6.45–8.16)	40.42 (25.69–47.18)
2011–2012	MEOHP	Children	Unknown income	208	208 (99.52%)	8.7 (3.4–12.6)	37.5 (23.2–70.7)	9.3 (4.22–13.81)	43.37 (16.43–52.31)
2011–2012	MEOHP	Children	White non-Hispanic	149	149 (99.33%)	7.3 (4.3–10.5)	35.1 (24–71.2)	7.64 (6.13–9.42)	33.33 (24.88–46.22)
2011–2012	MEOHP	WRA	All women of reproductive age	536	536 (99.25%)	4.7 (4–5.8)	31.9 (25–46.6)	12.2 (10–14.23)	41.95 (23.57–48.17)
2011–2012	MEOHP	WRA	At or above poverty level	119	119 (100%)	4.4 (3.4–5.2)	27.8 (21.1–46.6)	10.24 (7.18–15.1)	27.95 (20.61–46.22)
2011–2012	MEOHP	WRA	Below poverty level	150	150 (99.33%)	7.2 (5.5–10.3)	31.9 (24.5–62.1)	14.18 (11.04–15.45)	41.95 (22.16–60)
2011–2012	MEOHP	WRA	Black non-Hispanic	135	135 (100%)	8 (4.8–11.8)	48.2 (32.5–64.8)	9.74 (6.39–16.39)	42.87 (16.39–48.17)
2011–2012	MEOHP	WRA	Mexican American	53	53 (100%)	6.4 (3.5–13.5)	25.4 (13.6–174.2)	11.3 (6.67–19.01)	34.46 (15.85–60)
2011–2012	MEOHP	WRA	Other	169	169 (98.22%)	4.9 (3.5–9.1)	29.6 (18.7–229.7)	13.49 (8.16–17.97)	47.18 (22.94–48.39)
2011–2012	MEOHP	WRA	Unknown income	225	225 (99.11%)	4.6 (2–11.1)	174.2 (8.3–174.2)	14.23 (2.63–47.18)	36.53 (2.63–47.18)
2011–2012	MEOHP	WRA	White non-Hispanic	179	179 (99.44%)	4.4 (3.1–5.8)	21.1 (15–46.6)	11.04 (5.75–15.78)	25.64 (15.78–46.22)
2009–2010	MECPP	Adults	All adults	2,127	2,127 (99.95%)	20.79 (18.15–25.08)	199.15 (92.72–502.01)	19.5 (17.53–22.12)	123.64 (90.58–208.8)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MECPP	Adults	At or above poverty level	550	550 (99.82%)	20.24 (17.25–24.31)	165.08 (92.59–473.59)	19.48 (17.4–22.12)	122.49 (85.62–210.12)
2009–2010	MECPP	Adults	Below poverty level	469	469 (100%)	24.82 (18.63–28.61)	130.85 (76–302.54)	19.54 (16.49–23.69)	125.67 (80.97–230.9)
2009–2010	MECPP	Adults	Black non-Hispanic	400	400 (100%)	17.62 (12.75–26.24)	172.31 (56.84–521.88)	14.92 (11.78–18.83)	78.2 (51.17–135.2)
2009–2010	MECPP	Adults	Females	1,040	1,040 (100%)	18.86 (15.31–24.05)	97.09 (80.88–148.23)	22.65 (19.5–25.56)	120.96 (85.62–223.78)
2009–2010	MECPP	Adults	Males	1,087	1,087 (99.91%)	20.79 (18.06–25.18)	211.91 (92.72–521.88)	18.43 (16.09–20.35)	125.31 (93.44–210.12)
2009–2010	MECPP	Adults	Mexican American	393	393 (100%)	22.36 (18.63–29.17)	165.08 (84.17–348.66)	22.95 (20.73–26.66)	147.93 (112.53–209.62)
2009–2010	MECPP	Adults	Other	336	336 (100%)	21.21 (15.13–28.19)	109.63 (82.37–502.01)	19.52 (16.42–22.9)	169.6 (81.6–278.58)
2009–2010	MECPP	Adults	Unknown income	905	905 (100%)	27.42 (14.56–49.55)	521.88 (82.37–931.11)	20.5 (16.29–28.86)	135.2 (68.07–439.47)
2009–2010	MECPP	Adults	White non-Hispanic	998	998 (99.9%)	20.94 (17.5–25.39)	214.16 (91.44–658.93)	20 (18.04–22.53)	121.58 (83.47–228.39)
2009–2010	MECPP	Children	Adolescents (11 to <16 years)	281	281 (100%)	9.77 (7.85–11.52)	54.35 (30.14–99.77)	20.45 (17.88–23.69)	104.01 (62.71–190.44)
2009–2010	MECPP	Children	Adolescents (11 to <16 years)	281	281 (100%)	9.77 (7.85–11.52)	54.35 (30.14–99.77)	20.45 (17.88–23.69)	44.08 (23.61–89.08)
2009–2010	MECPP	Children	Adolescents (11 to <16 years)	281	281 (100%)	9.77 (7.85–11.52)	54.35 (30.14–99.77)	7.31 (6.52–8.66)	104.01 (62.71–190.44)
2009–2010	MECPP	Children	Adolescents (11 to <16 years)	281	281 (100%)	9.77 (7.85–11.52)	54.35 (30.14–99.77)	7.31 (6.52–8.66)	44.08 (23.61–89.08)
2009–2010	MECPP	Children	All children	622	622 (100%)	27.54 (24.42–31.23)	124.04 (94.23–203)	28.63 (25.47–30.85)	121.54 (91.8–190.44)
2009–2010	MECPP	Children	At or above poverty level	167	167 (100%)	27.52 (24.71–31.03)	120.73 (84.17–203)	28.38 (23.78–30.62)	120.24 (78.33–188.38)
2009–2010	MECPP	Children	Below poverty level	186	186 (100%)	31.23 (24.44–35.4)	154.27 (93.12–348.66)	29.68 (27.06–34.35)	202.94 (88.65–316.5)
2009–2010	MECPP	Children	Black non-Hispanic	116	116 (100%)	27.18 (23.14–33.18)	100.54 (77.15–320.06)	20.53 (16.52–26.55)	104.29 (55.85–262.16)
2009–2010	MECPP	Children	Children (6 to <11 years)	341	341 (100%)	11.46 (9.06–12.72)	48.38 (37–66.83)	13.54 (11.87–14.89)	118.52 (92.32–223.78)
2009–2010	MECPP	Children	Children (6 to <11 years)	341	341 (100%)	11.46 (9.06–12.72)	48.38 (37–66.83)	13.54 (11.87–14.89)	45.49 (33.75–74.52)
2009–2010	MECPP	Children	Children (6 to <11 years)	341	341 (100%)	11.46 (9.06–12.72)	48.38 (37–66.83)	36.42 (32.84–41.09)	118.52 (92.32–223.78)
2009–2010	MECPP	Children	Children (6 to <11 years)	341	341 (100%)	11.46 (9.06–12.72)	48.38 (37–66.83)	36.42 (32.84–41.09)	45.49 (33.75–74.52)
2009–2010	MECPP	Children	Females	310	310 (100%)	24.75 (21.49–27.37)	146.16 (84.17–246.58)	28.9 (24.02–32.15)	121.54 (76.61–223.78)
2009–2010	MECPP	Children	Males	312	312 (100%)	32.18 (27.09–35.87)	111.29 (87.25–202.09)	28.38 (22.27–33.2)	121.58 (82.12–214.05)
2009–2010	MECPP	Children	Mexican American	173	173 (100%)	32.74 (24.32–40.72)	202.09 (112.63–348.66)	30.11 (27.06–35.1)	208.34 (112.89–425.63)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MECPP	Children	Other	125	125 (100%)	27.19 (22.88–33.9)	153.95 (63.32–436.99)	29.36 (23.69–33.24)	208.26 (68.88–297.34)
2009–2010	MECPP	Children	Unknown income	214	214 (100%)	20.14 (14.43–32.74)	106.52 (37.15–147.31)	20.91 (13.63–40.3)	140.91 (72.6–229)
2009–2010	MECPP	Children	White non-Hispanic	208	208 (100%)	27.15 (22.21–31.95)	106.52 (70.83–162.13)	28.87 (25.45–31.86)	104.01 (72.72–188.38)
2009–2010	MECPP	WRA	All women of reproductive age	608	608 (100%)	18.86 (15.31–24.05)	97.09 (80.88–148.23)	34.97 (32.46–41.09)	109.72 (80.98–223.78)
2009–2010	MECPP	WRA	At or above poverty level	162	162 (100%)	18.4 (14.67–23.04)	96.06 (75.14–240.65)	33.31 (29.95–38.53)	92.87 (65.51–264.3)
2009–2010	MECPP	WRA	Below poverty level	186	186 (100%)	20.56 (12.75–32.2)	96.66 (61.97–441.89)	39.51 (34.21–54.61)	155.94 (88.75–336.21)
2009–2010	MECPP	WRA	Black non-Hispanic	113	113 (100%)	27.04 (20.2–29.96)	139.19 (70.42–662.67)	41.72 (18.29–67)	125.67 (55.85–336.21)
2009–2010	MECPP	WRA	Mexican American	102	102 (100%)	23.62 (13.09–46.06)	93.74 (59.28–246.94)	43.22 (28.91–69.67)	155.94 (88.75–535.82)
2009–2010	MECPP	WRA	Other	116	116 (100%)	19.83 (15.97–24.13)	157.49 (39.8–609.22)	32.75 (23.19–51.35)	223.78 (33.04–248.82)
2009–2010	MECPP	WRA	Unknown income	211	211 (100%)	23.62 (14.56–39.56)	80.9 (28.05–198.82)	66.36 (20.36–223.78)	223.78 (20.36–223.78)
2009–2010	MECPP	WRA	White non-Hispanic	277	277 (100%)	15.72 (12.64–22.25)	95.1 (54.88–109.57)	34.21 (31.22–41.09)	82.5 (50.58–112.84)
2009–2010	MEHHP	Adults	All adults	2,127	2,127 (99.91%)	13.53 (12.37–16.16)	134.02 (84.29–315.41)	12.38 (10.83–13.94)	90.89 (64.88–152.49)
2009–2010	MEHHP	Adults	At or above poverty level	550	550 (100%)	13.41 (12.24–15.71)	128.27 (81.68–284.49)	12.33 (10.89–13.91)	87.84 (59.19–143.5)
2009–2010	MEHHP	Adults	Below poverty level	469	469 (99.79%)	15.31 (10.72–18.97)	116.65 (55.87–233.8)	12.33 (10.31–14.84)	92.18 (49.31–199.7)
2009–2010	MEHHP	Adults	Black non-Hispanic	400	400 (100%)	14.18 (9.86–21.56)	136.88 (48.17–416.07)	10.44 (8.51–13.16)	71.78 (38.46–87.84)
2009–2010	MEHHP	Adults	Females	1,040	1,040 (99.9%)	11.91 (9.29–14.52)	67.73 (50.16–180.7)	14 (11.46–16.18)	77.42 (49.63–142.28)
2009–2010	MEHHP	Adults	Males	1087	1087 (99.91%)	13.61 (12.26–16.27)	135.95 (84.29–461.3)	11.55 (10.52–13.07)	103.02 (73.28–177.79)
2009–2010	MEHHP	Adults	Mexican American	393	393 (100%)	15.27 (13.31–17.44)	125.41 (51.35–231.69)	14.66 (13.39–15.81)	97.14 (70.43–142.39)
2009–2010	MEHHP	Adults	Other	336	336 (99.7%)	13.2 (9.8–18.4)	76.82 (37.26–399.38)	12.55 (10.1–14.79)	112.6 (47.55–213.29)
2009–2010	MEHHP	Adults	Unknown income	905	905 (99.89%)	17.08 (9.25–29.67)	416.07 (66.11–555.9)	13.02 (9.32–17.53)	87.22 (52.77–394.78)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MEHHP	Adults	White non-Hispanic	998	998 (99.9%)	13.35 (12.37–15.71)	166.3 (81.68–519.94)	12.42 (10.82–14.2)	96.13 (61.01–177.79)
2009–2010	MEHHP	Children	Adolescents (11 to <16 years)	281	281 (100%)	14.72 (11.57–17.37)	109.86 (46.78–170.93)	10.61 (9.28–13.62)	73.63 (43.93–152.62)
2009–2010	MEHHP	Children	All children	622	622 (100%)	15.78 (13.6–18.14)	99.85 (67.27–135.95)	15.2 (12.81–17.73)	83.11 (58.61–135.95)
2009–2010	MEHHP	Children	At or above poverty level	167	167 (100%)	15.55 (13.27–17.77)	99.85 (60.25–118.09)	15.45 (12.4–17.73)	64.78 (56.33–133.66)
2009–2010	MEHHP	Children	Below poverty level	186	186 (100%)	17.91 (13.71–21.88)	116.7 (62.89–191.59)	16.3 (13.72–20.17)	105.31 (55.07–282.34)
2009–2010	MEHHP	Children	Black non-Hispanic	116	116 (100%)	16.83 (11.97–24.8)	80.33 (45.87–177.79)	13.01 (10.92–14.84)	72.37 (41.27–198.13)
2009–2010	MEHHP	Children	Children (6 to <11 years)	341	341 (100%)	17.19 (14.09–20.1)	75.14 (55.83–111.67)	20.27 (17.73–22.79)	72.37 (56.63–152.7)
2009–2010	MEHHP	Children	Females	310	310 (100%)	13.42 (11.5–15.5)	87.06 (40.88–170.93)	15.5 (12.75–17.53)	72.83 (47.77–152.62)
2009–2010	MEHHP	Children	Males	312	312 (100%)	18.22 (14.09–22.85)	101.88 (66.97–132.89)	15.12 (11.79–19.66)	89.63 (56.33–159.94)
2009–2010	MEHHP	Children	Mexican American	173	173 (100%)	18.98 (13.1–23.09)	111.67 (75.14–183.59)	16.93 (14.39–20.09)	108.5 (72.83–208.48)
2009–2010	MEHHP	Children	Other	125	125 (100%)	15.43 (11.23–19.72)	98.24 (41.19–437.63)	14.46 (10.61–18.26)	140.42 (45.41–282.34)
2009–2010	MEHHP	Children	Unknown income	214	214 (100%)	10.68 (8.48–18.4)	80.33 (44.16–84.46)	12.38 (8.66–18.05)	72.37 (43.79–195.41)
2009–2010	MEHHP	Children	White non-Hispanic	208	208 (100%)	15.02 (12.25–17.68)	82.31 (47.93–118.09)	16.07 (10.46–19.61)	61.01 (47.77–152.62)
2009–2010	MEHHP	WRA	All women of reproductive age	608	608 (99.84%)	11.91 (9.29–14.52)	67.73 (50.16–180.7)	18.43 (16.25–22.38)	72.37 (49.63–171.44)
2009–2010	MEHHP	WRA	At or above poverty level	162	162 (100%)	10.76 (8.19–12.93)	67.73 (42.57–229.08)	16.93 (15.45–20.52)	60.15 (34.39–152.7)
2009–2010	MEHHP	WRA	Below poverty level	186	186 (99.46%)	13.3 (7.44–19.19)	67.48 (39.93–206.55)	22.41 (17.33–33.55)	101.95 (47.58–401.96)
2009–2010	MEHHP	WRA	Black non-Hispanic	113	113 (100%)	19.75 (13.3–27.33)	76.58 (45.06–545.39)	22.76 (12.8–33.55)	85.07 (32.79–401.96)
2009–2010	MEHHP	WRA	Mexican American	102	102 (100%)	14.13 (6.29–27.42)	65.41 (37.88–345.35)	20.64 (13.99–60.15)	101.95 (55.07–288.71)
2009–2010	MEHHP	WRA	Other	116	116 (100%)	12.51 (10.44–15.44)	71.13 (23.7–311.01)	18.22 (11.09–28.66)	171.44 (20.52–171.44)
2009–2010	MEHHP	WRA	Unknown income	211	211 (100%)	14.93 (9.95–25.32)	53.15 (20.55–199.16)	38.71 (11.09–171.44)	171.44 (11.09–171.44)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MEHHP	WRA	White non-Hispanic	277	277 (99.64%)	9.15 (6.09–12.93)	54.35 (30.27–206.55)	16.52 (14.32–20.33)	47.58 (29.76–61.01)
2009–2010	MEHP	Adults	All adults	2,127	2,127 (76.35%)	1.85 (1.65–2.18)	22.44 (11.55–60.12)	1.49 (1.32–1.73)	12.53 (8.06–19.53)
2009–2010	MEHP	Adults	At or above poverty level	550	550 (75.09%)	1.76 (1.56–2.06)	21.66 (10.41–49.14)	1.48 (1.3–1.67)	11.27 (7.36–20.94)
2009–2010	MEHP	Adults	Below poverty level	469	469 (78.04%)	2.34 (1.66–3.14)	16.89 (9.54–38.16)	1.77 (1.39–2.18)	9.95 (6.9–22.2)
2009–2010	MEHP	Adults	Black non-Hispanic	400	400 (82%)	2.21 (1.64–2.68)	28.42 (7.39–81.33)	1.4 (1.11–1.76)	7.92 (6.43–12.53)
2009–2010	MEHP	Adults	Females	1,040	1,040 (74.13%)	1.65 (1.37–2.03)	11.81 (9.02–20.2)	1.47 (1.21–1.74)	10.33 (6.9–18.33)
2009–2010	MEHP	Adults	Males	1,087	1,087 (78.47%)	1.85 (1.65–2.21)	22.62 (11.55–60.12)	1.52 (1.39–1.74)	12.97 (8.65–22.16)
2009–2010	MEHP	Adults	Mexican American	393	393 (81.17%)	2.72 (2.1–3.35)	25.6 (8.69–40.49)	1.83 (1.66–2.04)	14.46 (11.1–19.57)
2009–2010	MEHP	Adults	Other	336	336 (78.57%)	2.04 (1.67–2.78)	14.21 (6.07–213.45)	1.8 (1.49–2.19)	18.26 (6.62–52.41)
2009–2010	MEHP	Adults	Unknown income	905	905 (75.47%)	1.94 (1.16–4.68)	81.33 (8.33–175.99)	1.45 (1.1–1.84)	16.98 (5.08–95.91)
2009–2010	MEHP	Adults	White non-Hispanic	998	998 (71.44%)	1.63 (1.33–1.86)	22.62 (9.58–67.77)	1.43 (1.23–1.67)	10.73 (7.25–22.16)
2009–2010	MEHP	Children	Adolescents (11 to <16 years)	281	281 (80.43%)	1.51 (1.22–1.79)	25.4 (21.86–30.46)	1.33 (1.09–1.59)	13.32 (4.51–23.33)
2009–2010	MEHP	Children	Adolescents (11 to <16 years)	281	281 (80.43%)	1.51 (1.22–1.79)	25.4 (21.86–30.46)	1.33 (1.09–1.59)	20.45 (17.88–23.69)
2009–2010	MEHP	Children	All children	622	622 (81.03%)	1.65 (1.43–1.86)	13.09 (7.63–21.66)	1.71 (1.49–1.94)	12.97 (7.17–18)
2009–2010	MEHP	Children	At or above poverty level	167	167 (80.84%)	1.62 (1.33–1.82)	13.8 (7.15–22.68)	1.61 (1.37–1.97)	12.26 (5.99–18)
2009–2010	MEHP	Children	Below poverty level	186	186 (81.18%)	1.83 (1.36–2.11)	15.63 (8.58–24.27)	1.91 (1.51–2.35)	9.96 (6.25–48.04)
2009–2010	MEHP	Children	Black non-Hispanic	116	116 (84.48%)	2.34 (1.56–3.21)	11.69 (8.51–13.8)	1.76 (1.53–2.08)	7.13 (4.55–10.53)
2009–2010	MEHP	Children	Children (6 to <11 years)	341	341 (81.52%)	1.79 (1.24–2.18)	29.51 (25.65–33.24)	2.3 (1.94–2.61)	36.42 (32.84–41.09)
2009–2010	MEHP	Children	Children (6 to <11 years)	341	341 (81.52%)	1.79 (1.24–2.18)	29.51 (25.65–33.24)	2.3 (1.94–2.61)	8.89 (6.53–25.87)
2009–2010	MEHP	Children	Females	310	310 (79.03%)	1.25 (1.11–1.56)	14.96 (5.95–36.15)	1.6 (1.4–1.94)	13.32 (5.99–26.68)
2009–2010	MEHP	Children	Males	312	312 (83.01%)	1.87 (1.63–2.13)	12.89 (7.47–21.02)	1.79 (1.53–1.94)	12.47 (5.88–19.53)
2009–2010	MEHP	Children	Mexican American	173	173 (80.92%)	1.69 (1.21–2.58)	16.59 (9.67–26.25)	1.83 (1.53–2.52)	17.65 (8.87–29.33)
2009–2010	MEHP	Children	Other	125	125 (84%)	1.7 (0.93–2.66)	20.26 (7.14–45.93)	1.67 (1.11–2.38)	26.68 (6.46–70.56)
2009–2010	MEHP	Children	Unknown income	214	214 (79.44%)	1.7 (0.66–2.96)	7.47 (6.35–20.26)	1.67 (1.1–2.64)	11.93 (4.51–70.56)
2009–2010	MEHP	Children	White non-Hispanic	208	208 (77.4%)	1.58 (1.22–1.8)	12.4 (5.45–21.66)	1.6 (1.31–1.94)	10.03 (5.22–20.94)
2009–2010	MEHP	WRA	All women of reproductive age	608	608 (78.62%)	1.65 (1.37–2.03)	11.81 (9.02–20.2)	2.11 (1.59–2.74)	10.53 (6.58–60.19)
2009–2010	MEHP	WRA	At or above poverty level	162	162 (79.63%)	1.56 (1.26–2.02)	14 (7.35–26.57)	1.93 (1.54–2.6)	7.46 (5.22–26.68)
2009–2010	MEHP	WRA	Below poverty level	186	186 (77.42%)	1.61 (1.13–2.46)	11.19 (7.76–14.94)	2.38 (1.23–3.99)	7.17 (5.91–33.55)
2009–2010	MEHP	WRA	Black non-Hispanic	113	113 (86.73%)	2.75 (1.99–3.96)	20.18 (7.58–119.36)	2.69 (0.97–5.1)	10.53 (4.4–33.55)
2009–2010	MEHP	WRA	Mexican American	102	102 (82.35%)	1.92 (1.19–4.3)	13.73 (5.13–79.48)	2.34 (1.44–4.31)	10.73 (4.23–60.19)
2009–2010	MEHP	WRA	Other	116	116 (86.21%)	1.62 (1.47–2.07)	11.81 (4.47–33)	2.71 (1.31–7.17)	26.68 (3.25–85.16)
2009–2010	MEHP	WRA	Unknown income	211	211 (75.83%)	2.78 (1.96–3.94)	11.68 (6.48–13.73)	7.95 (0.62–70.56)	70.56 (0.62–70.56)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MEHP	WRA	White non-Hispanic	277	277 (70.76%)	1.36 (1–1.81)	8.93 (5.1–16.62)	1.63 (1.17–2.68)	5.54 (3.64–7.46)
2009–2010	MEOHP	Adults	All adults	2,127	2,127 (99.67%)	8.05 (7.28–9.75)	70.34 (47.32–149.41)	7.47 (6.84–8.24)	49.72 (36.91–76.65)
2009–2010	MEOHP	Adults	At or above poverty level	550	550 (99.82%)	7.85 (7.21–9.37)	70.16 (43.94–149.41)	7.44 (6.8–8.24)	47.86 (35.13–76.62)
2009–2010	MEOHP	Adults	Below poverty level	469	469 (99.36%)	9.11 (6.46–11.14)	55.69 (33.57–106.28)	7.36 (6.28–8.67)	50.43 (30.12–103.18)
2009–2010	MEOHP	Adults	Black non-Hispanic	400	400 (100%)	8.33 (6.22–12.17)	56.74 (25.45–205.08)	6.31 (5.13–7.93)	32.2 (21.37–53.13)
2009–2010	MEOHP	Adults	Females	1040	1040 (99.62%)	8.03 (6.51–9.39)	42.31 (29.88–64.51)	8.54 (7.18–9.7)	47.23 (32.13–82.49)
2009–2010	MEOHP	Adults	Males	1,087	1,087 (99.72%)	8.05 (7.28–9.81)	70.34 (47.32–172.13)	7.07 (6.59–7.55)	52.01 (41.21–82.28)
2009–2010	MEOHP	Adults	Mexican American	393	393 (100%)	8.38 (7.49–10)	68.48 (32.25–116.62)	8.7 (7.97–9.61)	56.66 (39.48–88.8)
2009–2010	MEOHP	Adults	Other	336	336 (99.4%)	8.28 (5.52–10.68)	42.42 (21.38–213.55)	7.08 (6.04–8.16)	58.15 (29.11–125.62)
2009–2010	MEOHP	Adults	Unknown income	905	905 (99.67%)	8.57 (6.08–24.18)	205.08 (37.97–281.22)	8 (5.84–10.74)	56.66 (32.76–90.11)
2009–2010	MEOHP	Adults	White non-Hispanic	998	998 (99.5%)	7.88 (7.27–9.83)	70.59 (50.03–280.02)	7.65 (6.87–8.45)	50.39 (34.56–86.64)
2009–2010	MEOHP	Children	Adolescents (11 to <16 years)	281	281 (99.64%)	131.05 (94.23–246.58)	25.4 (21.86–30.46)	10.61 (9.28–13.62)	44.08 (23.61–89.08)
2009–2010	MEOHP	Children	Adolescents (11 to <16 years)	281	281 (99.64%)	131.05 (94.23–246.58)	25.4 (21.86–30.46)	10.61 (9.28–13.62)	73.63 (43.93–152.62)
2009–2010	MEOHP	Children	Adolescents (11 to <16 years)	281	281 (99.64%)	131.05 (94.23–246.58)	25.4 (21.86–30.46)	7.31 (6.52–8.66)	44.08 (23.61–89.08)
2009–2010	MEOHP	Children	Adolescents (11 to <16 years)	281	281 (99.64%)	131.05 (94.23–246.58)	25.4 (21.86–30.46)	7.31 (6.52–8.66)	73.63 (43.93–152.62)
2009–2010	MEOHP	Children	All children	622	622 (99.84%)	10.83 (8.84–12.21)	54.35 (37.76–70.19)	9.81 (8.28–11.75)	47.86 (33.48–76.44)
2009–2010	MEOHP	Children	At or above poverty level	167	167 (100%)	10.86 (8.5–12.21)	54.51 (37.06–70.19)	9.61 (7.96–11.17)	44.05 (33.03–66.22)
2009–2010	MEOHP	Children	Below poverty level	186	186 (99.46%)	12.42 (9.61–15.94)	63.15 (41.08–124.61)	11.22 (9.31–13.42)	68.5 (34.59–149.9)
2009–2010	MEOHP	Children	Black non-Hispanic	116	116 (99.14%)	11.11 (7.45–16.17)	44.63 (30.31–101.22)	8.04 (6.57–9.55)	41.21 (24.63–93.84)
2009–2010	MEOHP	Children	Children (6 to <11 years)	341	341 (100%)	118.4 (87.05–154.27)	29.51 (25.65–33.24)	13.54 (11.87–14.89)	45.49 (33.75–74.52)
2009–2010	MEOHP	Children	Children (6 to <11 years)	341	341 (100%)	118.4 (87.05–154.27)	29.51 (25.65–33.24)	13.54 (11.87–14.89)	72.37 (56.63–152.7)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2009–2010	MEOHP	Children	Children (6 to <11 years)	341	341 (100%)	118.4 (87.05–154.27)	29.51 (25.65–33.24)	20.27 (17.73–22.79)	45.49 (33.75–74.52)
2009–2010	MEOHP	Children	Children (6 to <11 years)	341	341 (100%)	118.4 (87.05–154.27)	29.51 (25.65–33.24)	20.27 (17.73–22.79)	72.37 (56.63–152.7)
2009–2010	MEOHP	Children	Females	310	310 (99.68%)	8.84 (7.45–10.86)	58.9 (32.86–99.77)	9.9 (8.28–11.75)	47.86 (32.18–89.08)
2009–2010	MEOHP	Children	Males	312	312 (100%)	12.21 (9.41–15.85)	54.35 (38.91–70.18)	9.57 (7.31–12.96)	49.72 (32.93–83.05)
2009–2010	MEOHP	Children	Mexican American	173	173 (100%)	11.98 (9.91–14.85)	70.19 (46.01–101.94)	11.3 (9.58–13.07)	68.5 (49.72–122.19)
2009–2010	MEOHP	Children	Other	125	125 (100%)	9.84 (7.96–12.06)	69.59 (25.04–232.35)	9.35 (6.64–12.6)	79.74 (29.46–149.9)
2009–2010	MEOHP	Children	Unknown income	214	214 (100%)	7.86 (4.94–11.95)	47.17 (13.93–58.9)	8.5 (5.38–13.27)	47.47 (30.66–114.2)
2009–2010	MEOHP	Children	White non-Hispanic	208	208 (100%)	10.23 (8.33–12.68)	53.3 (30.14–68.37)	9.94 (7.92–12.32)	38.62 (31.05–76.44)
2009–2010	MEOHP	WRA	All women of reproductive age	608	608 (99.51%)	8.03 (6.51–9.39)	42.31 (29.88–64.51)	12.6 (10.55–14.89)	40.21 (32.18–90.11)
2009–2010	MEOHP	WRA	At or above poverty level	162	162 (100%)	7.52 (5.46–8.95)	41.76 (23.34–70.15)	11.75 (9.63–13.73)	32.18 (23.35–71.96)
2009–2010	MEOHP	WRA	Below poverty level	186	186 (99.46%)	8.5 (5.17–14.03)	44.04 (27.08–95.17)	17.55 (12.13–21.85)	70.65 (33.67–211.63)
2009–2010	MEOHP	WRA	Black non-Hispanic	113	113 (100%)	11.14 (9.64–17.67)	50.47 (27.75–236.9)	14.09 (8.04–20.51)	48.43 (19.76–211.63)
2009–2010	MEOHP	WRA	Mexican American	102	102 (100%)	8.28 (4.62–16.62)	42.86 (21.8–205.9)	14.19 (10.71–34.59)	70.65 (33.48–164)
2009–2010	MEOHP	WRA	Other	116	116 (100%)	8.05 (7.18–9.67)	37.61 (16.03–80.68)	11.12 (7.62–19.98)	90.11 (12.16–90.11)
2009–2010	MEOHP	WRA	Unknown income	211	211 (99.05%)	10.43 (7.5–14.95)	33.01 (21.34–50.79)	29.7 (6.14–90.11)	90.11 (6.14–90.11)
2009–2010	MEOHP	WRA	White non-Hispanic	277	277 (98.92%)	6.91 (4.77–8.88)	36.87 (22.19–97.35)	11.77 (8.9–14.74)	32.13 (19.11–38.62)
2007–2008	MECPP	Adults	All adults	2,021	2,021 (99.9%)	31.3 (25.4–37.2)	338.4 (213.3–455.7)	28.46 (25–31.5)	233.06 (176–317.92)
2007–2008	MECPP	Adults	At or above poverty level	505	505 (100%)	33.6 (28.3–38.8)	336.7 (215.6–415)	28.43 (25.06–31.16)	233.16 (175.5–331.07)
2007–2008	MECPP	Adults	Below poverty level	392	392 (99.74%)	31.7 (21.6–62.3)	423.2 (135.1–977.4)	31.28 (25.49–36.21)	239.71 (136.07–389.57)
2007–2008	MECPP	Adults	Black non-Hispanic	434	434 (99.77%)	38.4 (30.7–40.4)	283.6 (174.3–477)	23.12 (20.74–27.13)	177.67 (112.45–258.78)
2007–2008	MECPP	Adults	Females	1,030	1,030 (99.9%)	41.9 (35.2–50.5)	375.4 (252.2–489.7)	34.44 (30.63–38.26)	255.81 (159.82–461.75)
2007–2008	MECPP	Adults	Males	991	991 (99.9%)	30.9 (24.2–36)	320.5 (213.3–455.7)	25.06 (21.63–28.76)	206.56 (156.52–331.07)
2007–2008	MECPP	Adults	Mexican American	371	371 (100%)	31 (24.2–43.1)	308.6 (128.9–699.5)	30.55 (22.5–39.17)	309.84 (174.78–586.17)
2007–2008	MECPP	Adults	Other	294	294 (100%)	32.4 (18.2–131.7)	369.8 (169.6–496.9)	33.8 (25.32–41.69)	228.97 (144.64–555.03)
2007–2008	MECPP	Adults	Unknown income	948	948 (99.89%)	15.9 (11.8–23.8)	233.3 (41.9–909.9)	23.13 (17.31–31.67)	150.3 (105.61–366.04)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2007–2008	MECPP	Adults	White non-Hispanic	922	922 (99.89%)	28.8 (22.3–38)	316.3 (161.2–469.2)	28.46 (23.92–32.5)	233.16 (164–364.22)
2007–2008	MECPP	Children	Adolescents (11 to <16 years)	265	265 (100%)	16.3 (10.9–21.7)	222.1 (71.9–337.2)	13.71 (10.99–16.85)	119.2 (52.82–159.06)
2007–2008	MECPP	Children	Adolescents (11 to <16 years)	265	265 (100%)	16.3 (10.9–21.7)	222.1 (71.9–337.2)	13.71 (10.99–16.85)	204.27 (133.28–489.25)
2007–2008	MECPP	Children	Adolescents (11 to <16 years)	265	265 (100%)	16.3 (10.9–21.7)	222.1 (71.9–337.2)	33.58 (28.69–39.64)	119.2 (52.82–159.06)
2007–2008	MECPP	Children	Adolescents (11 to <16 years)	265	265 (100%)	16.3 (10.9–21.7)	222.1 (71.9–337.2)	33.58 (28.69–39.64)	204.27 (133.28–489.25)
2007–2008	MECPP	Children	All children	583	583 (100%)	41.2 (33.2–51.4)	420.3 (253.2–467.5)	40.38 (34.47–48.96)	309.84 (204.27–396.54)
2007–2008	MECPP	Children	At or above poverty level	162	162 (100%)	37.7 (31–51.4)	422.4 (292.8–539.3)	38.07 (31.12–46.23)	315.21 (185.2–485.68)
2007–2008	MECPP	Children	Below poverty level	186	186 (100%)	48.3 (40–58.1)	264.6 (155.4–638.7)	50.31 (36.41–66.77)	294.15 (156.81–389.57)
2007–2008	MECPP	Children	Black non-Hispanic	163	163 (100%)	38.6 (30.5–47.7)	271.9 (162.1–421.4)	32.16 (28.11–41.21)	208.89 (140.17–376)
2007–2008	MECPP	Children	Children (6 to <11 years)	318	318 (100%)	16.9 (12–23.2)	143.7 (81.5–197.3)	19.52 (15.22–23.3)	150.77 (68.89–238.72)
2007–2008	MECPP	Children	Children (6 to <11 years)	318	318 (100%)	16.9 (12–23.2)	143.7 (81.5–197.3)	19.52 (15.22–23.3)	396.37 (198.26–410.82)
2007–2008	MECPP	Children	Children (6 to <11 years)	318	318 (100%)	16.9 (12–23.2)	143.7 (81.5–197.3)	51.58 (43.49–67.86)	150.77 (68.89–238.72)
2007–2008	MECPP	Children	Children (6 to <11 years)	318	318 (100%)	16.9 (12–23.2)	143.7 (81.5–197.3)	51.58 (43.49–67.86)	396.37 (198.26–410.82)
2007–2008	MECPP	Children	Females	280	280 (100%)	48.6 (32.4–64.3)	356.9 (168.6–440.8)	53.32 (41.54–66.77)	374.84 (173.19–525.38)
2007–2008	MECPP	Children	Males	303	303 (100%)	37.5 (31.6–45.3)	422.4 (223.8–617.6)	34.5 (28.11–40.77)	310 (185.2–396.54)
2007–2008	MECPP	Children	Mexican American	160	160 (100%)	48.7 (34.9–58.9)	251.7 (157.4–421.8)	46.78 (31.5–64.49)	289.59 (187.38–421.17)
2007–2008	MECPP	Children	Other	105	105 (100%)	32.6 (21.6–51.8)	708.8 (130.3–1060.1)	39.44 (32.22–52.46)	204.27 (121.53–703.18)
2007–2008	MECPP	Children	Unknown income	196	196 (100%)	34.9 (23.8–64.3)	360.7 (50.4–581.8)	38.78 (22–76.79)	396.37 (56.96–461.75)
2007–2008	MECPP	Children	White non-Hispanic	155	155 (100%)	41.4 (29.9–54.7)	420.3 (220.6–539.3)	40.77 (31.12–53.75)	393.37 (185.18–485.68)
2007–2008	MECPP	WRA	All women of reproductive age	571	571 (100%)	41.9 (35.2–50.5)	375.4 (252.2–489.7)	62.31 (47.18–86.36)	396.37 (159.68–525.38)
2007–2008	MECPP	WRA	At or above poverty level	132	132 (100%)	41.7 (32.5–52.8)	376.9 (162.4–499.1)	61.04 (43.49–88.56)	404.4 (138.08–703.18)
2007–2008	MECPP	WRA	Below poverty level	143	143 (100%)	44.1 (28–81.1)	342.6 (138.6–664.5)	81.56 (47.42–112.77)	294.15 (135.17–389.57)
2007–2008	MECPP	WRA	Black non-Hispanic	129	129 (100%)	44.1 (29.6–68)	343.55 (116.4–937.3)	47.16 (26.67–92.9)	374.84 (109.33–979.33)
2007–2008	MECPP	WRA	Mexican American	125	125 (100%)	34 (23.6–50.6)	336.7 (113–792.3)	71.03 (37.55–130)	309.84 (130–849.76)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2007–2008	MECPP	WRA	Other	95	95 (100%)	39.5 (27.7–53.8)	423.2 (48.2–490.2)	39.44 (8.82–1732.41)	389.57 (8.82–1732.41)
2007–2008	MECPP	WRA	Unknown income	250	250 (100%)	48.2 (13–59.1)	867.8 (86–1870.2)	22 (19.35–461.75)	374.84 (19.35–461.75)
2007–2008	MECPP	WRA	White non-Hispanic	222	222 (100%)	44 (24.5–74)	375.4 (120.5–544.9)	63.85 (39.49–135.17)	396.37 (138.08–525.38)
2007–2008	MEHHP	Adults	All adults	2021	2021 (99.06%)	21.3 (18–26.1)	276.6 (168.9–326.5)	18.7 (16.76–20.96)	174.08 (132.63–258.01)
2007–2008	MEHHP	Adults	At or above poverty level	505	505 (99.41%)	22.7 (18.7–27)	237.9 (168.9–326.5)	18.67 (16.7–20.96)	186.61 (145.41–280.51)
2007–2008	MEHHP	Adults	Below poverty level	392	392 (99.23%)	21 (16.7–38.1)	347 (101.4–601)	20.12 (18.19–23.6)	148.5 (89.84–256.13)
2007–2008	MEHHP	Adults	Black non-Hispanic	434	434 (99.08%)	24.8 (22.2–33.9)	209.5 (120.4–405.5)	18.77 (16.76–20.2)	132.6 (78.41–243.02)
2007–2008	MEHHP	Adults	Females	1,030	1,030 (99.03%)	29.9 (19.7–41.5)	301.6 (214–406.1)	21.91 (19.87–24.11)	212.16 (152.68–302.75)
2007–2008	MEHHP	Adults	Males	991	991 (99.09%)	21.1 (18–26.1)	278.2 (168.9–326.5)	16.8 (14.56–20)	163.53 (106.92–258.01)
2007–2008	MEHHP	Adults	Mexican American	371	371 (99.73%)	20.1 (16.6–28.1)	240.7 (129.9–344.1)	18.5 (15.11–22.8)	196.74 (127.74–301.14)
2007–2008	MEHHP	Adults	Other	294	294 (99.66%)	22.7 (9.8–68.9)	327.2 (175.5–566.6)	19.11 (14.24–29.46)	155.34 (99.25–423.24)
2007–2008	MEHHP	Adults	Unknown income	948	948 (98.63%)	13.4 (9.8–15.9)	185.9 (23.7–467.5)	16.52 (12.3–22.22)	117.62 (50–280)
2007–2008	MEHHP	Adults	White non-Hispanic	922	922 (98.59%)	20.8 (16.1–26.2)	278.2 (155.6–347)	18.64 (16.03–21.88)	182.36 (133.75–281.69)
2007–2008	MEHHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	2.3 (1.6–2.7)	30.2 (14.3–42.4)	2.48 (1.7–3.05)	16.31 (11.58–36.4)
2007–2008	MEHHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	2.3 (1.6–2.7)	30.2 (14.3–42.4)	2.48 (1.7–3.05)	203.82 (92.16–372.84)
2007–2008	MEHHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	2.3 (1.6–2.7)	30.2 (14.3–42.4)	24.51 (20.37–28.05)	16.31 (11.58–36.4)
2007–2008	MEHHP	Children	Adolescents (11 to <16 years)	265	265 (99.62%)	2.3 (1.6–2.7)	30.2 (14.3–42.4)	24.51 (20.37–28.05)	203.82 (92.16–372.84)
2007–2008	MEHHP	Children	All children	583	583 (99.83%)	26.2 (20.3–34.4)	343.9 (209.2–393.5)	25.83 (22.11–32.5)	269.17 (169.9–306.59)
2007–2008	MEHHP	Children	At or above poverty level	162	162 (100%)	23.7 (18.2–31.3)	350.9 (229.5–432.5)	24.77 (20.94–31.43)	282.8 (163.96–372.84)
2007–2008	MEHHP	Children	Below poverty level	186	186 (100%)	33.5 (23.5–38.3)	217.6 (88.1–484)	31.52 (20.77–42.82)	187.74 (89.89–296.96)
2007–2008	MEHHP	Children	Black non-Hispanic	163	163 (100%)	28.5 (21.6–34.9)	192.7 (133.3–254.6)	24.42 (18–30.56)	203 (125.8–271.63)
2007–2008	MEHHP	Children	Children (6 to <11 years)	318	318 (100%)	2.1 (1.5–2.9)	15.1 (8.3–24.1)	2.69 (2.11–3.33)	15.63 (11.91–26.48)
2007–2008	MEHHP	Children	Children (6 to <11 years)	318	318 (100%)	2.1 (1.5–2.9)	15.1 (8.3–24.1)	2.69 (2.11–3.33)	282.8 (122.36–466.97)
2007–2008	MEHHP	Children	Children (6 to <11 years)	318	318 (100%)	2.1 (1.5–2.9)	15.1 (8.3–24.1)	33.03 (25.68–40.43)	15.63 (11.91–26.48)
2007–2008	MEHHP	Children	Children (6 to <11 years)	318	318 (100%)	2.1 (1.5–2.9)	15.1 (8.3–24.1)	33.03 (25.68–40.43)	282.8 (122.36–466.97)
2007–2008	MEHHP	Children	Females	280	280 (99.64%)	27.7 (17.4–41.8)	279 (139.6–509)	32.56 (24.63–40.43)	296.96 (139.2–466.97)
2007–2008	MEHHP	Children	Males	303	303 (100%)	24.2 (20–32.4)	347 (203.4–393.5)	24.05 (20.08–26.79)	234.46 (123.15–289.86)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2007–2008	MEHHP	Children	Mexican American	160	160 (100%)	26.1 (20.9–33.6)	169.2 (92.9–281.9)	25.86 (16.18–42.04)	212.43 (127.74–269.17)
2007–2008	MEHHP	Children	Other	105	105 (100%)	19.8 (12.1–32.6)	450.9 (104–1106.5)	24.32 (18.84–32.14)	229.69 (73.35–530)
2007–2008	MEHHP	Children	Unknown income	196	196 (100%)	25.2 (12.2–38.5)	279 (35.6–281.9)	29.17 (14.13–50)	306.59 (40.68–612.22)
2007–2008	MEHHP	Children	White non-Hispanic	155	155 (99.35%)	27.7 (17.5–37.6)	350.9 (203.4–432.5)	26.79 (21.26–35.92)	282.8 (148.47–372.84)
2007–2008	MEHHP	WRA	All women of reproductive age	571	571 (98.95%)	29.9 (19.7–41.5)	301.6 (214–406.1)	37.78 (25.2–48.82)	296.96 (118.54–466.97)
2007–2008	MEHHP	WRA	At or above poverty level	132	132 (98.48%)	27.5 (17.9–43.9)	327.2 (214–566.6)	34.71 (20–48.82)	282.8 (64.62–495.48)
2007–2008	MEHHP	WRA	Below poverty level	143	143 (100%)	29.9 (18.2–57)	235.7 (99.8–478.5)	44.36 (38.68–55.43)	236.15 (89.89–483.56)
2007–2008	MEHHP	WRA	Black non-Hispanic	129	129 (100%)	37.6 (20.7–48.7)	236.9 (72.7–692)	33.03 (14–51.2)	271.63 (95.79–483.56)
2007–2008	MEHHP	WRA	Mexican American	125	125 (99.2%)	20.6 (13.3–42.2)	251.2 (74–559.2)	30.12 (21.71–42.1)	281.89 (63.48–495.48)
2007–2008	MEHHP	WRA	Other	95	95 (100%)	21.2 (15.8–45.7)	506.7 (31.4–3398.7)	23 (2.58–1027.04)	296.96 (2.58–1027.04)
2007–2008	MEHHP	WRA	Unknown income	250	250 (98.4%)	24.2 (7.7–68.2)	588.7 (62.4–1077.5)	18 (7.81–306.59)	293.3 (9.92–306.59)
2007–2008	MEHHP	WRA	White non-Hispanic	222	222 (97.75%)	33.7 (16.6–48.2)	214 (94.6–406.1)	39 (20–64.31)	306.59 (64.62–466.97)
2007–2008	MEHP	Adults	All adults	2,021	2,021 (66.06%)	2.8 (2.1–3.7)	31.9 (22.1–53.8)	2.18 (1.96–2.48)	20.2 (14.16–29.19)
2007–2008	MEHP	Adults	At or above poverty level	505	505 (65.54%)	2.9 (2.2–3.9)	35.2 (22.1–64)	2.18 (1.96–2.45)	21.21 (14.63–30.22)
2007–2008	MEHP	Adults	Below poverty level	392	392 (68.88%)	2.8 (1.3–4.5)	29.8 (16.8–55.9)	2.14 (1.79–2.67)	15.38 (11.15–27.33)
2007–2008	MEHP	Adults	Black non-Hispanic	434	434 (73.96%)	3.8 (3.2–4.6)	29.6 (17.1–42.8)	2.31 (2.08–2.51)	16.42 (11.37–26.26)
2007–2008	MEHP	Adults	Females	1,030	1,030 (62.52%)	3.1 (2.4–4.3)	39.7 (27.3–71.6)	2.57 (2.2–2.99)	22.09 (11.37–46.13)
2007–2008	MEHP	Adults	Males	991	991 (69.73%)	2.8 (1.9–3.5)	30.6 (21.9–53.8)	2 (1.7–2.34)	20 (14.59–26.26)
2007–2008	MEHP	Adults	Mexican American	371	371 (68.73%)	3.4 (2.4–4.8)	30.6 (23.1–70.9)	2.29 (1.81–2.94)	27.21 (12.25–55.25)
2007–2008	MEHP	Adults	Other	294	294 (68.37%)	3.5 (0.78–13)	30.3 (20.6–63.1)	2.6 (2.11–3.39)	19.26 (15.26–49.77)
2007–2008	MEHP	Adults	Unknown income	948	948 (66.14%)	1.6 (0.78–3.7)	23.1 (6.8–70.9)	2.39 (1.64–3.27)	15.6 (6.86–46.13)
2007–2008	MEHP	Adults	White non-Hispanic	922	922 (60.52%)	2.4 (1.7–3.3)	39.7 (16.8–68.6)	2.09 (1.92–2.4)	19.84 (12.14–30.22)
2007–2008	MEHP	Children	Adolescents (11 to <16 years)	265	265 (70.19%)	2.3 (1.6–2.7)	40.3 (28.1–52.1)	2.48 (1.7–3.05)	16.31 (11.58–36.4)
2007–2008	MEHP	Children	Adolescents (11 to <16 years)	265	265 (70.19%)	2.3 (1.6–2.7)	40.3 (28.1–52.1)	2.48 (1.7–3.05)	33.58 (28.69–39.64)
2007–2008	MEHP	Children	All children	583	583 (70.5%)	2.1 (1.6–2.6)	24.8 (16.6–32.8)	2.39 (1.97–2.9)	16.15 (12.92–23.49)
2007–2008	MEHP	Children	At or above poverty level	162	162 (74.07%)	2.1 (1.3–2.7)	25.6 (13.6–35.1)	2.17 (1.86–2.98)	16.31 (12.44–21.89)
2007–2008	MEHP	Children	Below poverty level	186	186 (72.58%)	2.4 (1.8–2.9)	15.3 (8.2–30.7)	2.79 (1.92–3.82)	13.55 (11.91–24.76)
2007–2008	MEHP	Children	Black non-Hispanic	163	163 (76.69%)	2.4 (2–3.6)	18.2 (14–28.5)	2.64 (2.06–3.36)	16.42 (13.39–38.89)
2007–2008	MEHP	Children	Children (6 to <11 years)	318	318 (70.75%)	2.1 (1.5–2.9)	43.2 (34.9–56.5)	2.69 (2.11–3.33)	15.63 (11.91–26.48)
2007–2008	MEHP	Children	Children (6 to <11 years)	318	318 (70.75%)	2.1 (1.5–2.9)	43.2 (34.9–56.5)	2.69 (2.11–3.33)	51.58 (43.49–67.86)
2007–2008	MEHP	Children	Females	280	280 (68.57%)	2.4 (1.4–3.6)	27.6 (14.3–42.4)	2.9 (2–3.71)	17.72 (14.31–37.3)
2007–2008	MEHP	Children	Males	303	303 (72.28%)	2.1 (1.7–2.5)	24.8 (12.4–35.1)	1.96 (1.72–2.55)	13.51 (11.58–20.7)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2007–2008	MEHP	Children	Mexican American	160	160 (69.38%)	2.4 (1.8–2.7)	24.3 (10.7–55.1)	2.23 (1.92–2.7)	26 (12.6–55.25)
2007–2008	MEHP	Children	Other	105	105 (67.62%)	1.8 (0.78–2.8)	34.9 (7.2–63.1)	2.57 (1.56–3.5)	16.31 (10–71.7)
2007–2008	MEHP	Children	Unknown income	196	196 (65.31%)	1.7 (0.78–2.8)	22.9 (2.8–63.4)	2.79 (1.38–5.2)	17.72 (4.02–50.32)
2007–2008	MEHP	Children	White non-Hispanic	155	155 (67.1%)	2 (1.3–3)	21.1 (12.4–32.8)	2.17 (1.86–3.06)	15.54 (8.27–23.49)
2007–2008	MEHP	WRA	All women of reproductive age	571	571 (71.28%)	3.1 (2.4–4.3)	39.7 (27.3–71.6)	2.83 (2–3.87)	16.15 (10.5–46.13)
2007–2008	MEHP	WRA	At or above poverty level	132	132 (74.24%)	3.1 (2.2–4.4)	47 (19.8–74.1)	2.52 (1.86–3.95)	15.12 (6.51–108.89)
2007–2008	MEHP	WRA	Below poverty level	143	143 (73.43%)	3.1 (2–6)	29.7 (13–104.2)	3.55 (1.9–4.78)	16.15 (7.42–60)
2007–2008	MEHP	WRA	Black non-Hispanic	129	129 (79.84%)	5.2 (3.4–7)	48.6 (14–78.7)	3.17 (2.23–4.78)	38.89 (12.92–48.16)
2007–2008	MEHP	WRA	Mexican American	125	125 (74.4%)	2.9 (2–4.5)	74.3 (17.3–139.1)	2.78 (2.05–3.55)	60 (4.81–131.19)
2007–2008	MEHP	WRA	Other	95	95 (73.68%)	3.9 (1.9–5.6)	31.9 (5–216.5)	2.79 (0.58–108.89)	9.35 (1.81–108.89)
2007–2008	MEHP	WRA	Unknown income	250	250 (68%)	3.6 (0.78–10.4)	60 (10.4–204.7)	2.43 (0.98–50.32)	46.13 (1.7–50.32)
2007–2008	MEHP	WRA	White non-Hispanic	222	222 (63.51%)	2.9 (1.7–5.1)	25 (11.9–58.2)	2.2 (1.86–3.87)	10.6 (4.92–26.48)
2007–2008	MEOHP	Adults	All adults	2,021	2,021 (98.02%)	11 (9.3–14)	126.4 (83.7–168.5)	10.37 (9.25–11.88)	102.4 (74.66–144.13)
2007–2008	MEOHP	Adults	At or above poverty level	505	505 (98.42%)	12 (9.5–14.4)	129.8 (83.7–157.1)	10.35 (9.16–11.89)	106.91 (80–148.73)
2007–2008	MEOHP	Adults	Below poverty level	392	392 (98.47%)	12.9 (9.1–20)	167.5 (57.3–353.8)	11.36 (10.14–13.64)	92.79 (53.03–135.83)
2007–2008	MEOHP	Adults	Black non-Hispanic	434	434 (98.62%)	14.4 (12.7–16.6)	110.9 (57.9–201.3)	9.7 (9.12–11.02)	73.3 (42.24–123.5)
2007–2008	MEOHP	Adults	Females	1,030	1,030 (98.16%)	15.9 (12.1–21.4)	168.5 (101.3–246.5)	12.94 (11.89–13.72)	118.25 (84.13–179.85)
2007–2008	MEOHP	Adults	Males	991	991 (97.88%)	10.9 (9.1–14)	118.3 (83.7–174)	9.24 (8.08–10.56)	86.29 (56.54–144.13)
2007–2008	MEOHP	Adults	Mexican American	371	371 (98.65%)	11.2 (8.6–14.8)	115.1 (47.4–162.4)	10.2 (8.27–12.67)	108.01 (67.86–163.55)
2007–2008	MEOHP	Adults	Other	294	294 (98.98%)	11 (6.4–32.7)	162.2 (81–278.8)	11.76 (8.29–15.61)	80.57 (53.04–249.15)
2007–2008	MEOHP	Adults	Unknown income	948	948 (97.57%)	7 (4.4–8.3)	91.7 (14–269.3)	8.18 (6.71–11.09)	63.28 (48.65–150.77)
2007–2008	MEOHP	Adults	White non-Hispanic	922	922 (97.18%)	10.6 (8.3–14.1)	129.8 (74–174)	10.37 (8.93–12.26)	106.91 (74.79–151.09)
2007–2008	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.25%)	361.9 (204.4–826.5)	40.3 (28.1–52.1)	13.71 (10.99–16.85)	119.2 (52.82–159.06)
2007–2008	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.25%)	361.9 (204.4–826.5)	40.3 (28.1–52.1)	13.71 (10.99–16.85)	203.82 (92.16–372.84)
2007–2008	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.25%)	361.9 (204.4–826.5)	40.3 (28.1–52.1)	24.51 (20.37–28.05)	119.2 (52.82–159.06)
2007–2008	MEOHP	Children	Adolescents (11 to <16 years)	265	265 (99.25%)	361.9 (204.4–826.5)	40.3 (28.1–52.1)	24.51 (20.37–28.05)	203.82 (92.16–372.84)
2007–2008	MEOHP	Children	All children	583	583 (99.31%)	16.2 (12.4–19.8)	174 (121.4–242.7)	15 (13.12–18.71)	137.14 (107.38–163)
2007–2008	MEOHP	Children	At or above poverty level	162	162 (100%)	13.7 (10.9–19.3)	197.3 (145.4–242.7)	14.34 (12.52–18.1)	151.09 (90.43–198.71)
2007–2008	MEOHP	Children	Below poverty level	186	186 (99.46%)	19.2 (14.3–23.3)	127.8 (50.8–274.7)	18.44 (13.64–25)	105 (66.33–186.52)
2007–2008	MEOHP	Children	Black non-Hispanic	163	163 (99.39%)	16.7 (13–20.2)	120.4 (65.1–229.3)	13.04 (11.27–15.29)	105 (73.04–154.49)
2007–2008	MEOHP	Children	Children (6 to <11 years)	318	318 (99.37%)	356.9 (155.4–440.8)	43.2 (34.9–56.5)	19.52 (15.22–23.3)	150.77 (68.89–238.72)
2007–2008	MEOHP	Children	Children (6 to <11 years)	318	318 (99.37%)	356.9 (155.4–440.8)	43.2 (34.9–56.5)	19.52 (15.22–23.3)	282.8 (122.36–466.97)
2007–2008	MEOHP	Children	Children (6 to <11 years)	318	318 (99.37%)	356.9 (155.4–440.8)	43.2 (34.9–56.5)	33.03 (25.68–40.43)	150.77 (68.89–238.72)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2007–2008	MEOHP	Children	Children (6 to <11 years)	318	318 (99.37%)	356.9 (155.4–440.8)	43.2 (34.9–56.5)	33.03 (25.68–40.43)	282.8 (122.36–466.97)
2007–2008	MEOHP	Children	Females	280	280 (98.93%)	17 (10.9–24.2)	146 (75.7–260.2)	19.52 (14.15–23.48)	166.77 (84.79–238.72)
2007–2008	MEOHP	Children	Males	303	303 (99.67%)	14.2 (11.9–19)	174 (80–242.7)	13.85 (11.35–15.63)	131.82 (68.89–151.09)
2007–2008	MEOHP	Children	Mexican American	160	160 (99.38%)	15.7 (12.9–19.4)	113.1 (56.9–172.7)	14.72 (9.61–22.6)	112.56 (67.74–137.14)
2007–2008	MEOHP	Children	Other	105	105 (100%)	11.5 (7.8–20.1)	211.3 (57.5–531.4)	14.2 (12–19.38)	113.18 (35.97–283.98)
2007–2008	MEOHP	Children	Unknown income	196	196 (98.98%)	16.9 (6.7–21.8)	137.2 (21.8–172.8)	16.54 (8.4–30)	137.14 (22.21–166.77)
2007–2008	MEOHP	Children	White non-Hispanic	155	155 (98.71%)	17.1 (10.9–22.6)	178.8 (119.9–257.7)	16.67 (12.88–20.77)	150.77 (84.26–198.71)
2007–2008	MEOHP	WRA	All women of reproductive age	571	571 (98.6%)	15.9 (12.1–21.4)	168.5 (101.3–246.5)	21.3 (15.29–27.43)	166.77 (84.13–238.72)
2007–2008	MEOHP	WRA	At or above poverty level	132	132 (96.97%)	15.8 (10.7–23.3)	171.9 (101.3–246.5)	20.51 (12.97–26.92)	163 (37.58–269.29)
2007–2008	MEOHP	WRA	Below poverty level	143	143 (100%)	18.6 (12.7–26.1)	110.9 (52.5–218.3)	26.15 (20.83–37.08)	120.38 (56.85–186.52)
2007–2008	MEOHP	WRA	Black non-Hispanic	129	129 (100%)	22.1 (11.8–30.5)	220.1 (51.5–368.8)	20.83 (10–29.74)	154.49 (50.96–319.33)
2007–2008	MEOHP	WRA	Mexican American	125	125 (98.4%)	13.1 (8.7–22.9)	167.5 (41.5–332)	17.71 (12.67–24.84)	141.56 (36.67–269.29)
2007–2008	MEOHP	WRA	Other	95	95 (100%)	12.7 (9–22.7)	227.7 (19.3–1919.9)	13.92 (1.72–549.07)	186.52 (1.72–549.07)
2007–2008	MEOHP	WRA	Unknown income	250	250 (98.4%)	13.7 (4.9–43.9)	320 (43.9–753.1)	12 (4.22–166.77)	137.14 (5.45–166.77)
2007–2008	MEOHP	WRA	White non-Hispanic	222	222 (97.3%)	16.6 (10.6–24.8)	134 (52.5–246.5)	24.92 (12.33–37.58)	163 (37.58–238.72)
2005–2006	MECPP	Adults	All adults	1,831	1,831 (99.95%)	43.5 (31.8–51.7)	642.2 (386.2–905.4)	32.58 (29.11–37.59)	289.2 (251.44–324.34)
2005–2006	MECPP	Adults	At or above poverty level	436	436 (99.77%)	45 (31.8–52.7)	642.2 (380.4–968.8)	32.42 (28.71–37.33)	289.2 (251.44–324.34)
2005–2006	MECPP	Adults	Below poverty level	340	340 (100%)	32.8 (23.4–57.4)	536.7 (337.5–1215.9)	34.63 (28.07–40.29)	311.78 (205.98–457.83)
2005–2006	MECPP	Adults	Black non-Hispanic	464	464 (99.78%)	39.5 (32.3–47)	436.6 (205.4–968.8)	26.49 (22.34–30.81)	311.78 (201.46–426.98)
2005–2006	MECPP	Adults	Females	935	935 (100%)	32 (26.1–39.8)	385.6 (213.7–958.8)	39.47 (34.55–46.71)	257.53 (205.71–325.78)
2005–2006	MECPP	Adults	Males	896	896 (99.89%)	44.3 (31.8–51.9)	642.2 (380.4–885.2)	28.87 (25.74–32.12)	301.38 (248.5–376.31)
2005–2006	MECPP	Adults	Mexican American	390	390 (100%)	32.8 (21–50.7)	641.3 (164.8–1215.9)	29.69 (24.46–34.85)	295.31 (172.12–501.2)
2005–2006	MECPP	Adults	Other	131	131 (100%)	28.5 (18.7–46)	322.6 (66.2–2997.5)	30.77 (19.33–43.72)	287.81 (107.5–1541.45)
2005–2006	MECPP	Adults	Unknown income	955	955 (100%)	29.6 (14.1–217.1)	269 (24.1–806.7)	39.26 (23.05–56.19)	202.26 (81–442)
2005–2006	MECPP	Adults	White non-Hispanic	846	846 (100%)	48.8 (36.8–53.9)	642.2 (364.6–1203.9)	34.95 (30.04–39.94)	284.33 (242.91–324.34)
2005–2006	MECPP	Children	Adolescents (11 to <16 years)	412	412 (100%)	22.5 (19.1–26.2)	204.6 (147.5–368.8)	16.79 (14.17–21.57)	136.4 (76.72–222.77)
2005–2006	MECPP	Children	Adolescents (11 to <16 years)	412	412 (100%)	22.5 (19.1–26.2)	204.6 (147.5–368.8)	16.79 (14.17–21.57)	301.48 (155.22–500.46)
2005–2006	MECPP	Children	Adolescents (11 to <16 years)	412	412 (100%)	22.5 (19.1–26.2)	204.6 (147.5–368.8)	37.08 (31.6–45.1)	136.4 (76.72–222.77)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2005–2006	MECPP	Children	Adolescents (11 to <16 years)	412	412 (100%)	22.5 (19.1–26.2)	204.6 (147.5–368.8)	37.08 (31.6–45.1)	301.48 (155.22–500.46)
2005–2006	MECPP	Children	All children	717	717 (100%)	51.9 (44.1–63.2)	416.5 (275.8–815.5)	47.44 (41.73–54.21)	350.65 (218.06–479.52)
2005–2006	MECPP	Children	At or above poverty level	185	185 (100%)	53.5 (44.1–63.7)	418.5 (275.8–613.8)	45.67 (41.73–53.31)	296.09 (248.5–460)
2005–2006	MECPP	Children	Below poverty level	195	195 (100%)	52 (38.5–73.9)	431.3 (131.9–1572.2)	45.34 (35.95–58.96)	389.85 (134.55–802.14)
2005–2006	MECPP	Children	Black non-Hispanic	214	214 (100%)	53.7 (43.7–67)	454.5 (283.9–1159.8)	38.99 (30.79–49.21)	377.55 (214.8–716.14)
2005–2006	MECPP	Children	Children (6 to <11 years)	305	305 (100%)	24.3 (19.7–28.1)	124.3 (80.7–336.7)	24.71 (22.43–26.19)	129.35 (85.85–195.06)
2005–2006	MECPP	Children	Children (6 to <11 years)	305	305 (100%)	24.3 (19.7–28.1)	124.3 (80.7–336.7)	24.71 (22.43–26.19)	311.78 (185–479.52)
2005–2006	MECPP	Children	Children (6 to <11 years)	305	305 (100%)	24.3 (19.7–28.1)	124.3 (80.7–336.7)	56.02 (49.75–66.51)	129.35 (85.85–195.06)
2005–2006	MECPP	Children	Children (6 to <11 years)	305	305 (100%)	24.3 (19.7–28.1)	124.3 (80.7–336.7)	56.02 (49.75–66.51)	311.78 (185–479.52)
2005–2006	MECPP	Children	Females	343	343 (100%)	48.6 (43.3–55)	384.9 (225.8–547.6)	51.35 (44.67–55.7)	296.09 (172.28–460)
2005–2006	MECPP	Children	Males	374	374 (100%)	58 (42.6–69)	510 (246–1273.5)	43.01 (35.07–54.06)	384.05 (219.43–531.24)
2005–2006	MECPP	Children	Mexican American	247	247 (100%)	41.3 (31.3–54.2)	362.1 (224.7–514.5)	38.25 (31.9–46.8)	277.89 (194.82–542.98)
2005–2006	MECPP	Children	Other	64	64 (100%)	60.5 (45.2–78.9)	903.1 (166.3–1273.5)	62.46 (42.24–78.44)	531.24 (118.49–597.89)
2005–2006	MECPP	Children	Unknown income	319	319 (100%)	33.9 (11.5–57.7)	126.8 (43.3–416.5)	55.67 (12.52–81.7)	150.32 (61.23–277.89)
2005–2006	MECPP	Children	White non-Hispanic	192	192 (100%)	51.6 (42.6–67.7)	367.8 (203.2–1447.4)	48.46 (42.02–55.67)	289.2 (160.28–479.52)
2005–2006	MECPP	WRA	All women of reproductive age	616	616 (100%)	32 (26.1–39.8)	385.6 (213.7–958.8)	63.24 (51.68–75.97)	289.2 (172.28–479.52)
2005–2006	MECPP	WRA	At or above poverty level	143	143 (100%)	31.1 (25.5–37.7)	385.6 (160.2–1055)	56.94 (47.78–71.31)	265 (159.01–479.52)
2005–2006	MECPP	WRA	Below poverty level	146	146 (100%)	32.8 (23.8–50.7)	290.1 (165.5–3289.1)	84.36 (51.68–118.96)	311.78 (118.96–860.21)
2005–2006	MECPP	WRA	Black non-Hispanic	162	162 (100%)	41.1 (25.8–70.3)	485.9 (324.2–722.8)	71.31 (42.5–147.22)	716.14 (156.78–802.14)
2005–2006	MECPP	WRA	Mexican American	158	158 (100%)	28.1 (19.2–41.3)	393.9 (104.3–7782.6)	52.92 (42.07–80)	296.09 (186.52–860.21)
2005–2006	MECPP	WRA	Other	62	62 (100%)	32.1 (20.3–63)	297.4 (69–1571.7)	70.86 (30.89–457.83)	457.83 (30.89–457.83)
2005–2006	MECPP	WRA	Unknown income	299	299 (100%)	75 (11.2–265.3)	385.7 (27.1–1155.4)	61.23 (20.53–277.89)	277.89 (20.53–277.89)
2005–2006	MECPP	WRA	White non-Hispanic	234	234 (100%)	29.6 (20.4–44.9)	339.8 (160.2–958.8)	59.41 (47.44–82.57)	172.28 (118.96–479.52)
2005–2006	MEHHP	Adults	All adults	1,831	1,831 (99.56%)	29.1 (23.2–35.3)	623.5 (354.8–738.4)	21.55 (18.86–24.06)	235.16 (181.46–298.1)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2005–2006	MEHHP	Adults	At or above poverty level	436	436 (99.54%)	29.6 (23.7–36.3)	625.9 (275.1–793.2)	21.43 (18.53–24.06)	230.96 (180.95–321.09)
2005–2006	MEHHP	Adults	Below poverty level	340	340 (99.12%)	21.8 (15.4–41)	354.8 (112.4–788.2)	23.12 (17.94–28.89)	232.41 (115.77–319.11)
2005–2006	MEHHP	Adults	Black non-Hispanic	464	464 (99.78%)	32.2 (26.7–41.2)	546.7 (192.8–918.2)	18.56 (16.67–22.76)	279.21 (154.19–400.69)
2005–2006	MEHHP	Adults	Females	935	935 (99.36%)	21.8 (17.3–26.6)	288.2 (169.9–598.4)	25 (19.63–28.85)	181.46 (118.61–258.33)
2005–2006	MEHHP	Adults	Males	896	896 (99.78%)	29.6 (23.2–36.3)	623.5 (364.4–738.4)	20.17 (17.5–23.33)	248.97 (202.16–352.46)
2005–2006	MEHHP	Adults	Mexican American	390	390 (99.23%)	19.05 (13.8–22.9)	354.8 (140.1–813.5)	17.49 (14.73–20.95)	248.97 (115.77–372.1)
2005–2006	MEHHP	Adults	Other	131	131 (100%)	20.4 (11.8–41.6)	384.4 (35.3–2231.7)	17.82 (13.6–26.36)	224.18 (55.4–724.47)
2005–2006	MEHHP	Adults	Unknown income	955	955 (99.69%)	23.5 (7.6–106.9)	133 (111.4–313.4)	19.12 (14–33.67)	83.76 (45.96–181.46)
2005–2006	MEHHP	Adults	White non-Hispanic	846	846 (99.53%)	31.1 (25.1–39.8)	625.9 (237.9–793.2)	22.53 (19.51–25.26)	226.65 (176.06–296.85)
2005–2006	MEHHP	Children	Adolescents (11 to <16 years)	412	412 (99.51%)	2.8 (2.1–3.6)	39.7 (18–59.6)	2.47 (1.93–3.11)	197.34 (118.71–342.39)
2005–2006	MEHHP	Children	Adolescents (11 to <16 years)	412	412 (99.51%)	2.8 (2.1–3.6)	39.7 (18–59.6)	2.47 (1.93–3.11)	23.64 (10.9–43.69)
2005–2006	MEHHP	Children	Adolescents (11 to <16 years)	412	412 (99.51%)	2.8 (2.1–3.6)	39.7 (18–59.6)	26.15 (21.72–32.18)	197.34 (118.71–342.39)
2005–2006	MEHHP	Children	Adolescents (11 to <16 years)	412	412 (99.51%)	2.8 (2.1–3.6)	39.7 (18–59.6)	26.15 (21.72–32.18)	23.64 (10.9–43.69)
2005–2006	MEHHP	Children	All children	717	717 (99.72%)	34.3 (30.9–40.5)	287.9 (185.5–480.3)	29.53 (27.47–34.31)	224.18 (151.61–333)
2005–2006	MEHHP	Children	At or above poverty level	185	185 (100%)	34.3 (30.3–40.8)	257.6 (174.9–480.3)	29.07 (26.96–33.01)	212.68 (130.52–280.26)
2005–2006	MEHHP	Children	Below poverty level	195	195 (100%)	37 (27.5–45.7)	288.1 (94.5–1061.4)	34.31 (25.1–39.24)	342.39 (71.49–896.73)
2005–2006	MEHHP	Children	Black non-Hispanic	214	214 (99.07%)	36.6 (30.2–43.3)	434.6 (217–981.8)	27.39 (23.13–32.08)	278.95 (155.24–702.63)
2005–2006	MEHHP	Children	Children (6 to <11 years)	305	305 (100%)	2.9 (2.4–3.3)	19.7 (13.9–28.7)	3.22 (2.69–3.7)	20.74 (11.25–29.25)
2005–2006	MEHHP	Children	Children (6 to <11 years)	305	305 (100%)	2.9 (2.4–3.3)	19.7 (13.9–28.7)	3.22 (2.69–3.7)	248.97 (132.95–346.87)
2005–2006	MEHHP	Children	Children (6 to <11 years)	305	305 (100%)	2.9 (2.4–3.3)	19.7 (13.9–28.7)	37.69 (33.67–40.91)	20.74 (11.25–29.25)
2005–2006	MEHHP	Children	Children (6 to <11 years)	305	305 (100%)	2.9 (2.4–3.3)	19.7 (13.9–28.7)	37.69 (33.67–40.91)	248.97 (132.95–346.87)
2005–2006	MEHHP	Children	Females	343	343 (99.71%)	30.9 (28.1–33.2)	257.6 (174.9–335.9)	31.93 (27.97–36.98)	182.08 (118.71–272.42)
2005–2006	MEHHP	Children	Males	374	374 (99.73%)	39 (31.6–44.9)	434.6 (164.8–836.4)	28.37 (25.04–34.81)	248.97 (138.87–363.65)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2005–2006	MEHHP	Children	Mexican American	247	247 (100%)	25.7 (21.2–30)	223.2 (117.9–479.3)	23.92 (19.58–26.98)	181.46 (118.86–417.28)
2005–2006	MEHHP	Children	Other	64	64 (100%)	40.5 (26–69.1)	618.2 (105.3–672)	37.98 (28.02–49.67)	346.87 (88.41–436.36)
2005–2006	MEHHP	Children	Unknown income	319	319 (99.37%)	17 (11.1–33.2)	94 (33.2–405)	33.67 (14.91–62.64)	151.61 (40.27–212.04)
2005–2006	MEHHP	Children	White non-Hispanic	192	192 (100%)	34.7 (30.3–44)	231.9 (156.1–597.8)	32.18 (26.96–37.29)	202.16 (118.61–333)
2005–2006	MEHHP	WRA	All women of reproductive age	616	616 (99.35%)	21.8 (17.3–26.6)	288.2 (169.9–598.4)	37.57 (29.53–49.48)	223.33 (105.46–346.87)
2005–2006	MEHHP	WRA	At or above poverty level	143	143 (98.6%)	21.5 (16.8–27)	287.3 (137.3–646.6)	36.98 (29.25–48.15)	180.76 (100.85–272.42)
2005–2006	MEHHP	WRA	Below poverty level	146	146 (99.32%)	23.1 (18.1–32.5)	237 (99.6–1425)	40 (31.43–65.71)	266.28 (65.71–1103.01)
2005–2006	MEHHP	WRA	Black non-Hispanic	162	162 (100%)	31.1 (19.6–50.2)	355.8 (215.4–631.8)	39.84 (27.88–91.42)	702.63 (114.67–1103.01)
2005–2006	MEHHP	WRA	Mexican American	158	158 (98.1%)	17.3 (11.4–23.9)	288.2 (91.3–7438.1)	29.7 (25.54–43.6)	181.46 (86.47–547.37)
2005–2006	MEHHP	WRA	Other	62	62 (100%)	26 (14.3–39.9)	155.9 (42–1025.5)	49.48 (15.8–346.87)	346.87 (15.8–346.87)
2005–2006	MEHHP	WRA	Unknown income	299	299 (99.67%)	45 (6.4–240.3)	313.4 (23.5–666.4)	19.47 (14.91–181.46)	181.46 (14.91–181.46)
2005–2006	MEHHP	WRA	White non-Hispanic	234	234 (99.57%)	21.2 (14.9–26.6)	208.8 (121.7–1071.1)	36.98 (27.97–52.39)	100.85 (69.88–272.42)
2005–2006	MEHP	Adults	All adults	1,831	1,831 (67.67%)	3.7 (2.8–4.3)	65.2 (35.2–112.6)	2.5 (2.27–2.66)	26.36 (19.28–33.12)
2005–2006	MEHP	Adults	At or above poverty level	436	436 (64.91%)	3.6 (2.8–4.3)	70.7 (35.4–112.6)	2.55 (2.3–2.81)	26.5 (18.51–35.8)
2005–2006	MEHP	Adults	Below poverty level	340	340 (70.59%)	3.4 (1.9–5.1)	46.35 (14.4–152.3)	2.21 (1.93–2.5)	33.12 (15.96–50.87)
2005–2006	MEHP	Adults	Black non-Hispanic	464	464 (75%)	4.2 (3.1–6)	125.1 (24.8–254.6)	2.26 (1.86–2.64)	46.84 (16.69–84.43)
2005–2006	MEHP	Adults	Females	935	935 (65.13%)	3.1 (2.3–3.8)	45.3 (26.2–90.2)	2.87 (2.43–3.25)	18.06 (13.73–20.89)
2005–2006	MEHP	Adults	Males	896	896 (70.31%)	3.6 (2.8–4.4)	62.8 (35.2–112.6)	2.3 (2.12–2.61)	31 (21.47–51.15)
2005–2006	MEHP	Adults	Mexican American	390	390 (66.92%)	2.9 (1.8–3.7)	43.8 (28.1–178.5)	2.19 (1.98–2.5)	26.36 (16.59–39.47)
2005–2006	MEHP	Adults	Other	131	131 (74.81%)	3.4 (0.85–14.8)	43.4 (11.6–318.1)	2.3 (1.57–4.17)	31.13 (8.18–135.94)
2005–2006	MEHP	Adults	Unknown income	955	955 (68.27%)	3.5 (0.85–9.2)	20.1 (9.2–30.1)	2.66 (1.89–3.54)	10.6 (6.92–16.59)
2005–2006	MEHP	Adults	White non-Hispanic	846	846 (62.88%)	3.7 (2.5–4.5)	60 (27.3–112.6)	2.64 (2.36–2.91)	23.68 (18.02–33.12)
2005–2006	MEHP	Children	Adolescents (11 to <16 years)	412	412 (69.9%)	2.8 (2.1–3.6)	50.5 (41–62.8)	2.47 (1.93–3.11)	23.64 (10.9–43.69)
2005–2006	MEHP	Children	Adolescents (11 to <16 years)	412	412 (69.9%)	2.8 (2.1–3.6)	50.5 (41–62.8)	2.47 (1.93–3.11)	37.08 (31.6–45.1)
2005–2006	MEHP	Children	All children	717	717 (71.69%)	2.9 (2.7–3.2)	27.3 (19.3–53.2)	2.65 (2.4–3.09)	22.37 (14.17–31.3)
2005–2006	MEHP	Children	At or above poverty level	185	185 (67.03%)	2.9 (2.6–3.2)	27.3 (19.3–51.6)	2.71 (2.46–3.22)	23.15 (14.17–30.23)
2005–2006	MEHP	Children	Below poverty level	195	195 (68.72%)	2.3 (1.4–3.4)	36.6 (9.8–164.8)	2.24 (1.6–3.26)	19.57 (6.39–124.85)
2005–2006	MEHP	Children	Black non-Hispanic	214	214 (77.57%)	3.3 (2.3–4.6)	59 (17.8–164.8)	2.69 (1.86–3.33)	39.95 (15.27–98.17)
2005–2006	MEHP	Children	Children (6 to <11 years)	305	305 (74.1%)	2.9 (2.4–3.3)	51.8 (42.5–69.3)	3.22 (2.69–3.7)	20.74 (11.25–29.25)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2005–2006	MEHP	Children	Children (6 to <11 years)	305	305 (74.1%)	2.9 (2.4–3.3)	51.8 (42.5–69.3)	3.22 (2.69–3.7)	56.02 (49.75–66.51)
2005–2006	MEHP	Children	Females	343	343 (69.1%)	2.8 (2.3–3.4)	22.3 (17–39.7)	2.94 (2.48–3.7)	22.37 (11.36–31.76)
2005–2006	MEHP	Children	Males	374	374 (74.06%)	3 (2.5–3.3)	28.7 (16.9–59.2)	2.5 (2.16–2.97)	23.15 (12.34–30.23)
2005–2006	MEHP	Children	Mexican American	247	247 (63.56%)	1.8 (1.4–2.4)	19.7 (13.6–38)	2.11 (1.87–2.35)	20.26 (11.86–31.3)
2005–2006	MEHP	Children	Other	64	64 (82.81%)	3.1 (2.4–4.7)	43.4 (10–59.2)	3.83 (2.48–5.78)	26.24 (7.46–34.82)
2005–2006	MEHP	Children	Unknown income	319	319 (75.55%)	2.2 (0.85–2.5)	25.7 (2.5–46.6)	3.67 (1.57–4.82)	19.03 (4.53–24.4)
2005–2006	MEHP	Children	White non-Hispanic	192	192 (71.88%)	3 (2.4–3.4)	23.2 (16.9–39.7)	2.7 (2.36–3.5)	17.75 (11.25–28.23)
2005–2006	MEHP	WRA	All women of reproductive age	616	616 (71.59%)	3.1 (2.3–3.8)	45.3 (26.2–90.2)	3.44 (2.5–4.42)	20.3 (9.72–35.44)
2005–2006	MEHP	WRA	At or above poverty level	143	143 (72.73%)	2.9 (2–3.7)	45.3 (24.5–130.3)	3.61 (2.35–4.88)	20.3 (8.5–28.23)
2005–2006	MEHP	WRA	Below poverty level	146	146 (76.03%)	3.6 (2.3–6.2)	36.2 (17.3–72.8)	3.17 (1.1–6.38)	17.35 (6.39–124.85)
2005–2006	MEHP	WRA	Black non-Hispanic	162	162 (84.57%)	4.5 (3.2–5.6)	70.7 (34.5–93.4)	3.45 (2.07–7.46)	103.51 (11.42–124.85)
2005–2006	MEHP	WRA	Mexican American	158	158 (67.09%)	2.4 (0.85–4.2)	41.3 (10.5–1966.1)	2.5 (1.98–4.11)	31.3 (6.07–122.32)
2005–2006	MEHP	WRA	Other	62	62 (77.42%)	3.5 (2.1–6.3)	20.1 (6.4–167.5)	3.61 (0.84–17.59)	7.27 (0.84–17.59)
2005–2006	MEHP	WRA	Unknown income	299	299 (68.56%)	10.5 (0.85–26.2)	34.1 (10.5–123.9)	2.63 (0.75–20.89)	20.89 (0.75–20.89)
2005–2006	MEHP	WRA	White non-Hispanic	234	234 (64.1%)	2.2 (1.5–3.7)	42 (13.2–225.6)	3.7 (2.39–4.88)	9.72 (5.69–28.23)
2005–2006	MEOHP	Adults	All adults	1831	1831 (98.8%)	17.9 (15–21.1)	271 (188.8–447.8)	13.33 (12.1–15)	137.39 (111.84–156.06)
2005–2006	MEOHP	Adults	At or above poverty level	436	436 (99.31%)	18.4 (15.1–22.4)	298.4 (180–492.1)	13.27 (11.86–15)	136.94 (105.64–181.5)
2005–2006	MEOHP	Adults	Below poverty level	340	340 (98.82%)	15.4 (10.7–23.5)	211 (70.7–415)	14.61 (10.98–17.45)	148.96 (77.23–200)
2005–2006	MEOHP	Adults	Black non-Hispanic	464	464 (99.57%)	19.3 (15.7–24.4)	276.4 (134.6–394.1)	10.8 (9.46–15.34)	162.63 (99.57–239.29)
2005–2006	MEOHP	Adults	Females	935	935 (98.4%)	14.5 (12.5–18)	186.7 (103–444.4)	15.71 (13.24–19)	117.48 (79.01–168.29)
2005–2006	MEOHP	Adults	Males	896	896 (99.22%)	18.2 (15.1–22.3)	293.1 (196.1–451.2)	12.53 (10.87–14.34)	146.76 (120.14–190.19)
2005–2006	MEOHP	Adults	Mexican American	390	390 (99.49%)	11.7 (8.3–16.1)	211 (76.7–505.5)	11.3 (9.02–13.59)	143.94 (63.53–200.29)
2005–2006	MEOHP	Adults	Other	131	131 (99.24%)	13.6 (8.3–20.5)	167.1 (24.8–1411.9)	12.22 (8.95–18.04)	140.4 (48.87–570.66)
2005–2006	MEOHP	Adults	Unknown income	955	955 (98.43%)	11.7 (3.9–61.7)	89.1 (61.7–352.1)	13.4 (9.2–22.86)	46.39 (28.89–146.5)
2005–2006	MEOHP	Adults	White non-Hispanic	846	846 (97.99%)	20.7 (15.4–23)	271 (168.2–853.4)	14.04 (12.69–15.8)	136.94 (111.84–156.06)
2005–2006	MEOHP	Children	Adolescents (11 to <16 years)	412	412 (99.27%)	540.5 (225.8–903.1)	50.5 (41–62.8)	16.79 (14.17–21.57)	136.4 (76.72–222.77)
2005–2006	MEOHP	Children	Adolescents (11 to <16 years)	412	412 (99.27%)	540.5 (225.8–903.1)	50.5 (41–62.8)	16.79 (14.17–21.57)	197.34 (118.71–342.39)
2005–2006	MEOHP	Children	Adolescents (11 to <16 years)	412	412 (99.27%)	540.5 (225.8–903.1)	50.5 (41–62.8)	26.15 (21.72–32.18)	136.4 (76.72–222.77)
2005–2006	MEOHP	Children	Adolescents (11 to <16 years)	412	412 (99.27%)	540.5 (225.8–903.1)	50.5 (41–62.8)	26.15 (21.72–32.18)	197.34 (118.71–342.39)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2005–2006	MEOHP	Children	All children	717	717 (99.44%)	23.4 (21.2–25.9)	179.1 (125.8–260)	19.93 (18.35–22.64)	137.3 (91.13–211.36)
2005–2006	MEOHP	Children	At or above poverty level	185	185 (99.46%)	23.9 (21.3–26.1)	159.4 (118.1–240)	19.23 (17.91–22.28)	136.4 (85.85–181.5)
2005–2006	MEOHP	Children	Below poverty level	195	195 (99.49%)	23.5 (19.6–30.5)	196.9 (63.5–690.6)	22.47 (13.86–28.6)	193.04 (45.14–504.11)
2005–2006	MEOHP	Children	Black non-Hispanic	214	214 (98.6%)	24.3 (19.9–28)	252.8 (147.5–635)	17.16 (14.36–21.41)	168.29 (84.89–356.14)
2005–2006	MEOHP	Children	Children (6 to <11 years)	305	305 (99.67%)	297.3 (196.4–492.4)	51.8 (42.5–69.3)	24.71 (22.43–26.19)	129.35 (85.85–195.06)
2005–2006	MEOHP	Children	Children (6 to <11 years)	305	305 (99.67%)	297.3 (196.4–492.4)	51.8 (42.5–69.3)	24.71 (22.43–26.19)	248.97 (132.95–346.87)
2005–2006	MEOHP	Children	Children (6 to <11 years)	305	305 (99.67%)	297.3 (196.4–492.4)	51.8 (42.5–69.3)	37.69 (33.67–40.91)	129.35 (85.85–195.06)
2005–2006	MEOHP	Children	Children (6 to <11 years)	305	305 (99.67%)	297.3 (196.4–492.4)	51.8 (42.5–69.3)	37.69 (33.67–40.91)	248.97 (132.95–346.87)
2005–2006	MEOHP	Children	Females	343	343 (99.42%)	21.3 (17.9–25)	161.9 (110.3–204.6)	22.02 (18.66–24.89)	129.35 (74.82–195.06)
2005–2006	MEOHP	Children	Males	374	374 (99.47%)	25.4 (22.3–27.6)	231.5 (101.6–591.7)	18.65 (16.18–23.64)	149.31 (85.85–241.83)
2005–2006	MEOHP	Children	Mexican American	247	247 (99.6%)	15.9 (13.3–19)	151.3 (75.3–259.1)	14.64 (13.24–17.77)	101.91 (74.41–247.63)
2005–2006	MEOHP	Children	Other	64	64 (100%)	27 (18.8–42.7)	325.5 (69.1–515.1)	22.71 (18.66–34.09)	211.36 (50.47–249.65)
2005–2006	MEOHP	Children	Unknown income	319	319 (99.37%)	13.5 (8.6–21.9)	55.1 (21.9–276.9)	23.13 (9.32–41.32)	83.06 (25.61–144.97)
2005–2006	MEOHP	Children	White non-Hispanic	192	192 (100%)	23.9 (20.5–27.5)	133.8 (93.9–368.8)	20.93 (18.35–24.83)	130.66 (66.6–222.22)
2005–2006	MEOHP	WRA	All women of reproductive age	616	616 (99.19%)	14.5 (12.5–18)	186.7 (103–444.4)	24.89 (20.93–30.83)	136.94 (74.82–195.06)
2005–2006	MEOHP	WRA	At or above poverty level	143	143 (99.3%)	13.9 (10.7–18.1)	186.9 (88.8–461.6)	25.2 (20.58–30.78)	116.8 (63.53–172.04)
2005–2006	MEOHP	WRA	Below poverty level	146	146 (99.32%)	15.8 (12.7–20.3)	153.3 (65.1–1209.2)	29.59 (23.27–42.73)	143.94 (42.73–600.71)
2005–2006	MEOHP	WRA	Black non-Hispanic	162	162 (100%)	18.8 (12.7–31)	255.5 (153.1–394.1)	25.41 (15.81–55.94)	356.14 (70.44–600.71)
2005–2006	MEOHP	WRA	Mexican American	158	158 (99.37%)	11.7 (10–16.1)	186.9 (61.5–4743.3)	20.75 (16.69–32.71)	129.35 (59.18–337.37)
2005–2006	MEOHP	WRA	Other	62	62 (100%)	18.1 (7.6–29.3)	103 (29.3–650.1)	34.09 (12.82–195.06)	195.06 (12.82–195.06)
2005–2006	MEOHP	WRA	Unknown income	299	299 (99%)	37.5 (4.5–131.1)	181.7 (17.4–402.1)	15.09 (8.07–129.35)	129.35 (8.07–129.35)
2005–2006	MEOHP	WRA	White non-Hispanic	234	234 (98.29%)	13.9 (11.5–17.1)	135.1 (80.1–795)	24.89 (20.58–31.67)	89.22 (43.37–136.94)
2003–2004	MECPP	Adults	All adults	1,889	1,889 (99.95%)	33.4 (27–38.4)	519.5 (222.4–858.8)	26.57 (23.48–30.81)	241.83 (174.85–369.27)
2003–2004	MECPP	Adults	At or above poverty level	474	474 (100%)	34 (26.5–38.7)	512.4 (243.7–858.8)	26.44 (23.37–30.49)	238.43 (177.97–360.11)
2003–2004	MECPP	Adults	Below poverty level	393	393 (100%)	30.2 (21.5–39.8)	335.2 (104.6–770.9)	27.26 (21.75–34.89)	224.41 (135.71–499.93)
2003–2004	MECPP	Adults	Black non-Hispanic	423	423 (99.76%)	43 (30.1–66.8)	390.9 (243.7–658.6)	26.83 (21.85–30.81)	205.21 (147.44–264.96)
2003–2004	MECPP	Adults	Females	980	980 (100%)	34.6 (29.1–42.4)	413.3 (222.1–658.6)	32.32 (26.76–38.29)	234.8 (150.73–362.99)
2003–2004	MECPP	Adults	Males	909	909 (99.89%)	33.2 (26.5–38.6)	525.5 (211.4–858.8)	23.54 (21.36–27.11)	247.53 (158.93–421.6)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2003–2004	MECPP	Adults	Mexican American	423	423 (100%)	33 (25.6–40.3)	168.8 (82.5–1098.6)	25.6 (23.55–28.12)	151.78 (118.46–207.47)
2003–2004	MECPP	Adults	Other	142	142 (100%)	29.3 (19.6–47.6)	472.1 (59.1–836.6)	30.52 (23.33–42.2)	209.61 (120.94–910.77)
2003–2004	MECPP	Adults	Unknown income	904	904 (99.89%)	33.9 (21.9–39.6)	870.8 (135–2131.8)	36.36 (20.78–56.88)	349.47 (85.85–1071.26)
2003–2004	MECPP	Adults	White non-Hispanic	901	901 (100%)	30.6 (24.8–38.4)	610.9 (186.5–942.2)	26.57 (23.11–31.38)	256.14 (177.97–417.38)
2003–2004	MECPP	Children	Adolescents (11 to <16 years)	430	430 (100%)	20.5 (17.6–23.6)	133.2 (63.6–248)	12.92 (11.82–15.04)	204.81 (120.48–360.25)
2003–2004	MECPP	Children	Adolescents (11 to <16 years)	430	430 (100%)	20.5 (17.6–23.6)	133.2 (63.6–248)	12.92 (11.82–15.04)	91.11 (46.48–159.04)
2003–2004	MECPP	Children	Adolescents (11 to <16 years)	430	430 (100%)	20.5 (17.6–23.6)	133.2 (63.6–248)	29.71 (26.12–34.27)	204.81 (120.48–360.25)
2003–2004	MECPP	Children	Adolescents (11 to <16 years)	430	430 (100%)	20.5 (17.6–23.6)	133.2 (63.6–248)	29.71 (26.12–34.27)	91.11 (46.48–159.04)
2003–2004	MECPP	Children	All children	716	716 (100%)	48.6 (42.2–55.6)	380.1 (238.3–596.9)	40.13 (33.7–49.29)	265.71 (180.77–446.69)
2003–2004	MECPP	Children	At or above poverty level	183	183 (100%)	45.6 (38.4–57)	373.1 (191.5–531.6)	38.4 (31.63–47.59)	247.26 (145.33–446.69)
2003–2004	MECPP	Children	Below poverty level	237	237 (100%)	51.7 (41.4–69.6)	472.8 (187.5–1097)	46.8 (32.91–66.75)	417.38 (135.71–987.57)
2003–2004	MECPP	Children	Black non-Hispanic	258	258 (100%)	56.6 (45.9–69.6)	413.3 (228.5–930.7)	41.63 (34.87–54.2)	293.35 (187.84–660.16)
2003–2004	MECPP	Children	Children (6 to <11 years)	286	286 (100%)	29 (18.7–39.8)	205.1 (98.7–261.6)	26.81 (19.3–34.16)	151.8 (79.73–447.65)
2003–2004	MECPP	Children	Children (6 to <11 years)	286	286 (100%)	29 (18.7–39.8)	205.1 (98.7–261.6)	26.81 (19.3–34.16)	385.23 (209.61–987.57)
2003–2004	MECPP	Children	Children (6 to <11 years)	286	286 (100%)	29 (18.7–39.8)	205.1 (98.7–261.6)	57.5 (45.05–79.01)	151.8 (79.73–447.65)
2003–2004	MECPP	Children	Children (6 to <11 years)	286	286 (100%)	29 (18.7–39.8)	205.1 (98.7–261.6)	57.5 (45.05–79.01)	385.23 (209.61–987.57)
2003–2004	MECPP	Children	Females	375	375 (100%)	44.1 (36.8–56)	468.4 (291.8–780.5)	42.97 (34.27–54.37)	360.25 (203.99–987.57)
2003–2004	MECPP	Children	Males	341	341 (100%)	51.3 (43.7–59.1)	337.2 (187.3–472.1)	37.73 (32.5–46.38)	213.88 (139.78–386.97)
2003–2004	MECPP	Children	Mexican American	229	229 (100%)	43.7 (36.8–56.1)	211.7 (136.6–378.2)	42 (35.76–53.79)	207.16 (144.41–369.27)
2003–2004	MECPP	Children	Other	52	52 (100%)	51.3 (33.9–59.3)	380.1 (189–472.1)	42.97 (26.12–64.04)	209.61 (81.88–386.97)
2003–2004	MECPP	Children	Unknown income	267	267 (100%)	56.8 (13.9–125.4)	228.5 (107.8–287.4)	64.21 (17.86–100.75)	187.84 (100.75–237.83)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2003–2004	MECPP	Children	White non-Hispanic	177	177 (100%)	45.7 (38.4–57.1)	394.8 (187.3–741.5)	37.27 (30.81–48.6)	282.89 (147.86–772.94)
2003–2004	MECPP	WRA	All women of reproductive age	606	606 (100%)	34.6 (29.1–42.4)	413.3 (222.1–658.6)	66.79 (46.89–100.34)	499.93 (245.31–1406.41)
2003–2004	MECPP	WRA	At or above poverty level	137	137 (100%)	32.8 (26.2–43.5)	364.8 (160.4–559.9)	65.95 (40.53–105.53)	256.14 (145.33–1027.06)
2003–2004	MECPP	WRA	Below poverty level	169	169 (100%)	37.9 (30–46.5)	257.2 (106.9–780.1)	69.76 (57.5–91.59)	1406.41 (98.57–1406.41)
2003–2004	MECPP	WRA	Black non-Hispanic	157	157 (100%)	49.7 (34.2–58.3)	617.2 (245.7–967)	66.79 (54.37–78.61)	200.65 (122.05–660.16)
2003–2004	MECPP	WRA	Mexican American	146	146 (100%)	29.6 (18.8–42.4)	311.7 (92.2–481.3)	63.87 (38–86)	224.41 (97.33–995.49)
2003–2004	MECPP	WRA	Other	49	49 (100%)	26.2 (19.8–50.8)	148.8 (36.1–148.8)	43.24 (23.33–196.94)	196.94 (23.33–196.94)
2003–2004	MECPP	WRA	Unknown income	262	262 (100%)	33.9 (21–125.4)	1097 (72.9–1097)	74.09 (30.5–237.83)	200.65 (30.5–237.83)
2003–2004	MECPP	WRA	White non-Hispanic	254	254 (100%)	35.9 (26.2–47.6)	465.2 (222.1–808.3)	71.55 (33.33–245.31)	987.57 (245.31–1406.41)
2003–2004	MEHHP	Adults	All adults	1,889	1,889 (99.68%)	22.9 (18.8–28.6)	387 (144.9–694.2)	17.9 (16.22–20)	174.4 (121.04–262.46)
2003–2004	MEHHP	Adults	At or above poverty level	474	474 (99.37%)	24.3 (18.6–29.7)	387 (139.5–757.2)	17.66 (16.15–19.57)	168.5 (118.77–231.61)
2003–2004	MEHHP	Adults	Below poverty level	393	393 (99.75%)	21 (15.7–27.3)	237 (75.9–515.3)	18.94 (15.45–21.46)	142.84 (97.89–277.64)
2003–2004	MEHHP	Adults	Black non-Hispanic	423	423 (99.76%)	33.5 (22.4–58.2)	301.6 (166.9–428.1)	19.61 (16.63–23)	154.8 (107.89–205.82)
2003–2004	MEHHP	Adults	Females	980	980 (99.69%)	23.2 (17.3–28.6)	266.2 (133.4–491.8)	20.13 (17.14–23.47)	164.77 (87.89–267.16)
2003–2004	MEHHP	Adults	Males	909	909 (99.67%)	22.9 (18.6–28.6)	399.3 (136.1–743.2)	17.08 (15.16–18.58)	192.52 (108.61–293.62)
2003–2004	MEHHP	Adults	Mexican American	423	423 (99.76%)	20.6 (16.7–25.8)	119.8 (55.2–743.2)	15.8 (13.48–19.3)	119.18 (73.95–160.91)
2003–2004	MEHHP	Adults	Other	142	142 (99.3%)	25.9 (11.2–40.5)	403.3 (103.1–827.7)	20.64 (15.96–25.68)	164.77 (108.9–563.08)
2003–2004	MEHHP	Adults	Unknown income	904	904 (99.78%)	23.5 (17.1–29.3)	553 (110.2–3141.4)	22 (15.16–33.53)	246.23 (54.34–1578.59)
2003–2004	MEHHP	Adults	White non-Hispanic	901	901 (99.67%)	22.5 (15.6–28.6)	420.1 (121.4–787.5)	17.71 (16.22–19.62)	193.51 (96.21–328.25)
2003–2004	MEHHP	Children	Adolescents (11 to <16 years)	430	430 (99.77%)	2 (1.4–2.8)	20.6 (12.3–35.6)	1.76 (1.49–2.22)	133.01 (70.29–267.16)
2003–2004	MEHHP	Children	Adolescents (11 to <16 years)	430	430 (99.77%)	2 (1.4–2.8)	20.6 (12.3–35.6)	1.76 (1.49–2.22)	14.34 (8.75–24.81)
2003–2004	MEHHP	Children	Adolescents (11 to <16 years)	430	430 (99.77%)	2 (1.4–2.8)	20.6 (12.3–35.6)	20.28 (17.9–22.27)	133.01 (70.29–267.16)
2003–2004	MEHHP	Children	Adolescents (11 to <16 years)	430	430 (99.77%)	2 (1.4–2.8)	20.6 (12.3–35.6)	20.28 (17.9–22.27)	14.34 (8.75–24.81)
2003–2004	MEHHP	Children	All children	716	716 (99.86%)	33.2 (27.5–38.9)	275 (160.9–365.3)	25.62 (20.71–33.81)	193.51 (121.04–332.42)
2003–2004	MEHHP	Children	At or above poverty level	183	183 (99.45%)	31.3 (25.3–36.5)	230.9 (138.5–365.3)	24.6 (19.85–33.28)	168.5 (92.63–313.53)
2003–2004	MEHHP	Children	Below poverty level	237	237 (100%)	38.6 (25.9–43.9)	328.2 (145.1–1075.1)	30.22 (22.46–45.96)	273 (102.67–1378.33)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2003–2004	MEHHP	Children	Black non-Hispanic	258	258 (100%)	39.9 (32.4–49.1)	302.1 (156.4–619)	28.59 (22.31–38.17)	230.66 (112.57–525.71)
2003–2004	MEHHP	Children	Children (6 to <11 years)	286	286 (100%)	3 (1.9–4.7)	26.1 (11.3–64.7)	3.02 (2.13–4.28)	253.11 (133.26–707.84)
2003–2004	MEHHP	Children	Children (6 to <11 years)	286	286 (100%)	3 (1.9–4.7)	26.1 (11.3–64.7)	3.02 (2.13–4.28)	28.73 (14.19–68.04)
2003–2004	MEHHP	Children	Children (6 to <11 years)	286	286 (100%)	3 (1.9–4.7)	26.1 (11.3–64.7)	41.29 (29.39–51.67)	253.11 (133.26–707.84)
2003–2004	MEHHP	Children	Children (6 to <11 years)	286	286 (100%)	3 (1.9–4.7)	26.1 (11.3–64.7)	41.29 (29.39–51.67)	28.73 (14.19–68.04)
2003–2004	MEHHP	Children	Females	375	375 (99.73%)	33.4 (24.4–40.3)	350.4 (164.6–507.8)	28.53 (22.24–38.28)	261.39 (146.36–673.38)
2003–2004	MEHHP	Children	Males	341	341 (100%)	33.5 (28.5–38.2)	212.6 (119.8–328.2)	23.64 (20–29.74)	133.01 (101.67–268.91)
2003–2004	MEHHP	Children	Mexican American	229	229 (100%)	27.4 (23–33.2)	129.9 (81.8–356.8)	26.48 (21.26–31.7)	122.75 (73.33–220.42)
2003–2004	MEHHP	Children	Other	52	52 (100%)	31.4 (22.2–52.4)	318 (120–530)	28.16 (16.84–49.78)	164.77 (76.33–434.43)
2003–2004	MEHHP	Children	Unknown income	267	267 (100%)	41 (9.4–99.7)	106 (56.9–228.2)	37.52 (9.1–57.63)	102.22 (57.63–303.91)
2003–2004	MEHHP	Children	White non-Hispanic	177	177 (99.44%)	32.8 (25.3–37.5)	279.5 (152.4–365.3)	24.07 (19.73–33.28)	169.91 (90.23–348.52)
2003–2004	MEHHP	WRA	All women of reproductive age	606	606 (99.83%)	23.2 (17.3–28.6)	266.2 (133.4–491.8)	45.96 (35.95–58.53)	347.81 (168.5–1378.33)
2003–2004	MEHHP	WRA	At or above poverty level	137	137 (99.27%)	23.3 (16.9–29.7)	222.9 (109.6–422)	42.5 (23.64–73.33)	169.91 (77.22–707.84)
2003–2004	MEHHP	WRA	Below poverty level	169	169 (100%)	21.95 (16.2–28.1)	199.3 (75.3–515.3)	52.88 (45.96–68.25)	1378.33 (72.78–1378.33)
2003–2004	MEHHP	WRA	Black non-Hispanic	157	157 (100%)	32.6 (23.9–57.6)	437 (228.3–1036.7)	41.29 (23.64–57.57)	154.8 (77.01–445.56)
2003–2004	MEHHP	WRA	Mexican American	146	146 (100%)	18.9 (13.6–24.2)	81 (46.7–383)	38.57 (18.31–63.83)	176.02 (68.25–673.38)
2003–2004	MEHHP	WRA	Other	49	49 (100%)	17.9 (8.5–27.4)	124.6 (27.4–124.6)	29.39 (16.84–164.77)	164.77 (16.84–164.77)
2003–2004	MEHHP	WRA	Unknown income	262	262 (100%)	26.9 (11.7–81)	760.9 (67.4–760.9)	61.33 (5–303.91)	158.04 (5–303.91)
2003–2004	MEHHP	WRA	White non-Hispanic	254	254 (99.61%)	21.6 (15.6–30.9)	422 (133.4–559.7)	53.38 (27.72–128.59)	755.41 (146.8–1378.33)
2003–2004	MEHP	Adults	All adults	1,889	1,889 (66.91%)	2.4 (1.8–3.1)	45.5 (25–95.7)	1.82 (1.6–2.06)	22.47 (15.09–34.05)
2003–2004	MEHP	Adults	At or above poverty level	474	474 (68.99%)	2.4 (1.7–3.3)	42.2 (25–107.1)	1.75 (1.54–2.03)	22.47 (13.79–33.11)
2003–2004	MEHP	Adults	Below poverty level	393	393 (69.21%)	2.1 (1.5–2.8)	23.1 (11.5–47.2)	1.87 (1.33–2.33)	19.4 (11.61–41.36)
2003–2004	MEHP	Adults	Black non-Hispanic	423	423 (78.72%)	4.6 (2.7–7.8)	40 (22.7–159.5)	2.18 (1.85–2.74)	22.62 (12.03–37.05)
2003–2004	MEHP	Adults	Females	980	980 (66.02%)	3 (2.1–3.7)	33.1 (18.9–47)	2.13 (1.69–2.4)	18.88 (12.84–30.92)
2003–2004	MEHP	Adults	Males	909	909 (67.88%)	2.5 (1.8–3.1)	45.5 (24.9–95.7)	1.71 (1.46–1.89)	23.18 (14.97–41.08)
2003–2004	MEHP	Adults	Mexican American	423	423 (65.48%)	2.6 (1.3–4.3)	19.8 (11.5–134)	1.94 (1.44–2.39)	15.98 (9.86–27.06)
2003–2004	MEHP	Adults	Other	142	142 (61.97%)	3.7 (1.5–6.7)	35.4 (22.1–718)	2.17 (1.59–3.32)	23.27 (9.51–78.44)
2003–2004	MEHP	Adults	Unknown income	904	904 (64.16%)	3.9 (1.9–5.8)	83.3 (7.9–83.3)	2.24 (1.63–3.12)	44.91 (4.12–113.48)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2003–2004	MEHP	Adults	White non-Hispanic	901	901 (62.82%)	2.2 (1.5–2.8)	45.5 (16.8–108.4)	1.71 (1.53–1.91)	23.53 (12.84–37.73)
2003–2004	MEHP	Children	Adolescents (11 to <16 years)	430	430 (77.44%)	2 (1.4–2.8)	43.2 (35–51.6)	1.76 (1.49–2.22)	14.34 (8.75–24.81)
2003–2004	MEHP	Children	Adolescents (11 to <16 years)	430	430 (77.44%)	2 (1.4–2.8)	43.2 (35–51.6)	1.76 (1.49–2.22)	29.71 (26.12–34.27)
2003–2004	MEHP	Children	All children	716	716 (78.49%)	2.6 (2–3.2)	27 (13.1–52.4)	2.22 (1.73–2.67)	22.43 (10.36–44.65)
2003–2004	MEHP	Children	At or above poverty level	183	183 (79.23%)	2.5 (1.7–3)	20.7 (11.6–42.4)	2.22 (1.68–2.67)	18.42 (9.2–44.65)
2003–2004	MEHP	Children	Below poverty level	237	237 (80.59%)	3 (1.9–4.7)	34.6 (18.6–74.5)	2.38 (1.62–3.75)	34.02 (10.48–95.51)
2003–2004	MEHP	Children	Black non-Hispanic	258	258 (85.27%)	3.8 (2.8–5.2)	34 (20.6–77.9)	2.47 (1.99–3.65)	34.02 (14.97–71.03)
2003–2004	MEHP	Children	Children (6 to <11 years)	286	286 (80.07%)	3 (1.9–4.7)	57.1 (41.1–78.5)	3.02 (2.13–4.28)	28.73 (14.19–68.04)
2003–2004	MEHP	Children	Children (6 to <11 years)	286	286 (80.07%)	3 (1.9–4.7)	57.1 (41.1–78.5)	3.02 (2.13–4.28)	57.5 (45.05–79.01)
2003–2004	MEHP	Children	Females	375	375 (80.53%)	2.6 (2–3.5)	38.4 (13.4–62.4)	2.44 (1.85–3.21)	28.25 (13.88–50.33)
2003–2004	MEHP	Children	Males	341	341 (76.25%)	2.4 (1.6–3.4)	19.8 (14.7–29.4)	1.99 (1.51–2.6)	13.46 (9.48–18.3)
2003–2004	MEHP	Children	Mexican American	229	229 (76.42%)	2.3 (1.9–3.3)	16.5 (10.4–23.3)	2.5 (1.79–3.56)	14.34 (9.36–23.96)
2003–2004	MEHP	Children	Other	52	52 (82.69%)	3.1 (1.6–7.4)	23.1 (14.7–95.7)	2.65 (1.12–7.65)	28.73 (9.69–78.44)
2003–2004	MEHP	Children	Unknown income	267	267 (76.03%)	3.7 (0.6–9.1)	22.7 (10.3–34)	2.97 (1.12–5.68)	8.04 (5.81–113.48)
2003–2004	MEHP	Children	White non-Hispanic	177	177 (70.06%)	2.1 (1.3–2.8)	17.5 (8–52.4)	2.07 (1.51–2.6)	18.88 (6.25–45.25)
2003–2004	MEHP	WRA	All women of reproductive age	606	606 (74.59%)	3 (2.1–3.7)	33.1 (18.9–47)	4.18 (2.4–5.45)	44.65 (18–95.51)
2003–2004	MEHP	WRA	At or above poverty level	137	137 (81.75%)	2.8 (1.5–3.9)	36.9 (14–64.8)	4.09 (2.05–5.7)	24.37 (7.33–68.04)
2003–2004	MEHP	WRA	Below poverty level	169	169 (78.7%)	2.8 (2.5–3.7)	23.1 (12.3–67)	4.32 (2.29–9.36)	95.51 (7.97–95.51)
2003–2004	MEHP	WRA	Black non-Hispanic	157	157 (85.35%)	5.3 (3.4–7.9)	77.9 (33.1–173.4)	3.33 (2.18–5.45)	19 (8.04–42.74)
2003–2004	MEHP	WRA	Mexican American	146	146 (73.29%)	3 (1.7–4.6)	15.3 (6.7–64.8)	3.5 (2.05–6.67)	14.19 (7.25–113.48)
2003–2004	MEHP	WRA	Other	49	49 (73.47%)	2.6 (1.4–4.9)	31.4 (4.9–31.4)	4.7 (1.12–28.73)	18.42 (1.12–28.73)
2003–2004	MEHP	WRA	Unknown income	262	262 (68.32%)	4.9 (0.6–15)	20 (4.9–77.9)	3.73 (1.09–113.48)	8.04 (1.09–113.48)
2003–2004	MEHP	WRA	White non-Hispanic	254	254 (68.9%)	2.5 (1.5–3.7)	34.4 (13.6–67)	4.09 (1.26–17.87)	44.65 (17.87–95.51)
2003–2004	MEOHP	Adults	All adults	1,889	1,889 (98.94%)	14.7 (11.7–18.4)	211.9 (90.4–401.6)	11.92 (10.76–12.88)	111.06 (75.79–153.18)
2003–2004	MEOHP	Adults	At or above poverty level	474	474 (98.52%)	14.8 (11.4–19.3)	209.7 (90.4–401.6)	11.69 (10.47–12.64)	109.11 (75–152.23)
2003–2004	MEOHP	Adults	Below poverty level	393	393 (98.98%)	13.8 (10.5–16.8)	145.8 (44.4–339.8)	12.09 (9.9–14.63)	93.29 (60.41–181.35)
2003–2004	MEOHP	Adults	Black non-Hispanic	423	423 (99.53%)	23.8 (13.8–34.8)	208 (107.8–271.1)	13.06 (10.95–15.69)	91.11 (72.22–130.34)
2003–2004	MEOHP	Adults	Females	980	980 (98.78%)	16.4 (13.1–20.2)	183.8 (92.7–249.3)	13.08 (11.42–15.56)	104.85 (75.79–146)
2003–2004	MEOHP	Adults	Males	909	909 (99.12%)	14.6 (11.4–18.6)	210.6 (89.9–401.6)	11.11 (10–12)	120.29 (71.98–159.04)
2003–2004	MEOHP	Adults	Mexican American	423	423 (98.82%)	13.6 (11.3–15.7)	73.1 (36.6–522.2)	10.6 (9.09–12.42)	67.33 (48.61–95.37)
2003–2004	MEOHP	Adults	Other	142	142 (97.89%)	16 (7.8–29.2)	211.9 (52.8–369.9)	12.38 (10.19–16.09)	106.27 (69.46–271.99)
2003–2004	MEOHP	Adults	Unknown income	904	904 (99.12%)	14.7 (11.2–21)	498.5 (68.4–1215.9)	14.39 (10.65–21.79)	138.5 (69.7–201.32)
2003–2004	MEOHP	Adults	White non-Hispanic	901	901 (98.89%)	13.9 (10.2–19)	233.8 (77.6–559.1)	11.76 (10.24–12.92)	120.29 (75.79–166.28)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2003–2004	MEOHP	Children	Adolescents (11 to <16 years)	430	430 (99.53%)	337.2 (156.4–468.4)	43.2 (35–51.6)	12.92 (11.82–15.04)	133.01 (70.29–267.16)
2003–2004	MEOHP	Children	Adolescents (11 to <16 years)	430	430 (99.53%)	337.2 (156.4–468.4)	43.2 (35–51.6)	12.92 (11.82–15.04)	91.11 (46.48–159.04)
2003–2004	MEOHP	Children	Adolescents (11 to <16 years)	430	430 (99.53%)	337.2 (156.4–468.4)	43.2 (35–51.6)	20.28 (17.9–22.27)	133.01 (70.29–267.16)
2003–2004	MEOHP	Children	Adolescents (11 to <16 years)	430	430 (99.53%)	337.2 (156.4–468.4)	43.2 (35–51.6)	20.28 (17.9–22.27)	91.11 (46.48–159.04)
2003–2004	MEOHP	Children	All children	716	716 (99.72%)	23.1 (18.7–27.4)	172.4 (97.6–228.3)	17.57 (14.55–22.59)	118.37 (71.76–208.18)
2003–2004	MEOHP	Children	At or above poverty level	183	183 (99.45%)	22.6 (18.2–26.5)	167.7 (88.2–214.7)	16.48 (13.41–20.98)	106.14 (70.33–219.41)
2003–2004	MEOHP	Children	Below poverty level	237	237 (100%)	24.1 (17.4–31.4)	231.6 (91–533.7)	19.35 (14.97–31.69)	161.8 (69.7–609.49)
2003–2004	MEOHP	Children	Black non-Hispanic	258	258 (99.61%)	28.1 (21.1–34.7)	183.8 (99.2–261.6)	18.96 (15.33–25.27)	121.11 (76.1–194.38)
2003–2004	MEOHP	Children	Children (6 to <11 years)	286	286 (100%)	473.5 (248.8–780.5)	57.1 (41.1–78.5)	26.81 (19.3–34.16)	151.8 (79.73–447.65)
2003–2004	MEOHP	Children	Children (6 to <11 years)	286	286 (100%)	473.5 (248.8–780.5)	57.1 (41.1–78.5)	26.81 (19.3–34.16)	253.11 (133.26–707.84)
2003–2004	MEOHP	Children	Children (6 to <11 years)	286	286 (100%)	473.5 (248.8–780.5)	57.1 (41.1–78.5)	41.29 (29.39–51.67)	151.8 (79.73–447.65)
2003–2004	MEOHP	Children	Children (6 to <11 years)	286	286 (100%)	473.5 (248.8–780.5)	57.1 (41.1–78.5)	41.29 (29.39–51.67)	253.11 (133.26–707.84)
2003–2004	MEOHP	Children	Females	375	375 (99.73%)	23.6 (18.2–28.4)	210.5 (97.6–472.6)	18.57 (15.33–26.81)	155.06 (91.11–285.4)
2003–2004	MEOHP	Children	Males	341	341 (99.71%)	22.9 (19.4–28.5)	132.9 (87.6–211.9)	15.62 (13.68–19.19)	78.82 (63.16–159.04)
2003–2004	MEOHP	Children	Mexican American	229	229 (100%)	19.5 (15.2–24.4)	76.7 (51.6–224.4)	17.72 (14.66–21.4)	83.5 (48–156.88)
2003–2004	MEOHP	Children	Other	52	52 (100%)	22.1 (13.7–29.1)	205.1 (82.3–325.5)	17.65 (12.32–32.36)	106.27 (45.67–266.8)
2003–2004	MEOHP	Children	Unknown income	267	267 (99.63%)	34.7 (6.8–71.4)	71.4 (32.1–114.7)	20.62 (7.44–41.27)	84.9 (41.27–168.26)
2003–2004	MEOHP	Children	White non-Hispanic	177	177 (99.44%)	22.8 (18.2–27.3)	180.7 (88.2–242.1)	16.14 (13.06–22.8)	118.37 (70.66–285.4)
2003–2004	MEOHP	WRA	All women of reproductive age	606	606 (99.34%)	16.4 (13.1–20.2)	183.8 (92.7–249.3)	32.36 (25.26–38.74)	237.78 (98.74–477.57)
2003–2004	MEOHP	WRA	At or above poverty level	137	137 (99.27%)	15.5 (11.4–20.1)	152.5 (80.5–249.3)	27.4 (17.37–39.61)	106.14 (54.36–447.65)
2003–2004	MEOHP	WRA	Below poverty level	169	169 (99.41%)	15.4 (10.9–21.5)	126.9 (47.4–339.8)	34.74 (31.94–41.67)	609.49 (43.71–609.49)
2003–2004	MEOHP	WRA	Black non-Hispanic	157	157 (100%)	23 (17.3–35.3)	245.8 (146.3–555.6)	28.21 (18.27–38.74)	96.96 (50.49–237.78)
2003–2004	MEOHP	WRA	Mexican American	146	146 (99.32%)	12.8 (9.5–20.2)	57.4 (37.9–174.3)	28 (9.56–43.33)	124.52 (43.33–434.59)
2003–2004	MEOHP	WRA	Other	49	49 (97.96%)	13.5 (5.1–47.4)	80.5 (20.8–80.5)	18.03 (11.72–106.27)	106.27 (11.72–106.27)
2003–2004	MEOHP	WRA	Unknown income	262	262 (99.24%)	20.1 (9.9–51.4)	498.5 (44.9–498.5)	39.33 (4.5–168.26)	96.96 (4.5–168.26)
2003–2004	MEOHP	WRA	White non-Hispanic	254	254 (99.21%)	15.5 (10.7–20.2)	229.5 (92.7–339.8)	32.25 (17.81–76.25)	477.57 (98.74–609.49)
2001–2002	MEHHP	Adults	All adults	2,004	2,004 (97.65%)	21.2 (19.1–25.8)	232.3 (121.1–435.7)	16.58 (14.94–18.47)	136.92 (103.87–191.63)
2001–2002	MEHHP	Adults	At or above poverty level	463	463 (98.27%)	21 (18.4–25.1)	244.6 (130.1–493.7)	16.09 (14.71–18.24)	146.72 (106.49–203.1)
2001–2002	MEHHP	Adults	Below poverty level	361	361 (99.17%)	25.1 (20.5–31)	111.4 (79.1–187.4)	20 (14.83–25.98)	106.3 (78–188.95)
2001–2002	MEHHP	Adults	Black non-Hispanic	414	414 (98.55%)	35.7 (25.8–47.2)	313.5 (126–485.2)	19.63 (17.22–22.81)	150.55 (112.83–194.74)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2001–2002	MEHHP	Adults	Females	1019	1019 (97.45%)	19.9 (13.7–29.7)	316.2 (96.9–529.9)	18.68 (16.62–21.25)	134.3 (97.32–198.46)
2001–2002	MEHHP	Adults	Males	985	985 (97.87%)	21.3 (19.1–26.4)	242.8 (117.6–435.7)	15.44 (13.8–17.89)	136.92 (97.74–224.04)
2001–2002	MEHHP	Adults	Mexican American	445	445 (97.53%)	17.1 (14–20.7)	103.2 (54.8–299.2)	16.07 (14.66–17.63)	108.02 (83.92–146.98)
2001–2002	MEHHP	Adults	Other	162	162 (98.15%)	19.4 (14.4–34.4)	94.2 (47.4–575.6)	15 (11.34–21.03)	80.65 (58.33–151.08)
2001–2002	MEHHP	Adults	Unknown income	1,052	1,052 (96.77%)	30.3 (12.2–64.3)	131.9 (82.9–679.6)	16 (10.66–25.62)	126.68 (56.91–277.29)
2001–2002	MEHHP	Adults	White non-Hispanic	983	983 (97.25%)	21.1 (18.4–26.2)	244.6 (117.3–841.5)	16.17 (14.79–18.26)	139.62 (98.03–255.26)
2001–2002	MEHHP	Children	Adolescents (11 to <16 years)	456	456 (98.9%)	3.7 (3–4.7)	40.2 (21.1–67.8)	21.13 (18.85–25.06)	112.83 (83.6–237.29)
2001–2002	MEHHP	Children	Adolescents (11 to <16 years)	456	456 (98.9%)	3.7 (3–4.7)	40.2 (21.1–67.8)	21.13 (18.85–25.06)	25.21 (14.12–39.65)
2001–2002	MEHHP	Children	Adolescents (11 to <16 years)	456	456 (98.9%)	3.7 (3–4.7)	40.2 (21.1–67.8)	3.31 (2.59–4.51)	112.83 (83.6–237.29)
2001–2002	MEHHP	Children	Adolescents (11 to <16 years)	456	456 (98.9%)	3.7 (3–4.7)	40.2 (21.1–67.8)	3.31 (2.59–4.51)	25.21 (14.12–39.65)
2001–2002	MEHHP	Children	All children	778	778 (99.1%)	30 (25.4–35)	222.9 (151.6–274.9)	26.82 (25.06–29.58)	175.3 (121.59–242.4)
2001–2002	MEHHP	Children	At or above poverty level	192	192 (98.44%)	30.8 (25.1–37)	206.8 (116.7–279.5)	26.53 (24.27–30)	146.98 (101.22–249.63)
2001–2002	MEHHP	Children	Below poverty level	237	237 (100%)	28.2 (21.3–36.7)	216.3 (126.8–513.1)	28.76 (22.12–35)	222.75 (97.32–401.6)
2001–2002	MEHHP	Children	Black non-Hispanic	275	275 (99.27%)	41.8 (33.2–51.5)	275.6 (206.8–389.9)	29.58 (25.56–34.11)	194.74 (123.16–354.84)
2001–2002	MEHHP	Children	Children (6 to <11 years)	322	322 (99.38%)	4.9 (4.1–5.7)	35.7 (25.9–48.1)	38.93 (32.14–45.32)	233.45 (128.84–362.03)
2001–2002	MEHHP	Children	Children (6 to <11 years)	322	322 (99.38%)	4.9 (4.1–5.7)	35.7 (25.9–48.1)	38.93 (32.14–45.32)	32.41 (24.43–49.38)
2001–2002	MEHHP	Children	Children (6 to <11 years)	322	322 (99.38%)	4.9 (4.1–5.7)	35.7 (25.9–48.1)	5.86 (4.88–6.91)	233.45 (128.84–362.03)
2001–2002	MEHHP	Children	Children (6 to <11 years)	322	322 (99.38%)	4.9 (4.1–5.7)	35.7 (25.9–48.1)	5.86 (4.88–6.91)	32.41 (24.43–49.38)
2001–2002	MEHHP	Children	Females	392	392 (98.72%)	29.6 (24.7–35.2)	215.6 (126.8–279.9)	26.82 (23.49–31)	159.67 (101.22–312.9)
2001–2002	MEHHP	Children	Males	386	386 (99.48%)	30.1 (25.1–36.5)	242.5 (146–275.6)	26.85 (24–31.2)	182.52 (98.35–264.33)
2001–2002	MEHHP	Children	Mexican American	232	232 (98.71%)	22.3 (19.5–28.7)	141.9 (101.5–215.6)	24.97 (21.9–29.83)	120.74 (83.92–329.6)
2001–2002	MEHHP	Children	Other	49	49 (97.96%)	34.5 (13.5–66.9)	181.8 (70.8–569.8)	25 (18.13–42.19)	161.05 (69.88–459.18)
2001–2002	MEHHP	Children	Unknown income	313	313 (98.72%)	25 (16.9–45.2)	262.5 (37.3–262.5)	28.98 (16.77–36.55)	273.44 (32.88–273.44)
2001–2002	MEHHP	Children	White non-Hispanic	222	222 (99.55%)	28.1 (23.7–35.3)	215.9 (114.7–330)	26.56 (23.28–31.2)	121.59 (96.34–273.44)
2001–2002	MEHHP	WRA	All women of reproductive age	659	659 (97.42%)	19.9 (13.7–29.7)	316.2 (96.9–529.9)	38.97 (29.52–51.88)	211.14 (109.15–401.6)
2001–2002	MEHHP	WRA	At or above poverty level	154	154 (98.7%)	16.9 (12.6–25.1)	175.1 (76.2–462)	39.57 (29.52–52.11)	200.78 (103.9–529.38)
2001–2002	MEHHP	WRA	Below poverty level	136	136 (98.53%)	32.7 (16.2–42.5)	529.9 (51.3–1523.6)	40.19 (21.03–66.53)	233.45 (50.57–401.6)
2001–2002	MEHHP	WRA	Black non-Hispanic	144	144 (97.92%)	42.6 (23.4–55.4)	313.5 (96.9–1009.3)	40.43 (23.49–71.88)	308.71 (103.48–523.74)
2001–2002	MEHHP	WRA	Mexican American	172	172 (97.09%)	17.1 (12.6–24.9)	112.8 (84.3–138.1)	35.38 (21.09–61.46)	106.79 (69.31–233.45)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2001–2002	MEHHP	WRA	Other	57	57 (96.49%)	14.7 (6.9–22.3)	45 (38.4–361.7)	21.03 (7–103.9)	177.14 (20–211.14)
2001–2002	MEHHP	WRA	Unknown income	331	331 (96.68%)	31.6 (12.2–56.7)	781.8 (40.6–781.8)	25.45 (11.69–175.3)	71.88 (11.69–175.3)
2001–2002	MEHHP	WRA	White non-Hispanic	286	286 (97.55%)	17.3 (12–29.9)	493.7 (67.4–781.8)	38.97 (29.52–51.88)	121.59 (65.95–529.38)
2001–2002	MEHP	Adults	All adults	2,004	2,004 (82.58%)	5.1 (4.2–6.1)	41.4 (31.8–63.9)	3.68 (3.21–4.29)	31.6 (24.26–41.39)
2001–2002	MEHP	Adults	At or above poverty level	463	463 (80.99%)	4.9 (3.7–6.2)	41.4 (31.8–68)	3.6 (3.1–4.29)	32.22 (22.37–49.95)
2001–2002	MEHP	Adults	Below poverty level	361	361 (84.21%)	5.2 (4.5–6.8)	52.3 (24.5–117.4)	4.13 (3.21–5.38)	32.41 (19.62–54.87)
2001–2002	MEHP	Adults	Black non-Hispanic	414	414 (87.92%)	7 (4.5–10.7)	82.1 (26.5–172)	3.99 (3.23–4.66)	32.95 (23.04–48.08)
2001–2002	MEHP	Adults	Females	1019	1019 (82.53%)	6 (4.6–6.8)	52 (28.4–100.5)	4.44 (3.67–5.26)	34.67 (24.9–50.1)
2001–2002	MEHP	Adults	Males	985	985 (82.64%)	5 (4.1–6)	38.5 (31.7–63.9)	3.33 (2.81–3.9)	31.6 (20.51–49.38)
2001–2002	MEHP	Adults	Mexican American	445	445 (84.49%)	4.5 (3.5–5.9)	28.1 (19.6–56.8)	4.07 (3.47–4.71)	24.29 (16.95–33.59)
2001–2002	MEHP	Adults	Other	162	162 (88.89%)	6.3 (4.6–7.9)	28.4 (15.3–62.7)	4.54 (2.7–6.16)	31.6 (17.19–65.79)
2001–2002	MEHP	Adults	Unknown income	1,052	1,052 (81.94%)	10.6 (4.1–19.1)	41.2 (22.3–148.2)	3.85 (2.52–5.1)	20.07 (14.51–44.64)
2001–2002	MEHP	Adults	White non-Hispanic	983	983 (78.43%)	4.8 (3.7–5.9)	43.1 (31.7–68)	3.5 (3–4.11)	32.78 (21.09–54.87)
2001–2002	MEHP	Children	Adolescents (11 to <16 years)	456	456 (85.75%)	3.7 (3–4.7)	40.2 (21.1–67.8)	3.31 (2.59–4.51)	25.21 (14.12–39.65)
2001–2002	MEHP	Children	All children	778	778 (85.99%)	4.3 (3.7–5)	35.7 (28–47.5)	4.51 (3.6–5.13)	29.14 (24.9–33.59)
2001–2002	MEHP	Children	At or above poverty level	192	192 (84.38%)	4.3 (3.7–5.1)	37.2 (25.8–53.7)	4.34 (3.54–4.87)	28.75 (21.92–39.19)
2001–2002	MEHP	Children	Below poverty level	237	237 (89.45%)	4.1 (2.6–5.3)	34 (20.1–54.1)	5.31 (3.09–6.31)	29.35 (16.53–40.72)
2001–2002	MEHP	Children	Black non-Hispanic	275	275 (86.91%)	6.6 (5–8.9)	52.1 (39.6–77.8)	5.05 (3.83–6.69)	40 (29.23–50.1)
2001–2002	MEHP	Children	Children (6 to <11 years)	322	322 (86.34%)	4.9 (4.1–5.7)	35.7 (25.9–48.1)	5.86 (4.88–6.91)	32.41 (24.43–49.38)
2001–2002	MEHP	Children	Females	392	392 (87.24%)	4.4 (3.8–5.3)	46.7 (28.1–63.3)	4.7 (3.67–5.7)	32.95 (24.8–49.78)
2001–2002	MEHP	Children	Males	386	386 (84.72%)	4.1 (3–5)	28 (18.2–47.4)	4.29 (3.04–4.94)	28.75 (16.74–31.38)
2001–2002	MEHP	Children	Mexican American	232	232 (85.34%)	4.3 (3.3–5.6)	28.4 (22.2–47.5)	4.67 (3.33–6.46)	29.35 (17.81–40.35)
2001–2002	MEHP	Children	Other	49	49 (89.8%)	4.6 (2.1–11.8)	56.3 (15.4–151.1)	5.96 (1.9–9.69)	35.19 (10.84–71.27)
2001–2002	MEHP	Children	Unknown income	313	313 (85.3%)	4.5 (1–6.5)	47.4 (6.5–47.4)	3.11 (1.22–7.45)	49.38 (5.86–49.38)
2001–2002	MEHP	Children	White non-Hispanic	222	222 (84.68%)	3.9 (3–4.4)	26.9 (17.9–45.7)	4.12 (3.33–4.75)	24.9 (14.67–31.38)
2001–2002	MEHP	WRA	All women of reproductive age	659	659 (86.34%)	6 (4.6–6.8)	52 (28.4–100.5)	5.48 (4.14–6.91)	39.91 (18.36–63.3)
2001–2002	MEHP	WRA	At or above poverty level	154	154 (86.36%)	4.5 (3.5–6)	41.4 (23.5–62.9)	4.77 (3.79–6.14)	40.35 (14.79–63.3)
2001–2002	MEHP	WRA	Below poverty level	136	136 (90.44%)	7.8 (6–14.1)	117.4 (16.8–177.5)	6.21 (2.35–10)	40.63 (10–40.72)
2001–2002	MEHP	WRA	Black non-Hispanic	144	144 (93.06%)	12.8 (7.2–17.3)	53.6 (40.1–549.2)	6.67 (3.37–13.44)	40.54 (19.86–119.52)
2001–2002	MEHP	WRA	Mexican American	172	172 (88.37%)	5.7 (3.1–6.9)	26 (16.9–37.8)	6.92 (3.79–12.35)	32.41 (15.38–40.35)
2001–2002	MEHP	WRA	Other	57	57 (89.47%)	4.6 (1.8–13)	52.3 (8.9–100.5)	6.21 (1.8–63.3)	24.43 (6.21–63.3)
2001–2002	MEHP	WRA	Unknown income	331	331 (83.99%)	11 (0.7–16.9)	45.8 (12.2–82.1)	3.18 (1.15–39.91)	19.86 (1.15–39.91)
2001–2002	MEHP	WRA	White non-Hispanic	286	286 (81.12%)	5.6 (3.6–6.7)	52 (22.7–117.4)	4.56 (3.47–5.57)	18.36 (10–57.73)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2001–2002	MEOHP	Adults	All adults	2,004	2,004 (96.01%)	14.6 (12.9–17.3)	149.4 (86.3–213.4)	11.13 (10.16–12.25)	83.59 (69.66–109.68)
2001–2002	MEOHP	Adults	At or above poverty level	463	463 (95.9%)	14.3 (12.7–16.6)	159.7 (83.7–283.1)	10.88 (9.96–11.92)	84.64 (68.03–122.55)
2001–2002	MEOHP	Adults	Below poverty level	361	361 (96.68%)	15.7 (12–20.3)	72.7 (46.2–111)	13.16 (10.79–15.22)	71.46 (58.67–101.27)
2001–2002	MEOHP	Adults	Black non-Hispanic	414	414 (97.83%)	20.9 (16–28.5)	205.1 (71.4–658.7)	12.84 (11.3–14)	99.33 (69.84–128.14)
2001–2002	MEOHP	Adults	Females	1,019	1,019 (95.78%)	14.4 (10.4–20.5)	188.3 (68.2–363.2)	12.79 (11.45–15)	81.43 (55.45–120.82)
2001–2002	MEOHP	Adults	Males	985	985 (96.24%)	14.6 (12.9–17.3)	150.6 (82.3–237.1)	10.17 (8.93–11.71)	83.32 (69.63–104.46)
2001–2002	MEOHP	Adults	Mexican American	445	445 (96.63%)	11.6 (8.6–15)	70.8 (34.4–237.1)	10.66 (10.34–11.46)	65.88 (55.11–83.13)
2001–2002	MEOHP	Adults	Other	162	162 (94.44%)	14.4 (9.5–24.1)	55.5 (33.4–345.9)	10.6 (7.65–14.94)	49.78 (40.33–91.88)
2001–2002	MEOHP	Adults	Unknown income	1,052	1,052 (95.53%)	20.2 (10.1–36)	69.9 (50.4–645.1)	10.17 (7.43–17.75)	54.29 (37.19–209.32)
2001–2002	MEOHP	Adults	White non-Hispanic	983	983 (95.22%)	14.6 (12.7–17.8)	158.3 (77.3–324)	11.13 (9.9–12.29)	90.27 (68.03–161.41)
2001–2002	MEOHP	Children	Adolescents (11 to <16 years)	456	456 (98.68%)	19.6 (16.9–22.6)	118.1 (69.4–169.3)	15.66 (12.39–19.24)	112.83 (83.6–237.29)
2001–2002	MEOHP	Children	Adolescents (11 to <16 years)	456	456 (98.68%)	19.6 (16.9–22.6)	118.1 (69.4–169.3)	15.66 (12.39–19.24)	75.09 (55–164.3)
2001–2002	MEOHP	Children	Adolescents (11 to <16 years)	456	456 (98.68%)	19.6 (16.9–22.6)	118.1 (69.4–169.3)	21.13 (18.85–25.06)	112.83 (83.6–237.29)
2001–2002	MEOHP	Children	Adolescents (11 to <16 years)	456	456 (98.68%)	19.6 (16.9–22.6)	118.1 (69.4–169.3)	21.13 (18.85–25.06)	75.09 (55–164.3)
2001–2002	MEOHP	Children	All children	778	778 (98.84%)	20.7 (18.2–24.1)	142.2 (111–170.2)	19.09 (17.07–20.47)	100.8 (78.98–162.5)
2001–2002	MEOHP	Children	At or above poverty level	192	192 (98.44%)	20.9 (18–25)	142.1 (81.6–178.6)	19.24 (16.74–20.74)	91.88 (74.41–141.93)
2001–2002	MEOHP	Children	Below poverty level	237	237 (99.58%)	17.8 (14–26.2)	142.3 (79–255.7)	18.71 (16.37–21.47)	100.8 (68.33–233.15)
2001–2002	MEOHP	Children	Black non-Hispanic	275	275 (98.91%)	27.7 (22.2–33.1)	180.6 (130.7–216.5)	20.32 (17.44–23.2)	130 (84.64–195.61)
2001–2002	MEOHP	Children	Children (6 to <11 years)	322	322 (99.07%)	23.3 (18.2–29.4)	142.2 (93.9–178.4)	25.37 (21.21–29.36)	135.05 (83.01–207.58)
2001–2002	MEOHP	Children	Children (6 to <11 years)	322	322 (99.07%)	23.3 (18.2–29.4)	142.2 (93.9–178.4)	25.37 (21.21–29.36)	233.45 (128.84–362.03)
2001–2002	MEOHP	Children	Children (6 to <11 years)	322	322 (99.07%)	23.3 (18.2–29.4)	142.2 (93.9–178.4)	38.93 (32.14–45.32)	135.05 (83.01–207.58)
2001–2002	MEOHP	Children	Children (6 to <11 years)	322	322 (99.07%)	23.3 (18.2–29.4)	142.2 (93.9–178.4)	38.93 (32.14–45.32)	233.45 (128.84–362.03)
2001–2002	MEOHP	Children	Females	392	392 (98.72%)	20.6 (17.3–24.7)	126.5 (93.8–164.3)	19.26 (16.82–21.78)	101.17 (65.73–206.23)
2001–2002	MEOHP	Children	Males	386	386 (98.96%)	20.4 (17.8–25)	152.7 (105.2–178.4)	18.94 (16.74–20.27)	100.8 (74.41–171.54)
2001–2002	MEOHP	Children	Mexican American	232	232 (98.28%)	16.5 (13.4–20.8)	97.8 (73.7–130.5)	18.42 (16.13–20.55)	77.61 (57.45–204.42)
2001–2002	MEOHP	Children	Other	49	49 (97.96%)	21.8 (9.6–42.3)	129.3 (47.5–287.8)	19.35 (12.64–23.8)	91.05 (40.33–233.15)
2001–2002	MEOHP	Children	Unknown income	313	313 (98.4%)	18 (11.8–33.9)	156 (25.4–156)	19.04 (12.17–22.45)	162.5 (22.45–162.5)
2001–2002	MEOHP	Children	White non-Hispanic	222	222 (99.55%)	19.5 (15.7–25)	142.3 (70.9–205.8)	18.8 (16.49–21.03)	82.62 (69.63–171.54)
2001–2002	MEOHP	WRA	All women of reproductive age	659	659 (96.21%)	14.4 (10.4–20.5)	188.3 (68.2–363.2)	28.38 (19.63–36.31)	130.71 (69.04–254.38)
2001–2002	MEOHP	WRA	At or above poverty level	154	154 (98.7%)	12.5 (9.8–17.4)	116.4 (53.8–277.9)	29.38 (19.63–36.33)	130 (69.04–536.72)
2001–2002	MEOHP	WRA	Below poverty level	136	136 (97.06%)	20 (12.3–30.7)	409.1 (34.8–851.1)	24.94 (15.52–44.71)	187.07 (34.85–254.38)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
2001–2002	MEOHP	WRA	Black non-Hispanic	144	144 (97.92%)	27.2 (19.6–34.9)	195.7 (62.4–851.1)	29 (15.89–51.74)	149.76 (59.34–316.67)
2001–2002	MEOHP	WRA	Mexican American	172	172 (97.09%)	14 (10.4–21.3)	79.2 (40.6–149.4)	27.31 (19.09–33.43)	68.33 (48.17–187.07)
2001–2002	MEOHP	WRA	Other	57	57 (92.98%)	10.6 (5.5–18.7)	35.2 (30.7–191.8)	15.52 (8–71.7)	81.43 (15.23–130.71)
2001–2002	MEOHP	WRA	Unknown income	331	331 (94.86%)	22.6 (6.1–38.3)	645.1 (31.2–645.1)	19.34 (9.01–116.32)	51.74 (9.01–116.32)
2001–2002	MEOHP	WRA	White non-Hispanic	286	286 (95.45%)	13.4 (8.7–20)	270.3 (50.9–409.1)	27.09 (19.34–36.31)	83.01 (45.7–536.72)
1999–2000	MEHP	Adults	All adults	1,827	1,827 (76.03%)	3.7 (3–4.7)	30.5 (20.2–38.4)	2.86 (2.7–3.08)	20 (15–21.79)
1999–2000	MEHP	Adults	At or above poverty level	412	412 (73.79%)	4.1 (3–5.3)	33.4 (20.2–39.1)	2.87 (2.66–3.17)	19.53 (13.53–22.26)
1999–2000	MEHP	Adults	Below poverty level	377	377 (80.64%)	3.5 (2.2–4.8)	24.3 (9–115.4)	3 (2.44–3.71)	18.75 (11.34–32.09)
1999–2000	MEHP	Adults	Black non-Hispanic	363	363 (83.75%)	4.8 (3.4–5.5)	25.6 (19.5–37.5)	2.93 (2.28–3.61)	13.61 (11.74–22.26)
1999–2000	MEHP	Adults	Females	964	964 (73.55%)	3.6 (3.1–4.2)	24.1 (17.2–30.7)	3.2 (2.65–3.72)	14.97 (11.48–23.67)
1999–2000	MEHP	Adults	Males	863	863 (78.79%)	3.7 (2.9–4.8)	29.2 (20.2–38.4)	2.76 (2.53–2.96)	21.54 (13.96–27.73)
1999–2000	MEHP	Adults	Mexican American	550	550 (76.73%)	3.5 (2.7–4)	24.9 (16.1–28.9)	2.83 (2.43–3.58)	17.33 (12.77–35.06)
1999–2000	MEHP	Adults	Other	176	176 (76.7%)	4.2 (2.3–8.1)	42.5 (14.7–229.6)	2.83 (2.56–3.81)	24.37 (10.88–50)
1999–2000	MEHP	Adults	Unknown income	798	798 (74.94%)	2.3 (1.3–6)	19.2 (10.6–24.9)	2.76 (2.14–3.48)	20.91 (8.87–41.86)
1999–2000	MEHP	Adults	White non-Hispanic	738	738 (71.54%)	3 (2.6–4.7)	28.5 (15.4–52)	2.86 (2.57–3.15)	20 (13.12–23.67)
1999–2000	MEHP	Children	Adolescents (11 to <16 years)	438	438 (84.7%)	3.8 (2.8–4.9)	23.35 (14.5–44.1)	2.76 (2.29–3.78)	17.25 (9.11–32.08)
1999–2000	MEHP	Children	All children	714	714 (86.97%)	4.6 (3.3–5.3)	29.8 (19.1–46.2)	3.82 (3.18–4.67)	27.79 (13.46–42.9)
1999–2000	MEHP	Children	At or above poverty level	191	191 (87.96%)	4 (3–4.9)	29.8 (14.5–130.1)	3.61 (2.87–4.21)	26.6 (11.35–86.16)
1999–2000	MEHP	Children	Below poverty level	215	215 (86.51%)	5.1 (2.9–6.4)	32.2 (17.8–101.4)	5 (3.04–5.87)	22.48 (12.31–44.15)
1999–2000	MEHP	Children	Black non-Hispanic	229	229 (90.83%)	6.1 (4.9–7.3)	30.9 (23.7–35.4)	4.35 (3.7–5.79)	17.71 (12.78–24.58)
1999–2000	MEHP	Children	Children (6 to <11 years)	276	276 (90.58%)	5.2 (3.8–6.4)	34.5 (14.7–130.1)	5.41 (4.67–6.13)	33.67 (13.46–86.16)
1999–2000	MEHP	Children	Females	362	362 (85.36%)	4.7 (3–5.6)	22.8 (16.9–35.3)	4.55 (2.74–5.85)	19.56 (11.11–32.08)
1999–2000	MEHP	Children	Males	352	352 (88.64%)	4.4 (2.9–5.5)	36.1 (15–130.1)	3.57 (2.83–4.13)	33.67 (12.12–86.16)
1999–2000	MEHP	Children	Mexican American	264	264 (84.09%)	3.4 (2.8–4.2)	31.4 (14.2–60.1)	3.87 (3.13–4.41)	27.76 (13.08–54.64)
1999–2000	MEHP	Children	Other	63	63 (92.06%)	5.3 (3.3–6.8)	19.3 (11.2–24.7)	4.56 (2.25–6.46)	24.37 (8.89–41.86)
1999–2000	MEHP	Children	Unknown income	220	220 (84.09%)	5.5 (3.1–11.3)	24.3 (12.4–157.5)	4.65 (2.84–7.51)	33.19 (8.73–221.34)
1999–2000	MEHP	Children	White non-Hispanic	158	158 (84.18%)	3.9 (2.8–5.2)	29.3 (14–130.1)	3.66 (2.57–4.78)	32.08 (11.32–86.16)
1999–2000	MEHP	WRA	All women of reproductive age	618	618 (80.1%)	3.6 (3.1–4.2)	24.1 (17.2–30.7)	5.5 (4–7.05)	17.07 (11.2–25.94)
1999–2000	MEHP	WRA	At or above poverty level	118	118 (76.27%)	3 (2.1–3.8)	24.1 (14.9–33.8)	5.41 (3.82–7.01)	20 (8.5–54.64)
1999–2000	MEHP	WRA	Below poverty level	146	146 (84.93%)	4.2 (2.3–8)	13.7 (10.8–65.1)	5.3 (2.05–9.94)	12.31 (7.9–23.97)
1999–2000	MEHP	WRA	Black non-Hispanic	126	126 (89.68%)	6.4 (3.4–8.1)	98.2 (13.1–274.8)	5.71 (3.31–8.5)	20.26 (8.5–221.34)
1999–2000	MEHP	WRA	Mexican American	208	208 (78.85%)	3.8 (3.2–4.6)	24.1 (10.5–65.1)	5.2 (2.27–11.61)	37.06 (12.46–97.18)
1999–2000	MEHP	WRA	Other	71	71 (74.65%)	2.5 (0.8–7.3)	26.3 (8.2–51.8)	6.46 (0.48–11.2)	10.46 (2.44–11.2)

NHANES Cycle	Metabolite	Age Group	Subset	Sample Size	Detection Frequency	50th Percentile (95% CI) (ng/mL)	95th Percentile (95% CI) (ng/mL)	Creatinine Corrected 50th Percentile (95% CI) (ng/mL)	Creatinine Corrected 95th Percentile (95% CI) (ng/mL)
1999–2000	MEHP	WRA	Unknown income	275	275 (78.91%)	5 (2.5–16.6)	28.5 (9.3–306.9)	7.35 (2.67–8.73)	10.2 (7.61–221.34)
1999–2000	MEHP	WRA	White non-Hispanic	213	213 (77.46%)	3.6 (2.7–4.5)	23.7 (12.4–28.5)	5.37 (2.21–7.9)	13.46 (8.46–21.7)

Table_Apx G-3. Regression Coefficients and P-Values for Statistical Analyses of DEHP Urinary Metabolite Concentrations

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
2003–2018	MECPP	Adults	All adults	Age	sex race income	–	<0.001	– [a]	<0.001
2003–2018	MECPP	Adults	All adults	Income	age sex race	–	0.584	– [a]	<0.001
2003–2018	MECPP	Adults	All adults	Race	age sex income	–	<0.001	– [a]	<0.001
2003–2018	MECPP	Adults	All adults	Sex	age race income	–	0.2139	– [a]	<0.001
2003–2018	MECPP	Adults	All adults	Years	age sex race income	–0.939	<0.001	–2.1203	<0.001
2003–2018	MECPP	Adults	At or above poverty level	Years	age sex race	–1.498	<0.001	–4.1107	<0.001
2003–2018	MECPP	Adults	Below poverty level	Years	age sex race	–0.8018	<0.001	–2.0987	<0.001
2003–2018	MECPP	Adults	Black non-Hispanic	Years	age sex income	–1.2505	<0.001	–5.4108	<0.001
2003–2018	MECPP	Adults	Females	Years	age race income	–0.6395	<0.001	–3.1084	<0.001
2003–2018	MECPP	Adults	Males	Years	age race income	–0.9408	<0.001	–1.6263	<0.001
2003–2018	MECPP	Adults	Mexican-American	Years	age sex income	–1.453	<0.001	–3.9172	<0.001
2003–2018	MECPP	Adults	Other	Years	age sex income	–1.0003	<0.001	–2.8331	<0.001
2003–2018	MECPP	Adults	Unknown income	Years	age sex race	–0.6199	<0.001	–0.8257	<0.001
2003–2018	MECPP	Adults	White non-Hispanic	Years	age sex income	–0.6911	<0.001	–3.3279	<0.001
2003–2018	MECPP	Children	All children (<16 years)	Age	sex race income	–	<0.001	– [a]	<0.001
2003–2018	MECPP	Children	All children (<16 years)	Income	age sex race	–	0.0094	– [a]	<0.001
2003–2018	MECPP	Children	All children (<16 years)	Race	age sex income	–	0.0352	– [a]	<0.001
2003–2018	MECPP	Children	All children (<16 years)	Sex	age race income	–	0.9975	– [a]	<0.001
2003–2018	MECPP	Children	Adolescents (11 to <16 years)	Years	sex race income	–1.8931	<0.001	–6.6558	<0.001
2003–2018	MECPP	Children	Toddlers (3 to <6 years)	Years	sex race income	–1.1744	<0.001	–0.9294	<0.001
2003–2018	MECPP	Children	Children (6 to <10 years)	Years	sex race income	–1.7573	<0.001	–5.4932	<0.001
2003–2018	MECPP	Children	All children (<16 years)	Years	age sex race income	–1.3523	<0.001	–2.2530	<0.001
2003–2018	MECPP	Children	At or above poverty level	Years	age sex race	–1.6375	<0.001	–2.4018	<0.001
2003–2018	MECPP	Children	Below poverty level	Years	age sex race	–1.0812	<0.001	–4.7347	<0.001
2003–2018	MECPP	Children	Black non-Hispanic	Years	age sex income	–1.9923	<0.001	–7.7017	<0.001
2003–2018	MECPP	Children	Females	Years	age race income	–1.5085	<0.001	–2.7541	<0.001

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
2003–2018	MECPP	Children	Males	Years	age race income	–1.3680	<0.001	–2.2876	<0.001
2003–2018	MECPP	Children	Mexican-American	Years	age sex income	–2.3116	<0.001	–5.0453	<0.001
2003–2018	MECPP	Children	Other	Years	age sex income	–1.5945	<0.001	–1.5408	<0.001
2003–2018	MECPP	Children	Unknown income	Years	age sex race	–3.0859	<0.001	1.57951	<0.001
2003–2018	MECPP	Children	White non-Hispanic	Years	age sex income	–0.9862	<0.001	–4.0156	<0.001
2003–2018	MECPP	Women	All women of reproductive age	Age	sex race income	–	<0.001	– [a]	<0.001
2003–2018	MECPP	Women	All women of reproductive age	Income	age sex race	–	0.0042	– [a]	0.0147
2003–2018	MECPP	Women	All women of reproductive age	Race	age sex income	–	0.0179	– [a]	0.0434
2003–2018	MECPP	Women	All women of reproductive age	Sex	age race income	–	<0.001	– [a]	<0.001
2003–2018	MECPP	Women	All women of reproductive age	Years	age sex race income	–1.841	<0.001	–8.5550	<0.001
2003–2018	MECPP	Women	At or above poverty level	Years	age sex race	–1.7110	<0.001	–7.8222	<0.001
2003–2018	MECPP	Women	Below poverty level	Years	age sex race	–2.0664	<0.001	–10.646	<0.001
2003–2018	MECPP	Women	Black non-Hispanic	Years	age sex income	–2.7311	<0.001	–10.204	<0.001
2003–2018	MECPP	Women	Females	Years	age race income	–1.841	<0.001	–8.5550	<0.001
2003–2018	MECPP	Women	Mexican-American	Years	age sex income	–2.2672	<0.001	–7.1762	<0.001
2003–2018	MECPP	Women	Other	Years	age sex income	–1.6618	<0.001	–12.044	<0.001
2003–2018	MECPP	Women	Unknown income	Years	age sex race	–2.3972	<0.001	–7.9441	<0.001
2003–2018	MECPP	Women	White non-Hispanic	Years	age sex income	–1.2791	<0.001	–6.2747	<0.001
2001–2018	MEHHP	Adults	All adults	Age	sex race income	–	<0.001	– [a]	<0.001
2001–2018	MEHHP	Adults	All adults	Income	age sex race	–	0.7342	– [a]	<0.001
2001–2018	MEHHP	Adults	All adults	Race	age sex income	–	<0.001	– [a]	<0.001
2001–2018	MEHHP	Adults	All adults	Sex	age race income	–	0.1888	– [a]	0.3215
2001–2018	MEHHP	Adults	All adults	Years	age sex race income	–0.0974	<0.001	–1.9545	<0.001
2001–2018	MEHHP	Adults	All adults	Years	age sex race income	–0.0974	<0.001	–1.9545	<0.001
2001–2018	MEHHP	Adults	At or above poverty level	Years	age sex race	–0.7895	<0.001	–2.4851	<0.001
2001–2018	MEHHP	Adults	Below poverty level	Years	age sex race	–0.5358	<0.001	–2.2096	<0.001
2001–2018	MEHHP	Adults	Black non-Hispanic	Years	age sex income	0.10090	<0.001	–3.7382	<0.001
2001–2018	MEHHP	Adults	Females	Years	age race income	0.03775	0.0031	–2.3491	<0.001
2001–2018	MEHHP	Adults	Males	Years	age race income	–0.590	<0.001	–1.58	<0.001
2001–2018	MEHHP	Adults	Mexican-American	Years	age sex income	–0.788	<0.001	–2.7665	<0.001
2001–2018	MEHHP	Adults	Other	Years	age sex income	–0.6400	<0.001	–1.8098	<0.001
2001–2018	MEHHP	Adults	Unknown income	Years	age sex race	0.07215	<0.001	–1.189	<0.001
2001–2018	MEHHP	Adults	White non-Hispanic	Years	age sex income	–0.3740	<0.001	–2.0198	<0.001
2001–2018	MEHHP	Children	All children (<16 years)	Age	sex race income	–	<0.001	– [a]	<0.001

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
2001–2018	MEHHP	Children	All children (<16 years)	Income	age sex race	–	0.0017	– [a]	<0.001
2001–2018	MEHHP	Children	All children (<16 years)	Race	age sex income	–	<0.001	– [a]	<0.001
2001–2018	MEHHP	Children	All children (<16 years)	Sex	age race income	–	0.2855	– [a]	<0.001
2001–2018	MEHHP	Children	Adolescents (11 to <16 years)	Years	sex race income	–1.1661	<0.001	–2.903	<0.001
2001–2018	MEHHP	Children	Toddlers (3 to <6 years)	Years	sex race income	–0.8912	<0.001	–1.2079	<0.001
2001–2018	MEHHP	Children	Children (6 to <10 years)	Years	sex race income	–1.1453	<0.001	–2.9793	<0.001
2001–2018	MEHHP	Children	All children (<16 years)	Years	age sex race income	–0.9545	<0.001	–2.0582	<0.001
2001–2018	MEHHP	Children	At or above poverty level	Years	age sex race	–1.280	<0.001	–2.5921	<0.001
2001–2018	MEHHP	Children	Below poverty level	Years	age sex race	–0.5822	<0.001	–2.1731	<0.001
2001–2018	MEHHP	Children	Black non-Hispanic	Years	age sex income	–1.2606	<0.001	–5.002	<0.001
2001–2018	MEHHP	Children	Females	Years	age race income	–1.0314	<0.001	–1.7216	<0.001
2001–2018	MEHHP	Children	Males	Years	age race income	–1.0503	<0.001	–2.7046	<0.001
2001–2018	MEHHP	Children	Mexican-American	Years	age sex income	–1.4428	<0.001	–3.6433	<0.001
2001–2018	MEHHP	Children	Other	Years	age sex income	–1.2887	<0.001	–1.4094	<0.001
2001–2018	MEHHP	Children	Unknown income	Years	age sex race	–1.4285	<0.001	0.11830	0.5082
2001–2018	MEHHP	Children	White non-Hispanic	Years	age sex income	–0.7446	<0.001	–1.8951	<0.001
2001–2018	MEHHP	Women	All women of reproductive age	Age	sex race income	–	<0.001	– [a]	<0.001
2001–2018	MEHHP	Women	All women of reproductive age	Income	age sex race	–	0.0021	– [a]	<0.001
2001–2018	MEHHP	Women	All women of reproductive age	Race	age sex income	–	0.0121	– [a]	<0.001
2001–2018	MEHHP	Women	All women of reproductive age	Sex	age race income	–	<0.001	– [a]	<0.001
2001–2018	MEHHP	Women	All women of reproductive age	Years	age sex race income	–0.9187	<0.001	–3.2276	<0.001
2001–2018	MEHHP	Women	At or above poverty level	Years	age sex race	–0.8637	<0.001	–4.77	<0.001
2001–2018	MEHHP	Women	Below poverty level	Years	age sex race	–1.2265	<0.001	–5.5480	<0.001
2001–2018	MEHHP	Women	Black non-Hispanic	Years	age sex income	–1.5789	<0.001	–4.0154	<0.001
2001–2018	MEHHP	Women	Females	Years	age race income	–0.9187	<0.001	–3.2276	<0.001
2001–2018	MEHHP	Women	Mexican-American	Years	age sex income	–1.0165	<0.001	–2.0953	<0.001
2001–2018	MEHHP	Women	Other	Years	age sex income	–0.9191	<0.001	–7.541	<0.001
2001–2018	MEHHP	Women	Unknown income	Years	age sex race	–0.9015	<0.001	–2.6315	<0.001
2001–2018	MEHHP	Women	White non-Hispanic	Years	age sex income	–0.7152	<0.001	–3.5766	<0.001
1999–2018	MEHP	Adults	All adults	Age	sex race income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Adults	All adults	Income	age sex race	–	0.0345	– [a]	0.1771
1999–2018	MEHP	Adults	All adults	Race	age sex income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Adults	All adults	Sex	age race income	–	0.0414	– [a]	0.2461
1999–2018	MEHP	Adults	All adults	Years	age sex race income	–0.1218	<0.001	–0.1546	<0.001

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
1999–2018	MEHP	Adults	At or above poverty level	Years	age sex race	–0.1254	<0.001	–0.2806	<0.001
1999–2018	MEHP	Adults	Below poverty level	Years	age sex race	–0.1217	<0.001	–0.2488	<0.001
1999–2018	MEHP	Adults	Black non-Hispanic	Years	age sex income	–0.1024	<0.001	–0.2884	<0.001
1999–2018	MEHP	Adults	Females	Years	age race income	–0.141	<0.001	–0.165	<0.001
1999–2018	MEHP	Adults	Males	Years	age race income	–0.0816	<0.001	–0.2445	<0.001
1999–2018	MEHP	Adults	Mexican-American	Years	age sex income	–0.1635	<0.001	–0.3473	<0.001
1999–2018	MEHP	Adults	Other	Years	age sex income	–0.1205	<0.001	–0.0705	<0.001
1999–2018	MEHP	Adults	Unknown income	Years	age sex race	–0.0154	0.1757	–0.2285	<0.001
1999–2018	MEHP	Adults	White non-Hispanic	Years	age sex income	–0.1318	<0.001	–0.2365	<0.001
1999–2018	MEHP	Children	All children (<16 years)	Age	sex race income	–	0.0041	– [a]	<0.001
1999–2018	MEHP	Children	All children (<16 years)	Income	age sex race	–	0.8476	– [a]	<0.001
1999–2018	MEHP	Children	All children (<16 years)	Race	age sex income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Children	All children (<16 years)	Sex	age race income	–	0.494	– [a]	<0.001
1999–2018	MEHP	Children	Adolescents (11 to <16 years)	Years	sex race income	–0.1386	<0.001	–0.4696	<0.001
1999–2018	MEHP	Children	Toddlers (3 to <6 years)	Years	sex race income	–0.102	<0.001	–0.1756	<0.001
1999–2018	MEHP	Children	Children (6 to <10 years)	Years	sex race income	–0.1128	<0.001	–0.1827	<0.001
1999–2018	MEHP	Children	All children (<16 years)	Years	age sex race income	–0.1068	<0.001	–0.1953	<0.001
1999–2018	MEHP	Children	At or above poverty level	Years	age sex race	–0.0748	<0.001	–0.3	<0.001
1999–2018	MEHP	Children	Below poverty level	Years	age sex race	–0.1531	<0.001	–0.355	<0.001
1999–2018	MEHP	Children	Black non-Hispanic	Years	age sex income	–0.2306	<0.001	–0.9370	<0.001
1999–2018	MEHP	Children	Females	Years	age race income	–0.1200	<0.001	–0.1576	<0.001
1999–2018	MEHP	Children	Males	Years	age race income	–0.0715	<0.001	–0.2587	<0.001
1999–2018	MEHP	Children	Mexican-American	Years	age sex income	–0.1251	<0.001	–0.2955	<0.001
1999–2018	MEHP	Children	Other	Years	age sex income	–0.1008	<0.001	–0.0395	<0.001
1999–2018	MEHP	Children	Unknown income	Years	age sex race	–0.082	<0.001	–0.2594	<0.001
1999–2018	MEHP	Children	White non-Hispanic	Years	age sex income	–0.1127	<0.001	–0.3788	<0.001
1999–2018	MEHP	Women	All women of reproductive age	Age	sex race income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Women	All women of reproductive age	Income	age sex race	–	<0.001	– [a]	0.0222
1999–2018	MEHP	Women	All women of reproductive age	Race	age sex income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Women	All women of reproductive age	Sex	age race income	–	<0.001	– [a]	<0.001
1999–2018	MEHP	Women	All women of reproductive age	Years	age sex race income	–0.1127	<0.001	–0.5276	<0.001
1999–2018	MEHP	Women	At or above poverty level	Years	age sex race	–0.1055	<0.001	–1.1006	<0.001
1999–2018	MEHP	Women	Below poverty level	Years	age sex race	–0.1104	<0.001	–0.7468	<0.001
1999–2018	MEHP	Women	Black non-Hispanic	Years	age sex income	–0.2597	<0.001	–1.4436	<0.001

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
1999–2018	MEHP	Women	Females	Years	age race income	–0.1127	<0.001	–0.5276	<0.001
1999–2018	MEHP	Women	Mexican-American	Years	age sex income	–0.1458	<0.001	–0.4580	<0.001
1999–2018	MEHP	Women	Other	Years	age sex income	–0.0687	<0.001	–0.5467	<0.001
1999–2018	MEHP	Women	Unknown income	Years	age sex race	–0.1915	<0.001	–0.4109	<0.001
1999–2018	MEHP	Women	White non-Hispanic	Years	age sex income	–0.0956	<0.001	–0.6195	<0.001
2001–2018	MEOHP	Adults	All adults	Age	sex race income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Adults	All adults	Income	age sex race	–	0.8358	– [a]	<0.001
2001–2018	MEOHP	Adults	All adults	Race	age sex income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Adults	All adults	Sex	age race income	–	0.317	– [a]	0.0036
2001–2018	MEOHP	Adults	All adults	Years	age sex race income	–0.1459	<0.001	–1.2980	<0.001
2001–2018	MEOHP	Adults	At or above poverty level	Years	age sex race	–0.5595	<0.001	–1.6873	<0.001
2001–2018	MEOHP	Adults	Below poverty level	Years	age sex race	–0.3147	<0.001	–1.4170	<0.001
2001–2018	MEOHP	Adults	Black non-Hispanic	Years	age sex income	0.03284	0.015	–2.3565	<0.001
2001–2018	MEOHP	Adults	Females	Years	age race income	–0.0108	0.276	–1.6376	<0.001
2001–2018	MEOHP	Adults	Males	Years	age race income	–0.4339	<0.001	–1.0345	<0.001
2001–2018	MEOHP	Adults	Mexican-American	Years	age sex income	–0.4845	<0.001	–1.6891	<0.001
2001–2018	MEOHP	Adults	Other	Years	age sex income	–0.3827	<0.001	–1.3555	<0.001
2001–2018	MEOHP	Adults	Unknown income	Years	age sex race	0.02996	0.0282	–0.8155	<0.001
2001–2018	MEOHP	Adults	White non-Hispanic	Years	age sex income	–0.258	<0.001	–1.4009	<0.001
2001–2018	MEOHP	Children	All children (<16 years)	Age	sex race income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Children	All children (<16 years)	Income	age sex race	–	0.0062	– [a]	<0.001
2001–2018	MEOHP	Children	All children (<16 years)	Race	age sex income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Children	All children (<16 years)	Sex	age race income	–	0.7878	– [a]	<0.001
2001–2018	MEOHP	Children	Adolescents (11 to <16 years)	Years	sex race income	–0.7989	<0.001	–2.3415	<0.001
2001–2018	MEOHP	Children	Toddlers (3 to <6 years)	Years	sex race income	–0.6942	<0.001	–0.7357	<0.001
2001–2018	MEOHP	Children	Children (6 to <10 years)	Years	sex race income	–0.7737	<0.001	–1.6676	<0.001
2001–2018	MEOHP	Children	All children (<16 years)	Years	age sex race income	–0.6650	<0.001	–1.3688	<0.001
2001–2018	MEOHP	Children	At or above poverty level	Years	age sex race	–0.8607	<0.001	–1.4015	<0.001
2001–2018	MEOHP	Children	Below poverty level	Years	age sex race	–0.4608	<0.001	–1.5464	<0.001
2001–2018	MEOHP	Children	Black non-Hispanic	Years	age sex income	–0.7965	<0.001	–2.6023	<0.001
2001–2018	MEOHP	Children	Females	Years	age race income	–0.7635	<0.001	–1.1351	<0.001
2001–2018	MEOHP	Children	Males	Years	age race income	–0.6372	<0.001	–1.604	<0.001
2001–2018	MEOHP	Children	Mexican-American	Years	age sex income	–0.930	<0.001	–2.2588	<0.001
2001–2018	MEOHP	Children	Other	Years	age sex income	–0.8906	<0.001	–0.43	<0.001

Years	Metabolite	Age Group	Subset	Regression Variable	Covariates	Regression Coefficient, 50th Percentile	P-Value, 50th Percentile	Regression Coefficient, 95th Percentile	P-Value, 95th Percentile
2001–2018	MEOHP	Children	Unknown income	Years	age sex race	–0.70	<0.001	–0.0488	0.6605
2001–2018	MEOHP	Children	White non-Hispanic	Years	age sex income	–0.5662	<0.001	–1.7545	<0.001
2001–2018	MEOHP	Women	All women of reproductive age	Age	sex race income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Women	All women of reproductive age	Income	age sex race	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Women	All women of reproductive age	Race	age sex income	–	0.0032	– [a]	<0.001
2001–2018	MEOHP	Women	All women of reproductive age	Sex	age race income	–	<0.001	– [a]	<0.001
2001–2018	MEOHP	Women	All women of reproductive age	Years	age sex race income	–0.6609	<0.001	–1.8870	<0.001
2001–2018	MEOHP	Women	At or above poverty level	Years	age sex race	–0.6628	<0.001	–2.8456	<0.001
2001–2018	MEOHP	Women	Below poverty level	Years	age sex race	–0.9992	<0.001	–4.1163	<0.001
2001–2018	MEOHP	Women	Black non-Hispanic	Years	age sex income	–1.114	<0.001	–3.2604	<0.001
2001–2018	MEOHP	Women	Females	Years	age race income	–0.6609	<0.001	–1.8870	<0.001
2001–2018	MEOHP	Women	Mexican-American	Years	age sex income	–0.6201	<0.001	–1.2304	<0.001
2001–2018	MEOHP	Women	Other	Years	age sex income	–0.7211	<0.001	–4.5349	<0.001
2001–2018	MEOHP	Women	Unknown income	Years	age sex race	–0.5111	<0.001	–1.4544	<0.001
2001–2018	MEOHP	Women	White non-Hispanic	Years	age sex income	–0.5774	<0.001	–2.2609	<0.001