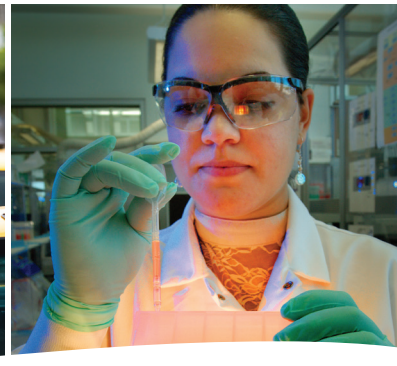


Fourth National Report on Human Exposure to Environmental Chemicals

Updated Tables, March 2021

Volume Four: Analysis of Chemicals Found in Cigarette Smoke in a Special Sample of U.S. Adults, NHANES 2011-2016



**U.S. Department of
Health and Human Services**
Centers for Disease
Control and Prevention

General Information

Overview of the Fourth National Report on Human Exposure to Environmental Chemicals: Updated Tables, March 2021

The *Fourth National Report on Human Exposure to Environmental Chemicals: Updated Tables, March 2021* (the *Updated Tables, March 2021*) presents nationally representative, cumulative biomonitoring data gathered from 1999–2000 through 2015–2016. It includes all the data from each of the previous *National Reports on Human Exposure to Environmental Chemicals* and each of the previous *Updated Tables* (collectively, the *Report and Updated Tables*).

In each survey period, the reported chemicals or their metabolites were measured in blood, serum, and urine samples from random subsamples of the National Health and Nutrition Examination Survey (NHANES). These subsamples typically consisted of about 2,500 participants – exact numbers are included in the tables. Survey data and samples are collected by the Centers for Disease Control and Prevention (CDC) National Center for Health Statistics. CDC's Environmental Health Laboratory (Division of Laboratory Sciences (DLS), National Center for Environmental Health) used mass spectrometry methods to obtain the blood, serum, and urine exposure measurements presented in the *Report and Updated Tables*.

The term *environmental chemical* refers to a chemical compound or chemical element present in air, water, food, soil, dust, or other environmental media (e.g., consumer products). Biomonitoring is the assessment of human exposure to chemicals by measuring the chemicals or their metabolites in human specimens such as blood or urine. A metabolite is a chemical alteration of the original compound produced by body tissues. Blood, serum, and urine levels reflect the amount of the chemical that gets into the body by all routes of exposure, including ingestion, inhalation, and dermal absorption. The measurement of an environmental chemical in a person's blood or urine is a measure of exposure; it does not by itself mean that the chemical causes disease or an adverse effect. Research studies, separate from these data, are required to determine which blood or urine levels are safe and which are associated with disease or an adverse effect.

The *Report and Updated Tables* provide geometric means and percentiles of environmental chemicals by age group, gender, and race/ethnicity for blood, serum, and urine levels measured in individual samples. For serum levels measured in pooled samples, weighted arithmetic means, and unadjusted standard errors are provided for categories defined by race/ethnicity, gender, age group, and survey years. More in-depth statistical analysis, including multivariate analysis incorporating health endpoints and other predictive variables, is beyond the scope of this document. We encourage scientists to examine the data further through analysis of the raw data available at <https://www.cdc.gov/nchs/nhanes/>.

The *Updated Tables* has been reorganized and expanded into four volumes. Data on the general U.S. population from NHANES 1999–2000 through 2015–2016 is now divided chronologically into Volumes One and Two.

- **Volume One: NHANES 1999-2010** provides data on the general U.S. population from NHANES 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, and 2009–2010.
- **Volume Two: NHANES 2011-2016** provides data on the general U.S. population from NHANES 2011–2012, 2013–2014, and 2015–2016.

The table titles include the survey periods for which data are displayed in that table. Of note, not all chemicals have data for all survey cycles.

Data for chemicals measured in pooled samples and data from special samples are now found Volumes Three and Four.

- **Volume Three: Analysis of Pooled Serum Samples for Select Chemicals, NHANES 2005-2016** provides data for chemicals measured in pooled samples from NHANES 2005–2006, 2007–2008, 2009–2010, 2011–2012, 2013–2014, and 2015–2016. Some of these chemicals were previously measured in individual samples from the general U.S. population; these data can be found in Volume One: NHANES 1999–2010.
- **Volume Four: Analysis of Chemicals Found in Cigarette Smoke in a Special Sample of U.S. Adults, NHANES 2011-2016** provides data for a sample of adult cigarette smokers and nonsmokers from NHANES 2011–2012, 2013–2014, and 2015–2016. The Special Sample was created to determine the effectiveness of tobacco product standards under The Family Smoking Prevention and Tobacco Control Act of 2009. Of note, the age for eligibility in the Special Sample decreased from 20 years and older in NHANES 2011–2012 to 18 years and older in NHANES 2013–2014 and 2015–2016 (NHANES lowered the age for asking the smoking questions in 2013).

The *Updated Tables, March 2021* provides data for more than 400 chemicals, of which 73 are reported for the first time or measured in a new matrix and 108 have been updated since the *Updated Tables, January 2019*. Hyperlinks to biomonitoring summaries that have information about a specific chemical or chemical group can be found in the footnotes for many data tables. Several tables also contain a link to a factsheet about the chemical or chemical group within the footnotes. Two appendices are updated to include information pertinent to the chemicals reported in the *Updated Tables, March 2021* (Appendix C. Limit of Detection Table; Appendix D. References for Biomonitoring Methods).

The [National Report on Human Exposure to Environmental Chemicals](#) website is the best resource for updates of available data. It includes the document, “Chemicals in the Fourth Report and Updated Tables,” which is a complete list of the chemicals in *Updated Tables, March 2021*. The *Fourth National Report on Human Exposure to Environmental Chemicals, 2009*, can also be downloaded from this website.

Public Health Uses of the *Report and Updated Tables*

The overall purpose of the *Report and Updated Tables* is to provide specific information to scientists, physicians, and health officials to help prevent exposure to environmental chemicals. Some public health uses of the exposure information in the *Report and Updated Tables* include the following:

- To determine which chemicals are getting into U.S. residents and at what concentrations.
- To determine the prevalence of people with levels of chemicals above known toxicity levels (e.g., blood lead level greater than or equal to a specific concentration).
- To determine the prevalence of people with levels of chemicals that put them at increased risk for toxicity.
- To establish reference ranges that physicians and scientists can use to determine whether a person or group has an unusually high exposure. (This information is especially helpful to identify population groups that merit further assessment of exposure sources or health effects.)
- To assess the effectiveness of public health efforts to reduce exposure of U.S. residents to specific chemicals.
- To determine whether exposure levels are higher among potentially vulnerable groups, such as minorities and children.
- To track trends in levels of exposure of the population.
- To set priorities for research on human health effects.

What's New and Different?

The *Updated Tables, March 2021* includes chemicals that have results available from the NHANES survey periods 1999–2000 through 2015–2016.

Updated Tables in Four Volumes

The *Updated Tables, March 2021* has been reorganized and expanded into **four volumes**, each a separate document. Data for chemicals measured in individual samples from the general U.S. population are found in Volumes One and Two. Other types of data, such as measurements in pooled samples or from special subsets of the NHANES population, are in Volumes Three and Four. The format of each document is compliant with Section 508 Accessibility requirements to assist visually impaired users.

Volumes are organized chronologically, with **Volume One** containing data from NHANES 1999-2010 and **Volume Two** containing data from NHANES 2011-2016. Within each volume, chemical groups and their analytes are listed in a navigable table of contents on the left side pane.

As an example, if users are interested in blood lead data from NHANES 2013-2014, they would open Volume Two, scroll down to the “Metals and Metalloids” section within the navigable table of contents in the left side pane, expand the section, select “Lead,” and then find the rows containing summary data for NHANES 2013-2014. Users interested in analyzing trends in biomonitoring data may wish to access tables in both volumes, which together contain all the years of available data for the general U.S. population.

Volume Three: Analysis of Pooled Serum Samples for Select Chemicals, NHANES 2005-2016 presents data tables for persistent organic pollutants and pesticides that were measured in pooled samples. Data tables for these chemicals that are based on individual samples can be found in Volume One: NHANES 1999-2010.

Volume Four: Analysis of Chemicals Found in Cigarette Smoke in a Special Sample of U.S. Adults, NHANES 2011-2016 presents data for a sample of adult cigarette smokers and nonsmokers from NHANES 2011-2012 through 2015-2016.

New Chemicals

Chemicals reported for the first time and those measured in a new matrix include:

- Adducts of hemoglobin in the general population and in a special sample of adult smokers and nonsmokers
 - Formaldehyde
- Urinary tobacco alkaloids and metabolites in the general population and in a special sample of adult smokers and nonsmokers
 - Anabasine
 - Anatabine
 - Cotinine
 - Cotinine-n-oxide
 - Hydroxycotinine
 - Trans-3'-hydroxycotinine
 - 1-(3-Pyridyl)-1-butanol-4-carboxylic acid
 - Nicotine
 - Nicotine-N'-oxide

- Nornicotine
- Urinary tobacco-specific nitrosamines (TSNAs)
 - N'-Nitrosoanabasine (NAB)
 - N'-Nitrosoanatabine (NAT)
 - N'-Nitrososornicotine (NNN)
- Urinary volatile N-nitrosamine compounds (VNAs) in the general population and in a special sample of adult smokers and nonsmokers
 - N-Nitrosodiethylamine (NDEA)
 - N-Nitrosoethylmethylamine (NMEA)
 - N-Nitrosomorpholine (NMOR)
 - N-Nitrosopiperidine (NPIP)
 - N-Nitrosopyrrolidine (NPYR)
- Urinary flame retardants
 - Dicycyl phosphates (DCPs)
- Urinary insect repellent and metabolites
 - 3-(Ethylcarbamoyl) benzoic acid (ECBA)
- Urinary neonicotinoids
 - Acetamiprid
 - Clothianidin
 - N-desmethylacetamiprid
 - 5-hydroxyimidacloprid
 - Imidacloprid
 - Thiacloprid
- Urinary per- and polyfluoroalkyl substances (PFAS)
 - Perfluorobutanoic acid (PFBA)
 - Perfluorobutane sulfonic acid (PFBS)
 - Perfluorodecanoic acid (PFDA)
 - Perfluoroheptane sulfonic acid (PFHpS)
 - Perfluoroheptanoic acid (PFHpA)
 - Perfluorohexane sulfonic acid (PFHxS)
 - Perfluorohexanoic acid (PFHxA)
 - Perfluorononanoic acid (PFNA)
 - N-perfluorooctanoic acid (n-PFOA)
 - Branched perfluorooctanoic acid isomers (Sb-PFOA)
 - N-perfluorooctane sulfonic acid (n-PFOS)
 - Branched perfluoromethylheptane sulfonic acid isomers (Sm-PFOS)
 - Perfluoropentanoic acid (PFPeA)
 - Perfluoroundecanoic acid (PFUnDA)
 - 9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)
 - Adona (ammonium salt of 4,8-dioxo-3H-perfluorononanoic acid)
 - GenX (ammonium salt of 2,3,3,3-tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid (HFPO-DA))
- Serum sex steroid hormones
 - Estradiol
 - Sex hormone-binding globulin (SHBG)
 - Total testosterone
- Urinary volatile organic compound (VOC) metabolites

- N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine
 - N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine
 - N-Acetyl-S-(4-hydroxy-2-methyl-2-buten-1-yl)-L-cysteine
- Serum aldehydes in the general population and in a special sample of adult smokers and nonsmokers
 - Benzaldehyde
 - Butyraldehyde
 - Crotonaldehyde
 - Decanaldehyde
 - Heptanaldehyde
 - Hexanaldehyde
 - Isopentanaldehyde
 - Nonanaldehyde
 - Octanaldehyde
 - Pentanaldehyde
 - Propanaldehyde
 - O-Tolualdehyde
- Urinary aromatic amines in the general population and in a special sample of adult smokers and nonsmokers
 - 4-Aminobiphenyl
 - 1-Aminonaphthalene
 - 2-Aminonaphthalene
 - O-Anisidine
 - 2,6-Dimethylaniline
 - O-Toluidine
- Urinary aromatic diamines
 - 4,4'-Diaminodiphenylmethane (4MDA)
 - 1,5-Diaminonaphthalene (5NDA)
 - 2,4-Diaminotoluene (4TDA)
 - 2,6-Diaminotoluene (6TDA)
 - P-Phenylenediamine (PPDA)

Updated Data

Chemical groups with updated data in this release are:

- Adducts of Hemoglobin
- Tobacco Alkaloids and Metabolites
- Tobacco-Specific Nitrosamines
- Personal Care and Consumer Product Chemicals and Metabolites
- Flame Retardant Metabolites
- Herbicides and Metabolites
- Insect Repellent and Metabolites
- Organophosphorus Insecticides: Dialkyl Phosphate Metabolites
- Organochlorine Pesticides and Metabolites
- Polybrominated diphenyl ethers and PBB 153
- Dioxin-like Polychlorinated Biphenyls: mono-ortho-substituted PCBs

- Polychlorinated Biphenyls: Non-Dioxin-Like
- Metals and metalloids
- Perchlorate and Other Anions
- Phthalate and Phthalate Alternative Metabolites
- Volatile Organic Compound (VOC) Metabolites

Stratification by Cigarette Smoking Status

For the first time, summary statistics for chemicals within the following sections have been stratified by cigarette smoking status, which is defined as a serum cotinine concentration more than 10 ng/mL in adults participants from NHANES, excluding those who reported using other tobacco products.

- Tobacco alkaloids and metabolites
- TSNA
- Aromatic amines

Change in the Population Sampled for Urinary Chemicals: NHANES 2015–2016

Beginning with the NHANES 2015–2016 survey period, the age for urine collection was lowered from age 6 years to age 3 years. This change was made to obtain data for younger children, a vulnerable population with limited urinary data. The urinary environmental chemicals are measured in a full sample (i.e., all children able to provide a urine specimen) of children 3 to 5 years old. For ages 6 years and older, the urinary environmental chemicals are measured in a representative one-third sample of participants.

The addition of ages 3 to 5 years to the survey population will mean that descriptive statistics (geometric mean, selected percentiles) for the total population and non-age-related demographic groups in NHANES 2015–2016 will not be directly comparable to descriptive statistics in earlier NHANES survey periods. This is because the populations sampled are not equivalent.

PFOS and PFOA Results for NHANES 2013–2014 and 2015–2016

Starting in 2013, we began measuring linear and branched isomers of both PFOS and PFOA and no longer measured total PFOS and total PFOA. Collectively, the isomers of each chemical represent more than 95% of what was previously reported as PFOS and PFOA. Data tables for each of the four isomers are also presented.

PFOS and PFOA are calculated by summing the linear and branched isomers for each participant before applying the appropriate sample weight. Because the 2013–2014 and 2015–2016 values are a calculated sum, there is no limit of detection (LOD) for PFOS and PFOA. See Calculation of PFOS and PFOA as the Sum of Isomers for more details. The calculated PFOS and PFOA results can be used to compare with previous measurements and to examine trends in the general U.S. population.

“What’s New and Different” Archives

The “What’s New and Different” sections from previous releases of *Updated Tables* are available in the archives from *Updated Tables* at: <https://www.cdc.gov/exposurereport/>.

Overview of Volume Three: Analysis of Pooled Serum Samples for Select Chemicals, NHANES 2005-2016

Background

In the National Biomonitoring Program, pooling samples to make chemical measurements is used to address:

- The need to improve the sensitivity of the measurement; that is, the chemical concentrations are so low that a larger sample volume is necessary to achieve lower limits of detection and greater likelihood of detectable results; and
- The need to reduce the number of samples analyzed, based on weighing the costs of the analysis against a low frequency of detectable results.

Pooled Samples in the *Updated Tables*

Volume Three of the *Updated Tables, March 2021* includes results for chemicals that were measured in samples created from pools of serum samples from NHANES 2005-2006, 2007-2008, 2009-2010, 2011-2012, 2013-2014, and 2015-2016. Some of these chemicals were previously measured in individual samples from the general U.S. population; these data can be found in Volume One: NHANES 1999-2010.

Overview of Sample Pooling

Beginning with NHANES 2005-2006, the CDC used a weighted pooled-sample design to measure serum concentrations of dioxins, furans, polychlorinated biphenyls (PCBs), organochlorine pesticides and metabolites, and the brominated flame retardants (polybrominated diphenyl ethers and the polybrominated diphenyl, PBB 153). In previous NHANES survey periods, measurements were made on individual serum samples from the U.S. population using stratified multistage selection.

Although NHANES sampling weights can be incorporated to make pooled sample estimates representative of the non-institutionalized U.S. population, there are statistical estimation challenges. Measurements of these chemicals in individuals tend to have a log-normal distribution with central tendency best estimated using a geometric mean. However, the measured value for a pooled sample is comparable to an arithmetic average of measurements in individuals. Consequently, the pooled sample result is expected to be higher than the geometric mean of multiple individual results. Another challenge is that direct calculation of the design effects required for accurate standard error and confidence interval estimation is not possible because samples are pooled across the design cells of the original survey. For these reasons, data tables showing the pooled sample results present only weighted arithmetic means and unadjusted standard errors for each category.

Interpreting the Data

The following cautions and suggestions apply to the pooled sample results and data tables:

a) Individual sample data, as explained above, tend to be log-normally distributed with central tendency best estimated using a geometric mean. Pooled data are comparable to an arithmetic mean of individual sample results and therefore, pooled data results are expected to be higher than the geometric mean of individual sample results. Therefore, the weighted arithmetic means from pooled samples are expected to be higher than the geometric means provided in the historical (companion) data tables or in other publications based on data provided on individual results.

b) The standard errors are unadjusted and therefore, do not reflect the design effects of the survey. In many cases, the standard errors are based on very few pooled sample measurements and cannot be expected to accurately reflect the true imprecision of the weighted arithmetic mean estimates. Therefore, when the unadjusted standard error was more than 30% of the weighted arithmetic mean, this is noted with a double asterisk (**) and footnoted.

Additional information about sample pooling is available from the following sources:

Geometric mean estimation from pooled samples (2007)

<https://pubmed.ncbi.nlm.nih.gov/17618673/>

Characterizing populations of individuals using pooled samples (2010)

<https://pubmed.ncbi.nlm.nih.gov/19002216/>

Use of pooled samples from the National Health and Nutrition Examination Survey (2012)

<https://pubmed.ncbi.nlm.nih.gov/22492247/>

Estimation of exposure distributions from pooled samples (2014)

<https://pubmed.ncbi.nlm.nih.gov/25213192/>

Overview of Volume Four: Analysis of Chemicals Found in Cigarette Smoke in a Special Sample of U.S. Adults, NHANES 2011-2016

Background

The Family Smoking Prevention and Tobacco Control Act of 2009 gave the Food and Drug Administration regulatory authority over tobacco products. In Section 907(a)¹, the Act states that the Secretary of Health and Human Services shall establish tobacco product standards. These product standards will include provisions for the testing of tobacco products. To determine the effectiveness of these product standards, surveillance systems need to be in place before the standards are enacted to determine their impact on exposure among people who continue to use tobacco products. NHANES is an ideal source of samples of clinical specimens from humans for assessing smokers in multiple locations around the country. NHANES will provide a robust dataset for identifying changes in exposure of smokers that follow enactment of tobacco product standards.

Special Sample in NHANES

Beginning with NHANES 2011-2012, a Special Sample was selected for measurement of certain groups of chemicals associated with tobacco smoke exposure. The Special Sample consists of: 1) a nationally representative sample of adults; and 2) all adults who reported being current cigarette smokers. For this sample, adults were defined as ages 20 years and older in 2011-2012 and 18 years and older beginning in 2013.

Cigarette smokers were defined by their responses to the Smoking-Cigarette Use (SMQ_G) questionnaire: "Have you smoked at least 100 cigarettes in your life?" (SMQ020=1), and then, confirmed that they smoke every day (SMQ040=1) or some days (SMQ040=2). The nonsmoker category was comprised of the remaining adults in the Special Sample who were not categorized as smokers of any tobacco products. Excluded from the nonsmoker category was any adult who reported that they used any of the following non-cigarette tobacco products: cigars; pipes; chewing tobacco; snuff; or nicotine patch, gum or other replacement product. This resulted in exclusion of 3.54% (weighted) from the total sample for NHANES 2011-2012, 4.85% (weighted) in NHANES 2013-2014, and 4.18% (weighted) in NHANES 2015-2016.

Too few adults reported use of non-cigarette tobacco products to allow separate categories for these products. We did not use serum cotinine concentrations to distinguish between smokers and nonsmokers because not all adults in the sample had results: for example, 4.17% (weighted) and 3.68% (weighted) of the 2011-2012 and 2013-2014 samples, respectively, were missing serum cotinine results. In 2013-2014 and 2015-2016 four additional non-cigarette tobacco products were included in the NHANES questionnaire, but in order to maintain consistency across surveys, users of these products were not included in the nonsmoker category in the later surveys. If these products had been included in the later surveys, the weighted percentages of subjects in the non-smoker category would have changed by only 1.3% and 2.0%, respectively, for the 2013-2014 and 2015-2016 surveys; and the smoker category would have changed by only 0.04% and 0.24%, respectively.

Results are displayed separately for adult cigarette smokers and nonsmokers. Each data table shows geometric mean and selected percentiles by three categories: total, age group (20-49 or 18-49 years, 50 years and older), and sex (male, female). Racial/ethnic categories are not presented because the sample sizes were too small to yield reliable estimates in one or more of the categories.

¹ <https://www.fda.gov/tobacco-products/rules-regulations-and-guidance/section-907-federal-food-drug-and-cosmetic-act-tobacco-product-standards>

Data Sources and Data Analysis

Blood, serum, and urine samples from NHANES

Biomonitoring measurements for CDC's *National Report on Human Exposure to Environmental Chemicals* and *Updated Tables* (referred to as the *Report* and *Updated Tables*, respectively) are made using samples from participants in the National Health and Nutrition Examination Survey (NHANES), conducted by CDC's National Center for Health Statistics (NCHS). NHANES is designed to collect data on the health and nutritional status of the U.S. population. NHANES collects information about a wide range of health-related behaviors, performs physical examinations, and collects clinical samples for laboratory tests. Beginning in 1999, NHANES became a continuous survey, sampling the U.S. population annually and releasing the data in 2-year cycles. The sampling plan follows a complex, stratified, multistage, probability-cluster design to select a representative sample of the civilian, noninstitutionalized population in the United States based on age, gender, and race/ethnicity.

The NHANES protocol includes a home interview, followed by a standardized physical examination in a mobile examination center. As part of the examination, blood is obtained by venipuncture from participants aged 1 year and older, and urine specimens are collected from participants aged 6 years and older. Starting with the 2015–2016 survey, urine specimens were collected from children ages 3–5 years. Additional detailed information on the design and conduct of the NHANES survey is available at <https://www.cdc.gov/nchs/nhanes/>.

NHANES measures environmental chemicals in blood, serum, or urine collected from participants. Most of the environmental chemicals are measured in randomly selected subsamples within specific age groups. Randomization of subsample selection is built into the NHANES design before sample collection begins. Different random subsamples include different participants. Subsampling is needed to ensure an adequate quantity of sample for analysis and the mass spectrometry analytical methods.

- Data tables in the *Report* and *Updated Tables* specify age groups and sample sizes for each exposure measurement.
- Blood measurements in children younger than 12 years are limited by the amount of blood that can be collected.
- Blood metals are measured in participants aged 1 year and older.
- Beginning in 2011, the blood mercury species methyl mercury and ethyl mercury were added.
- Most measurements of chemicals in serum are made in samples from participants ages 12 years and older.
- Urine was collected from participants ages 6 years and older until 2015, when it became possible to collect urine from children as young as 3 years.
- Most urine chemicals are measured in a representative one-third subsample, but a full sample is used for participants ages 3–5 years.

If a particular chemical or an entire chemical group has no detectable results for three survey periods, it is usually not measured in subsequent survey periods. Some examples include:

- The sulfonyl urea herbicide group was measured in NHANES 2003–2004, 2005–2006, and 2007–2008 with no detections, even at the 95th percentile, so this group is no longer measured in the ongoing survey.
- Mono-*n*-octyl phthalate (MOP), a phthalate urinary metabolite, was not detected above the 95th percentile for more than three survey cycles, so it was no longer reported after 2010.

- Several banned organophosphate and organochlorine pesticides have become largely undetectable and are no longer measured.
- Some chemicals are widely detected but have had unchanging levels in the population (e.g., phytoestrogens) and are no longer measured.

By discontinuing measurements of chemicals that are rarely or not detected, and well-characterized chemicals for which the source of exposure is consistent, CDC's Division of Laboratory Sciences can better focus its resources on assessing exposure to chemicals of highest priority. In addition to performing measurements on NHANES samples, these efforts include developing new and improving existing biomonitoring methods for chemicals of concern.

Beginning with NHANES 2005–2006, CDC used a weighted pooled-sample design to measure serum concentrations of dioxins, furans, polychlorinated biphenyls (PCBs), organochlorine pesticides and metabolites, and brominated flame retardants (polybrominated diphenyl ethers and polybrominated biphenyl [PBB] 153). Pooled samples are used when larger sample volumes are needed to improve the sensitivity of the measurements and to reduce the number of samples being analyzed, balancing the cost of the analysis against a low frequency of detectable results.

The following considerations guided the selection of chemicals in the *Report and Updated Tables*:

- Scientific data suggested exposure in the U.S. population.
- Health effects known or suspected to result from some levels of exposure were serious enough to cause concern.
- Data were needed to assess the effectiveness of public health actions to reduce exposure to a chemical.
- Biomonitoring analytical methods could provide results with adequate accuracy, precision, sensitivity, specificity, and throughput.
- Adequate blood or urine samples were available.
- Incremental analytical costs to perform the biomonitoring analysis for the chemical were reasonable.

The availability of biomonitoring methods with adequate performance and acceptable cost was a major consideration. Details on the prioritization process for scoring nominated chemicals and the resulting scores are available at: https://www.cdc.gov/exposurereport/chemical_selection.html.

Laboratory Analysis

CDC's Division of Laboratory Sciences made the blood, serum, and urine exposure measurements in the *Report and Updated Tables*. The following analytical techniques were used for measuring the environmental chemicals or their metabolites in blood, serum, and urine:

- Isotope dilution mass spectrometry
- Inductively coupled plasma mass spectrometry
- Graphite furnace atomic absorption spectrometry

Laboratory measurements underwent extensive quality control and quality assurance review:

- Tolerance limits for operational parameters were maintained.
- Quality control samples were measured in each analytical run to detect unacceptable performance in accuracy or precision.
- Traceable calibration materials were verified.

Appendix D lists references for the analytical methods used to measure the different chemicals.

Data Analysis

NHANES is a complex, stratified, multistage, probability-cluster design survey. This survey design requires sample weights to be used to adjust for the unequal probability of selection into the survey. Sample weights are also used to adjust for possible bias resulting from nonresponse and are post-stratified to U.S. Census Bureau estimates of the U.S. population. Data were analyzed using Statistical Analysis System (SAS) (SAS Institute Inc.) and the SUDAAN (RTI International, NC) statistical software packages. SUDAAN uses sample weights and calculates variance estimates that account for the complex survey design. The design does not permit straightforward analysis of exposure levels by non-targeted strata such as locality, state, or region; seasons of the year; proximity to sources of exposure; or by use of particular products. NCHS guidelines for analysis of NHANES data are available at <https://wwwn.cdc.gov/nchs/nhanes/analyticguidelines.aspx>.

The *Report and Updated Tables* present descriptive statistics on the blood, serum, or urine levels for each environmental chemical reported. Statistics include unadjusted geometric means and percentiles with confidence intervals. In each table, results are given for the total population and by age group, gender, and race/ethnicity, as defined in NHANES. For these analyses, based on the sample design, race/ethnicity is categorized as Mexican American, non-Hispanic black, and non-Hispanic white. Beginning in 2011–2012, two additional categories were added: all Hispanic and non-Hispanic Asian (referred to as Asian in the tables). Other racial/ethnic groups are sampled, but the proportion of the total U.S. population represented by other racial/ethnic groups is not large enough to produce valid estimates. Other racial/ethnic groups are included in estimates that are based on the entire population sample. Age groups are as described for each chemical in each data table. Gender is coded as male or female.

Units

For chemicals measured in urine, levels are presented per volume of urine and per gram of creatinine. Urinary levels are expressed both ways in the literature and used for different purposes. Levels per gram of creatinine (i.e., creatinine corrected) adjust for urine dilution. For example, a person who drinks more fluids than another person will likely have a higher, but more dilute, urine output. Interpretation of creatinine-corrected results should also recognize that creatinine correction can partially adjust for differences in lean body mass or renal function among persons. Children and young adolescents typically have less muscle mass than adults. Because muscle is an important source of creatinine in urine, children have lower urinary creatinine concentrations than do adults. The lower urine creatinine concentration can result in higher creatinine-corrected results in children in comparison with adults.

For dioxins, furans, PCBs, and organochlorine pesticides, serum levels are presented per gram of total lipid and per whole weight of serum. These compounds are lipophilic and concentrate in the body's lipid stores, including the lipid in serum. Serum levels reported per gram of total lipid reflect the amount of these compounds stored in body fat. Serum levels per whole weight of serum are also included for easier comparison with studies investigating exposure to these chemicals that reported levels in these units. Other, mostly non-lipophilic chemicals, measured in serum are expressed per liter of serum (e.g., micrograms per liter). Hemoglobin adducts are expressed in nanomoles or picomoles per gram of blood hemoglobin.

Results are reported in standard units, generally conforming to those most commonly used in biomonitoring measurements. The table below shows some useful unit conversions.

Table: Units of measurement and abbreviations

Unit	Abbreviation	Value
liter	L	--
deciliter	dL	10 ⁻¹ liters
milliliter	mL	10 ⁻³ liters
gram	g	--
milligram	mg	10 ⁻³ grams
microgram	µg	10 ⁻⁶ grams
nanogram	ng	10 ⁻⁹ grams
picogram	pg	10 ⁻¹² grams
femtogram	fg	10 ⁻¹⁵ grams

Geometric means

A geometric mean gives a better estimate of central tendency for data that are distributed with a long tail at the upper end of the distribution. This type of distribution is common when measuring environmental chemicals in blood or urine. The geometric mean is influenced less by high values than is the arithmetic mean. In the *Report* and *Updated Tables*, geometric means are calculated by taking the log of each concentration and then using SUDAAN software to compute the weighted mean of those log-transformed values. Ninety-five percent confidence intervals around the weighted mean are calculated by adding and subtracting an amount equal to the product of a Student's *t*-statistic and the standard error of the weighted mean estimate. The degrees of freedom of the *t*-statistic was determined by subtracting the number of strata from the number of primary sampling units, according to the data available from the complex survey design. The standard error was computed with SUDAAN's PROC DESCRIPT procedure and "with replacement" design option (design = WR), with Taylor series linearization used for variance estimation. The weighted geometric mean and its confidence limits were obtained by taking the antilog of this weighted mean and its upper and lower confidence limits.

The measured value for a pooled sample is comparable to an arithmetic average of measurements in individuals. Consequently, the pooled sample result is expected to be higher than the geometric mean of multiple individual results. In addition, direct calculation of the design effects required for accurate standard error and confidence interval estimation is not possible because samples are pooled across the design cells of the original survey. For these reasons, data tables showing the pooled sample results present only weighted arithmetic means and unadjusted standard errors for each category. The standard errors are unadjusted and therefore, do not reflect the design effects of the survey. In many cases, the standard errors are based on very few pooled sample measurements and cannot be expected to accurately reflect the true imprecision of the weighted arithmetic mean estimates. Therefore, when the unadjusted standard error was more than 30% of the weighted arithmetic mean, this is noted with a double asterisk (**) and footnoted.

Limit of detection

The limit of detection (LOD) is the level at which the measurement has a 95% probability of being greater than zero (Taylor, 1987). In the *Updated Tables*, the LODs for each chemical and survey period are provided in a footnote to each data table and collectively in Appendix C. Concentrations less than the LOD are assigned a value equal to the LOD divided by the square root of two for calculation of geometric means (Hornung and Reed, 1990). Assigning concentrations less than the LOD a value equal to the LOD divided by the square root of two made little difference in geometric mean estimates. If the proportion of results below the LOD was greater than 40%, geometric means were not calculated. For the same chemical, LOD values sometimes change over time as a result of improvements to analytical

methods. One possible consequence is that results reported as “< LOD” in the 1999–2000 data might be reported as a concentration value above the LOD in 2001–2002 or 2003–2004 because the analytical method had improved. Thus, for proper interpretation of LODs in the data tables, care must be taken to use the LOD that applies to the survey period. Percentile estimates (see below) that are less than the LOD for the chemical analysis were reported as “< LOD.”

For most chemicals, the LOD is constant for each specimen analyzed. Dioxins, furans, PCBs, organochlorine pesticides, and a few other pesticides are different: these have an individual LOD for each sample, mostly because the sample volume used for each analysis was different. A higher volume of the specimen results in a lower LOD (i.e., a better ability to detect low levels). The maximum LOD values are given in each data table and in Appendix C. The maximum LOD was the highest LOD among all samples analyzed. Typically, the mean LOD is about 40%–50% of the maximum LOD. The same procedure for imputing values below the LOD in calculations of geometric means was used for chemicals with individual LODs for each sample. Concentrations less than the individual LOD were assigned a value equal to the individual LOD divided by the square root of two. When reporting percentiles for chemicals with individual sample LODs, if any sample LOD in the demographic group was above the percentile estimate, then the percentile estimate was not reported.

For chemicals measured in urine, separate tables are presented for the chemical concentration expressed per volume of urine (uncorrected table) and the chemical concentration expressed per gram of creatinine (creatinine corrected table). Geometric mean and percentile calculations were performed separately for each of these concentrations. LOD calculations were performed using the chemical concentration expressed per volume of urine, because this concentration determines the analytical sensitivity. For this reason, LOD results for urine measurements in each data table and in Appendix C are in units of weight per volume of urine. In the creatinine corrected tables, a result for a geometric mean or percentile was reported as < LOD if the corresponding geometric mean or percentile was < LOD in the table using weight per volume of urine. For example, if the 50th percentile for males was < LOD in the table using weight per volume of urine, it would also be < LOD in the creatinine corrected table.

For chemicals measured in serum lipid, separate tables are presented for the chemical concentration expressed per volume of serum (lipid unadjusted or whole weight table) and the chemical concentration expressed per amount of lipid (lipid adjusted table). Geometric mean and percentile calculations were performed separately for each of these concentrations. LOD calculations were performed using the chemical concentration expressed per amount of lipid, because this concentration determines the analytical sensitivity. For this reason, LOD results for chemicals measured in each data table and in Appendix C are expressed in units of weight per amount of lipid. In the lipid unadjusted tables, a result for a geometric mean or percentile was reported as < LOD if the corresponding geometric mean or percentile was < LOD in the lipid adjusted table.

Percentiles

Percentiles (50th, 75th, 90th, and 95th) provide additional information about the shape of the distribution. Percentile estimates and 95% confidence interval estimates less than the limit of detection in the data tables are indicated as <LOD. An explanation of the procedure for estimating percentiles is provided in Appendix A and an example using SAS-callable SUDAAN is provided on the website (see “SAS Code Example” at: <https://www.cdc.gov/exposurereport/>).

References

Taylor JK. 1987. Quality assurance of chemical measurements. Boca Raton, FL: Lewis Publishers.

Hornung RW, Reed LD. 1990. Estimation of average concentration in the presence of nondetectable values. *Appl Occup Environ Hyg* 5(1):46-51.

Interpretation of Report and Updated Tables Data: Important Considerations

Research studies, separate from the *Report* and *Updated Tables*, are required to determine whether blood or urine levels are safe or are associated with disease or adverse effects.

The measurement of an environmental chemical in a person's blood or urine does not mean, by itself, that the chemical causes disease. Advances in analytical methods allow us to measure low levels of environmental chemicals in people, but separate studies of varying exposure levels and health effects are needed to determine whether blood or urine levels result in disease. These studies must also consider other factors such as duration of exposure. The *Report* and *Updated Tables* do not present new data on health risks from different exposures.

For some environmental chemicals, such as lead, research studies have given us a good understanding of the health risks associated with different blood levels. However, for many environmental chemicals, we need more research to assess health risks from different blood or urine levels. The results shown in the *Report* and *Updated Tables* should help prioritize and foster research on human health risks that result from exposure to environmental chemicals. For more information about exposure to environmental chemicals, see the section in this document titled "Chemical and Toxicological Information," which includes Internet reference sites.

Persistent and non-persistent chemicals; Use of percentiles; Comparison of levels between groups

In the *Report* and *Updated Tables*, most measurements in urine quantify chemical metabolites of non-persistent chemicals (those that do not stay in the body a long time). Metals and some tobacco biomarkers (e.g., heterocyclic amines) measured in urine are exceptions for they are not metabolites. Persistent chemicals (those that stay in the body for a long time) are usually measured in serum as the parent chemical.

The higher percentiles (75th, 90th, 95th) provided for each chemical convey useful information about the upper distribution and range of levels in the population. The 95th percentile is helpful when determining whether levels observed in separate public health investigations or other studies are unusual.

Levels of chemicals are provided for the demographic groups as stratified by age, gender, and race/ethnicity. Demographic groups may not be equal in their composition with respect to other variables. Chemicals measured in pooled serum samples are stratified by combined demographic groups (e.g., non-Hispanic black females, ages 12-19 years). CDC scientists publish separate scientific papers that make detailed comparisons of levels of chemicals in different demographic groups. See <https://www.cdc.gov/exposurereport/> for a list of peer-reviewed biomonitoring papers.

Not all the chemicals in the *Report* and *Updated Tables* are measured in the same individuals. Therefore, it is not possible to determine the fraction of all measured chemicals that were found at detectable levels in each person.

Blood, serum, and urine levels of a chemical should not be confused with levels of the chemical in air, water, food, soil, or dust.

Concentrations of environmental chemicals in blood or urine are not the same as those in air, water, food, soil, or dust. For example, a chemical concentration of 10 µg/L in water does not produce a level of 10 µg/L in blood or urine. Blood or urine levels may reflect exposure from one or more sources, including air, water, food, soil, and dust.

Levels of a chemical in blood, serum, and urine are determined by how much of the chemical has entered the body through all routes of exposure, including ingestion, inhalation, and dermal absorption, and how the chemical is distributed in body tissues, transformed into metabolites, and eliminated from the body. Although the levels in the blood, serum and urine are measures of the amount of a chemical that has entered the body by all routes of exposure, the blood or urine level alone does not indicate the specific exposure source or route of exposure.

Calculation of Inorganic-related Arsenic Species

We present data for the urinary inorganic-related arsenic species. The values are calculated using results for each NHANES survey period for the following four arsenic species: arsenic (V) acid, arsenous (III) acid, dimethylarsinic acid (DMA), and monomethylarsonic acid (MMA). The sum of the four species is calculated for each individual NHANES participant. If the value of a species is less than the limit of detection (LOD), then the imputed value is used. The imputed value is calculated as the LOD divided by the square root of two (Hornung and Reed, 1990) and imputed values are provided in the NHANES public release file. If all four arsenic species are reported as less than the LOD, then the sum will be the sum of the four imputed values.

The geometric means, selected percentiles, and confidence intervals are calculated using sums with detectable values of 60 percent or higher. If the detection frequency for a category is less than 60 percent, this is indicated by an asterisk (*). There is no LOD for the inorganic-related arsenic species because the values are calculated, rather than measured.

Reference

Hornung RW, Reed LD. 1990. Estimation of average concentration in the presence of nondetectable values. *Appl Occup Environ Hyg* 5(1):46-51.

Calculation of PFOS and PFOA as the Sum of Isomers

Whereas we directly measured and reported serum total PFOS and PFOA prior to 2013, beginning with NHANES 2013-14 we began measuring linear and branched isomers of serum PFOS and PFOA and summing them to arrive at total PFOS and PFOA. This calculated sum of PFOS (or PFOA) isomers is comparable to the total PFOS (or PFOA) that we reported previously.

The decision to measure linear and branched isomers relates to the processes historically used to produce PFOS and PFOA. From the early 1950s to the early 2000s, electrochemical fluorination (ECF) was the primary process used to synthesize these compounds; thereafter, fluorotelomerization became the primary method. While ECF yielded linear and branched isomers, fluorotelomerization produced almost exclusively linear compounds. Measurement of the two types of isomers is informative because branched isomers may be eliminated from the body more rapidly than linear isomers (Benskin et al, 2009a). In some cases, measurement of the two isomers provides information that is helpful for evaluating exposure source contributions (Benskin et al, 2010, 2009b).

The value of PFOS is calculated as the sum of branched PFOS isomers (perfluoromethylheptane sulfonate isomers, Sm-PFOS) plus the linear isomer (*n*-PFOS). PFOA is calculated as the sum of branched PFOA isomers (Sb-PFOA) plus the linear isomer (*n*-PFOA). For each chemical (PFOS and PFOA), the sum of the branched and linear isomers is calculated for each individual NHANES participant. If the value for any isomer is below the limit of detection (LOD), then the imputed value is used. The imputed value is calculated as the LOD divided by the square root of two (Hornung and Reed, 1990) and imputed values are provided in the NHANES public release file. If both isomers for calculating either PFOS or PFOA are reported as less than the LOD, then two imputed values are summed. These calculated PFOA and PFOS results can be used to compare with previous measurements and examine trends in the U.S. population.

The geometric means, selected percentiles, and confidence intervals are calculated using sums with detectable values of 60 percent or higher. If the detection frequency for a category is less than 60 percent, this is indicated by an asterisk (*). Because the 2013-2014 and 2015-2016 values for PFOA and PFOS are a calculated sum, there is no limit of detection (LOD) for either of these two chemicals.

The branched isomers of PFOS (Sm-PFOS) and PFOA (Sb-PFOA) are a mixture of isomers. The isomers known to be included in Sm-PFOS are perfluoro-3-methylheptane sulfonate, perfluoro-4-methylheptane sulfonate, perfluoro-5-methylheptane sulfonate, and perfluoro-6-methylheptane sulfonate. The isomers known to be included in Sb-PFOA are perfluoro-3-methylheptanoic acid, perfluoro-4-methylheptanoic acid, perfluoro-5-methylheptanoic acid, perfluoro-6-methylheptanoic acid, perfluoro-4,4-dimethylhexanoic acid, perfluoro-5,5-dimethylhexanoic acid, perfluoro-3,5-dimethylhexanoic acid, and perfluoro-4,5-dimethylhexanoic acid. The linear isomers of PFOS (*n*-PFOS) and PFOA (*n*-PFOA) are single chemicals. Data tables are also presented for each of the four isomers that were measured.

References

Benskin JP, Hold A, Martin JW. 2009a. Isomer-specific biotransformation rates of a perfluorooctane sulfonate (PFOS) precursor by cytochrome P450 isozymes and human liver microsomes. *Environ Sci Technol* 43:8566-8572.

Benskin JP, DeSilver AO, Martin LJ, Arsenault G, McCrindle R, Riddell N, et al. 2009b. Disposition of perfluorinated acid isomers in Sprague-Dawley rats: part 1: single dose. *Environ Toxicol Chem* 28:542-554.

Benskin JP, DeSilver AG, Martin JW. 2010. Isomer profiling of perfluorinated substances as a tool for source tracking: a review of early findings and future applications. *Rev Environ Contamin Toxicol* 208:111-160.

Hornung RW, Reed LD. 1990. Estimation of average concentration in the presence of nondetectable values. *Appl Occup Environ Hyg* 5(1):46-51.

Chemical and Toxicological Information

The *National Report on Human Exposure to Environmental Chemicals* and *Updated Tables* (referred to as the *Report* and *Updated Tables*, respectively) present biomonitoring data on the exposure of the U.S. population to environmental chemicals. The measurement of an environmental chemical in a person's blood or urine does not mean, by itself, that the chemical causes disease or adverse effects. Advances in analytical methods allow us to measure lower and lower levels of environmental chemicals in people. Separate studies of varying exposure levels and health effects associated with these levels are required to determine whether blood, serum, and urine levels result in disease or adverse effects. The data and information in the *Report* and *Updated Tables* do not establish health effects nor do they create guidelines.

Where can I find more information?

For more information about environmental chemicals, web links are provided below. Links to nonfederal organizations are provided solely as a service to our readers. These links do not constitute an endorsement of these organizations or their programs by CDC or the federal government. CDC is not responsible for the content of an individual organization's Web pages found at these links.

U.S. Governmental Sources

Centers for Disease Control and Prevention (CDC)

National Center for Health Statistics (NCHS)

<https://www.cdc.gov/nchs/>

National Health and Nutrition Examination Survey (NHANES)

<https://www.cdc.gov/nchs/nhanes.htm>

National Institute for Occupational Safety and Health (NIOSH)

<https://www.cdc.gov/niosh/data/>

- Registry of Toxic Effects of Chemical Substances (RTECS)
<https://www.cdc.gov/niosh/rtecs/>

National Center for Environmental Health (NCEH)

<https://www.cdc.gov/nceh/>

National Biomonitoring Program

<https://www.cdc.gov/biomonitoring/>

Agency for Toxic Substances and Disease Registry (ATSDR)

Toxicological Profiles and ToxFAQs

- ToxFAQs
<https://www.atsdr.cdc.gov/toxfaqs/>
- Toxicological Profiles
<https://www.atsdr.cdc.gov/ToxProfiles/>

Toxic Substances Portal

<https://www.atsdr.cdc.gov/substances/>

U.S. Food and Drug Administration (FDA)

Center for Food Safety and Applied Nutrition

<https://www.fda.gov/AboutFDA/CentersOffices/OfficeofFoods/CFSAN/>

National Center for Toxicological Research

<https://www.fda.gov/AboutFDA/CentersOffices/OC/OfficeofScientificandMedicalPrograms/NCTR/>

U.S. Environmental Protection Agency (EPA)

Integrated Risk Information System (IRIS)

<https://www.epa.gov/iris/>

Office of Chemical Safety and Pollution Prevention (OCSP)

<https://www.epa.gov/aboutepa/about-office-chemical-safety-and-pollution-prevention-ocsp>

Office of Drinking Water

<https://www.epa.gov/ground-water-and-drinking-water>

U.S. Geological Survey (USGS)

<https://www.usgs.gov/>

U.S. Department of Agriculture (USDA)

Food Safety and Inspection Service

<https://www.fsis.usda.gov/wps/portal/fsis/home>

National Institutes of Health (NIH)

National Institute for Environmental Health Sciences (NIEHS)

<https://www.niehs.nih.gov/>

National Toxicology Program (NTP)

<http://ntp.niehs.nih.gov>

14th Report on Carcinogens

<https://ntp.niehs.nih.gov/pubhealth/roc/index-1.html>

National Library of Medicine (NLM), Toxicology Data Network

<https://toxnet.nlm.nih.gov/>

National Library of Medicine (NLM); MedlinePlus Health Topics: Poisoning, Toxicology, and Environmental Health

<https://medlineplus.gov/poisoningtoxicologyenvironmentalhealth.html>

National Library of Medicine (NLM), Environmental Health and Toxicology, online Toxicology Tutorial

<https://toxtutor.nlm.nih.gov/>

Professional and Academic Organizations

American Conference of Governmental Industrial Hygienists

<http://www.acgih.org/home>

Association of Public Health Laboratories

<http://www.aphl.org/>

Pediatric Environmental Health Specialty Units (PEHSUs)

<http://www.PEHSU.net/>

International Labour Organization

- International Chemical Safety Cards

http://www.ilo.org/safework/info/publications/WCMS_113134/lang--en/index.htm

The Extension TOXicology NETwork (EXTOXNET)

- Pesticide Information Profiles

<http://extoxnet.orst.edu/pips/ghindex.html>

World Health Organization

International Programme on Chemical Safety (IPCS)

<https://www.who.int/health-topics/chemical-safety>

- Monographs of the Joint FAO/WHO Meeting on Pesticide Residues

<http://www.inchem.org/pages/jmpr.html>

- Environmental Health Criteria documents

<http://www.who.int/ipcs/publications/ehc/en/>

International Agency for Research on Cancer (IARC)

<https://www.iarc.fr/>

- Monographs on the Evaluation of Carcinogenic Risks to Humans

<https://monographs.iarc.fr/>

Adducts of Hemoglobin

Acrylamide in Smokers (2013 - 2014)

CAS Number 79-06-1

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in pmol/g hemoglobin) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	113 (100-128)	108 (94.0-129)	166 (137-202)	250 (220-281)	306 (281-341)	878
Age 18-49 years	13-14	113 (98.8-129)	105 (90.6-132)	166 (139-212)	269 (230-301)	325 (296-379)	519
Age 50+ years	13-14	114 (101-129)	113 (94.2-130)	166 (127-193)	210 (189-242)	269 (218-332)	359
Males	13-14	114 (99.8-131)	114 (91.5-135)	171 (146-218)	268 (239-296)	311 (281-362)	463
Females	13-14	112 (98.3-128)	107 (94.2-127)	160 (131-193)	228 (198-269)	301 (249-333)	415

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.110.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Acrylamide in Non-smokers (2013 - 2014)

CAS Number 79-06-1

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in pmol/g hemoglobin) for the non-smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	40.7 (38.9-42.6)	39.5 (37.5-41.7)	49.3 (47.2-51.6)	62.2 (59.8-66.0)	75.7 (69.8-87.9)	1320
Age 18-49 years	13-14	41.7 (39.6-43.8)	39.3 (37.5-41.7)	49.9 (46.6-54.1)	66.0 (61.4-71.2)	87.0 (72.6-110)	693
Age 50+ years	13-14	39.6 (37.1-42.2)	39.5 (36.0-42.0)	48.8 (45.0-51.9)	60.0 (56.1-61.7)	69.8 (62.2-78.7)	627
Males	13-14	42.9 (41.2-44.7)	41.3 (39.4-43.1)	51.9 (48.4-57.1)	66.0 (62.0-71.1)	83.8 (71.2-117)	591
Females	13-14	38.9 (36.7-41.2)	38.5 (35.7-40.5)	47.2 (43.4-50.0)	58.5 (53.7-63.5)	71.3 (61.4-87.6)	729

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.110.

^ Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Formaldehyde in Smokers (2013 - 2014)

CAS Number 50-00-0

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in nmol/g hemoglobin) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	132 (128-136)	133 (129-137)	146 (141-150)	156 (150-167)	164 (156-174)	771
Age 18-49 years	13-14	133 (129-137)	134 (130-139)	148 (141-153)	156 (150-169)	164 (157-173)	460
Age 50+ years	13-14	130 (125-134)	130 (126-136)	143 (136-149)	153 (146-170)	167 (150-187)	311
Males	13-14	133 (129-138)	135 (129-141)	149 (140-156)	156 (149-173)	164 (159-171)	410
Females	13-14	131 (127-135)	131 (127-136)	143 (138-148)	153 (147-170)	169 (152-178)	361

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.670.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Formaldehyde in Non-smokers (2013 - 2014)

CAS Number 50-00-0

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in nmol/g hemoglobin) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	136 (132-139)	136 (131-141)	150 (145-154)	161 (156-165)	168 (163-173)	1208
Age 18-49 years	13-14	136 (132-140)	136 (131-141)	150 (144-156)	162 (158-167)	169 (164-177)	626
Age 50+ years	13-14	135 (132-139)	136 (130-142)	149 (145-153)	160 (155-165)	166 (161-173)	582
Males	13-14	135 (132-138)	135 (130-140)	148 (142-153)	159 (154-162)	165 (161-171)	530
Females	13-14	136 (132-141)	136 (130-144)	152 (146-156)	164 (158-168)	170 (164-175)	678

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.670.

[^] Cigarette non-smokers who used other tobacco products were excluded

Glycidamide in Smokers (2013 - 2014)

CAS Number 486-56-6

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in pmol/g hemoglobin) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	76.5 (68.2-85.8)	75.6 (68.3-90.3)	115 (99.0-127)	163 (136-192)	207 (184-248)	895
Age 18-49 years	13-14	77.6 (67.5-89.3)	76.6 (67.2-93.3)	117 (98.0-134)	170 (144-199)	214 (190-255)	537
Age 50+ years	13-14	74.3 (66.8-82.7)	75.5 (70.3-81.4)	108 (92.3-126)	144 (128-173)	200 (148-256)	358
Males	13-14	74.9 (67.1-83.6)	74.5 (69.6-84.2)	113 (99.9-126)	163 (139-200)	214 (184-248)	478
Females	13-14	78.2 (67.8-90.2)	77.1 (65.4-94.9)	116 (98.0-131)	163 (133-192)	201 (168-258)	417

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.660.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Glycidamide in Non-smokers (2013 - 2014)

CAS Number 486-56-6

Geometric mean and selected percentiles of hemoglobin adduct concentrations (in pmol/g hemoglobin) for the non-smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	35.3 (33.5-37.2)	34.8 (33.1-37.0)	43.8 (42.6-46.3)	58.2 (53.6-62.4)	71.2 (62.4-85.5)	1283
Age 18-49 years	13-14	36.7 (34.8-38.7)	36.6 (34.0-38.3)	45.4 (42.8-47.7)	60.7 (53.2-70.0)	84.1 (67.3-102)	678
Age 50+ years	13-14	33.9 (31.6-36.3)	33.6 (31.7-35.2)	42.9 (41.3-44.6)	57.3 (50.9-60.0)	62.4 (57.3-82.3)	605
Males	13-14	35.4 (33.5-37.4)	34.8 (32.4-38.0)	45.0 (41.5-50.1)	57.3 (54.5-62.4)	68.2 (62.4-80.2)	580
Females	13-14	35.3 (33.1-37.6)	34.7 (33.2-37.0)	43.6 (42.1-45.6)	58.7 (50.8-67.3)	75.1 (60.6-89.6)	703

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.660.

^ Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Tobacco Alkaloids and Metabolites

Urinary Total Anabasine in Smokers (2013 - 2016)

CAS Number 13078-04-1

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	5.09 (4.38-5.91)	5.78 (5.22-6.47)	12.0 (10.8-13.2)	22.1 (19.2-23.5)	28.4 (23.9-32.9)	881
Total population	15-16	5.88 (5.15-6.71)	7.30 (6.17-8.58)	15.5 (12.7-17.6)	24.0 (20.7-29.4)	33.0 (25.3-37.9)	776
Age 20-49 years	13-14	4.87 (3.85-6.16)	5.75 (4.86-7.40)	12.1 (10.4-14.4)	22.8 (20.3-26.1)	31.8 (23.3-34.0)	523
Age 20-49 years	15-16	4.70 (3.73-5.91)	6.32 (4.91-7.09)	13.6 (11.1-16.6)	22.2 (19.9-27.9)	31.6 (22.9-37.5)	409
Age 50+ years	13-14	5.74 (4.96-6.64)	5.86 (5.16-6.43)	11.8 (8.93-13.5)	18.7 (13.5-25.6)	24.6 (18.2-29.2)	358
Age 50+ years	15-16	8.34 (7.06-9.86)	9.33 (7.25-12.2)	16.6 (13.1-21.3)	24.4 (19.4-35.1)	34.2 (24.0-40.9)	367
Males	13-14	4.74 (3.88-5.80)	5.74 (4.88-6.47)	11.0 (9.35-13.5)	22.1 (15.9-26.1)	27.7 (22.2-33.0)	493
Males	15-16	6.03 (4.68-7.76)	8.19 (6.10-9.35)	16.6 (13.4-19.5)	25.9 (21.8-33.5)	35.2 (27.6-40.6)	469
Females	13-14	5.47 (4.81-6.22)	5.77 (5.13-6.88)	12.5 (11.1-14.4)	21.5 (16.7-29.7)	31.8 (20.9-38.6)	416
Females	15-16	5.71 (5.08-6.41)	7.01 (5.43-8.29)	13.8 (11.6-16.3)	20.9 (19.4-23.3)	25.5 (22.0-31.3)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.510 and 0.510 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Anabasine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 13078-04-1

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	5.35 (4.44-6.45)	6.58 (5.37-7.98)	12.8 (11.1-14.4)	19.7 (17.9-22.4)	24.3 (22.7-28.3)	880
Total population	15-16	5.94 (5.23-6.74)	7.75 (6.96-8.47)	13.8 (12.3-15.4)	20.7 (17.4-26.2)	29.7 (21.5-34.5)	776
Age 20-49 years	13-14	4.61 (3.63-5.85)	5.57 (4.21-7.36)	11.5 (10.2-13.6)	19.2 (17.0-22.0)	24.5 (21.6-28.9)	522
Age 20-49 years	15-16	4.41 (3.47-5.60)	6.03 (4.17-7.85)	11.7 (10.4-14.3)	18.5 (16.1-22.3)	23.8 (18.7-33.5)	409
Age 50+ years	13-14	7.43 (6.37-8.67)	8.28 (6.69-10.4)	13.9 (12.5-16.4)	21.7 (16.4-24.0)	24.2 (22.2-32.3)	358
Age 50+ years	15-16	9.45 (8.46-10.6)	10.1 (8.36-11.7)	15.8 (12.3-19.0)	26.6 (20.1-32.4)	33.3 (22.0-45.6)	367
Males	13-14	4.23 (3.45-5.20)	5.44 (4.44-6.51)	10.4 (8.66-13.4)	17.2 (15.5-19.2)	21.6 (18.4-24.4)	492
Males	15-16	5.17 (4.31-6.19)	7.10 (6.30-7.89)	12.0 (10.9-12.9)	17.0 (15.1-21.1)	22.7 (17.0-30.3)	469
Females	13-14	6.81 (5.61-8.26)	8.49 (6.41-9.83)	14.3 (11.8-17.4)	22.7 (19.4-24.2)	27.7 (23.9-32.0)	416
Females	15-16	7.01 (5.96-8.23)	8.39 (6.59-10.7)	15.8 (12.9-19.0)	27.1 (19.0-34.5)	34.5 (22.3-45.6)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Anatabine in Smokers (2013 - 2016)

CAS Number 2743-90-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	7.24 (6.05-8.67)	9.11 (8.18-10.6)	19.4 (17.0-21.9)	35.8 (31.5-39.5)	48.6 (43.6-55.0)	881
Total population	15-16	9.37 (8.10-10.8)	12.9 (11.5-14.2)	27.1 (22.5-29.8)	48.5 (40.5-52.6)	60.6 (52.6-66.3)	776
Age 20-49 years	13-14	6.80 (5.12-9.03)	9.11 (6.71-12.1)	19.7 (16.4-23.6)	37.6 (32.2-44.1)	52.0 (44.4-58.8)	523
Age 20-49 years	15-16	7.28 (5.57-9.50)	10.8 (7.27-13.3)	22.8 (18.5-27.9)	47.7 (36.8-58.6)	60.1 (48.9-65.3)	409
Age 50+ years	13-14	8.60 (7.30-10.1)	9.12 (7.31-12.2)	19.0 (14.0-23.9)	31.4 (22.6-43.6)	39.7 (29.1-51.1)	358
Age 50+ years	15-16	14.0 (11.6-16.9)	16.7 (12.4-19.7)	29.8 (22.6-37.3)	50.3 (37.5-60.8)	62.1 (44.1-78.8)	367
Males	13-14	6.55 (5.21-8.23)	8.32 (6.76-9.77)	18.8 (15.1-21.8)	34.6 (26.5-44.4)	45.7 (37.0-61.3)	493
Males	15-16	9.60 (7.34-12.5)	13.9 (10.7-16.3)	30.1 (22.5-35.3)	51.3 (42.5-60.1)	64.3 (51.8-78.8)	469
Females	13-14	8.04 (6.82-9.47)	9.81 (8.33-11.9)	20.7 (16.7-23.6)	35.8 (28.7-41.1)	51.9 (36.6-62.3)	416
Females	15-16	9.11 (7.77-10.7)	12.1 (10.5-13.8)	22.9 (19.2-27.1)	41.4 (32.0-48.7)	55.0 (47.7-62.1)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.390 and 0.390 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Anatabine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 2743-90-0

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	7.62 (6.12-9.47)	9.79 (8.73-11.2)	21.3 (18.5-24.9)	35.1 (31.6-39.4)	45.3 (39.4-55.5)	880
Total population	15-16	9.47 (8.15-11.0)	13.3 (11.7-15.2)	24.7 (22.3-27.3)	40.1 (32.0-50.7)	58.6 (42.3-63.6)	776
Age 20-49 years	13-14	6.43 (4.82-8.57)	8.46 (6.58-10.0)	19.8 (15.6-25.2)	34.1 (29.0-41.5)	45.8 (39.6-55.5)	522
Age 20-49 years	15-16	6.83 (5.14-9.07)	9.75 (6.30-13.4)	22.4 (18.3-24.8)	33.8 (29.8-40.1)	40.5 (34.0-59.2)	409
Age 50+ years	13-14	11.1 (9.42-13.2)	13.5 (10.5-17.0)	24.0 (20.2-27.3)	35.6 (30.7-41.3)	42.8 (35.6-73.5)	358
Age 50+ years	15-16	15.9 (13.8-18.3)	17.8 (14.3-21.3)	28.2 (22.6-34.5)	50.7 (36.9-60.2)	62.7 (52.6-78.2)	367
Males	13-14	5.84 (4.59-7.44)	8.00 (6.43-9.79)	17.1 (14.2-21.4)	29.6 (24.5-34.8)	39.4 (30.6-47.3)	492
Males	15-16	8.23 (6.73-10.1)	11.9 (10.4-13.3)	22.3 (19.6-22.6)	33.7 (29.9-40.1)	41.8 (34.0-55.8)	469
Females	13-14	10.0 (7.98-12.6)	12.2 (9.64-15.1)	25.1 (21.8-28.0)	39.2 (33.7-42.8)	50.0 (42.0-67.0)	416
Females	15-16	11.2 (9.11-13.7)	14.5 (11.1-18.2)	27.5 (24.1-31.5)	50.7 (34.6-62.7)	62.7 (50.7-78.2)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Cotinine in Smokers (2013 - 2016)

CAS Number 486-56-6

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1500 (1180-1910)	2020 (1720-2330)	3710 (3390-4100)	5890 (5420-6460)	7520 (6790-8140)	893
Total population	15-16	1600 (1260-2030)	2330 (2160-2510)	4340 (3780-4740)	6480 (5480-7390)	7750 (6960-8740)	796
Age 20-49 years	13-14	1410 (995-1990)	2030 (1690-2440)	3930 (3410-4430)	6390 (5760-6990)	7960 (7010-9080)	532
Age 20-49 years	15-16	1160 (781-1720)	2080 (1740-2320)	4060 (3580-4520)	6330 (5450-7140)	7480 (6710-8870)	424
Age 50+ years	13-14	1710 (1360-2140)	1980 (1620-2270)	3360 (2740-3660)	5310 (4730-5550)	6450 (5420-7580)	361
Age 50+ years	15-16	2560 (2230-2940)	2680 (2410-3200)	4570 (3760-5370)	6600 (5370-8380)	8490 (6840-8970)	372
Males	13-14	1440 (1050-1990)	2020 (1720-2410)	3820 (2900-4490)	5880 (5140-6670)	7370 (6490-7740)	500
Males	15-16	1480 (1030-2120)	2410 (2000-2850)	4650 (3820-5450)	7070 (6180-8310)	8740 (7070-10700)	482
Females	13-14	1560 (1200-2040)	1930 (1660-2150)	3540 (3240-3880)	5890 (5120-6790)	8300 (5940-10800)	422
Females	15-16	1760 (1500-2070)	2290 (2060-2540)	3890 (3670-4370)	5530 (4920-6600)	7140 (5530-8400)	335

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.030 and 0.030 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Cotinine in Non-smokers (2013 - 2016)

CAS Number 486-56-6

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.470 (.377-.587)	.231 (.196-.275)	.824 (.613-1.19)	6.82 (3.88-17.8)	84.4 (21.5-345)	1350
Total population	15-16	.414 (.329-.520)	.199 (.176-.239)	.651 (.477-.964)	6.37 (3.46-19.1)	249 (53.8-1250)	1392
Age 20-49 years	13-14	.588 (.447-.774)	.268 (.217-.363)	1.25 (.796-2.29)	15.6 (6.65-41.9)	269 (41.9-673)	663
Age 20-49 years	15-16	.603 (.459-.791)	.269 (.210-.366)	.838 (.615-1.51)	44.1 (4.86-243)	1060 (262-2310)	680
Age 50+ years	13-14	.332 (.251-.439)	.197 (.173-.244)	.633 (.427-.824)	2.70 (1.51-7.43)	26.4 (5.56-259)	687
Age 50+ years	15-16	.271 (.202-.362)	.167 (.138-.188)	.432 (.266-.893)	2.94 (1.14-8.70)	14.5 (4.39-143)	712
Males	13-14	.577 (.441-.753)	.273 (.217-.343)	.995 (.714-1.51)	20.8 (6.65-41.9)	252 (50.2-865)	655
Males	15-16	.636 (.462-.875)	.259 (.203-.340)	1.06 (.597-2.43)	63.4 (7.15-316)	1630 (104-2480)	657
Females	13-14	.396 (.299-.524)	.205 (.174-.264)	.834 (.510-1.40)	6.42 (2.81-13.1)	42.8 (13.1-301)	792
Females	15-16	.290 (.232-.364)	.182 (.162-.203)	.488 (.366-.735)	2.43 (1.59-3.97)	20.5 (4.86-153)	794

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.030 and 0.030 respectively.

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Cotinine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 486-56-6

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1590 (1220-2060)	2490 (2120-2770)	3850 (3450-4190)	5590 (5140-6700)	7410 (7010-8120)	892
Total population	15-16	1630 (1280-2070)	2610 (2340-2740)	4230 (3800-4720)	6120 (5520-6630)	7270 (6540-8060)	796
Age 20-49 years	13-14	1350 (979-1860)	2120 (1550-2570)	3540 (3230-3930)	5340 (5070-6440)	7180 (6440-7900)	531
Age 20-49 years	15-16	1100 (731-1670)	1970 (1520-2650)	3810 (2960-4190)	5190 (4350-6040)	6240 (5190-7270)	424
Age 50+ years	13-14	2200 (1700-2850)	2930 (2550-3210)	4110 (3690-4790)	6480 (5020-7350)	8110 (6560-10300)	361
Age 50+ years	15-16	2900 (2570-3270)	3150 (2700-3910)	5230 (4320-6060)	6840 (6060-8060)	8060 (7140-8860)	372
Males	13-14	1300 (954-1780)	2040 (1560-2350)	3340 (3020-3730)	5000 (4310-5470)	6690 (5370-7010)	499
Males	15-16	1290 (941-1760)	2210 (1880-2570)	3540 (3030-4090)	5260 (4380-5970)	6120 (5520-6630)	482
Females	13-14	1940 (1450-2610)	2850 (2570-3160)	4360 (3750-4960)	6710 (5320-7350)	8040 (7150-9460)	422
Females	15-16	2170 (1800-2620)	3150 (2700-3580)	5020 (4240-5750)	7150 (6240-8060)	8860 (7270-10000)	335

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Cotinine in Non-smokers (creatinine corrected, 2013 - 2016)

CAS Number 486-56-6

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.558 (.442-.704)	.306 (.257-.368)	.981 (.711-1.23)	6.96 (3.77-15.0)	49.2 (19.5-347)	1349
Total population	15-16	.471 (.372-.596)	.235 (.196-.298)	.675 (.501-1.00)	5.40 (2.82-24.7)	184 (47.9-776)	1390
Age 20-49 years	13-14	.662 (.502-.873)	.336 (.274-.431)	1.39 (.956-2.50)	10.7 (6.52-27.3)	190 (35.9-463)	663
Age 20-49 years	15-16	.640 (.474-.865)	.296 (.236-.362)	.854 (.610-1.41)	33.8 (5.10-171)	776 (116-1720)	678
Age 50+ years	13-14	.421 (.327-.543)	.281 (.244-.315)	.671 (.543-.937)	2.94 (1.32-10.0)	26.3 (4.01-168)	686
Age 50+ years	15-16	.335 (.246-.455)	.193 (.148-.286)	.495 (.355-.867)	2.77 (1.29-7.05)	14.9 (4.87-106)	712
Males	13-14	.540 (.411-.709)	.282 (.230-.351)	.900 (.621-1.20)	15.8 (5.41-30.5)	108 (28.3-500)	654
Males	15-16	.586 (.423-.812)	.241 (.189-.324)	.778 (.479-1.98)	42.8 (4.87-249)	1060 (67.3-2250)	657
Females	13-14	.573 (.426-.771)	.338 (.264-.450)	1.13 (.752-1.57)	6.49 (3.14-18.5)	49.2 (15.1-346)	792
Females	15-16	.393 (.313-.494)	.234 (.196-.311)	.637 (.502-.850)	2.72 (1.54-5.77)	24.7 (5.82-129)	792

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Cotinine N-Oxide in Smokers (2013 - 2016)

CAS Number 36508-80-2

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	210 (184-240)	244 (214-285)	467 (425-514)	775 (665-910)	1100 (900-1300)	881
Total population	15-16	238 (203-279)	304 (256-340)	555 (516-616)	901 (790-957)	1040 (972-1220)	776
Age 20-49 years	13-14	205 (166-252)	256 (192-325)	497 (434-536)	798 (706-884)	1080 (845-1360)	523
Age 20-49 years	15-16	196 (157-246)	272 (222-327)	516 (428-645)	846 (736-936)	992 (915-1220)	409
Age 50+ years	13-14	222 (187-263)	229 (184-293)	423 (349-527)	712 (553-1070)	1110 (686-1450)	358
Age 50+ years	15-16	318 (272-371)	341 (255-468)	610 (522-739)	957 (739-1080)	1110 (984-1240)	367
Males	13-14	202 (171-238)	260 (222-308)	475 (434-519)	750 (633-928)	1020 (750-1220)	493
Males	15-16	235 (177-312)	309 (228-391)	607 (482-730)	910 (755-984)	1010 (919-1280)	469
Females	13-14	219 (193-248)	229 (194-275)	448 (386-518)	821 (657-1000)	1200 (944-1530)	416
Females	15-16	242 (223-263)	277 (246-329)	540 (485-603)	911 (739-1030)	1110 (957-1240)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 2.02 and 2.02 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Cotinine N-Oxide in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 36508-80-2

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	221 (185-264)	283 (247-313)	435 (393-473)	606 (545-656)	761 (668-867)	880
Total population	15-16	241 (209-277)	317 (295-347)	463 (443-514)	651 (597-716)	815 (671-966)	776
Age 20-49 years	13-14	194 (157-239)	262 (227-285)	416 (367-453)	564 (506-644)	682 (604-867)	522
Age 20-49 years	15-16	184 (146-232)	262 (210-313)	413 (364-457)	541 (480-651)	686 (572-789)	409
Age 50+ years	13-14	288 (244-340)	323 (277-360)	480 (415-535)	684 (608-796)	867 (729-966)	358
Age 50+ years	15-16	360 (321-403)	377 (331-443)	595 (469-644)	773 (644-966)	966 (731-977)	367
Males	13-14	180 (151-214)	243 (214-266)	366 (328-420)	564 (453-668)	675 (572-761)	492
Males	15-16	201 (162-251)	275 (239-301)	401 (353-453)	523 (446-616)	616 (529-711)	469
Females	13-14	273 (227-328)	323 (276-379)	474 (423-523)	643 (552-818)	879 (698-1010)	416
Females	15-16	297 (272-325)	374 (344-406)	590 (482-643)	776 (647-913)	926 (761-973)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total trans-3'-Hydroxycotinine in Smokers (2013 - 2016)

CAS Number 34834-67-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2550 (1990-3260)	3670 (3040-4160)	7020 (6470-7730)	12200 (10300-13000)	15400 (13000-17400)	893
Total population	15-16	2740 (2140-3500)	4160 (3790-4640)	8030 (7410-8800)	13300 (11900-15200)	17900 (14500-22700)	796
Age 20-49 years	13-14	2340 (1650-3320)	3580 (2730-4350)	7100 (6130-7840)	12400 (10400-13500)	15500 (13000-18400)	532
Age 20-49 years	15-16	1920 (1290-2860)	3090 (2630-3910)	6960 (6440-8030)	12800 (10500-16600)	17600 (13500-27300)	424
Age 50+ years	13-14	3010 (2400-3780)	3700 (2850-4650)	6780 (5900-7830)	10700 (9380-12800)	15400 (10700-20300)	361
Age 50+ years	15-16	4620 (4050-5250)	5580 (4730-6490)	9270 (7890-10700)	14300 (11500-16100)	17900 (14300-22700)	372
Males	13-14	2370 (1710-3280)	3650 (2950-4210)	7120 (6580-7830)	11300 (9880-13000)	14600 (12800-17400)	500
Males	15-16	2560 (1750-3750)	4230 (3320-5220)	8540 (7280-10700)	14300 (11500-15500)	16600 (14300-24600)	482
Females	13-14	2740 (2020-3710)	3700 (2830-4450)	6780 (5490-8000)	12400 (9600-13100)	16100 (12700-18700)	422
Females	15-16	2960 (2430-3600)	4160 (3340-4690)	7320 (6580-8780)	12800 (10500-16500)	18900 (13600-25400)	335

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.030 and 0.030 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total trans-3'-Hydroxycotinine in Non-smokers (2013 - 2016)

CAS Number 34834-67-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.778 (.621-.976)	.371 (.330-.471)	1.57 (1.18-2.28)	16.7 (8.39-37.3)	161 (63.1-565)	1350
Total population	15-16	.721 (.577-.902)	.401 (.330-.479)	1.18 (.928-1.82)	12.1 (7.52-28.4)	423 (101-2380)	1392
Age 20-49 years	13-14	.954 (.711-1.28)	.448 (.326-.649)	2.30 (1.40-4.03)	37.3 (15.0-84.9)	361 (90.1-2150)	663
Age 20-49 years	15-16	.967 (.748-1.25)	.479 (.401-.558)	1.58 (1.14-2.58)	81.7 (12.7-357)	1430 (423-4090)	680
Age 50+ years	13-14	.563 (.430-.737)	.346 (.299-.417)	1.24 (.762-1.72)	6.89 (3.60-15.4)	45.5 (15.3-239)	687
Age 50+ years	15-16	.516 (.385-.691)	.312 (.268-.396)	.941 (.644-1.60)	7.42 (2.55-12.1)	39.8 (9.19-308)	712
Males	13-14	.943 (.724-1.23)	.452 (.362-.597)	1.76 (1.38-2.67)	38.4 (13.8-84.9)	280 (110-1210)	655
Males	15-16	1.12 (.799-1.55)	.507 (.440-.616)	1.79 (1.15-3.31)	103 (9.19-688)	3740 (191-9540)	657
Females	13-14	.661 (.491-.890)	.348 (.289-.459)	1.53 (.939-2.87)	15.3 (7.10-31.0)	90.6 (31.0-548)	792
Females	15-16	.504 (.404-.629)	.312 (.270-.401)	.937 (.641-1.27)	6.28 (3.51-10.2)	29.5 (12.1-209)	794

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.030 and 0.030 respectively.

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total trans-3'-Hydroxycotinine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 34834-67-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2690 (2070-3500)	4080 (3360-4580)	6800 (6120-7470)	10100 (9430-10900)	12400 (11300-14200)	892
Total population	15-16	2780 (2190-3530)	4270 (3910-4800)	7660 (6760-8560)	11100 (9530-13300)	14100 (12200-17100)	796
Age 20-49 years	13-14	2250 (1650-3080)	3500 (2810-4290)	6470 (5410-6920)	9530 (8320-10100)	11000 (10100-12500)	531
Age 20-49 years	15-16	1830 (1210-2760)	3180 (2410-3910)	6080 (5200-7150)	10200 (8190-12200)	12900 (10700-13700)	424
Age 50+ years	13-14	3880 (2990-5040)	5000 (4110-5870)	7740 (7190-8510)	11900 (10100-14300)	16200 (12800-17700)	361
Age 50+ years	15-16	5230 (4670-5850)	6140 (5290-6760)	8970 (8270-9980)	14000 (10400-17300)	17300 (12500-24500)	372
Males	13-14	2140 (1590-2890)	3420 (2730-4010)	5680 (5080-6480)	8510 (7280-10600)	11500 (9150-14300)	499
Males	15-16	2230 (1610-3100)	3700 (3150-4030)	6310 (5490-7000)	9120 (8190-10500)	11100 (9950-13400)	482
Females	13-14	3410 (2450-4760)	4820 (3560-5950)	7700 (6750-9240)	10900 (9690-12400)	14100 (11800-16300)	422
Females	15-16	3650 (2990-4450)	5670 (4890-5970)	8970 (7800-9970)	13300 (11000-16300)	16300 (12900-18200)	335

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total trans-3'-Hydroxycotinine in Non-smokers (creatinine corrected, 2013 - 2016)

CAS Number 34834-67-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.924 (.728-1.17)	.490 (.395-.634)	1.71 (1.21-2.47)	15.6 (6.95-30.2)	102 (41.6-596)	1349
Total population	15-16	.820 (.652-1.03)	.422 (.333-.498)	1.19 (.943-1.79)	10.4 (5.91-33.1)	343 (99.5-1560)	1390
Age 20-49 years	13-14	1.07 (.796-1.45)	.566 (.408-.783)	2.66 (1.56-4.24)	30.4 (13.3-70.8)	254 (83.2-961)	663
Age 20-49 years	15-16	1.03 (.773-1.36)	.470 (.355-.647)	1.49 (1.09-2.39)	74.6 (7.68-210)	1730 (198-4760)	678
Age 50+ years	13-14	.718 (.558-.924)	.452 (.375-.528)	1.21 (.998-1.54)	6.48 (3.47-24.2)	60.5 (11.6-190)	686
Age 50+ years	15-16	.638 (.470-.865)	.372 (.291-.483)	1.01 (.668-1.93)	6.09 (2.76-16.0)	33.4 (10.2-180)	712
Males	13-14	.885 (.673-1.16)	.427 (.346-.563)	1.51 (.980-2.70)	28.2 (7.14-76.0)	190 (44.7-1040)	654
Males	15-16	1.03 (.734-1.44)	.405 (.308-.511)	1.51 (.947-3.32)	87.9 (10.2-633)	2320 (98.8-6570)	657
Females	13-14	.957 (.703-1.30)	.561 (.417-.738)	2.12 (1.37-3.12)	16.5 (6.78-36.3)	79.6 (31.3-699)	792
Females	15-16	.682 (.548-.847)	.422 (.338-.565)	1.18 (.932-1.48)	5.22 (3.12-14.4)	33.4 (11.4-219)	792

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary 1-(3-Pyridyl)-1-butanol-4-carboxylic acid in Smokers (2015 - 2016)

CAS Number 15569-97-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	361 (295-442)	490 (454-559)	1020 (906-1080)	1720 (1430-1930)	2140 (1870-2510)	776
Age 20-49 years	15-16	262 (189-365)	414 (324-480)	840 (715-1000)	1510 (1140-1870)	1890 (1510-2620)	409
Age 50+ years	15-16	583 (502-677)	642 (486-818)	1140 (955-1430)	1900 (1440-2140)	2190 (2000-2890)	367
Males	15-16	355 (242-519)	514 (417-654)	1080 (912-1290)	1790 (1440-2010)	2100 (1870-2310)	469
Females	15-16	369 (322-424)	479 (399-545)	848 (658-1080)	1440 (1180-1980)	2280 (1580-2510)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.38.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.38.

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary 1-(3-Pyridyl)-1-butanol-4-carboxylic acid in Smokers (creatinine corrected, 2015 - 2016)

CAS Number 15569-97-8

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	365 (296-450)	567 (514-587)	896 (802-978)	1460 (1150-1600)	1690 (1500-2050)	776
Age 20-49 years	15-16	246 (172-352)	410 (298-518)	681 (614-789)	1130 (914-1410)	1500 (1090-1730)	409
Age 50+ years	15-16	661 (583-750)	691 (605-880)	1140 (945-1450)	1600 (1430-2020)	2050 (1600-2220)	367
Males	15-16	304 (219-423)	491 (463-543)	746 (667-881)	1110 (884-1500)	1500 (1020-2050)	469
Females	15-16	454 (385-535)	614 (567-658)	1080 (884-1280)	1590 (1280-1960)	2000 (1590-2210)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

^ Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Nicotine in Smokers (2013 - 2016)

CAS Number 54-11-5

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	619 (482-795)	864 (711-1010)	1870 (1680-2130)	3370 (3020-3840)	4760 (4110-5200)	881
Total population	15-16	794 (661-954)	1100 (981-1310)	2510 (2220-2710)	4500 (3740-4790)	5530 (4790-6280)	776
Age 20-49 years	13-14	564 (404-788)	768 (626-964)	1870 (1680-2120)	3370 (2990-3910)	4710 (3840-5810)	523
Age 20-49 years	15-16	571 (426-764)	885 (615-1100)	2130 (1460-2570)	3790 (3100-4750)	5130 (4450-6000)	409
Age 50+ years	13-14	765 (645-909)	998 (870-1160)	1910 (1420-2390)	3410 (2830-4190)	5000 (3810-5400)	358
Age 50+ years	15-16	1320 (1080-1610)	1500 (1200-2100)	3020 (2270-4100)	4840 (3830-5560)	5560 (4840-6750)	367
Males	13-14	558 (418-745)	734 (601-975)	1860 (1530-2140)	3250 (2620-3840)	4490 (3840-5030)	493
Males	15-16	793 (567-1110)	1230 (914-1440)	2660 (2180-3440)	4660 (4240-5300)	5770 (5110-6830)	469
Females	13-14	689 (532-892)	916 (782-1100)	1900 (1610-2280)	3410 (2800-4130)	5070 (3660-6220)	416
Females	15-16	796 (656-966)	1070 (879-1310)	2450 (1870-2630)	3740 (3080-4620)	4840 (3830-5680)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 10.5 and 10.5 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Nicotine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 54-11-5

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	650 (483-876)	915 (742-1160)	2110 (1750-2560)	3800 (3080-4320)	4820 (4230-5530)	880
Total population	15-16	802 (660-975)	1230 (1030-1310)	2260 (2080-2790)	4050 (3360-4580)	5340 (4410-6090)	776
Age 20-49 years	13-14	533 (380-748)	742 (557-977)	1900 (1560-2120)	3240 (2800-4150)	4470 (3900-5410)	522
Age 20-49 years	15-16	535 (388-739)	814 (618-1150)	1910 (1560-2220)	3270 (2570-4100)	4280 (3170-5030)	409
Age 50+ years	13-14	992 (776-1270)	1350 (1160-1530)	2590 (1950-3480)	4230 (3170-5170)	5200 (4330-6320)	358
Age 50+ years	15-16	1490 (1320-1690)	1670 (1390-1940)	3210 (2220-3670)	5340 (3790-6210)	6990 (5440-7920)	367
Males	13-14	497 (363-682)	730 (563-927)	1760 (1410-2040)	2970 (2410-3600)	3930 (3170-4880)	492
Males	15-16	680 (517-894)	993 (894-1220)	1930 (1880-2150)	3340 (2860-3880)	4140 (3460-5340)	469
Females	13-14	858 (612-1200)	1090 (872-1380)	2640 (2020-2940)	4290 (3450-5200)	5460 (4430-6330)	416
Females	15-16	977 (760-1260)	1310 (955-1680)	2890 (2220-3400)	4580 (3660-5780)	6330 (4580-7810)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cotinine_FactSheet.html

Urinary Total Nicotine 1'-Oxide in Smokers (2013 - 2016)

CAS Number 51095-86-4

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	173 (142-212)	227 (204-259)	472 (419-540)	892 (781-1000)	1220 (1000-1530)	881
Total population	15-16	206 (174-244)	288 (263-325)	587 (507-666)	1030 (913-1150)	1400 (1200-1550)	776
Age 20-49 years	13-14	158 (114-218)	215 (177-268)	466 (404-538)	892 (768-1040)	1250 (1000-1570)	523
Age 20-49 years	15-16	150 (116-195)	244 (211-282)	486 (385-564)	966 (764-1130)	1270 (1070-1440)	409
Age 50+ years	13-14	216 (177-263)	243 (182-333)	512 (414-593)	828 (698-1050)	1210 (900-1490)	358
Age 50+ years	15-16	328 (273-395)	368 (288-451)	673 (583-793)	1190 (833-1530)	1540 (1170-1880)	367
Males	13-14	161 (121-213)	212 (177-263)	462 (393-574)	892 (722-1120)	1210 (1070-1390)	493
Males	15-16	200 (139-288)	290 (214-363)	599 (455-777)	1120 (913-1310)	1540 (1150-1950)	469
Females	13-14	188 (157-224)	231 (183-306)	479 (405-562)	829 (668-1050)	1250 (824-1570)	416
Females	15-16	213 (183-248)	281 (248-336)	534 (409-739)	984 (770-1220)	1320 (1150-1570)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 2.50 and 2.50 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Nicotine 1'-Oxide in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 51095-86-4

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	182 (142-233)	270 (230-307)	502 (450-547)	756 (686-851)	993 (860-1140)	880
Total population	15-16	208 (176-246)	296 (267-316)	520 (476-580)	913 (774-1080)	1120 (1070-1230)	776
Age 20-49 years	13-14	149 (108-206)	228 (186-275)	450 (388-484)	710 (606-774)	834 (738-1120)	522
Age 20-49 years	15-16	141 (106-188)	227 (201-238)	409 (364-496)	712 (563-812)	903 (734-1090)	409
Age 50+ years	13-14	280 (228-343)	367 (291-416)	601 (511-674)	909 (740-1010)	1150 (936-1480)	358
Age 50+ years	15-16	372 (325-426)	404 (324-473)	720 (569-860)	1100 (936-1220)	1260 (1100-1510)	367
Males	13-14	143 (106-194)	218 (179-256)	432 (357-526)	705 (633-774)	828 (769-893)	492
Males	15-16	171 (126-233)	250 (196-314)	439 (385-502)	718 (561-931)	942 (706-1100)	469
Females	13-14	234 (185-295)	321 (273-363)	530 (478-577)	834 (668-1060)	1160 (997-1260)	416
Females	15-16	262 (220-311)	344 (282-411)	655 (516-781)	1090 (904-1230)	1340 (1120-1600)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Nornicotine in Smokers (2013 - 2016)

CAS Number 5746-86-1

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	38.0 (32.4-44.6)	45.6 (42.1-49.8)	88.4 (82.7-97.5)	146 (128-170)	188 (170-215)	881
Total population	15-16	44.1 (38.2-50.8)	54.7 (48.8-64.5)	117 (105-124)	174 (152-200)	228 (181-297)	776
Age 20-49 years	13-14	36.6 (28.5-47.0)	48.3 (41.2-57.5)	91.5 (84.2-101)	149 (128-176)	189 (169-216)	523
Age 20-49 years	15-16	34.7 (27.6-43.7)	47.4 (37.7-52.1)	108 (85.7-121)	166 (148-198)	221 (169-294)	409
Age 50+ years	13-14	41.6 (35.7-48.5)	43.6 (36.6-46.6)	81.3 (67.0-101)	142 (110-179)	182 (153-214)	358
Age 50+ years	15-16	63.5 (53.8-75.0)	68.9 (52.7-92.2)	124 (102-150)	189 (138-232)	232 (175-357)	367
Males	13-14	36.6 (30.0-44.5)	47.0 (36.9-51.8)	88.5 (75.2-104)	150 (125-177)	187 (153-219)	493
Males	15-16	44.9 (33.5-60.2)	58.9 (44.9-76.0)	128 (99.2-155)	200 (159-231)	232 (200-322)	469
Females	13-14	39.5 (34.1-45.8)	45.3 (41.2-50.2)	88.1 (80.9-101)	146 (119-176)	189 (175-220)	416
Females	15-16	43.1 (38.1-48.7)	52.1 (40.9-62.3)	107 (87.2-117)	152 (126-167)	191 (161-213)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 2.50 and 2.50 respectively.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Urinary Total Nornicotine in Smokers (creatinine corrected, 2013 - 2016)

CAS Number 5746-86-1

Metabolite of Nicotine

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	39.9 (32.6-48.9)	50.4 (44.8-60.0)	89.3 (79.4-100)	127 (119-140)	158 (146-172)	880
Total population	15-16	44.5 (39.0-50.8)	61.6 (56.0-66.0)	98.4 (86.7-109)	143 (127-166)	190 (155-211)	776
Age 20-49 years	13-14	34.6 (26.9-44.5)	45.1 (38.4-52.0)	84.8 (74.6-96.9)	122 (114-132)	154 (133-167)	522
Age 20-49 years	15-16	32.6 (25.7-41.3)	47.0 (39.0-56.8)	82.6 (74.7-94.9)	119 (100-142)	151 (119-203)	409
Age 50+ years	13-14	53.9 (45.6-63.7)	64.4 (49.2-72.1)	97.7 (85.2-109)	140 (118-162)	171 (141-228)	358
Age 50+ years	15-16	72.0 (64.2-80.7)	76.8 (64.0-94.0)	124 (99.0-140)	174 (143-202)	206 (190-234)	367
Males	13-14	32.6 (26.4-40.3)	44.1 (39.2-47.9)	79.7 (66.3-88.6)	115 (105-127)	134 (116-168)	492
Males	15-16	38.5 (30.8-48.0)	56.4 (49.6-60.1)	85.4 (72.5-97.2)	124 (103-143)	143 (128-171)	469
Females	13-14	49.2 (39.5-61.4)	59.2 (49.6-71.1)	98.1 (89.3-111)	140 (126-157)	172 (151-198)	416
Females	15-16	52.9 (45.5-61.5)	68.4 (56.1-78.8)	114 (96.5-135)	173 (143-205)	211 (177-235)	328

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Volatile N-Nitrosamine Compounds (VNAs)

Urinary N-Nitrosodiethylamine (NDEA) in Smokers (2013 - 2014)

CAS Number 55-18-5

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	828
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	496
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	332
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	464
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	390

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 5.02.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosodiethylamine (NDEA) in Non-smokers (2013 - 2014)

CAS Number 55-18-5

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1304
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	647
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	657
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	632
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	768

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 5.02.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosodiethylamine (NDEA) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 55-18-5

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	827
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	495
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	332
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	463
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	390

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosodiethylamine (NDEA) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 55-18-5

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1303
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	647
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	656
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	631
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	768

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosoethylmethylamine (NMEA) in Smokers (2013 - 2014)

CAS Number 10595-95-6

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	870
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	516
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	354
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	482
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	412

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 3.64.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosoethylmethylamine (NMEA) in Non-smokers (2013 - 2014)

CAS Number 10595-95-6

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1311
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	657
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	636
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	772

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 3.64.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosoethylmethylamine (NMEA) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 10595-95-6

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	869
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	515
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	354
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	481
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	412

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosoethylmethylamine (NMEA) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 10595-95-6

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1310
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	656
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	635
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	772

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosomorpholine (NMOR) in Smokers (2013 - 2014)

CAS Number 59-89-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	8.43 (<LOD-10.5)	801
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	480
Age 50+ years	13-14	*	<LOD	<LOD	7.99 (<LOD-12.1)	10.5 (<LOD-16.9)	321
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	444
Females	13-14	*	<LOD	<LOD	<LOD	8.89 (<LOD-10.9)	382

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 7.84.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosomorpholine (NMOR) in Non-smokers (2013 - 2014)

CAS Number 59-89-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1257
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	617
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	8.65 (<LOD-10.0)	640
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	606
Females	13-14	*	<LOD	<LOD	<LOD	8.02 (<LOD-9.36)	744

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 7.84.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosomorpholine (NMOR) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 59-89-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	22.2 (<LOD-25.7)	800
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	479
Age 50+ years	13-14	*	<LOD	<LOD	22.2 (<LOD-25.7)	25.7 (<LOD-34.6)	321
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	13-14	*	<LOD	<LOD	<LOD	25.7 (<LOD-50.4)	382

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosomorpholine (NMOR) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 59-89-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1256
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	617
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	30.8 (<LOD-39.6)	639
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	605
Females	13-14	*	<LOD	<LOD	<LOD	30.8 (<LOD-32.6)	744

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosopiperidine (NPIP) in Smokers (2013 - 2014)

CAS Number 100-75-4

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	881
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	527
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	354
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	487
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	421

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 5.08.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosopiperidine (NPIP) in Non-smokers (2013 - 2014)

CAS Number 100-75-4

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1318
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	650
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	668
Males	13-14	*	<LOD	<LOD	<LOD	5.53 (<LOD-8.49)	638
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	778

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 5.08.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosopiperidine (NPIP) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 100-75-4

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	880
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	526
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	354
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	486
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	421

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosopiperidine (NPIP) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 100-75-4

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1317
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	650
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	667
Males	13-14	*	<LOD	<LOD	<LOD	12.4 (<LOD-19.9)	637
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	778

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosopyrrolidine (NPYR) in Smokers (2013 - 2014)

CAS Number 930-55-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	895
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	534
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	499
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	424

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 8.15.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosopyrrolidine (NPYR) in Non-smokers (2013 - 2014)

CAS Number 930-55-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1353
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	667
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	796

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 8.15.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Nitrosopyrrolidine (NPYR) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 930-55-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	894
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	533
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	498
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	424

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Nitrosopyrrolidine (NPYR) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 930-55-2

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1352
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	667
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	685
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	796

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Metals and Metalloids

Urinary Antimony in Smokers (2011 - 2016)

CAS Number 7440-36-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.061 (.052-.071)	.056 (.043-.071)	.098 (.080-.117)	.168 (.137-.184)	.233 (.173-.306)	876
Total population	13-14	.052 (.048-.058)	.051 (.045-.056)	.094 (.084-.103)	.164 (.139-.183)	.225 (.186-.261)	957
Total population	15-16	.054 (.049-.058)	.053 (.047-.057)	.092 (.083-.102)	.161 (.133-.195)	.238 (.174-.297)	834
Age 20-49 years	11-12	.066 (.057-.075)	.062 (.051-.073)	.109 (.085-.125)	.170 (.140-.184)	.236 (.180-.301)	522
Age 18-49 years	13-14	.054 (.049-.060)	.054 (.048-.058)	.097 (.086-.111)	.166 (.136-.189)	.223 (.182-.271)	583
Age 18-49 years	15-16	.058 (.051-.066)	.057 (.049-.067)	.102 (.084-.110)	.187 (.145-.238)	.242 (.217-.456)	457
Age 50+ years	11-12	*	.046 (<LOD-.065)	.089 (.059-.114)	.153 (.110-.233)	.233 (.137-.406)	354
Age 50+ years	13-14	.049 (.042-.057)	.044 (.040-.055)	.085 (.068-.099)	.160 (.127-.186)	.227 (.167-.485)	374
Age 50+ years	15-16	.047 (.042-.054)	.045 (.038-.055)	.087 (.065-.103)	.113 (.092-.161)	.204 (.133-.246)	377
Males	11-12	.065 (.054-.078)	.059 (.043-.079)	.110 (.084-.142)	.170 (.142-.200)	.243 (.177-.329)	527
Males	13-14	.057 (.052-.062)	.056 (.050-.061)	.097 (.080-.118)	.178 (.132-.210)	.227 (.182-.270)	512
Males	15-16	.058 (.052-.065)	.057 (.051-.067)	.102 (.087-.113)	.173 (.142-.189)	.244 (.194-.292)	487
Females	11-12	.056 (.048-.066)	.052 (<LOD-.066)	.081 (.069-.109)	.141 (.109-.206)	.207 (.129-.429)	349
Females	13-14	.049 (.042-.056)	.044 (.037-.055)	.092 (.074-.106)	.153 (.130-.183)	.204 (.178-.309)	445
Females	15-16	.049 (.044-.053)	.046 (.039-.053)	.081 (.075-.092)	.152 (.103-.238)	.238 (.132-.530)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.041, 0.022, and 0.022 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Antimony_BiomonitoringSummary.html

Urinary Antimony in Non-smokers (2011 - 2016)

CAS Number 7440-36-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	.042 (<LOD-.047)	.072 (.062-.081)	.122 (.108-.135)	.159 (.149-.199)	1343
Total population	13-14	.040 (.036-.044)	.037 (.031-.043)	.069 (.063-.074)	.116 (.103-.134)	.168 (.146-.210)	1487
Total population	15-16	.042 (.040-.044)	.042 (.038-.045)	.072 (.068-.077)	.118 (.106-.134)	.174 (.156-.203)	1470
Age 20-49 years	11-12	*	.045 (<LOD-.053)	.078 (.065-.091)	.137 (.118-.153)	.194 (.149-.309)	671
Age 18-49 years	13-14	.042 (.037-.047)	.040 (.032-.046)	.072 (.065-.086)	.131 (.113-.146)	.181 (.153-.228)	778
Age 18-49 years	15-16	.046 (.043-.049)	.045 (.041-.051)	.077 (.072-.085)	.137 (.106-.160)	.196 (.156-.216)	750
Age 50+ years	11-12	*	<LOD	.064 (.055-.074)	.103 (.092-.122)	.149 (.118-.224)	672
Age 50+ years	13-14	.038 (.034-.042)	.036 (.028-.042)	.064 (.057-.069)	.099 (.093-.108)	.158 (.110-.195)	709
Age 50+ years	15-16	.038 (.035-.042)	.039 (.035-.042)	.062 (.053-.076)	.102 (.086-.131)	.157 (.116-.203)	720
Males	11-12	*	.046 (<LOD-.053)	.080 (.066-.091)	.133 (.103-.158)	.179 (.152-.273)	635
Males	13-14	.046 (.041-.051)	.043 (.038-.050)	.078 (.068-.092)	.144 (.121-.164)	.213 (.159-.278)	663
Males	15-16	.047 (.043-.051)	.047 (.044-.051)	.078 (.072-.088)	.144 (.116-.156)	.175 (.149-.225)	663
Females	11-12	*	<LOD	.064 (.057-.074)	.116 (.095-.131)	.159 (.131-.194)	708
Females	13-14	.036 (.032-.040)	.032 (.027-.040)	.062 (.051-.070)	.097 (.088-.112)	.136 (.116-.162)	824
Females	15-16	.038 (.036-.041)	.037 (.034-.042)	.067 (.059-.071)	.105 (.092-.122)	.167 (.134-.199)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.041, 0.022, and 0.022 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Antimony_BiomonitoringSummary.html

Urinary Antimony in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-36-0

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.067 (.062-.073)	.064 (.056-.071)	.100 (.091-.110)	.171 (.138-.200)	.242 (.181-.279)	876
Total population	13-14	0.054 (.048-.060)	.051 (.044-.058)	.076 (.067-.090)	.114 (.096-.145)	.164 (.133-.223)	956
Total population	15-16	0.053 (.050-.057)	.050 (.046-.053)	.077 (.068-.085)	.126 (.103-.151)	.174 (.138-.233)	834
Age 20-49 years	11-12	0.068 (.063-.074)	.066 (.059-.073)	.101 (.092-.110)	.171 (.124-.207)	.242 (.171-.291)	522
Age 18-49 years	13-14	0.051 (.045-.057)	.047 (.042-.057)	.071 (.063-.085)	.100 (.090-.122)	.133 (.100-.181)	582
Age 18-49 years	15-16	0.054 (.048-.061)	.050 (.046-.056)	.078 (.067-.092)	.123 (.105-.174)	.187 (.115-.324)	457
Age 50+ years	11-12	*	.059 (<LOD-.071)	.096 (.074-.137)	.171 (.134-.215)	.242 (.171-.344)	354
Age 50+ years	13-14	0.06 (.054-.067)	.057 (.053-.061)	.085 (.070-.108)	.164 (.119-.239)	.255 (.148-.429)	374
Age 50+ years	15-16	0.053 (.048-.058)	.048 (.043-.052)	.074 (.062-.092)	.130 (.082-.164)	.151 (.085-.189)	377
Males	11-12	0.061 (.057-.066)	.056 (.051-.064)	.091 (.075-.101)	.164 (.122-.214)	.256 (.166-.282)	527
Males	13-14	0.05 (.046-.055)	.047 (.044-.049)	.068 (.060-.080)	.103 (.089-.123)	.133 (.109-.200)	511
Males	15-16	0.05 (.046-.055)	.047 (.044-.052)	.074 (.065-.090)	.127 (.094-.151)	.151 (.100-.282)	487
Females	11-12	0.075 (.067-.085)	.073 (<LOD-.086)	.110 (.094-.138)	.175 (.141-.207)	.210 (.158-.344)	349
Females	13-14	0.057 (.049-.067)	.057 (.045-.066)	.085 (.070-.097)	.133 (.096-.221)	.221 (.145-.309)	445
Females	15-16	0.057 (.053-.063)	.052 (.047-.058)	.081 (.066-.093)	.126 (.101-.187)	.187 (.115-.283)	347

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Antimony_BiomonitoringSummary.html

Urinary Antimony in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-36-0

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	.056 (<LOD-.060)	.088 (.076-.101)	.153 (.127-.171)	.215 (.179-.240)	1342
Total population	13-14	0.048 (.043-.052)	.045 (.042-.048)	.069 (.063-.075)	.104 (.094-.117)	.151 (.127-.172)	1486
Total population	15-16	0.047 (.045-.050)	.045 (.042-.048)	.069 (.062-.078)	.107 (.100-.117)	.140 (.127-.169)	1468
Age 20-49 years	11-12	*	.055 (<LOD-.060)	.088 (.072-.107)	.161 (.126-.214)	.224 (.179-.297)	670
Age 18-49 years	13-14	0.046 (.042-.050)	.043 (.039-.048)	.064 (.059-.070)	.100 (.089-.113)	.155 (.133-.173)	778
Age 18-49 years	15-16	0.048 (.044-.053)	.044 (.041-.049)	.070 (.061-.083)	.108 (.092-.130)	.137 (.119-.172)	748
Age 50+ years	11-12	*	<LOD	.088 (.076-.103)	.135 (.121-.155)	.183 (.152-.224)	672
Age 50+ years	13-14	0.05 (.045-.056)	.047 (.044-.051)	.073 (.066-.084)	.109 (.096-.127)	.147 (.122-.178)	708
Age 50+ years	15-16	0.047 (.043-.051)	.046 (.042-.051)	.067 (.060-.080)	.104 (.089-.117)	.149 (.115-.187)	720
Males	11-12	*	.047 (<LOD-.049)	.069 (.062-.076)	.118 (.100-.128)	.170 (.125-.224)	634
Males	13-14	0.044 (.040-.049)	.041 (.037-.046)	.059 (.052-.068)	.100 (.086-.122)	.162 (.114-.229)	662
Males	15-16	0.043 (.039-.048)	.040 (.037-.044)	.061 (.057-.070)	.100 (.088-.112)	.154 (.109-.184)	663
Females	11-12	*	<LOD	.104 (.088-.116)	.171 (.143-.207)	.224 (.181-.284)	708
Females	13-14	0.051 (.046-.055)	.048 (.045-.052)	.075 (.069-.081)	.109 (.097-.122)	.147 (.123-.167)	824
Females	15-16	0.051 (.047-.055)	.049 (.045-.052)	.077 (.065-.085)	.115 (.100-.125)	.138 (.123-.166)	805

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Antimony_BiomonitoringSummary.html

Urinary Total Arsenic in Smokers (2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	6.08 (4.78-7.73)	5.38 (3.98-6.74)	12.0 (8.59-18.2)	31.8 (20.8-43.3)	48.4 (33.2-112)	876
Total population	13-14	6.04 (5.08-7.17)	5.85 (4.91-7.10)	11.4 (9.83-13.6)	22.7 (18.2-29.1)	40.2 (27.9-64.7)	976
Total population	15-16	6.00 (5.31-6.78)	5.52 (4.87-6.38)	11.6 (9.20-15.4)	24.3 (20.8-29.9)	40.8 (29.2-52.4)	834
Age 20-49 years	11-12	6.15 (4.86-7.79)	5.70 (3.96-7.23)	12.0 (8.59-18.5)	26.8 (20.3-38.7)	43.3 (32.0-82.1)	522
Age 18-49 years	13-14	6.34 (5.15-7.80)	6.15 (5.09-7.91)	11.7 (9.88-14.6)	23.9 (17.7-30.7)	40.2 (27.9-63.0)	591
Age 18-49 years	15-16	6.20 (5.09-7.54)	5.80 (4.72-7.39)	13.3 (9.34-18.7)	23.2 (19.8-34.7)	39.2 (25.7-49.1)	457
Age 50+ years	11-12	5.97 (4.28-8.31)	4.69 (3.68-6.86)	12.2 (6.86-21.1)	35.9 (15.1-121)	80.5 (29.0-144)	354
Age 50+ years	13-14	5.45 (4.72-6.28)	5.28 (4.41-6.10)	10.6 (8.07-12.4)	20.4 (15.5-34.2)	39.3 (23.9-108)	385
Age 50+ years	15-16	5.71 (4.92-6.62)	5.32 (4.16-6.44)	9.42 (8.27-11.4)	26.1 (16.3-33.9)	44.6 (30.0-60.3)	377
Males	11-12	6.65 (5.05-8.74)	5.71 (4.33-8.55)	14.8 (9.40-19.9)	33.2 (22.3-44.1)	44.1 (37.7-94.5)	527
Males	13-14	6.95 (5.65-8.55)	6.86 (5.82-7.91)	12.7 (10.4-15.2)	27.9 (15.3-51.7)	55.5 (24.4-99.0)	524
Males	15-16	6.76 (5.71-8.01)	6.26 (5.15-8.31)	11.9 (9.97-15.6)	25.2 (20.8-32.0)	46.2 (27.8-60.3)	487
Females	11-12	5.43 (4.40-6.71)	4.69 (3.38-5.95)	9.67 (6.86-15.0)	30.5 (15.7-48.4)	62.1 (22.4-209)	349
Females	13-14	5.21 (4.26-6.38)	5.09 (4.02-6.15)	10.2 (7.44-14.2)	18.9 (16.5-25.4)	31.0 (23.9-40.2)	452
Females	15-16	5.22 (4.67-5.83)	4.74 (4.01-5.38)	10.1 (7.39-16.7)	24.3 (17.2-38.2)	40.6 (25.7-54.3)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.25, 0.260, and 0.260 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Total Arsenic in Non-smokers (2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	7.34 (6.27-8.60)	6.66 (5.39-8.11)	13.7 (11.4-18.6)	34.2 (25.9-41.9)	55.8 (41.5-82.2)	1343
Total population	13-14	6.54 (5.66-7.56)	6.13 (5.02-7.32)	12.5 (10.8-14.5)	29.3 (24.7-33.6)	48.5 (38.2-56.6)	1549
Total population	15-16	6.44 (5.93-6.99)	6.10 (5.36-6.69)	11.9 (10.8-14.0)	29.1 (24.0-35.5)	51.1 (41.0-62.7)	1470
Age 20-49 years	11-12	7.37 (6.29-8.65)	6.79 (5.42-7.99)	13.3 (11.2-18.6)	35.7 (26.3-43.9)	56.4 (45.9-89.5)	671
Age 18-49 years	13-14	6.35 (5.59-7.22)	5.94 (5.43-6.76)	11.5 (9.99-13.4)	24.9 (20.2-30.5)	42.8 (30.2-58.3)	821
Age 18-49 years	15-16	6.10 (5.36-6.95)	5.50 (4.82-6.45)	11.8 (9.47-14.4)	30.1 (22.1-37.4)	51.3 (35.7-70.3)	750
Age 50+ years	11-12	7.31 (5.97-8.96)	6.57 (5.22-8.57)	14.4 (10.7-20.5)	34.2 (21.1-50.6)	55.8 (35.8-82.8)	672
Age 50+ years	13-14	6.77 (5.45-8.42)	6.31 (4.28-9.08)	13.7 (10.8-19.1)	36.0 (23.8-45.6)	52.2 (39.5-68.0)	728
Age 50+ years	15-16	6.84 (6.07-7.71)	6.60 (5.56-7.41)	12.0 (10.7-14.4)	28.3 (18.2-46.3)	49.7 (32.1-111)	720
Males	11-12	8.18 (6.66-10.0)	7.41 (5.62-9.98)	15.8 (11.8-21.0)	36.5 (26.3-42.7)	56.0 (39.0-82.8)	635
Males	13-14	7.12 (6.25-8.11)	6.86 (5.86-7.83)	12.7 (10.9-15.4)	30.5 (23.9-36.5)	50.6 (36.0-62.0)	718
Males	15-16	7.25 (6.53-8.05)	6.52 (5.52-7.54)	12.9 (10.8-15.0)	33.2 (24.7-42.4)	67.2 (35.7-165)	663
Females	11-12	6.75 (5.79-7.87)	5.98 (5.05-7.49)	13.0 (10.3-17.5)	31.9 (23.9-45.6)	55.2 (41.4-83.2)	708
Females	13-14	6.06 (5.07-7.24)	5.44 (4.53-6.68)	12.1 (9.75-14.6)	28.3 (22.3-36.0)	45.1 (36.0-63.1)	831
Females	15-16	5.85 (5.19-6.59)	5.56 (4.89-6.50)	11.7 (10.0-13.9)	26.4 (17.8-32.6)	46.3 (32.1-53.9)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.25, 0.260, and 0.260 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Total Arsenic in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	6.69 (5.68-7.87)	5.42 (4.46-6.87)	10.9 (8.91-14.7)	24.5 (19.6-29.7)	43.6 (24.8-91.3)	876
Total population	13-14	6.28 (5.49-7.18)	5.31 (4.79-6.04)	9.35 (7.78-11.4)	24.5 (15.0-34.7)	41.5 (28.4-54.0)	975
Total population	15-16	5.98 (5.57-6.42)	4.85 (4.36-5.68)	9.26 (8.00-11.0)	23.2 (16.4-28.1)	34.2 (28.1-49.4)	834
Age 20-49 years	11-12	6.38 (5.43-7.49)	5.27 (4.21-6.76)	10.3 (8.80-13.3)	22.8 (16.1-28.8)	38.6 (22.1-103)	522
Age 18-49 years	13-14	6.02 (5.07-7.14)	5.22 (4.45-5.91)	8.55 (7.34-11.4)	24.4 (13.4-35.3)	35.8 (21.5-52.1)	590
Age 18-49 years	15-16	5.76 (5.21-6.36)	4.76 (4.31-5.41)	9.32 (7.32-13.6)	20.7 (15.3-28.1)	30.5 (20.7-62.5)	457
Age 50+ years	11-12	7.2 (5.62-9.22)	5.85 (4.77-7.46)	12.4 (8.32-19.6)	26.1 (19.6-50.6)	70.5 (20.4-108)	354
Age 50+ years	13-14	6.87 (6.21-7.61)	5.72 (5.00-6.88)	10.3 (8.69-12.5)	24.6 (14.7-52.6)	53.8 (25.6-91.3)	385
Age 50+ years	15-16	6.34 (5.48-7.32)	5.01 (4.11-7.00)	8.99 (7.36-11.1)	25.8 (18.7-29.1)	38.9 (27.7-52.3)	377
Males	11-12	6.27 (5.17-7.61)	5.18 (4.43-6.80)	10.6 (8.79-14.7)	21.7 (16.1-24.8)	30.6 (22.6-70.5)	527
Males	13-14	6.33 (5.36-7.48)	5.61 (4.81-6.59)	8.74 (7.58-11.8)	24.6 (13.0-35.8)	35.8 (19.7-64.6)	523
Males	15-16	5.83 (5.02-6.77)	4.56 (4.01-5.61)	8.35 (7.36-10.7)	24.4 (13.6-32.5)	32.8 (28.1-46.3)	487
Females	11-12	7.25 (5.95-8.82)	5.52 (4.38-6.93)	11.1 (8.31-15.3)	30.8 (16.7-65.0)	72.1 (24.5-179)	349
Females	13-14	6.23 (5.40-7.19)	5.22 (4.45-5.78)	9.75 (7.25-11.9)	24.5 (17.0-33.9)	49.5 (24.9-62.0)	452
Females	15-16	6.16 (5.76-6.59)	5.19 (4.46-6.21)	10.8 (7.32-14.1)	22.8 (16.4-28.1)	34.3 (22.8-62.5)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Total Arsenic in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	8.57 (7.44-9.86)	7.18 (6.16-8.60)	16.2 (12.9-20.3)	33.7 (28.3-44.3)	52.8 (39.9-71.8)	1342
Total population	13-14	7.74 (6.93-8.65)	6.56 (5.69-7.64)	13.0 (11.1-15.1)	31.8 (24.5-40.8)	57.2 (47.9-74.7)	1548
Total population	15-16	7.25 (6.78-7.74)	5.83 (5.49-6.33)	11.4 (10.4-14.6)	29.2 (22.3-37.6)	58.2 (42.4-83.3)	1468
Age 20-49 years	11-12	8.06 (7.00-9.28)	6.88 (5.54-8.60)	15.0 (11.5-20.1)	31.7 (26.2-39.4)	47.5 (36.6-70.1)	670
Age 18-49 years	13-14	6.81 (6.12-7.58)	5.94 (5.15-6.67)	11.1 (9.35-12.4)	23.7 (18.7-29.9)	48.7 (29.9-68.2)	821
Age 18-49 years	15-16	6.36 (5.76-7.03)	5.19 (4.65-5.79)	10.1 (8.64-12.3)	24.8 (18.3-31.5)	45.2 (31.1-83.4)	748
Age 50+ years	11-12	9.14 (7.40-11.3)	7.57 (6.16-9.71)	18.3 (12.8-24.6)	37.5 (27.9-52.8)	53.5 (37.5-94.6)	672
Age 50+ years	13-14	8.99 (7.50-10.8)	7.67 (5.83-9.93)	16.0 (11.6-23.8)	40.8 (27.1-61.4)	69.6 (49.8-83.6)	727
Age 50+ years	15-16	8.37 (7.39-9.47)	6.99 (6.03-7.97)	14.1 (10.7-17.6)	33.5 (20.4-57.2)	66.2 (40.9-113)	720
Males	11-12	7.31 (5.97-8.94)	6.29 (5.05-8.02)	14.3 (10.6-18.1)	32.2 (20.2-44.3)	48.7 (32.8-69.6)	634
Males	13-14	6.93 (6.17-7.78)	5.82 (4.87-6.89)	12.0 (10.0-13.7)	27.6 (20.8-40.8)	49.3 (37.9-67.9)	717
Males	15-16	6.66 (6.09-7.28)	5.50 (4.91-5.99)	10.7 (9.30-13.8)	27.9 (19.7-38.7)	65.3 (31.2-98.0)	663
Females	11-12	9.7 (8.62-10.9)	7.98 (6.87-9.34)	19.1 (13.7-24.4)	38.2 (28.7-48.6)	63.6 (45.9-86.7)	708
Females	13-14	8.56 (7.48-9.80)	7.33 (6.39-8.36)	14.7 (11.7-17.0)	34.3 (24.5-43.2)	68.3 (41.8-98.1)	831
Females	15-16	7.76 (6.96-8.66)	6.23 (5.47-7.40)	12.3 (10.5-16.5)	29.9 (22.7-42.1)	57.2 (34.4-91.7)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenic (V) acid in Smokers (2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	1.10 (<LOD-3.06)	871
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	972
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	839
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	1.29 (<LOD-3.87)	521
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	588
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	459
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	384
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	380
Males	11-12	*	<LOD	<LOD	<LOD	1.37 (<LOD-6.54)	524
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	523
Males	15-16	*	<LOD	<LOD	<LOD	.800 (<LOD-1.15)	489
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	449
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.870, 0.790, and 0.790 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenic (V) acid in Non-smokers (2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1343
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1549
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1479
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	671
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	824
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	754
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	725
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	725
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	635
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	715
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	665
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	834
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.870, 0.790, and 0.790 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenic (V) acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	3.65 (<LOD-5.17)	871
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	971
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	839
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	3.65 (<LOD-4.13)	521
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	587
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	459
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	384
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	380
Males	11-12	*	<LOD	<LOD	<LOD	3.44 (<LOD-3.76)	524
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	522
Males	15-16	*	<LOD	<LOD	<LOD	1.93 (<LOD-2.80)	489
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	449
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	350

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenic (V) acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-38-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1342
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1548
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1477
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	670
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	824
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	752
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	724
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	725
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	634
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	714
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	665
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	834
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	812

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenobetaine in Smokers (2011 - 2016)

CAS Number 64436-13-1

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	3.00 (1.36-5.05)	13.1 (8.32-20.4)	25.7 (16.7-68.4)	871
Total population	13-14	*	<LOD	3.36 (2.20-5.03)	13.1 (7.32-20.0)	25.1 (15.1-52.1)	972
Total population	15-16	*	<LOD	3.01 (2.18-5.86)	15.5 (8.56-21.0)	25.3 (17.5-40.1)	839
Age 20-49 years	11-12	*	<LOD	2.34 (1.32-4.47)	11.9 (6.90-20.1)	24.2 (11.9-42.8)	521
Age 18-49 years	13-14	*	<LOD	3.78 (2.27-5.26)	14.7 (7.32-20.4)	24.6 (15.1-52.5)	588
Age 18-49 years	15-16	*	<LOD	3.29 (1.42-8.81)	15.5 (7.02-20.5)	24.6 (16.0-36.7)	459
Age 50+ years	11-12	*	<LOD	4.03 (1.27-7.44)	13.7 (6.54-46.5)	46.5 (8.47-114)	350
Age 50+ years	13-14	*	<LOD	2.25 (1.60-3.93)	9.75 (5.60-18.5)	25.6 (11.9-48.4)	384
Age 50+ years	15-16	*	<LOD	2.86 (2.18-4.11)	13.4 (7.83-21.9)	33.1 (16.8-61.5)	380
Males	11-12	*	<LOD	3.26 (1.29-5.05)	11.0 (7.06-18.4)	25.1 (13.1-47.8)	524
Males	13-14	*	<LOD	3.92 (2.41-6.44)	18.5 (6.38-35.2)	35.2 (15.5-61.6)	523
Males	15-16	*	<LOD	3.64 (1.97-7.86)	16.0 (6.71-21.9)	24.6 (20.5-35.7)	489
Females	11-12	*	<LOD	2.82 (1.32-6.35)	16.8 (7.50-24.2)	44.8 (13.3-141)	347
Females	13-14	*	<LOD	2.83 (1.28-5.08)	12.1 (4.83-19.6)	19.6 (12.4-26.5)	449
Females	15-16	*	<LOD	2.87 (1.89-3.92)	14.0 (5.73-24.3)	27.6 (14.0-49.9)	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.19, 1.16, and 1.16 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenobetaine in Non-smokers (2011 - 2016)

CAS Number 64436-13-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	1.25 (<LOD-1.72)	5.83 (4.45-7.46)	18.7 (13.3-26.2)	37.4 (24.1-60.3)	1343
Total population	13-14	*	<LOD	4.60 (3.24-6.31)	18.7 (14.1-22.0)	35.4 (26.1-44.6)	1549
Total population	15-16	*	<LOD	4.46 (3.46-5.97)	17.5 (12.5-23.7)	35.2 (24.9-43.8)	1479
Age 20-49 years	11-12	*	<LOD	4.95 (3.58-6.54)	19.3 (11.8-24.1)	37.4 (24.1-53.4)	671
Age 18-49 years	13-14	*	<LOD	3.36 (2.72-4.61)	14.1 (9.20-21.3)	29.4 (19.2-41.8)	824
Age 18-49 years	15-16	*	<LOD	3.46 (2.61-4.48)	17.4 (10.8-23.7)	34.0 (22.3-48.8)	754
Age 50+ years	11-12	*	1.55 (<LOD-2.34)	7.21 (4.05-10.3)	18.6 (12.3-35.2)	38.8 (19.2-68.3)	672
Age 50+ years	13-14	*	1.39 (<LOD-2.21)	6.11 (3.33-10.6)	22.0 (13.2-35.4)	39.7 (29.0-53.5)	725
Age 50+ years	15-16	*	1.52 (<LOD-1.92)	5.89 (3.80-7.38)	19.5 (10.9-30.6)	39.7 (22.5-65.5)	725
Males	11-12	*	1.30 (<LOD-2.09)	6.27 (4.10-9.30)	23.3 (12.8-33.9)	37.4 (25.5-63.9)	635
Males	13-14	*	1.27 (<LOD-1.84)	4.95 (3.33-6.95)	18.7 (11.7-23.7)	36.6 (21.9-46.0)	715
Males	15-16	*	1.21 (<LOD-1.85)	4.72 (3.53-7.09)	20.0 (12.5-29.0)	45.4 (23.7-111)	665
Females	11-12	*	<LOD	5.65 (4.03-7.21)	18.2 (12.2-23.6)	36.9 (21.4-59.6)	708
Females	13-14	*	<LOD	4.16 (2.76-6.13)	18.4 (12.5-24.3)	34.1 (23.9-50.7)	834
Females	15-16	*	<LOD	4.32 (2.61-6.40)	14.4 (10.7-23.8)	31.1 (22.9-41.9)	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.19, 1.16, and 1.16 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenobetaine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 64436-13-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	4.00 (2.90-5.25)	12.5 (8.40-20.6)	29.1 (16.4-67.2)	871
Total population	13-14	*	<LOD	3.89 (3.04-4.82)	12.2 (6.89-21.2)	34.0 (14.6-51.6)	971
Total population	15-16	*	<LOD	3.90 (2.93-5.00)	12.7 (8.22-21.6)	25.6 (21.6-30.7)	839
Age 20-49 years	11-12	*	<LOD	4.00 (2.74-4.94)	10.3 (6.67-21.0)	26.8 (10.2-55.5)	521
Age 18-49 years	13-14	*	<LOD	3.83 (2.83-5.16)	12.9 (6.31-31.5)	34.0 (12.2-51.6)	587
Age 18-49 years	15-16	*	<LOD	3.57 (2.56-4.89)	12.7 (6.57-21.6)	21.6 (10.3-37.5)	459
Age 50+ years	11-12	*	<LOD	4.29 (2.83-9.20)	15.4 (11.9-39.6)	56.0 (12.3-82.7)	350
Age 50+ years	13-14	*	<LOD	4.18 (2.81-5.71)	11.4 (7.32-21.2)	36.1 (14.2-53.2)	384
Age 50+ years	15-16	*	<LOD	4.24 (3.08-5.86)	15.3 (7.88-27.0)	29.1 (17.5-50.1)	380
Males	11-12	*	<LOD	3.50 (2.47-4.94)	9.92 (5.99-13.8)	16.5 (12.0-39.7)	524
Males	13-14	*	<LOD	3.73 (2.71-4.97)	11.5 (5.01-34.0)	34.0 (9.62-51.2)	522
Males	15-16	*	<LOD	3.57 (2.34-5.46)	14.0 (5.86-22.8)	22.8 (20.1-30.7)	489
Females	11-12	*	<LOD	4.88 (2.90-10.2)	18.8 (10.6-30.3)	39.6 (16.5-100)	347
Females	13-14	*	<LOD	4.48 (3.31-5.38)	12.9 (7.45-19.0)	31.5 (12.2-51.8)	449
Females	15-16	*	<LOD	4.24 (3.03-6.26)	11.8 (8.22-20.9)	28.3 (16.0-57.3)	350

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenobetaine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 64436-13-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	2.10 (<LOD-2.48)	7.55 (5.25-10.2)	21.8 (14.4-35.7)	39.6 (27.5-46.8)	1342
Total population	13-14	*	<LOD	5.98 (4.61-7.62)	19.2 (14.5-26.3)	44.3 (34.4-59.4)	1548
Total population	15-16	*	<LOD	5.33 (4.20-6.81)	16.7 (12.5-24.6)	42.3 (26.7-68.0)	1477
Age 20-49 years	11-12	*	<LOD	6.21 (4.34-10.2)	17.2 (15.3-24.0)	35.1 (22.6-42.6)	670
Age 18-49 years	13-14	*	<LOD	4.21 (3.44-5.48)	13.8 (8.90-19.2)	35.5 (19.2-54.7)	824
Age 18-49 years	15-16	*	<LOD	3.93 (3.20-5.75)	13.7 (10.2-19.0)	29.3 (19.0-64.1)	752
Age 50+ years	11-12	*	2.43 (<LOD-3.37)	8.09 (4.78-14.3)	26.1 (14.0-42.6)	43.4 (26.1-76.9)	672
Age 50+ years	13-14	*	2.48 (<LOD-3.34)	8.44 (5.08-14.5)	26.9 (14.9-46.0)	56.1 (37.7-71.5)	724
Age 50+ years	15-16	*	2.65 (<LOD-3.15)	6.31 (4.75-10.0)	19.4 (11.9-40.1)	51.3 (21.3-119)	725
Males	11-12	*	1.75 (<LOD-2.10)	5.71 (3.57-10.0)	20.3 (11.2-35.7)	35.7 (20.7-52.1)	634
Males	13-14	*	1.67 (<LOD-2.00)	5.49 (3.80-7.92)	16.7 (12.7-24.4)	40.5 (24.1-59.4)	714
Males	15-16	*	1.67 (<LOD-1.96)	5.23 (3.84-6.83)	15.6 (11.8-27.0)	42.4 (19.1-95.1)	665
Females	11-12	*	<LOD	8.46 (6.46-11.3)	23.7 (16.6-36.9)	41.4 (29.2-66.4)	708
Females	13-14	*	<LOD	6.45 (4.82-8.13)	19.9 (13.8-33.3)	46.0 (33.3-82.4)	834
Females	15-16	*	<LOD	5.47 (4.13-7.41)	17.1 (11.9-26.7)	38.8 (19.8-71.1)	812

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenocholine in Smokers (2011 - 2016)

CAS Number 96055-45-7

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	871
Total population	13-14	*	<LOD	<LOD	.170 (<LOD-.250)	.280 (.190-.350)	972
Total population	15-16	*	<LOD	<LOD	.270 (<LOD-.440)	.440 (.290-.650)	839
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	521
Age 18-49 years	13-14	*	<LOD	<LOD	.190 (.130-.240)	.280 (.190-.350)	588
Age 18-49 years	15-16	*	<LOD	<LOD	.190 (<LOD-.410)	.410 (.190-.680)	459
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	.270 (<LOD-.410)	384
Age 50+ years	15-16	*	<LOD	<LOD	.300 (<LOD-.530)	.450 (.250-.720)	380
Males	11-12	*	<LOD	<LOD	<LOD	.310 (<LOD-4.53)	524
Males	13-14	*	<LOD	<LOD	.200 (<LOD-.280)	.280 (.170-.410)	523
Males	15-16	*	<LOD	<LOD	.330 (.140-.530)	.530 (.350-.650)	489
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347
Females	13-14	*	<LOD	<LOD	.150 (<LOD-.240)	.240 (.190-.300)	449
Females	15-16	*	<LOD	<LOD	.190 (<LOD-.410)	.350 (<LOD-.540)	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.280, 0.110, and 0.110 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenocholine in Non-smokers (2011 - 2016)

CAS Number 96055-45-7

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1343
Total population	13-14	*	<LOD	<LOD	.220 (.150-.280)	.350 (.290-.380)	1549
Total population	15-16	*	<LOD	<LOD	.230 (<LOD-.370)	.430 (.300-.570)	1479
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	671
Age 18-49 years	13-14	*	<LOD	<LOD	.200 (<LOD-.280)	.320 (.260-.380)	824
Age 18-49 years	15-16	*	<LOD	<LOD	.200 (<LOD-.360)	.380 (.240-.490)	754
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Age 50+ years	13-14	*	<LOD	<LOD	.220 (.140-.330)	.380 (.300-.390)	725
Age 50+ years	15-16	*	<LOD	<LOD	.270 (<LOD-.450)	.490 (.290-.820)	725
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	635
Males	13-14	*	<LOD	<LOD	.250 (.130-.330)	.360 (.290-.430)	715
Males	15-16	*	<LOD	<LOD	.240 (.110-.450)	.470 (.280-.980)	665
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708
Females	13-14	*	<LOD	<LOD	.200 (.110-.260)	.320 (.220-.380)	834
Females	15-16	*	<LOD	<LOD	.220 (<LOD-.370)	.390 (.280-.540)	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.280, 0.110, and 0.110 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenocholine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 96055-45-7

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	871
Total population	13-14	*	<LOD	<LOD	.286 (<LOD-.333)	.381 (.348-.444)	971
Total population	15-16	*	<LOD	<LOD	.320 (<LOD-.400)	.554 (.348-.855)	839
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	521
Age 18-49 years	13-14	*	<LOD	<LOD	.250 (.190-.333)	.364 (.286-.485)	587
Age 18-49 years	15-16	*	<LOD	<LOD	.307 (<LOD-.348)	.400 (.297-.855)	459
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	.444 (<LOD-.615)	384
Age 50+ years	15-16	*	<LOD	<LOD	.400 (<LOD-.579)	.628 (.364-1.25)	380
Males	11-12	*	<LOD	<LOD	<LOD	1.18 (<LOD-1.34)	524
Males	13-14	*	<LOD	<LOD	.229 (<LOD-.296)	.333 (.229-.444)	522
Males	15-16	*	<LOD	<LOD	.276 (.194-.379)	.379 (.313-.574)	489
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347
Females	13-14	*	<LOD	<LOD	.320 (<LOD-.442)	.471 (.364-.727)	449
Females	15-16	*	<LOD	<LOD	.400 (<LOD-.615)	.650 (<LOD-1.62)	350

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenocholine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 96055-45-7

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1342
Total population	13-14	*	<LOD	<LOD	.364 (.320-.421)	.578 (.471-.667)	1548
Total population	15-16	*	<LOD	<LOD	.364 (<LOD-.435)	.533 (.430-.638)	1477
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	670
Age 18-49 years	13-14	*	<LOD	<LOD	.296 (<LOD-.364)	.444 (.364-.523)	824
Age 18-49 years	15-16	*	<LOD	<LOD	.333 (<LOD-.413)	.467 (.400-.624)	752
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Age 50+ years	13-14	*	<LOD	<LOD	.471 (.333-.571)	.658 (.506-.800)	724
Age 50+ years	15-16	*	<LOD	<LOD	.381 (<LOD-.500)	.571 (.421-.672)	725
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	634
Males	13-14	*	<LOD	<LOD	.258 (.235-.333)	.571 (.333-.660)	714
Males	15-16	*	<LOD	<LOD	.302 (.254-.400)	.444 (.302-.638)	665
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708
Females	13-14	*	<LOD	<LOD	.421 (.364-.444)	.622 (.471-.727)	834
Females	15-16	*	<LOD	<LOD	.400 (<LOD-.447)	.571 (.444-.667)	812

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenous (III) acid in Smokers (2011 - 2016)

CAS Number 13464-58-9

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	.750 (.580-.980)	1.01 (.740-1.75)	871
Total population	13-14	.338 (.291-.393)	.500 (.400-.590)	.740 (.660-.840)	1.05 (.900-1.21)	1.30 (1.14-1.43)	972
Total population	15-16	*	.190 (<LOD-.400)	.560 (.430-.730)	.890 (.750-1.09)	1.15 (.980-1.36)	839
Age 20-49 years	11-12	*	<LOD	.510 (<LOD-.680)	.890 (.640-1.31)	1.31 (.890-2.22)	521
Age 18-49 years	13-14	.394 (.332-.467)	.560 (.460-.640)	.780 (.680-.870)	1.10 (.920-1.27)	1.32 (1.14-1.46)	588
Age 18-49 years	15-16	*	.260 (<LOD-.450)	.580 (.450-.740)	.900 (.700-1.24)	1.28 (.910-1.66)	459
Age 50+ years	11-12	*	<LOD	<LOD	.500 (<LOD-.740)	.640 (.490-.920)	350
Age 50+ years	13-14	*	.280 (<LOD-.460)	.660 (.540-.820)	.970 (.830-1.17)	1.24 (.970-1.48)	384
Age 50+ years	15-16	*	<LOD	.520 (.260-.770)	.870 (.730-1.04)	1.11 (.870-1.27)	380
Males	11-12	*	<LOD	.520 (<LOD-.720)	.900 (.680-1.31)	1.40 (.920-2.22)	524
Males	13-14	.401 (.327-.491)	.580 (.440-.660)	.800 (.680-.920)	1.14 (.940-1.33)	1.35 (1.15-1.52)	523
Males	15-16	.276 (.210-.362)	.370 (<LOD-.520)	.650 (.510-.900)	1.08 (.830-1.29)	1.30 (1.11-1.63)	489
Females	11-12	*	<LOD	<LOD	.520 (<LOD-.640)	.640 (.520-.830)	347
Females	13-14	.283 (.245-.327)	.430 (.280-.500)	.680 (.590-.780)	.940 (.800-1.20)	1.23 (.930-1.48)	449
Females	15-16	*	<LOD	.450 (.170-.640)	.720 (.530-.860)	.860 (.720-1.06)	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.480, 0.120, and 0.120 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenous (III) acid in Non-smokers (2011 - 2016)

CAS Number 13464-58-9

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	.490 (<LOD-.580)	.810 (.720-.930)	1.07 (.940-1.18)	1343
Total population	13-14	.298 (.260-.341)	.430 (.320-.530)	.720 (.640-.790)	.960 (.870-1.05)	1.12 (1.05-1.22)	1549
Total population	15-16	*	<LOD	.490 (.340-.640)	.870 (.650-1.10)	1.12 (.930-1.35)	1479
Age 20-49 years	11-12	*	<LOD	.580 (.480-.710)	.870 (.800-1.08)	1.25 (1.05-1.48)	671
Age 18-49 years	13-14	.364 (.316-.420)	.520 (.410-.590)	.770 (.690-.860)	1.04 (.960-1.11)	1.19 (1.12-1.35)	824
Age 18-49 years	15-16	*	.230 (<LOD-.360)	.540 (.430-.750)	.990 (.750-1.26)	1.26 (1.07-1.57)	754
Age 50+ years	11-12	*	<LOD	<LOD	.700 (.550-.830)	.920 (.700-1.15)	672
Age 50+ years	13-14	*	.240 (<LOD-.410)	.640 (.580-.690)	.870 (.790-.940)	1.03 (.940-1.11)	725
Age 50+ years	15-16	*	<LOD	.380 (.130-.590)	.770 (.530-.950)	.970 (.730-1.17)	725
Males	11-12	*	<LOD	.580 (.490-.690)	.940 (.820-1.12)	1.18 (1.05-1.47)	635
Males	13-14	.358 (.304-.421)	.540 (.410-.630)	.800 (.710-.870)	.990 (.940-1.08)	1.17 (1.06-1.35)	715
Males	15-16	*	.220 (<LOD-.380)	.560 (.410-.810)	1.00 (.720-1.34)	1.27 (1.00-1.66)	665
Females	11-12	*	<LOD	<LOD	.740 (.570-.820)	.880 (.800-1.07)	708
Females	13-14	*	.340 (.150-.440)	.630 (.580-.700)	.870 (.790-1.00)	1.10 (.950-1.20)	834
Females	15-16	*	<LOD	.420 (.260-.540)	.750 (.600-.940)	1.01 (.840-1.12)	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.480, 0.120, and 0.120 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenous (III) acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 13464-58-9

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	1.37 (1.06-1.70)	1.89 (1.42-2.13)	871
Total population	13-14	0.348 (.298-.405)	.374 (.320-.444)	.641 (.552-.776)	1.01 (.900-1.17)	1.37 (1.10-1.63)	971
Total population	15-16	*	.223 (<LOD-.333)	.457 (.305-.650)	.788 (.579-1.08)	1.08 (.750-1.44)	839
Age 20-49 years	11-12	*	<LOD	.773 (<LOD-.944)	1.42 (1.06-2.00)	2.00 (1.35-2.91)	521
Age 18-49 years	13-14	0.372 (.314-.440)	.398 (.331-.473)	.641 (.561-.777)	1.07 (.900-1.21)	1.38 (1.10-1.63)	587
Age 18-49 years	15-16	*	.241 (<LOD-.342)	.457 (.308-.648)	.764 (.546-1.04)	1.04 (.758-1.31)	459
Age 50+ years	11-12	*	<LOD	<LOD	1.31 (<LOD-1.55)	1.50 (1.26-2.13)	350
Age 50+ years	13-14	*	.348 (<LOD-.459)	.641 (.459-.838)	.944 (.816-1.13)	1.16 (1.00-1.80)	384
Age 50+ years	15-16	*	<LOD	.503 (.269-.706)	.811 (.579-1.18)	1.15 (.750-1.60)	380
Males	11-12	*	<LOD	.694 (<LOD-.850)	1.35 (.971-1.89)	2.00 (1.26-2.83)	524
Males	13-14	0.362 (.302-.433)	.381 (.320-.459)	.620 (.505-.730)	1.00 (.776-1.25)	1.27 (.985-1.65)	522
Males	15-16	0.237 (.177-.317)	.258 (<LOD-.356)	.536 (.344-.693)	.793 (.643-1.16)	1.15 (.725-1.93)	489
Females	11-12	*	<LOD	<LOD	1.37 (<LOD-1.70)	1.70 (1.37-2.13)	347
Females	13-14	0.333 (.279-.398)	.361 (.276-.443)	.675 (.559-.847)	1.01 (.900-1.21)	1.42 (1.10-1.81)	449
Females	15-16	*	<LOD	.421 (.250-.615)	.788 (.487-1.08)	1.08 (.758-1.44)	350

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Arsenous (III) acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 13464-58-9

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	.791 (<LOD-.855)	1.36 (1.21-1.55)	1.81 (1.54-2.00)	1342
Total population	13-14	0.351 (.304-.406)	.373 (.308-.444)	.701 (.597-.827)	1.21 (.989-1.35)	1.55 (1.31-1.85)	1548
Total population	15-16	*	<LOD	.440 (.326-.586)	.776 (.644-.985)	1.08 (.861-1.25)	1477
Age 20-49 years	11-12	*	<LOD	.815 (.723-.919)	1.48 (1.17-1.82)	1.96 (1.64-2.43)	670
Age 18-49 years	13-14	0.389 (.326-.464)	.401 (.329-.482)	.784 (.604-.943)	1.24 (1.02-1.57)	1.67 (1.26-2.06)	824
Age 18-49 years	15-16	*	.250 (<LOD-.314)	.473 (.348-.615)	.750 (.667-.953)	1.01 (.833-1.21)	752
Age 50+ years	11-12	*	<LOD	<LOD	1.26 (1.13-1.42)	1.67 (1.36-1.93)	672
Age 50+ years	13-14	*	.320 (<LOD-.406)	.620 (.560-.732)	1.04 (.861-1.30)	1.43 (1.30-1.59)	724
Age 50+ years	15-16	*	<LOD	.400 (.281-.566)	.791 (.525-1.17)	1.17 (.790-1.52)	725
Males	11-12	*	<LOD	.659 (.574-.708)	1.03 (.850-1.19)	1.48 (1.17-1.79)	634
Males	13-14	0.35 (.301-.406)	.371 (.301-.445)	.681 (.571-.806)	1.21 (.919-1.41)	1.51 (1.30-1.85)	714
Males	15-16	*	.235 (<LOD-.313)	.441 (.314-.645)	.744 (.614-1.00)	1.08 (.741-1.27)	665
Females	11-12	*	<LOD	<LOD	1.54 (1.36-1.81)	2.10 (1.69-2.62)	708
Females	13-14	*	.375 (.299-.445)	.711 (.612-.864)	1.17 (.982-1.35)	1.55 (1.30-1.85)	834
Females	15-16	*	<LOD	.434 (.320-.564)	.791 (.615-.985)	1.09 (.875-1.44)	812

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Dimethylarsinic acid in Smokers (2011 - 2016)

CAS Number 917-76-0

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.22 (2.83-3.66)	2.80 (2.45-3.29)	5.72 (4.29-7.10)	10.8 (7.78-16.1)	16.3 (10.9-24.3)	871
Total population	13-14	3.15 (2.83-3.51)	3.10 (2.69-3.48)	5.15 (4.51-5.95)	7.76 (6.76-9.70)	11.4 (8.76-14.1)	972
Total population	15-16	3.02 (2.80-3.25)	2.90 (2.48-3.27)	4.81 (4.39-5.17)	7.53 (6.43-8.92)	12.1 (8.43-18.7)	839
Age 20-49 years	11-12	3.17 (2.71-3.70)	2.95 (2.34-3.79)	5.48 (4.08-6.76)	8.92 (7.34-12.5)	14.6 (10.0-19.4)	521
Age 18-49 years	13-14	3.22 (2.84-3.66)	3.17 (2.69-3.76)	5.26 (4.66-5.96)	7.33 (6.81-9.19)	10.5 (7.77-12.8)	588
Age 18-49 years	15-16	3.08 (2.77-3.43)	3.02 (2.46-3.50)	4.85 (4.30-5.57)	7.89 (6.52-9.53)	12.1 (7.98-16.0)	459
Age 50+ years	11-12	3.31 (2.77-3.95)	2.58 (2.40-3.05)	5.92 (3.65-9.94)	13.3 (7.98-28.8)	20.2 (10.4-30.1)	350
Age 50+ years	13-14	3.01 (2.64-3.43)	2.93 (2.37-3.34)	4.97 (4.12-6.30)	8.58 (6.09-12.3)	12.3 (8.64-16.8)	384
Age 50+ years	15-16	2.92 (2.54-3.36)	2.69 (2.11-3.45)	4.61 (4.06-5.11)	6.81 (6.10-8.28)	12.4 (8.25-20.4)	380
Males	11-12	3.55 (3.14-4.01)	3.05 (2.57-3.91)	6.45 (4.96-8.96)	13.3 (9.85-16.8)	17.6 (13.3-30.1)	524
Males	13-14	3.34 (3.00-3.72)	3.34 (2.86-3.94)	5.75 (4.85-6.34)	8.19 (7.25-9.80)	11.1 (8.76-12.8)	523
Males	15-16	3.31 (2.96-3.71)	3.13 (2.67-3.64)	5.23 (4.53-6.10)	8.25 (6.55-11.3)	13.0 (8.75-20.9)	489
Females	11-12	2.84 (2.48-3.27)	2.57 (2.32-3.03)	4.41 (3.62-5.22)	7.95 (6.02-10.5)	11.8 (7.92-20.2)	347
Females	13-14	2.97 (2.58-3.41)	2.78 (2.24-3.34)	4.74 (4.07-5.95)	7.33 (6.02-10.2)	11.4 (7.77-15.1)	449
Females	15-16	2.70 (2.54-2.88)	2.38 (2.16-2.80)	4.43 (4.01-4.69)	6.54 (5.60-8.31)	9.94 (6.35-20.4)	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.80, 1.91, and 1.91 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Dimethylarsinic acid in Non-smokers (2011 - 2016)

CAS Number 917-76-0

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.56 (3.26-3.89)	3.44 (3.00-3.87)	5.93 (5.26-6.85)	9.87 (8.57-11.7)	14.2 (12.1-16.8)	1343
Total population	13-14	3.18 (2.91-3.49)	3.02 (2.63-3.49)	5.26 (4.67-5.89)	8.78 (7.86-9.62)	11.8 (10.2-15.0)	1549
Total population	15-16	3.09 (2.92-3.28)	2.95 (2.67-3.17)	5.05 (4.69-5.38)	8.76 (7.65-9.97)	12.0 (10.1-15.0)	1479
Age 20-49 years	11-12	3.71 (3.31-4.17)	3.56 (3.10-4.14)	6.74 (5.61-7.65)	10.6 (8.92-12.3)	15.9 (12.2-18.1)	671
Age 18-49 years	13-14	3.26 (2.98-3.57)	3.10 (2.69-3.57)	5.31 (4.68-5.87)	9.03 (7.62-10.7)	11.8 (10.5-16.4)	824
Age 18-49 years	15-16	3.12 (2.86-3.41)	2.83 (2.42-3.21)	5.20 (4.59-5.95)	9.30 (7.52-11.5)	14.1 (10.0-19.5)	754
Age 50+ years	11-12	3.40 (3.09-3.74)	3.21 (2.91-3.72)	5.44 (4.52-6.61)	9.02 (7.71-11.1)	13.6 (9.70-17.8)	672
Age 50+ years	13-14	3.09 (2.77-3.45)	2.87 (2.36-3.53)	5.21 (4.31-6.31)	8.52 (7.69-9.21)	11.9 (9.62-15.0)	725
Age 50+ years	15-16	3.06 (2.90-3.23)	3.09 (2.70-3.30)	4.81 (4.49-5.16)	7.96 (6.77-10.1)	10.5 (9.66-12.7)	725
Males	11-12	3.95 (3.53-4.42)	3.89 (3.33-4.52)	6.30 (5.30-7.68)	10.5 (8.45-13.7)	15.9 (12.1-17.8)	635
Males	13-14	3.32 (3.07-3.60)	3.27 (2.87-3.76)	5.45 (4.98-6.03)	8.56 (7.84-9.85)	11.6 (9.85-15.6)	715
Males	15-16	3.31 (3.08-3.55)	3.17 (2.73-3.66)	5.26 (4.74-6.04)	9.12 (7.80-10.5)	11.9 (10.0-16.8)	665
Females	11-12	3.28 (2.97-3.62)	3.01 (2.65-3.55)	5.53 (4.65-6.29)	9.52 (8.28-11.1)	13.8 (10.7-17.5)	708
Females	13-14	3.06 (2.73-3.44)	2.77 (2.37-3.26)	4.95 (3.98-6.01)	8.82 (7.58-10.0)	11.9 (9.79-15.7)	834
Females	15-16	2.93 (2.73-3.15)	2.76 (2.42-3.11)	4.80 (4.43-5.13)	8.18 (6.84-10.1)	12.1 (10.1-14.5)	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.80, 1.91, and 1.91 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Dimethylarsinic acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 917-76-0

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.53 (3.28-3.79)	3.27 (3.08-3.54)	5.56 (5.14-6.05)	8.95 (7.47-10.1)	10.9 (9.74-13.8)	871
Total population	13-14	3.24 (2.98-3.52)	3.03 (2.81-3.36)	4.82 (4.32-5.19)	7.46 (6.14-8.94)	10.4 (7.94-12.3)	971
Total population	15-16	2.99 (2.76-3.24)	2.86 (2.54-3.29)	4.28 (4.09-4.69)	7.10 (5.86-9.64)	10.5 (8.17-14.3)	839
Age 20-49 years	11-12	3.28 (2.99-3.61)	3.10 (2.65-3.56)	5.20 (4.45-6.04)	8.47 (6.48-9.46)	10.6 (8.12-12.7)	521
Age 18-49 years	13-14	3.04 (2.73-3.38)	2.83 (2.55-3.22)	4.50 (3.74-5.08)	6.19 (5.76-7.69)	9.51 (7.09-11.4)	587
Age 18-49 years	15-16	2.85 (2.64-3.07)	2.93 (2.50-3.21)	4.23 (4.09-4.55)	6.13 (5.38-7.94)	9.42 (6.67-11.1)	459
Age 50+ years	11-12	3.94 (3.48-4.46)	3.49 (3.20-4.06)	6.83 (4.77-7.95)	10.1 (7.00-20.2)	13.4 (10.1-25.1)	350
Age 50+ years	13-14	3.69 (3.19-4.26)	3.57 (2.87-4.38)	5.40 (4.57-6.84)	8.94 (6.69-12.3)	12.3 (8.88-25.4)	384
Age 50+ years	15-16	3.22 (2.84-3.64)	2.76 (2.34-3.31)	4.64 (3.73-5.71)	9.64 (7.10-10.7)	14.3 (10.3-15.3)	380
Males	11-12	3.35 (3.13-3.59)	3.13 (2.82-3.29)	5.30 (4.95-6.33)	9.37 (7.30-10.1)	10.6 (9.37-13.0)	524
Males	13-14	3.01 (2.75-3.31)	2.81 (2.65-3.27)	4.38 (3.94-4.82)	6.14 (5.16-7.74)	8.94 (6.14-11.4)	522
Males	15-16	2.84 (2.57-3.14)	2.70 (2.22-3.16)	4.23 (3.65-4.66)	7.04 (5.48-9.46)	9.82 (7.50-14.6)	489
Females	11-12	3.76 (3.30-4.28)	3.70 (3.10-4.23)	5.87 (4.64-7.00)	8.15 (7.00-11.5)	12.2 (8.10-21.4)	347
Females	13-14	3.49 (3.09-3.95)	3.24 (2.85-3.85)	5.19 (4.47-6.08)	8.41 (6.28-10.5)	12.3 (8.31-14.9)	449
Females	15-16	3.17 (2.89-3.47)	3.14 (2.70-3.31)	4.66 (4.09-5.19)	7.12 (5.63-10.7)	11.1 (6.75-14.5)	350

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Dimethylarsinic acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 917-76-0

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.15 (3.90-4.41)	3.92 (3.62-4.23)	6.43 (5.76-7.25)	10.8 (9.66-12.2)	14.8 (12.8-16.3)	1342
Total population	13-14	3.75 (3.49-4.03)	3.55 (3.22-3.91)	5.70 (5.14-6.21)	9.54 (8.26-10.6)	13.1 (11.6-15.0)	1548
Total population	15-16	3.47 (3.33-3.62)	3.38 (3.21-3.54)	5.40 (5.06-5.53)	8.51 (7.78-9.74)	13.0 (10.6-15.0)	1477
Age 20-49 years	11-12	4.06 (3.74-4.40)	3.95 (3.50-4.42)	6.61 (5.92-7.38)	10.6 (9.38-12.4)	14.1 (11.9-15.9)	670
Age 18-49 years	13-14	3.48 (3.25-3.73)	3.31 (2.96-3.63)	5.13 (4.78-5.70)	8.44 (7.34-9.33)	12.3 (9.71-13.5)	824
Age 18-49 years	15-16	3.24 (3.03-3.47)	3.19 (2.87-3.46)	5.02 (4.67-5.40)	8.00 (7.11-9.56)	11.6 (9.74-15.2)	752
Age 50+ years	11-12	4.25 (3.86-4.68)	3.88 (3.46-4.43)	6.14 (5.29-7.47)	11.3 (9.37-12.8)	15.4 (11.9-19.7)	672
Age 50+ years	13-14	4.1 (3.71-4.52)	3.86 (3.40-4.38)	6.43 (5.53-7.33)	10.6 (8.67-12.8)	14.6 (12.4-16.9)	724
Age 50+ years	15-16	3.75 (3.47-4.05)	3.55 (3.29-3.99)	5.49 (5.20-5.87)	9.29 (7.90-10.6)	13.7 (10.6-17.7)	725
Males	11-12	3.53 (3.18-3.91)	3.31 (3.03-3.78)	5.32 (4.56-6.22)	8.34 (7.04-10.1)	12.8 (9.07-15.8)	634
Males	13-14	3.24 (2.98-3.52)	3.00 (2.77-3.33)	4.72 (4.31-5.11)	7.99 (7.29-9.33)	11.0 (10.0-13.5)	714
Males	15-16	3.02 (2.83-3.23)	2.93 (2.64-3.19)	4.63 (4.37-4.87)	7.35 (6.41-8.28)	10.6 (8.12-14.3)	665
Females	11-12	4.71 (4.44-5.00)	4.54 (4.23-4.70)	7.49 (6.97-8.60)	11.9 (10.3-14.0)	15.9 (14.0-17.2)	708
Females	13-14	4.29 (3.92-4.68)	4.03 (3.66-4.56)	6.43 (5.81-7.13)	10.7 (8.72-12.8)	13.9 (12.4-16.9)	834
Females	15-16	3.89 (3.68-4.12)	3.75 (3.50-3.99)	5.69 (5.49-6.04)	10.0 (8.44-11.1)	13.5 (11.3-18.6)	812

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Monomethylarsonic acid in Smokers (2011 - 2016)

CAS Number 65513-69-1

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	1.38 (1.09-1.79)	1.93 (1.52-2.18)	871
Total population	13-14	.446 (.401-.496)	.510 (.430-.590)	.890 (.820-.990)	1.36 (1.18-1.53)	1.72 (1.42-2.04)	972
Total population	15-16	*	.350 (.230-.490)	.750 (.610-.920)	1.18 (1.05-1.35)	1.69 (1.40-2.00)	839
Age 20-49 years	11-12	*	<LOD	.920 (<LOD-1.07)	1.50 (1.23-1.93)	2.11 (1.52-3.33)	521
Age 18-49 years	13-14	.484 (.423-.553)	.560 (.470-.680)	.920 (.830-1.03)	1.36 (1.18-1.55)	1.70 (1.39-1.97)	588
Age 18-49 years	15-16	.364 (.311-.425)	.360 (.230-.530)	.740 (.610-.920)	1.20 (1.03-1.51)	1.69 (1.33-2.09)	459
Age 50+ years	11-12	*	<LOD	<LOD	1.12 (.960-1.44)	1.61 (1.12-2.04)	350
Age 50+ years	13-14	.378 (.318-.448)	.370 (.250-.460)	.830 (.600-1.01)	1.32 (1.01-1.91)	1.81 (1.15-3.22)	384
Age 50+ years	15-16	*	.340 (<LOD-.500)	.760 (.540-.920)	1.12 (.970-1.29)	1.63 (1.26-1.99)	380
Males	11-12	*	<LOD	.990 (<LOD-1.18)	1.71 (1.38-2.10)	2.18 (1.73-3.39)	524
Males	13-14	.490 (.421-.571)	.520 (.450-.720)	.990 (.840-1.10)	1.44 (1.12-1.72)	1.74 (1.44-2.00)	523
Males	15-16	.398 (.333-.477)	.440 (.250-.580)	.860 (.690-1.04)	1.33 (1.17-1.60)	1.89 (1.55-2.22)	489
Females	11-12	*	<LOD	<LOD	1.07 (.920-1.23)	1.31 (1.10-1.55)	347
Females	13-14	.404 (.361-.452)	.470 (.340-.550)	.810 (.680-.900)	1.27 (.960-1.52)	1.55 (1.27-2.56)	449
Females	15-16	*	.290 (<LOD-.470)	.640 (.490-.850)	1.02 (.870-1.26)	1.34 (1.03-2.00)	350

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.890, 0.200, and 0.200 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Monomethylarsonic acid in Non-smokers (2011 - 2016)

CAS Number 65513-69-1

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	1.32 (1.17-1.54)	1.85 (1.57-2.07)	1343
Total population	13-14	.402 (.357-.452)	.440 (.360-.530)	.770 (.720-.850)	1.19 (1.07-1.33)	1.54 (1.27-1.88)	1549
Total population	15-16	*	.280 (<LOD-.440)	.680 (.590-.800)	1.12 (.970-1.34)	1.46 (1.29-1.70)	1479
Age 20-49 years	11-12	*	<LOD	.940 (<LOD-1.06)	1.57 (1.26-1.88)	2.04 (1.76-2.39)	671
Age 18-49 years	13-14	.429 (.388-.475)	.480 (.400-.540)	.810 (.740-.870)	1.24 (1.08-1.38)	1.60 (1.31-1.95)	824
Age 18-49 years	15-16	*	.320 (<LOD-.500)	.770 (.660-.930)	1.26 (1.06-1.44)	1.56 (1.42-1.72)	754
Age 50+ years	11-12	*	<LOD	<LOD	1.13 (.970-1.41)	1.53 (1.28-1.75)	672
Age 50+ years	13-14	.371 (.322-.429)	.390 (.290-.490)	.740 (.650-.830)	1.14 (1.04-1.32)	1.44 (1.22-1.80)	725
Age 50+ years	15-16	*	.240 (<LOD-.340)	.590 (.540-.670)	.980 (.820-1.15)	1.22 (1.01-1.67)	725
Males	11-12	*	<LOD	.960 (<LOD-1.18)	1.52 (1.23-1.85)	2.05 (1.76-2.40)	635
Males	13-14	.461 (.407-.522)	.520 (.440-.630)	.900 (.830-.980)	1.28 (1.13-1.41)	1.64 (1.31-1.88)	715
Males	15-16	*	.450 (.220-.550)	.780 (.650-.930)	1.25 (.990-1.56)	1.63 (1.42-1.83)	665
Females	11-12	*	<LOD	<LOD	1.17 (1.00-1.44)	1.58 (1.42-1.88)	708
Females	13-14	.354 (.312-.402)	.380 (.250-.480)	.710 (.610-.750)	1.10 (.890-1.27)	1.39 (1.13-1.89)	834
Females	15-16	*	.200 (<LOD-.300)	.590 (.500-.690)	1.02 (.890-1.17)	1.29 (1.15-1.46)	814

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.890, 0.200, and 0.200 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Monomethylarsonic acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 65513-69-1

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	2.33 (2.03-2.63)	3.32 (2.63-3.72)	871
Total population	13-14	0.458 (.415-.506)	.471 (.424-.519)	.761 (.671-.867)	1.16 (1.00-1.30)	1.42 (1.27-1.69)	971
Total population	15-16	*	.365 (.306-.441)	.609 (.493-.733)	1.00 (.839-1.20)	1.42 (1.14-1.68)	839
Age 20-49 years	11-12	*	<LOD	1.29 (<LOD-1.54)	2.52 (1.85-3.32)	3.71 (2.10-4.20)	521
Age 18-49 years	13-14	0.456 (.409-.510)	.484 (.434-.520)	.728 (.681-.824)	1.08 (.975-1.15)	1.27 (1.11-1.41)	587
Age 18-49 years	15-16	0.336 (.278-.406)	.345 (.275-.438)	.558 (.483-.733)	.962 (.721-1.31)	1.31 (.928-1.64)	459
Age 50+ years	11-12	*	<LOD	<LOD	2.17 (1.91-2.63)	2.86 (2.33-3.50)	350
Age 50+ years	13-14	0.463 (.373-.574)	.445 (.350-.579)	.800 (.609-1.13)	1.33 (.978-1.84)	1.73 (1.22-3.07)	384
Age 50+ years	15-16	*	.389 (<LOD-.492)	.679 (.510-.750)	1.07 (.886-1.35)	1.61 (1.07-2.08)	380
Males	11-12	*	<LOD	1.24 (<LOD-1.40)	2.09 (1.58-2.86)	3.50 (2.03-3.72)	524
Males	13-14	0.443 (.397-.493)	.455 (.408-.513)	.746 (.636-.866)	1.07 (.930-1.20)	1.33 (1.13-1.60)	522
Males	15-16	0.342 (.283-.413)	.341 (.275-.434)	.607 (.483-.703)	1.01 (.737-1.37)	1.42 (1.14-1.93)	489
Females	11-12	*	<LOD	<LOD	2.42 (2.10-2.92)	3.15 (2.42-3.94)	347
Females	13-14	0.476 (.422-.536)	.491 (.400-.579)	.778 (.654-.967)	1.27 (.978-1.45)	1.48 (1.27-2.13)	449
Females	15-16	*	.392 (<LOD-.483)	.633 (.491-.786)	.967 (.789-1.19)	1.40 (1.05-1.64)	350

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Monomethylarsonic acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 65513-69-1

Metabolite of Arsenic

Geometric mean and selected percentiles of urine concentrations (in µg As/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	2.31 (1.92-2.52)	2.74 (2.42-3.53)	1342
Total population	13-14	0.474 (.424-.529)	.491 (.424-.556)	.820 (.737-.911)	1.27 (1.16-1.43)	1.62 (1.39-1.91)	1548
Total population	15-16	*	.388 (<LOD-.425)	.662 (.560-.747)	1.01 (.908-1.17)	1.24 (1.17-1.36)	1477
Age 20-49 years	11-12	*	<LOD	1.43 (<LOD-1.66)	2.33 (1.80-2.86)	3.32 (2.52-3.94)	670
Age 18-49 years	13-14	0.458 (.402-.522)	.478 (.415-.540)	.785 (.696-.875)	1.24 (1.06-1.43)	1.55 (1.29-1.94)	824
Age 18-49 years	15-16	*	.392 (<LOD-.452)	.687 (.560-.778)	1.01 (.883-1.17)	1.23 (1.15-1.45)	752
Age 50+ years	11-12	*	<LOD	<LOD	2.25 (1.85-2.52)	2.63 (2.33-3.50)	672
Age 50+ years	13-14	0.492 (.439-.552)	.500 (.424-.582)	.862 (.754-.991)	1.35 (1.18-1.53)	1.69 (1.44-2.04)	724
Age 50+ years	15-16	*	.378 (<LOD-.412)	.633 (.538-.727)	.989 (.846-1.18)	1.29 (1.08-1.49)	725
Males	11-12	*	<LOD	1.07 (<LOD-1.17)	1.70 (1.43-1.91)	2.17 (1.76-2.67)	634
Males	13-14	0.45 (.406-.499)	.473 (.402-.541)	.762 (.683-.857)	1.20 (1.04-1.32)	1.53 (1.30-1.73)	714
Males	15-16	*	.365 (.304-.427)	.642 (.511-.731)	.927 (.792-1.05)	1.17 (.982-1.30)	665
Females	11-12	*	<LOD	<LOD	2.63 (2.33-2.86)	3.50 (2.69-4.85)	708
Females	13-14	0.496 (.437-.563)	.508 (.429-.583)	.874 (.761-1.02)	1.36 (1.18-1.55)	1.77 (1.39-2.13)	834
Females	15-16	*	.398 (<LOD-.444)	.682 (.560-.785)	1.08 (.875-1.29)	1.31 (1.17-1.58)	812

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Trimethylarsine oxide in Smokers (2011 - 2012)

CAS Number 4964-14-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	871
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	521
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	524
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.250.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Trimethylarsine oxide in Non-smokers (2011 - 2012)

CAS Number 4964-14-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/L}$) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1343
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	671
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	635
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.250.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Trimethylarsine oxide in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 4964-14-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	871
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	521
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	350
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	524
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	347

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Trimethylarsine oxide in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 4964-14-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g As/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1342
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	670
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	672
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	634
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	708

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Arsenic_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Arsenic_FactSheet.html

Urinary Barium in Smokers (2011 - 2016)

CAS Number 81-25-4

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.16 (1.06-1.28)	1.24 (1.04-1.37)	2.37 (1.98-2.77)	3.79 (3.25-4.31)	5.43 (4.02-6.73)	876
Total population	13-14	1.14 (1.03-1.26)	1.12 (1.01-1.31)	2.21 (1.97-2.38)	4.06 (3.37-4.86)	5.98 (4.86-7.55)	957
Total population	15-16	1.26 (1.16-1.38)	1.26 (1.18-1.40)	2.31 (2.11-2.67)	4.89 (4.03-5.59)	7.19 (5.55-8.81)	834
Age 20-49 years	11-12	1.25 (1.13-1.38)	1.25 (1.01-1.47)	2.55 (1.98-3.20)	3.90 (3.35-4.45)	5.43 (4.25-6.52)	522
Age 18-49 years	13-14	1.20 (1.04-1.37)	1.26 (.980-1.52)	2.31 (1.94-2.86)	4.09 (3.58-4.47)	6.25 (4.78-7.67)	583
Age 18-49 years	15-16	1.32 (1.17-1.49)	1.35 (1.18-1.59)	2.53 (2.11-2.96)	5.02 (3.68-5.60)	7.19 (5.19-9.45)	457
Age 50+ years	11-12	1.04 (.875-1.24)	1.20 (.910-1.43)	2.19 (1.77-2.52)	3.43 (2.43-5.19)	5.34 (3.79-10.5)	354
Age 50+ years	13-14	1.02 (.875-1.18)	1.03 (.890-1.15)	1.86 (1.37-2.70)	3.59 (2.68-5.47)	5.62 (3.47-12.5)	374
Age 50+ years	15-16	1.18 (.984-1.42)	1.20 (.980-1.33)	2.13 (1.60-2.78)	4.45 (2.72-6.32)	7.02 (4.15-9.11)	377
Males	11-12	1.30 (1.10-1.54)	1.34 (1.00-1.81)	2.73 (1.94-3.27)	3.98 (3.27-5.49)	5.80 (3.99-8.89)	527
Males	13-14	1.19 (1.10-1.28)	1.24 (1.06-1.46)	2.16 (1.94-2.53)	3.88 (3.19-4.91)	5.96 (4.38-8.84)	512
Males	15-16	1.35 (1.18-1.54)	1.33 (1.20-1.61)	2.42 (2.11-2.98)	4.82 (4.00-5.60)	6.59 (5.19-8.67)	487
Females	11-12	1.01 (.892-1.14)	1.01 (.870-1.18)	2.20 (1.64-2.55)	3.14 (2.55-3.91)	4.80 (3.78-5.52)	349
Females	13-14	1.08 (.934-1.26)	1.04 (.900-1.25)	2.31 (1.78-2.78)	4.09 (3.44-5.47)	6.31 (4.42-7.75)	445
Females	15-16	1.17 (1.08-1.27)	1.18 (.940-1.32)	2.15 (1.64-2.76)	4.93 (3.41-5.83)	7.58 (4.44-13.9)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.100, 0.060, and 0.060 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Barium_BiomonitoringSummary.html

Urinary Barium in Non-smokers (2011 - 2016)

CAS Number 81-25-4

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.11 (1.02-1.20)	1.17 (1.03-1.28)	2.18 (1.98-2.45)	3.74 (3.39-4.02)	5.12 (4.61-5.57)	1343
Total population	13-14	.998 (.925-1.08)	.980 (.880-1.12)	2.00 (1.79-2.20)	3.62 (3.15-4.19)	5.19 (4.38-5.61)	1487
Total population	15-16	1.08 (1.00-1.17)	1.10 (1.01-1.24)	2.19 (2.02-2.33)	3.72 (3.25-4.15)	4.99 (4.06-6.13)	1470
Age 20-49 years	11-12	1.13 (1.03-1.25)	1.21 (1.08-1.38)	2.19 (1.94-2.58)	3.63 (3.20-4.15)	4.46 (4.21-5.52)	671
Age 18-49 years	13-14	1.05 (.947-1.17)	1.03 (.870-1.22)	2.07 (1.80-2.56)	3.96 (3.19-4.78)	5.60 (4.45-6.26)	778
Age 18-49 years	15-16	1.16 (1.04-1.29)	1.24 (1.04-1.37)	2.37 (2.08-2.63)	3.89 (3.36-4.47)	5.46 (4.19-7.50)	750
Age 50+ years	11-12	1.08 (.970-1.21)	1.09 (.890-1.29)	2.17 (1.79-2.53)	3.91 (3.01-5.13)	5.46 (4.62-7.13)	672
Age 50+ years	13-14	.940 (.833-1.06)	.950 (.810-1.14)	1.83 (1.53-2.17)	3.19 (2.62-4.10)	4.94 (3.66-5.61)	709
Age 50+ years	15-16	.998 (.903-1.10)	1.02 (.800-1.17)	1.98 (1.81-2.19)	3.51 (3.00-3.99)	4.93 (3.90-5.60)	720
Males	11-12	1.20 (1.05-1.37)	1.25 (1.12-1.38)	2.18 (1.91-2.61)	3.85 (3.37-4.40)	5.78 (4.46-7.13)	635
Males	13-14	1.10 (.973-1.25)	1.09 (.920-1.30)	2.09 (1.73-2.65)	4.18 (3.15-5.05)	5.61 (5.05-6.04)	663
Males	15-16	1.25 (1.10-1.41)	1.34 (1.10-1.54)	2.55 (2.03-2.95)	4.16 (3.32-5.39)	5.73 (4.44-8.40)	663
Females	11-12	1.04 (.928-1.17)	1.07 (.910-1.21)	2.16 (1.70-2.57)	3.63 (3.26-4.05)	5.05 (3.97-5.52)	708
Females	13-14	.921 (.838-1.01)	.870 (.790-1.03)	1.85 (1.64-2.16)	3.30 (3.04-3.74)	4.48 (4.02-5.19)	824
Females	15-16	.963 (.887-1.05)	.960 (.850-1.04)	2.00 (1.81-2.19)	3.36 (3.00-3.71)	4.45 (3.96-4.96)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.100, 0.060, and 0.060 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Barium_BiomonitoringSummary.html

Urinary Barium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 81-25-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.28 (1.14-1.44)	1.31 (1.15-1.46)	2.14 (1.89-2.79)	4.22 (3.30-5.68)	6.17 (4.65-7.09)	876
Total population	13-14	1.16 (1.05-1.28)	1.19 (.990-1.35)	2.21 (1.86-2.51)	3.39 (3.08-3.86)	4.51 (3.76-6.80)	956
Total population	15-16	1.26 (1.13-1.40)	1.28 (1.12-1.47)	2.19 (1.97-2.52)	4.43 (3.19-5.11)	6.28 (4.92-7.78)	834
Age 20-49 years	11-12	1.3 (1.12-1.50)	1.28 (1.07-1.38)	2.26 (1.84-3.00)	4.65 (3.30-5.76)	5.76 (4.13-7.22)	522
Age 18-49 years	13-14	1.12 (.987-1.28)	1.13 (.956-1.35)	2.14 (1.82-2.48)	3.36 (3.08-3.70)	4.32 (3.53-6.68)	582
Age 18-49 years	15-16	1.23 (1.06-1.41)	1.26 (1.08-1.53)	2.34 (1.97-2.78)	3.83 (3.00-4.92)	6.17 (4.85-7.98)	457
Age 50+ years	11-12	1.26 (1.12-1.40)	1.41 (1.24-1.54)	1.95 (1.76-2.74)	3.76 (3.00-5.68)	6.66 (3.43-7.36)	354
Age 50+ years	13-14	1.25 (1.00-1.55)	1.23 (.932-1.52)	2.46 (1.74-2.99)	3.39 (2.74-5.68)	5.68 (3.36-14.4)	374
Age 50+ years	15-16	1.31 (1.15-1.50)	1.28 (1.10-1.48)	2.10 (1.81-2.41)	4.67 (3.19-5.71)	6.28 (4.70-7.78)	377
Males	11-12	1.23 (1.07-1.42)	1.25 (1.04-1.48)	1.95 (1.78-2.68)	3.75 (2.81-5.76)	5.76 (3.49-7.75)	527
Males	13-14	1.05 (.957-1.16)	1.08 (.974-1.14)	1.89 (1.81-2.19)	3.26 (3.06-3.55)	4.24 (3.55-5.95)	511
Males	15-16	1.16 (.999-1.36)	1.21 (.943-1.58)	2.09 (1.66-2.47)	3.19 (2.79-4.85)	5.22 (3.93-6.44)	487
Females	11-12	1.35 (1.10-1.65)	1.38 (1.15-1.70)	2.38 (1.79-3.67)	4.69 (3.04-6.46)	6.39 (3.94-10.4)	349
Females	13-14	1.28 (1.11-1.48)	1.33 (.990-1.61)	2.45 (1.83-3.05)	3.54 (3.11-4.12)	5.42 (3.76-9.44)	445
Females	15-16	1.38 (1.23-1.54)	1.30 (1.21-1.38)	2.52 (2.09-2.97)	4.92 (3.83-6.02)	7.26 (5.19-8.67)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Barium_BiomonitoringSummary.html

Urinary Barium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 81-25-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.29 (1.18-1.41)	1.31 (1.21-1.40)	2.29 (1.98-2.70)	3.85 (3.46-4.37)	6.04 (4.37-8.33)	1342
Total population	13-14	1.19 (1.12-1.27)	1.14 (1.07-1.24)	2.07 (1.93-2.34)	3.97 (3.65-4.28)	5.19 (4.58-5.89)	1486
Total population	15-16	1.22 (1.11-1.34)	1.24 (1.09-1.38)	2.14 (1.91-2.43)	3.68 (3.00-4.35)	4.81 (4.15-5.50)	1468
Age 20-49 years	11-12	1.24 (1.09-1.41)	1.28 (1.11-1.42)	2.04 (1.74-2.40)	3.49 (3.09-4.10)	5.17 (3.72-6.84)	670
Age 18-49 years	13-14	1.15 (1.07-1.25)	1.10 (.994-1.21)	1.97 (1.79-2.26)	3.70 (2.93-4.32)	4.60 (4.20-5.89)	778
Age 18-49 years	15-16	1.22 (1.07-1.38)	1.24 (1.05-1.38)	2.06 (1.78-2.34)	3.62 (2.79-4.59)	4.82 (4.15-6.35)	748
Age 50+ years	11-12	1.36 (1.22-1.50)	1.36 (1.21-1.52)	2.64 (2.15-2.99)	4.31 (3.50-5.54)	6.83 (4.71-9.68)	672
Age 50+ years	13-14	1.24 (1.09-1.40)	1.19 (1.06-1.46)	2.24 (1.94-2.56)	4.25 (3.79-4.50)	5.70 (4.50-7.19)	708
Age 50+ years	15-16	1.22 (1.11-1.35)	1.25 (1.08-1.46)	2.26 (1.94-2.68)	3.69 (3.00-4.33)	4.53 (4.11-4.95)	720
Males	11-12	1.07 (.954-1.20)	1.05 (.938-1.21)	1.87 (1.64-2.11)	3.20 (2.71-3.83)	4.26 (3.43-5.89)	634
Males	13-14	1.06 (.963-1.18)	1.04 (.926-1.13)	1.89 (1.63-2.17)	3.29 (2.69-4.17)	4.38 (3.53-4.78)	662
Males	15-16	1.14 (1.01-1.29)	1.17 (1.03-1.35)	2.08 (1.65-2.48)	3.48 (2.97-4.15)	4.81 (3.69-6.15)	663
Females	11-12	1.5 (1.35-1.66)	1.45 (1.36-1.55)	2.67 (2.22-3.09)	4.71 (3.51-5.96)	7.71 (5.11-9.68)	708
Females	13-14	1.31 (1.21-1.41)	1.26 (1.14-1.45)	2.34 (2.02-2.69)	4.25 (3.76-4.94)	6.23 (5.45-7.86)	824
Females	15-16	1.28 (1.17-1.41)	1.28 (1.14-1.49)	2.25 (1.98-2.51)	3.78 (2.87-4.53)	4.82 (4.30-5.16)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Barium_BiomonitoringSummary.html

Urinary Cadmium in Smokers (2011 - 2016)

CAS Number 81271-94-5

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.308 (.264-.359)	.321 (.271-.411)	.683 (.552-.790)	1.29 (1.02-1.63)	1.85 (1.56-2.33)	876
Total population	13-14	.239 (.221-.257)	.258 (.232-.284)	.547 (.485-.639)	.927 (.831-.995)	1.22 (1.05-1.38)	957
Total population	15-16	.275 (.242-.314)	.282 (.241-.377)	.628 (.567-.708)	1.07 (.977-1.21)	1.48 (1.28-1.70)	834
Age 20-49 years	11-12	.220 (.182-.265)	.229 (.164-.298)	.508 (.371-.622)	.873 (.684-1.14)	1.27 (1.01-1.49)	522
Age 18-49 years	13-14	.171 (.158-.185)	.168 (.154-.189)	.372 (.316-.426)	.699 (.559-.770)	.821 (.754-.933)	583
Age 18-49 years	15-16	.181 (.157-.208)	.191 (.168-.209)	.408 (.323-.477)	.706 (.582-.822)	.976 (.762-1.19)	457
Age 50+ years	11-12	.522 (.447-.609)	.479 (.423-.608)	1.03 (.741-1.51)	1.82 (1.52-2.89)	3.45 (2.10-3.89)	354
Age 50+ years	13-14	.484 (.433-.540)	.497 (.413-.584)	.856 (.751-1.03)	1.32 (1.12-1.62)	1.75 (1.43-2.12)	374
Age 50+ years	15-16	.527 (.454-.612)	.586 (.464-.677)	.982 (.811-1.07)	1.53 (1.25-1.85)	2.10 (1.80-2.48)	377
Males	11-12	.324 (.272-.385)	.368 (.292-.429)	.714 (.552-.844)	1.31 (.988-1.69)	1.69 (1.29-2.09)	527
Males	13-14	.214 (.191-.240)	.238 (.180-.282)	.507 (.436-.593)	.856 (.792-.982)	1.12 (.977-1.39)	512
Males	15-16	.269 (.220-.329)	.292 (.231-.420)	.611 (.501-.713)	1.05 (.765-1.19)	1.42 (1.10-1.85)	487
Females	11-12	.289 (.229-.364)	.303 (.222-.416)	.629 (.455-.741)	1.25 (.783-2.05)	2.05 (1.16-2.53)	349
Females	13-14	.266 (.242-.293)	.277 (.246-.313)	.582 (.485-.721)	.950 (.804-1.12)	1.26 (1.12-1.55)	445
Females	15-16	.283 (.252-.318)	.281 (.220-.359)	.669 (.552-.781)	1.18 (.976-1.34)	1.62 (1.28-1.80)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.056, 0.036, and 0.036 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cadmium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cadmium_FactSheet.html

Urinary Cadmium in Non-smokers (2011 - 2016)

CAS Number 81271-94-5

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.174 (.158-.192)	.176 (.161-.192)	.314 (.279-.366)	.615 (.525-.705)	.842 (.738-1.04)	1343
Total population	13-14	.139 (.131-.148)	.147 (.135-.154)	.290 (.264-.313)	.570 (.515-.615)	.788 (.692-.907)	1487
Total population	15-16	.155 (.139-.173)	.159 (.144-.178)	.319 (.277-.370)	.630 (.492-.731)	.874 (.696-1.10)	1470
Age 20-49 years	11-12	.130 (.113-.151)	.134 (.113-.155)	.233 (.185-.281)	.486 (.338-.610)	.642 (.578-.827)	671
Age 18-49 years	13-14	.101 (.093-.110)	.094 (.087-.108)	.200 (.179-.229)	.358 (.312-.441)	.606 (.496-.654)	778
Age 18-49 years	15-16	.112 (.097-.129)	.112 (.094-.135)	.232 (.199-.268)	.392 (.325-.518)	.571 (.450-.683)	750
Age 50+ years	11-12	.236 (.212-.264)	.228 (.217-.259)	.395 (.336-.474)	.762 (.621-.873)	1.05 (.842-1.52)	672
Age 50+ years	13-14	.200 (.184-.217)	.213 (.186-.232)	.391 (.335-.446)	.702 (.606-.803)	1.01 (.820-1.30)	709
Age 50+ years	15-16	.222 (.197-.249)	.241 (.196-.267)	.446 (.364-.548)	.824 (.665-1.06)	1.14 (.909-1.44)	720
Males	11-12	.165 (.149-.184)	.169 (.154-.185)	.280 (.238-.338)	.546 (.412-.664)	.826 (.595-.939)	635
Males	13-14	.139 (.130-.149)	.148 (.131-.158)	.272 (.229-.314)	.516 (.435-.614)	.726 (.592-1.07)	663
Males	15-16	.147 (.134-.162)	.149 (.133-.165)	.287 (.250-.340)	.521 (.389-.683)	.823 (.598-1.09)	663
Females	11-12	.181 (.160-.205)	.184 (.152-.217)	.347 (.300-.405)	.643 (.583-.782)	.923 (.780-1.35)	708
Females	13-14	.139 (.126-.155)	.146 (.126-.166)	.302 (.267-.340)	.603 (.526-.692)	.820 (.705-.965)	824
Females	15-16	.161 (.138-.189)	.174 (.145-.213)	.350 (.284-.429)	.680 (.554-.798)	.947 (.713-1.22)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.056, 0.036, and 0.036 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cadmium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cadmium_FactSheet.html

Urinary Cadmium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 81271-94-5

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.339 (.307-.374)	.372 (.333-.421)	.631 (.559-.734)	1.09 (.990-1.23)	1.48 (1.27-1.71)	876
Total population	13-14	0.244 (.219-.272)	.260 (.219-.311)	.525 (.436-.650)	.907 (.727-1.05)	1.15 (1.00-1.36)	956
Total population	15-16	0.274 (.247-.305)	.302 (.259-.345)	.523 (.462-.633)	.950 (.760-1.14)	1.29 (1.11-1.57)	834
Age 20-49 years	11-12	0.228 (.201-.259)	.235 (.204-.267)	.424 (.363-.471)	.643 (.595-.735)	.935 (.725-1.19)	522
Age 18-49 years	13-14	0.16 (.149-.172)	.161 (.146-.175)	.295 (.270-.334)	.498 (.416-.650)	.727 (.584-.949)	582
Age 18-49 years	15-16	0.168 (.147-.191)	.172 (.139-.190)	.305 (.254-.372)	.492 (.390-.576)	.667 (.555-.745)	457
Age 50+ years	11-12	0.629 (.569-.696)	.594 (.507-.734)	.977 (.791-1.13)	1.48 (1.27-1.71)	1.97 (1.48-2.24)	354
Age 50+ years	13-14	0.594 (.540-.653)	.604 (.513-.675)	.899 (.722-1.05)	1.27 (1.09-1.49)	1.53 (1.25-1.79)	374
Age 50+ years	15-16	0.585 (.525-.653)	.524 (.475-.638)	.911 (.718-1.14)	1.32 (1.18-1.73)	1.80 (1.46-2.20)	377
Males	11-12	0.305 (.260-.358)	.372 (.281-.434)	.565 (.470-.667)	.932 (.745-1.13)	1.25 (.907-1.72)	527
Males	13-14	0.19 (.175-.206)	.192 (.173-.219)	.436 (.394-.466)	.697 (.602-.786)	.888 (.730-1.10)	511
Males	15-16	0.232 (.203-.265)	.254 (.197-.298)	.443 (.372-.506)	.738 (.544-.867)	.937 (.745-1.34)	487
Females	11-12	0.386 (.332-.448)	.373 (.331-.458)	.735 (.595-.873)	1.28 (.975-1.51)	1.68 (1.19-2.28)	349
Females	13-14	0.314 (.271-.364)	.334 (.270-.402)	.650 (.523-.767)	1.05 (.949-1.13)	1.27 (1.11-1.65)	445
Females	15-16	0.334 (.296-.377)	.385 (.310-.420)	.694 (.555-.911)	1.14 (.996-1.30)	1.53 (1.18-1.73)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cadmium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cadmium_FactSheet.html

Urinary Cadmium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 81271-94-5

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.203 (.185-.222)	.194 (.181-.218)	.353 (.317-.399)	.568 (.503-.660)	.870 (.638-1.03)	1342
Total population	13-14	0.166 (.158-.174)	.166 (.151-.184)	.301 (.272-.317)	.549 (.489-.608)	.771 (.675-.846)	1486
Total population	15-16	0.174 (.159-.191)	.175 (.156-.195)	.311 (.285-.340)	.541 (.459-.608)	.775 (.608-.924)	1468
Age 20-49 years	11-12	0.142 (.128-.158)	.138 (.122-.152)	.230 (.198-.275)	.398 (.310-.470)	.538 (.421-.741)	670
Age 18-49 years	13-14	0.111 (.101-.121)	.113 (.102-.121)	.186 (.161-.209)	.298 (.265-.328)	.421 (.364-.543)	778
Age 18-49 years	15-16	0.117 (.105-.129)	.117 (.098-.133)	.200 (.167-.231)	.311 (.284-.358)	.405 (.358-.521)	748
Age 50+ years	11-12	0.296 (.271-.322)	.296 (.257-.331)	.458 (.416-.526)	.759 (.613-.942)	1.09 (.892-1.22)	672
Age 50+ years	13-14	0.263 (.248-.278)	.260 (.235-.285)	.421 (.382-.455)	.726 (.622-.826)	.977 (.826-1.20)	708
Age 50+ years	15-16	0.271 (.247-.298)	.264 (.234-.301)	.434 (.403-.491)	.758 (.580-.916)	.961 (.753-1.20)	720
Males	11-12	0.148 (.131-.166)	.143 (.132-.157)	.230 (.193-.280)	.405 (.324-.524)	.549 (.463-.713)	634
Males	13-14	0.134 (.125-.144)	.132 (.114-.151)	.227 (.205-.261)	.369 (.334-.436)	.581 (.430-.669)	662
Males	15-16	0.135 (.127-.144)	.127 (.120-.137)	.225 (.202-.265)	.387 (.333-.459)	.587 (.459-.737)	663
Females	11-12	0.26 (.233-.289)	.271 (.241-.290)	.443 (.385-.477)	.671 (.568-.892)	1.03 (.823-1.22)	708
Females	13-14	0.198 (.184-.213)	.203 (.180-.219)	.356 (.317-.395)	.627 (.581-.726)	.928 (.713-1.03)	824
Females	15-16	0.214 (.188-.245)	.224 (.195-.254)	.389 (.327-.427)	.623 (.494-.833)	.906 (.639-1.25)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cadmium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Cadmium_FactSheet.html

Urinary Cesium in Smokers (2011 - 2016)

CAS Number 7440-46-2

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.73 (3.50-3.99)	4.03 (3.60-4.42)	6.34 (5.94-6.68)	8.73 (7.76-10.5)	11.1 (8.82-11.9)	876
Total population	13-14	3.97 (3.68-4.29)	4.14 (3.82-4.55)	6.95 (6.39-7.56)	9.72 (9.01-10.4)	11.6 (9.88-14.1)	957
Total population	15-16	3.90 (3.58-4.25)	3.96 (3.57-4.40)	6.44 (5.80-7.39)	8.93 (8.36-10.4)	11.7 (10.3-13.1)	834
Age 20-49 years	11-12	3.66 (3.40-3.93)	3.99 (3.54-4.52)	6.50 (5.79-7.08)	8.61 (7.54-10.8)	11.1 (7.76-11.9)	522
Age 18-49 years	13-14	4.02 (3.61-4.48)	4.19 (3.72-4.92)	7.05 (6.23-8.15)	9.54 (9.00-10.6)	11.7 (9.72-14.8)	583
Age 18-49 years	15-16	3.75 (3.32-4.24)	3.83 (3.37-4.35)	6.09 (5.51-7.29)	8.90 (8.03-10.3)	10.9 (9.32-13.1)	457
Age 50+ years	11-12	3.86 (3.44-4.33)	4.03 (3.27-4.61)	6.28 (5.53-6.63)	8.86 (7.52-10.8)	11.2 (8.86-11.5)	354
Age 50+ years	13-14	3.87 (3.55-4.22)	3.99 (3.42-4.54)	6.71 (5.72-7.60)	10.2 (8.36-11.4)	11.6 (9.88-14.0)	374
Age 50+ years	15-16	4.15 (3.78-4.55)	4.24 (3.64-5.23)	6.78 (5.80-8.03)	9.44 (8.57-10.9)	12.0 (9.93-13.7)	377
Males	11-12	3.94 (3.61-4.30)	4.53 (3.58-5.11)	6.93 (6.34-7.18)	8.51 (7.71-10.6)	11.2 (8.21-11.9)	527
Males	13-14	4.01 (3.64-4.42)	4.18 (3.97-4.79)	6.71 (6.17-7.34)	9.10 (8.48-9.89)	10.6 (9.54-11.6)	512
Males	15-16	4.08 (3.65-4.57)	4.55 (3.87-5.37)	6.78 (5.84-7.81)	8.75 (8.03-10.3)	11.4 (9.04-12.2)	487
Females	11-12	3.49 (3.03-4.02)	3.79 (3.20-4.03)	5.77 (4.62-6.64)	9.20 (6.63-11.1)	11.1 (7.19-16.0)	349
Females	13-14	3.93 (3.46-4.46)	4.04 (3.34-4.78)	7.19 (6.33-8.58)	10.6 (9.25-11.9)	12.8 (9.88-14.9)	445
Females	15-16	3.70 (3.43-4.00)	3.64 (3.14-4.01)	5.96 (5.19-7.15)	9.77 (8.61-10.8)	13.1 (10.7-14.0)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.120, 0.086, and 0.086 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cesium_BiomonitoringSummary.html

Urinary Cesium in Non-smokers (2011 - 2016)

CAS Number 7440-46-2

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.85 (3.63-4.09)	4.11 (3.89-4.42)	6.26 (5.86-6.84)	9.08 (8.48-9.44)	10.5 (9.58-11.6)	1342
Total population	13-14	3.86 (3.66-4.07)	4.09 (3.85-4.36)	6.39 (6.11-6.76)	8.96 (8.23-9.70)	10.9 (10.0-11.7)	1487
Total population	15-16	3.90 (3.61-4.21)	4.19 (3.77-4.59)	6.20 (5.76-6.62)	8.95 (8.31-9.59)	11.6 (9.76-13.1)	1470
Age 20-49 years	11-12	3.65 (3.34-4.00)	3.97 (3.68-4.34)	6.24 (5.58-6.95)	9.08 (7.97-9.27)	9.94 (9.48-11.2)	671
Age 18-49 years	13-14	3.85 (3.69-4.02)	4.13 (3.77-4.47)	6.41 (6.11-6.81)	8.74 (8.06-9.64)	10.2 (9.64-11.6)	778
Age 18-49 years	15-16	3.78 (3.36-4.25)	4.31 (3.66-4.86)	6.30 (5.71-6.87)	8.63 (7.57-9.76)	11.0 (8.95-13.6)	750
Age 50+ years	11-12	4.08 (3.80-4.38)	4.28 (3.91-4.59)	6.29 (5.76-7.08)	9.10 (8.06-10.2)	10.6 (9.44-13.8)	671
Age 50+ years	13-14	3.86 (3.50-4.26)	3.99 (3.54-4.47)	6.38 (5.80-7.08)	9.14 (7.67-10.4)	11.3 (9.22-13.5)	709
Age 50+ years	15-16	4.03 (3.72-4.36)	4.07 (3.66-4.49)	5.97 (5.74-6.40)	9.34 (8.75-9.96)	12.1 (9.96-13.6)	720
Males	11-12	4.40 (4.14-4.67)	4.71 (4.28-5.17)	6.63 (6.13-7.15)	9.18 (8.15-9.88)	10.7 (9.74-12.8)	634
Males	13-14	4.20 (3.88-4.55)	4.53 (4.10-4.97)	6.83 (6.39-7.39)	9.36 (8.42-10.2)	11.1 (9.36-13.5)	663
Males	15-16	4.24 (3.97-4.54)	4.77 (4.45-5.08)	6.46 (5.95-7.04)	8.96 (8.28-9.76)	11.1 (9.58-13.6)	663
Females	11-12	3.48 (3.22-3.75)	3.69 (3.46-3.90)	5.91 (5.33-6.62)	8.62 (7.79-9.48)	10.2 (9.48-11.5)	708
Females	13-14	3.60 (3.37-3.84)	3.67 (3.39-4.12)	6.09 (5.61-6.49)	8.33 (7.78-9.27)	10.7 (9.81-11.5)	824
Females	15-16	3.63 (3.27-4.03)	3.68 (3.26-4.30)	5.78 (5.09-6.54)	8.95 (7.82-10.3)	11.6 (9.37-13.2)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.120, 0.086, and 0.086 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cesium_BiomonitoringSummary.html

Urinary Cesium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-46-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.11 (3.77-4.47)	4.00 (3.69-4.36)	5.55 (5.22-5.70)	8.18 (6.39-10.7)	10.9 (7.48-14.4)	876
Total population	13-14	4.06 (3.81-4.33)	3.88 (3.60-4.31)	5.61 (5.17-6.03)	8.01 (7.13-8.59)	9.03 (8.57-10.3)	956
Total population	15-16	3.89 (3.67-4.12)	3.67 (3.48-3.98)	5.17 (4.71-5.90)	7.73 (7.11-8.62)	9.48 (8.47-11.0)	834
Age 20-49 years	11-12	3.79 (3.44-4.18)	3.69 (3.20-4.15)	5.29 (4.57-5.70)	7.76 (5.72-10.2)	9.27 (7.48-14.4)	522
Age 18-49 years	13-14	3.77 (3.50-4.06)	3.62 (3.26-4.04)	4.97 (4.66-5.37)	6.98 (6.17-8.01)	8.37 (7.13-10.1)	582
Age 18-49 years	15-16	3.49 (3.25-3.74)	3.30 (3.09-3.58)	4.35 (4.00-5.03)	6.89 (5.48-8.44)	9.16 (7.11-11.1)	457
Age 50+ years	11-12	4.65 (4.31-5.03)	4.51 (4.10-4.91)	6.10 (5.47-6.96)	9.36 (7.01-11.5)	11.5 (7.41-32.4)	354
Age 50+ years	13-14	4.75 (4.33-5.21)	4.64 (4.12-5.44)	7.00 (5.85-7.99)	8.67 (8.38-9.11)	9.95 (8.89-11.8)	374
Age 50+ years	15-16	4.61 (4.22-5.03)	4.58 (4.02-5.00)	6.18 (5.11-7.59)	8.58 (7.59-9.72)	10.4 (8.58-15.4)	377
Males	11-12	3.72 (3.37-4.10)	3.68 (3.20-4.15)	4.88 (4.43-5.41)	6.27 (5.59-7.91)	8.00 (6.10-14.4)	527
Males	13-14	3.56 (3.29-3.85)	3.52 (3.18-3.82)	4.67 (4.36-4.92)	6.24 (5.56-7.07)	7.99 (6.64-8.91)	511
Males	15-16	3.52 (3.27-3.78)	3.42 (3.10-3.62)	4.52 (4.13-5.02)	7.02 (5.19-7.77)	8.11 (7.11-9.42)	487
Females	11-12	4.66 (4.22-5.14)	4.53 (4.13-5.10)	6.95 (5.65-7.89)	9.27 (7.77-11.5)	11.5 (8.29-14.6)	349
Females	13-14	4.64 (4.33-4.97)	4.58 (3.99-5.07)	6.65 (5.66-7.75)	8.67 (8.00-9.89)	10.3 (8.71-12.5)	445
Females	15-16	4.38 (4.13-4.63)	4.16 (3.80-4.59)	5.93 (5.32-6.89)	9.01 (7.83-10.1)	12.4 (9.01-14.2)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cesium_BiomonitoringSummary.html

Urinary Cesium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-46-2

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.49 (4.24-4.76)	4.44 (4.20-4.75)	6.25 (5.71-6.77)	8.25 (7.65-8.86)	10.2 (8.73-11.9)	1341
Total population	13-14	4.61 (4.43-4.79)	4.49 (4.29-4.78)	6.30 (6.13-6.58)	8.48 (8.18-8.96)	10.4 (9.66-10.8)	1486
Total population	15-16	4.39 (4.16-4.63)	4.37 (4.05-4.68)	6.09 (5.56-6.58)	8.51 (7.55-9.44)	10.5 (9.33-11.1)	1468
Age 20-49 years	11-12	3.99 (3.80-4.18)	4.00 (3.70-4.27)	5.59 (5.05-5.91)	7.01 (6.45-7.54)	8.19 (7.65-8.75)	670
Age 18-49 years	13-14	4.22 (4.00-4.45)	4.12 (3.79-4.37)	5.73 (5.34-6.14)	7.84 (6.89-8.34)	9.47 (8.26-11.0)	778
Age 18-49 years	15-16	3.95 (3.76-4.15)	3.95 (3.61-4.16)	5.45 (4.99-5.98)	7.45 (6.73-8.76)	9.50 (8.24-10.7)	748
Age 50+ years	11-12	5.1 (4.62-5.63)	4.88 (4.35-5.61)	7.19 (5.91-8.22)	9.48 (8.25-10.7)	12.1 (10.2-13.5)	671
Age 50+ years	13-14	5.09 (4.79-5.40)	5.01 (4.78-5.49)	6.93 (6.46-7.55)	9.39 (8.38-10.2)	10.7 (9.98-12.0)	708
Age 50+ years	15-16	4.93 (4.61-5.26)	4.77 (4.53-5.26)	6.81 (6.05-7.48)	9.32 (8.16-10.0)	10.6 (9.86-11.7)	720
Males	11-12	3.92 (3.61-4.26)	3.78 (3.54-4.27)	5.36 (4.79-6.24)	7.86 (6.47-8.52)	8.65 (8.01-10.3)	633
Males	13-14	4.06 (3.87-4.27)	4.02 (3.78-4.29)	5.28 (5.00-5.71)	6.98 (6.42-8.00)	8.50 (7.85-9.06)	662
Males	15-16	3.9 (3.67-4.14)	3.91 (3.53-4.21)	5.39 (4.86-5.79)	7.18 (6.45-8.22)	9.71 (8.22-11.3)	663
Females	11-12	4.99 (4.75-5.25)	4.96 (4.72-5.20)	6.62 (6.25-7.17)	8.70 (8.10-9.98)	11.9 (9.48-13.5)	708
Females	13-14	5.11 (4.91-5.31)	5.15 (4.87-5.38)	7.05 (6.64-7.56)	9.51 (8.66-10.5)	11.3 (10.5-12.5)	824
Females	15-16	4.83 (4.52-5.17)	4.79 (4.32-5.17)	6.71 (6.02-7.43)	9.22 (7.95-9.86)	10.5 (9.33-12.1)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cesium_BiomonitoringSummary.html

Urinary Cobalt in Smokers (2011 - 2016)

CAS Number 7440-48-4

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.309 (.282-.339)	.309 (.281-.338)	.518 (.457-.573)	.880 (.735-.966)	1.19 (.942-1.50)	875
Total population	13-14	.409 (.365-.460)	.435 (.373-.500)	.710 (.667-.764)	1.07 (.970-1.19)	1.43 (1.30-1.70)	957
Total population	15-16	.417 (.382-.456)	.428 (.391-.483)	.682 (.615-.760)	1.02 (.938-1.16)	1.38 (1.20-1.88)	834
Age 20-49 years	11-12	.313 (.283-.347)	.315 (.281-.344)	.520 (.433-.619)	.904 (.690-1.05)	1.29 (.912-1.81)	521
Age 18-49 years	13-14	.427 (.380-.481)	.463 (.422-.534)	.726 (.670-.800)	1.13 (.970-1.25)	1.48 (1.25-1.78)	583
Age 18-49 years	15-16	.422 (.371-.480)	.436 (.379-.502)	.725 (.604-.818)	1.05 (.963-1.25)	1.63 (1.25-1.93)	457
Age 50+ years	11-12	.302 (.268-.341)	.296 (.251-.374)	.518 (.448-.603)	.840 (.661-1.00)	1.03 (.857-1.36)	354
Age 50+ years	13-14	.375 (.318-.441)	.364 (.281-.462)	.652 (.488-.779)	1.02 (.779-1.28)	1.38 (1.06-2.39)	374
Age 50+ years	15-16	.410 (.351-.479)	.419 (.339-.501)	.641 (.560-.747)	.998 (.812-1.15)	1.31 (1.01-2.01)	377
Males	11-12	.293 (.262-.329)	.300 (.263-.338)	.516 (.425-.566)	.688 (.603-.885)	.904 (.744-.966)	526
Males	13-14	.386 (.362-.411)	.442 (.391-.472)	.663 (.594-.700)	.827 (.798-.904)	1.03 (.922-1.31)	512
Males	15-16	.387 (.344-.435)	.428 (.359-.497)	.630 (.574-.678)	.838 (.799-.938)	1.05 (.887-1.20)	487
Females	11-12	.330 (.300-.362)	.321 (.258-.351)	.556 (.456-.681)	1.14 (.822-1.40)	1.50 (1.17-2.02)	349
Females	13-14	.435 (.360-.526)	.431 (.331-.554)	.811 (.665-1.00)	1.29 (1.13-1.50)	1.78 (1.39-2.28)	445
Females	15-16	.456 (.412-.506)	.428 (.408-.500)	.784 (.747-.905)	1.31 (1.07-1.59)	2.01 (1.38-2.33)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.048, 0.023, and 0.023 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cobalt_BiomonitoringSummary.html

Urinary Cobalt in Non-smokers (2011 - 2016)

CAS Number 7440-48-4

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.305 (.284-.328)	.300 (.284-.323)	.482 (.456-.515)	.815 (.702-.998)	1.23 (1.03-1.56)	1343
Total population	13-14	.368 (.349-.387)	.375 (.355-.404)	.640 (.604-.667)	.925 (.868-1.05)	1.24 (1.17-1.39)	1487
Total population	15-16	.382 (.360-.406)	.394 (.374-.429)	.633 (.590-.664)	.949 (.856-1.08)	1.45 (1.24-1.67)	1470
Age 20-49 years	11-12	.316 (.293-.341)	.328 (.295-.360)	.535 (.476-.596)	.883 (.736-1.06)	1.35 (1.00-1.61)	671
Age 18-49 years	13-14	.379 (.343-.418)	.406 (.357-.460)	.673 (.637-.747)	1.03 (.901-1.11)	1.32 (1.17-1.44)	778
Age 18-49 years	15-16	.408 (.381-.437)	.444 (.405-.489)	.664 (.632-.708)	1.01 (.890-1.22)	1.54 (1.28-1.66)	750
Age 50+ years	11-12	.294 (.269-.322)	.284 (.265-.306)	.447 (.401-.482)	.729 (.588-.986)	1.16 (.810-1.62)	672
Age 50+ years	13-14	.356 (.337-.376)	.353 (.329-.373)	.584 (.517-.647)	.873 (.741-.977)	1.23 (.900-2.13)	709
Age 50+ years	15-16	.356 (.321-.394)	.358 (.326-.405)	.555 (.512-.639)	.934 (.753-1.08)	1.33 (.969-1.77)	720
Males	11-12	.295 (.274-.318)	.292 (.277-.320)	.420 (.372-.475)	.656 (.541-.729)	.813 (.721-.982)	635
Males	13-14	.360 (.335-.387)	.376 (.340-.421)	.604 (.549-.645)	.820 (.765-.891)	1.06 (.873-1.24)	663
Males	15-16	.361 (.335-.388)	.403 (.378-.434)	.584 (.546-.629)	.814 (.666-.909)	.923 (.757-1.08)	663
Females	11-12	.313 (.282-.348)	.311 (.279-.360)	.542 (.482-.600)	1.06 (.754-1.32)	1.53 (1.16-1.82)	708
Females	13-14	.374 (.342-.410)	.374 (.340-.414)	.671 (.637-.717)	1.10 (.926-1.21)	1.40 (1.23-1.63)	824
Females	15-16	.401 (.370-.435)	.388 (.352-.442)	.679 (.632-.741)	1.31 (1.06-1.52)	1.77 (1.38-2.13)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.048, 0.023, and 0.023 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cobalt_BiomonitoringSummary.html

Urinary Cobalt in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-48-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.338 (.309-.370)	.327 (.289-.345)	.498 (.470-.514)	.756 (.688-.823)	1.16 (.875-1.50)	875
Total population	13-14	0.419 (.385-.456)	.408 (.372-.441)	.605 (.548-.661)	.932 (.845-1.00)	1.23 (1.06-1.48)	956
Total population	15-16	0.416 (.387-.447)	.394 (.365-.442)	.575 (.530-.633)	.896 (.788-1.05)	1.25 (1.08-1.53)	834
Age 20-49 years	11-12	0.322 (.285-.365)	.295 (.259-.339)	.474 (.442-.513)	.767 (.694-.919)	1.28 (.782-1.96)	521
Age 18-49 years	13-14	0.401 (.369-.435)	.403 (.355-.427)	.560 (.516-.636)	.880 (.749-1.00)	1.16 (.948-1.32)	582
Age 18-49 years	15-16	0.392 (.357-.431)	.368 (.333-.402)	.552 (.469-.612)	.914 (.675-1.10)	1.24 (1.04-1.41)	457
Age 50+ years	11-12	0.365 (.338-.394)	.336 (.329-.378)	.508 (.481-.573)	.688 (.622-.880)	1.04 (.800-1.50)	354
Age 50+ years	13-14	0.46 (.402-.527)	.436 (.367-.516)	.677 (.611-.759)	1.03 (.856-1.29)	1.53 (1.12-1.98)	374
Age 50+ years	15-16	0.455 (.416-.498)	.424 (.393-.480)	.589 (.531-.664)	.871 (.755-1.05)	1.63 (.977-1.85)	377
Males	11-12	0.274 (.253-.297)	.265 (.235-.300)	.400 (.336-.465)	.546 (.493-.622)	.622 (.513-.751)	526
Males	13-14	0.342 (.309-.379)	.347 (.321-.382)	.448 (.414-.513)	.630 (.559-.677)	.739 (.643-.986)	511
Males	15-16	0.333 (.303-.366)	.331 (.294-.362)	.455 (.387-.491)	.614 (.481-.719)	.795 (.649-.914)	487
Females	11-12	0.44 (.375-.516)	.417 (.337-.490)	.648 (.572-.729)	1.13 (.799-1.56)	1.88 (1.03-2.51)	349
Females	13-14	0.513 (.457-.576)	.509 (.433-.589)	.755 (.695-.855)	1.19 (1.00-1.24)	1.53 (1.23-1.73)	445
Females	15-16	0.539 (.498-.584)	.530 (.486-.551)	.755 (.648-.828)	1.14 (1.05-1.41)	1.67 (1.27-1.85)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cobalt_BiomonitoringSummary.html

Urinary Cobalt in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-48-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.356 (.338-.375)	.333 (.304-.350)	.517 (.469-.569)	.865 (.713-1.10)	1.30 (1.10-1.58)	1342
Total population	13-14	0.439 (.420-.458)	.425 (.392-.446)	.623 (.580-.683)	.961 (.885-1.06)	1.32 (1.19-1.60)	1486
Total population	15-16	0.43 (.412-.450)	.411 (.391-.438)	.603 (.563-.649)	.957 (.823-1.11)	1.22 (1.11-1.51)	1468
Age 20-49 years	11-12	0.345 (.322-.370)	.317 (.282-.349)	.520 (.463-.569)	.962 (.750-1.12)	1.27 (1.10-1.58)	670
Age 18-49 years	13-14	0.415 (.394-.436)	.397 (.377-.431)	.590 (.561-.638)	.904 (.827-.965)	1.10 (.971-1.29)	778
Age 18-49 years	15-16	0.426 (.411-.442)	.404 (.379-.421)	.592 (.551-.634)	.939 (.840-1.05)	1.25 (1.05-1.51)	748
Age 50+ years	11-12	0.368 (.338-.401)	.345 (.304-.390)	.514 (.451-.593)	.786 (.604-1.17)	1.41 (.871-2.13)	672
Age 50+ years	13-14	0.468 (.437-.500)	.443 (.405-.480)	.683 (.588-.743)	1.17 (.864-1.41)	1.50 (1.25-2.09)	708
Age 50+ years	15-16	0.435 (.402-.471)	.428 (.390-.464)	.608 (.531-.686)	.964 (.725-1.20)	1.21 (.972-1.61)	720
Males	11-12	0.263 (.246-.282)	.242 (.228-.260)	.353 (.320-.391)	.511 (.432-.625)	.665 (.514-1.03)	634
Males	13-14	0.348 (.326-.371)	.333 (.314-.351)	.471 (.431-.508)	.678 (.593-.739)	.884 (.683-1.41)	662
Males	15-16	0.331 (.310-.354)	.315 (.298-.338)	.442 (.408-.469)	.588 (.511-.732)	.746 (.583-1.11)	663
Females	11-12	0.45 (.419-.485)	.423 (.400-.457)	.638 (.594-.710)	1.10 (.957-1.30)	1.58 (1.18-2.24)	708
Females	13-14	0.531 (.497-.568)	.519 (.476-.554)	.767 (.698-.829)	1.17 (.980-1.31)	1.50 (1.25-2.00)	824
Females	15-16	0.533 (.502-.565)	.500 (.479-.530)	.754 (.689-.823)	1.18 (.979-1.25)	1.44 (1.22-1.98)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Cobalt_BiomonitoringSummary.html

Urinary Lead in Smokers (2011 - 2016)

CAS Number 7439-92-1

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.475 (.398-.565)	.440 (.390-.560)	.870 (.740-1.02)	1.54 (1.15-2.01)	2.36 (1.71-4.62)	876
Total population	13-14	.382 (.344-.425)	.390 (.340-.460)	.690 (.610-.820)	1.17 (1.02-1.30)	1.51 (1.30-1.91)	957
Total population	15-16	.389 (.346-.438)	.390 (.360-.450)	.700 (.570-.850)	1.16 (1.03-1.36)	1.61 (1.39-2.01)	834
Age 20-49 years	11-12	.422 (.350-.509)	.400 (.330-.550)	.790 (.660-.990)	1.20 (1.05-1.66)	1.78 (1.41-3.07)	522
Age 18-49 years	13-14	.348 (.303-.400)	.360 (.300-.440)	.610 (.520-.690)	1.02 (.890-1.16)	1.34 (1.13-1.92)	583
Age 18-49 years	15-16	.339 (.295-.389)	.360 (.290-.410)	.620 (.510-.720)	1.08 (.900-1.29)	1.55 (1.18-2.21)	457
Age 50+ years	11-12	.570 (.452-.718)	.500 (.430-.700)	1.01 (.740-1.36)	1.92 (1.36-2.97)	3.35 (1.62-6.83)	354
Age 50+ years	13-14	.466 (.401-.542)	.470 (.390-.570)	.920 (.710-1.13)	1.36 (1.25-1.43)	1.72 (1.40-2.03)	374
Age 50+ years	15-16	.482 (.413-.563)	.510 (.400-.580)	.790 (.650-1.00)	1.25 (.990-1.92)	1.89 (1.32-2.60)	377
Males	11-12	.583 (.476-.714)	.630 (.450-.750)	1.01 (.850-1.20)	1.80 (1.46-2.60)	3.07 (1.73-5.03)	527
Males	13-14	.442 (.390-.500)	.460 (.390-.550)	.820 (.680-.990)	1.23 (1.17-1.52)	1.91 (1.48-2.14)	512
Males	15-16	.450 (.377-.536)	.470 (.380-.570)	.800 (.650-1.01)	1.42 (1.17-1.61)	2.35 (1.52-2.60)	487
Females	11-12	.366 (.309-.434)	.350 (.280-.410)	.640 (.500-.750)	1.15 (.750-1.47)	1.58 (1.14-3.45)	349
Females	13-14	.331 (.291-.376)	.340 (.310-.370)	.570 (.460-.690)	1.01 (.830-1.24)	1.30 (1.12-1.41)	445
Females	15-16	.329 (.293-.369)	.340 (.290-.390)	.560 (.460-.690)	.960 (.750-1.02)	1.20 (.990-1.36)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.080, 0.030, and 0.030 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Lead_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Lead_FactSheet.html

Urinary Lead in Non-smokers (2011 - 2016)

CAS Number 7439-92-1

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.360 (.331-.392)	.380 (.340-.400)	.650 (.580-.710)	1.02 (.890-1.21)	1.38 (1.25-1.58)	1343
Total population	13-14	.272 (.257-.288)	.280 (.270-.290)	.500 (.470-.530)	.790 (.720-.900)	1.16 (.950-1.51)	1487
Total population	15-16	.282 (.257-.309)	.290 (.250-.330)	.530 (.470-.580)	.970 (.870-1.03)	1.30 (1.10-1.45)	1470
Age 20-49 years	11-12	.300 (.265-.339)	.300 (.260-.360)	.560 (.490-.650)	.950 (.770-1.15)	1.26 (1.02-1.38)	671
Age 18-49 years	13-14	.222 (.202-.244)	.230 (.210-.260)	.410 (.360-.480)	.650 (.600-.730)	.880 (.720-1.04)	778
Age 18-49 years	15-16	.230 (.206-.257)	.230 (.210-.260)	.420 (.360-.470)	.710 (.570-.900)	1.11 (.730-1.66)	750
Age 50+ years	11-12	.439 (.394-.489)	.440 (.390-.480)	.720 (.600-.820)	1.11 (.920-1.38)	1.63 (1.29-2.16)	672
Age 50+ years	13-14	.340 (.315-.366)	.340 (.320-.370)	.590 (.520-.670)	1.00 (.790-1.25)	1.48 (1.12-2.52)	709
Age 50+ years	15-16	.353 (.320-.389)	.380 (.340-.420)	.660 (.590-.720)	1.06 (.990-1.14)	1.45 (1.14-1.71)	720
Males	11-12	.417 (.374-.465)	.420 (.380-.450)	.700 (.600-.790)	1.11 (.900-1.38)	1.61 (1.18-2.13)	635
Males	13-14	.320 (.296-.345)	.320 (.290-.350)	.580 (.520-.630)	.960 (.740-1.25)	1.51 (1.04-2.68)	663
Males	15-16	.311 (.283-.342)	.340 (.290-.390)	.600 (.520-.670)	1.00 (.810-1.10)	1.23 (1.10-1.54)	663
Females	11-12	.321 (.288-.359)	.320 (.300-.380)	.590 (.500-.680)	.960 (.820-1.15)	1.32 (1.06-1.38)	708
Females	13-14	.237 (.219-.257)	.240 (.220-.270)	.450 (.410-.480)	.700 (.630-.770)	.950 (.790-1.15)	824
Females	15-16	.260 (.229-.296)	.260 (.220-.310)	.470 (.400-.540)	.900 (.700-1.08)	1.40 (.990-1.63)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.080, 0.030, and 0.030 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Lead_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Lead_FactSheet.html

Urinary Lead in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7439-92-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.522 (.463-.588)	.495 (.438-.542)	.800 (.684-.935)	1.23 (1.08-1.51)	1.93 (1.25-3.70)	876
Total population	13-14	0.391 (.358-.428)	.375 (.334-.419)	.631 (.563-.704)	.955 (.837-1.06)	1.26 (1.08-1.50)	956
Total population	15-16	0.388 (.346-.435)	.373 (.333-.435)	.602 (.517-.714)	.939 (.788-1.07)	1.17 (1.07-1.41)	834
Age 20-49 years	11-12	0.438 (.385-.498)	.400 (.373-.436)	.640 (.538-.789)	1.10 (.833-1.31)	1.72 (1.12-3.50)	522
Age 18-49 years	13-14	0.327 (.298-.359)	.317 (.284-.340)	.468 (.426-.563)	.775 (.667-.862)	1.04 (.837-1.26)	582
Age 18-49 years	15-16	0.315 (.272-.365)	.300 (.263-.353)	.463 (.387-.560)	.743 (.632-.846)	.990 (.750-1.18)	457
Age 50+ years	11-12	0.687 (.586-.805)	.664 (.559-.750)	.956 (.808-1.21)	1.51 (1.14-2.19)	2.15 (1.23-4.53)	354
Age 50+ years	13-14	0.572 (.508-.644)	.575 (.500-.647)	.833 (.742-.977)	1.15 (1.04-1.62)	1.85 (1.33-2.20)	374
Age 50+ years	15-16	0.536 (.477-.601)	.538 (.474-.588)	.747 (.619-.837)	1.09 (1.00-1.20)	1.41 (1.09-1.61)	377
Males	11-12	0.55 (.491-.616)	.496 (.430-.602)	.833 (.717-1.03)	1.47 (1.12-1.93)	2.19 (1.72-3.70)	527
Males	13-14	0.392 (.358-.430)	.373 (.330-.409)	.623 (.527-.697)	.983 (.821-1.05)	1.33 (1.06-1.66)	511
Males	15-16	0.387 (.332-.452)	.374 (.312-.461)	.619 (.515-.743)	.939 (.825-1.06)	1.25 (1.04-1.48)	487
Females	11-12	0.488 (.413-.578)	.493 (.410-.542)	.714 (.590-.864)	1.14 (.867-1.34)	1.34 (1.10-4.00)	349
Females	13-14	0.391 (.341-.447)	.376 (.333-.448)	.634 (.562-.756)	.955 (.775-1.25)	1.22 (1.01-1.54)	445
Females	15-16	0.389 (.351-.431)	.373 (.342-.409)	.600 (.511-.676)	.941 (.679-1.14)	1.12 (.958-1.41)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Lead_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Lead_FactSheet.html

Urinary Lead in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7439-92-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.421 (.391-.453)	.408 (.388-.431)	.653 (.589-.706)	.944 (.848-1.14)	1.46 (1.22-1.64)	1342
Total population	13-14	0.324 (.311-.339)	.317 (.303-.330)	.529 (.500-.558)	.833 (.750-.917)	1.18 (1.00-1.35)	1486
Total population	15-16	0.317 (.288-.350)	.307 (.277-.341)	.531 (.472-.570)	.864 (.709-1.00)	1.13 (.966-1.28)	1468
Age 20-49 years	11-12	0.328 (.292-.369)	.316 (.273-.368)	.510 (.447-.575)	.750 (.654-.916)	.944 (.851-1.17)	670
Age 18-49 years	13-14	0.243 (.222-.267)	.229 (.202-.255)	.381 (.340-.417)	.609 (.486-.732)	.828 (.647-1.11)	778
Age 18-49 years	15-16	0.24 (.217-.266)	.228 (.198-.249)	.348 (.317-.393)	.593 (.500-.718)	.888 (.611-1.13)	748
Age 50+ years	11-12	0.548 (.494-.608)	.500 (.437-.583)	.760 (.701-.814)	1.29 (1.06-1.62)	1.77 (1.48-2.12)	672
Age 50+ years	13-14	0.448 (.424-.475)	.447 (.395-.477)	.650 (.578-.750)	1.00 (.906-1.23)	1.47 (1.20-1.82)	708
Age 50+ years	15-16	0.431 (.390-.478)	.428 (.377-.504)	.667 (.584-.763)	1.05 (.920-1.14)	1.27 (1.13-1.37)	720
Males	11-12	0.374 (.329-.425)	.364 (.319-.425)	.543 (.488-.622)	.835 (.704-1.13)	1.26 (.965-1.65)	634
Males	13-14	0.31 (.286-.336)	.302 (.269-.324)	.483 (.431-.529)	.741 (.612-1.00)	1.18 (.828-1.76)	662
Males	15-16	0.286 (.257-.317)	.278 (.248-.310)	.473 (.410-.539)	.750 (.609-.891)	1.00 (.779-1.13)	663
Females	11-12	0.462 (.421-.505)	.441 (.400-.510)	.716 (.645-.775)	1.05 (.909-1.29)	1.62 (1.22-1.83)	708
Females	13-14	0.337 (.318-.357)	.333 (.313-.353)	.560 (.519-.617)	.897 (.789-.947)	1.20 (1.00-1.32)	824
Females	15-16	0.346 (.306-.391)	.333 (.302-.380)	.545 (.484-.672)	.946 (.766-1.14)	1.28 (1.02-1.37)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Lead_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Lead_FactSheet.html

Urinary Manganese in Smokers (2011 - 2016)

CAS Number 8075-39-6

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.123 (.111-.137)	.120 (.100-.150)	.200 (.180-.220)	.300 (.260-.360)	.410 (.290-.630)	876
Total population	13-14	*	<LOD	.130 (<LOD-.150)	.220 (.200-.250)	.300 (.260-.390)	957
Total population	15-16	*	<LOD	.140 (.130-.150)	.210 (.190-.240)	.300 (.230-.480)	834
Age 20-49 years	11-12	.135 (.117-.156)	.130 (.110-.160)	.230 (.190-.260)	.350 (.260-.590)	.570 (.290-.660)	522
Age 18-49 years	13-14	*	<LOD	.130 (<LOD-.160)	.230 (.210-.280)	.310 (.260-.460)	583
Age 18-49 years	15-16	*	<LOD	.140 (.130-.160)	.220 (.180-.270)	.350 (.200-.500)	457
Age 50+ years	11-12	.106 (.090-.125)	.100 (.080-.130)	.160 (.120-.210)	.250 (.190-.300)	.300 (.250-.360)	354
Age 50+ years	13-14	*	<LOD	<LOD	.200 (.150-.250)	.270 (.210-.310)	374
Age 50+ years	15-16	*	<LOD	.130 (<LOD-.160)	.210 (.160-.250)	.250 (.210-.490)	377
Males	11-12	.116 (.099-.134)	.110 (.080-.150)	.190 (.160-.220)	.290 (.230-.350)	.370 (.270-.570)	527
Males	13-14	*	<LOD	<LOD	.210 (.140-.240)	.260 (.210-.310)	512
Males	15-16	*	<LOD	.130 (<LOD-.150)	.190 (.170-.220)	.230 (.200-.330)	487
Females	11-12	.133 (.117-.152)	.130 (.110-.150)	.220 (.170-.270)	.310 (.250-.630)	.600 (.270-.920)	349
Females	13-14	*	<LOD	.140 (.130-.160)	.250 (.210-.290)	.350 (.280-.710)	445
Females	15-16	*	<LOD	.150 (.130-.170)	.250 (.190-.400)	.400 (.220-.530)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.080, 0.130, and 0.130 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Manganese in Non-smokers (2011 - 2016)

CAS Number 8075-39-6

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.122 (.110-.134)	.120 (.100-.140)	.190 (.170-.220)	.280 (.250-.300)	.350 (.300-.400)	1343
Total population	13-14	*	<LOD	.130 (<LOD-.140)	.200 (.180-.230)	.280 (.240-.330)	1487
Total population	15-16	*	<LOD	.130 (<LOD-.140)	.200 (.170-.220)	.280 (.230-.350)	1470
Age 20-49 years	11-12	.120 (.106-.136)	.110 (.100-.140)	.190 (.170-.220)	.280 (.250-.300)	.360 (.300-.440)	671
Age 18-49 years	13-14	*	<LOD	.130 (<LOD-.140)	.190 (.170-.220)	.250 (.210-.320)	778
Age 18-49 years	15-16	*	<LOD	<LOD	.200 (.190-.220)	.270 (.230-.310)	750
Age 50+ years	11-12	.123 (.111-.136)	.130 (.100-.150)	.190 (.170-.220)	.270 (.240-.300)	.340 (.290-.400)	672
Age 50+ years	13-14	*	<LOD	.130 (<LOD-.150)	.220 (.180-.260)	.310 (.240-.400)	709
Age 50+ years	15-16	*	<LOD	.130 (<LOD-.140)	.200 (.160-.240)	.280 (.210-.500)	720
Males	11-12	.121 (.109-.134)	.120 (.100-.140)	.190 (.170-.210)	.260 (.240-.290)	.330 (.290-.370)	635
Males	13-14	*	<LOD	<LOD	.180 (.150-.210)	.230 (.200-.260)	663
Males	15-16	*	<LOD	<LOD	.170 (.150-.200)	.240 (.190-.350)	663
Females	11-12	.122 (.109-.137)	.120 (.100-.140)	.200 (.170-.230)	.280 (.250-.300)	.360 (.300-.470)	708
Females	13-14	*	<LOD	.140 (<LOD-.160)	.230 (.190-.280)	.330 (.260-.450)	824
Females	15-16	*	<LOD	.140 (.130-.160)	.220 (.180-.270)	.290 (.240-.420)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.080, 0.130, and 0.130 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary Manganese in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 8075-39-6

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.135 (.118-.155)	.127 (.114-.144)	.238 (.197-.286)	.380 (.333-.413)	.485 (.423-.587)	876
Total population	13-14	*	<LOD	.192 (<LOD-.204)	.317 (.263-.400)	.483 (.329-.708)	956
Total population	15-16	*	<LOD	.192 (.173-.221)	.326 (.279-.383)	.414 (.317-.511)	834
Age 20-49 years	11-12	0.14 (.116-.168)	.131 (.106-.158)	.267 (.211-.315)	.406 (.335-.473)	.556 (.419-1.00)	522
Age 18-49 years	13-14	*	<LOD	.184 (<LOD-.196)	.288 (.244-.333)	.418 (.317-.657)	582
Age 18-49 years	15-16	*	<LOD	.180 (.144-.236)	.354 (.264-.400)	.414 (.317-.657)	457
Age 50+ years	11-12	0.128 (.113-.146)	.127 (.106-.150)	.211 (.175-.286)	.317 (.271-.387)	.415 (.333-.583)	354
Age 50+ years	13-14	*	<LOD	<LOD	.400 (.230-.816)	.541 (.387-.900)	374
Age 50+ years	15-16	*	<LOD	.214 (<LOD-.242)	.307 (.266-.365)	.434 (.317-.657)	377
Males	11-12	0.109 (.093-.128)	.104 (.090-.123)	.188 (.150-.218)	.318 (.241-.335)	.385 (.335-.423)	527
Males	13-14	*	<LOD	<LOD	.236 (.196-.297)	.326 (.279-.368)	511
Males	15-16	*	<LOD	.142 (<LOD-.176)	.263 (.200-.317)	.329 (.263-.460)	487
Females	11-12	0.178 (.152-.208)	.180 (.136-.219)	.292 (.227-.380)	.469 (.388-.587)	.740 (.473-1.12)	349
Females	13-14	*	<LOD	.230 (.196-.271)	.400 (.279-.708)	.642 (.400-.836)	445
Females	15-16	*	<LOD	.242 (.205-.288)	.414 (.288-.484)	.460 (.414-.708)	347

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Manganese in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 8075-39-6

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	0.142 (.128-.157)	.138 (.119-.154)	.238 (.200-.283)	.426 (.374-.518)	.571 (.526-.625)	1342
Total population	13-14	*	<LOD	.219 (<LOD-.244)	.368 (.329-.434)	.541 (.438-.657)	1486
Total population	15-16	*	<LOD	.214 (<LOD-.242)	.368 (.307-.438)	.511 (.438-.571)	1468
Age 20-49 years	11-12	0.131 (.117-.147)	.130 (.110-.145)	.213 (.186-.254)	.407 (.345-.529)	.625 (.444-1.06)	670
Age 18-49 years	13-14	*	<LOD	.196 (<LOD-.219)	.317 (.279-.393)	.434 (.358-.541)	778
Age 18-49 years	15-16	*	<LOD	<LOD	.350 (.297-.383)	.484 (.408-.511)	748
Age 50+ years	11-12	0.154 (.137-.173)	.144 (.127-.167)	.259 (.209-.318)	.441 (.374-.518)	.550 (.500-.605)	672
Age 50+ years	13-14	*	<LOD	.256 (<LOD-.286)	.484 (.333-.564)	.657 (.507-.905)	708
Age 50+ years	15-16	*	<LOD	.230 (<LOD-.271)	.397 (.307-.464)	.531 (.438-.630)	720
Males	11-12	0.108 (.095-.123)	.108 (.093-.119)	.172 (.157-.185)	.308 (.218-.379)	.385 (.341-.529)	634
Males	13-14	*	<LOD	<LOD	.253 (.224-.271)	.317 (.279-.434)	662
Males	15-16	*	<LOD	<LOD	.271 (.224-.307)	.438 (.307-.464)	663
Females	11-12	0.175 (.157-.196)	.160 (.143-.197)	.295 (.254-.342)	.519 (.426-.597)	.667 (.571-1.21)	708
Females	13-14	*	<LOD	.279 (<LOD-.317)	.484 (.383-.541)	.640 (.511-.836)	824
Females	15-16	*	<LOD	.263 (.242-.297)	.413 (.368-.487)	.571 (.487-.613)	805

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary Molybdenum in Smokers (2011 - 2016)

CAS Number 7439-98-7

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	32.6 (28.8-37.1)	36.0 (30.7-39.8)	67.2 (57.4-76.9)	105 (86.0-126)	140 (117-157)	876
Total population	13-14	30.5 (27.3-34.1)	33.5 (26.7-39.5)	61.8 (54.8-70.6)	102 (86.2-113)	125 (107-145)	957
Total population	15-16	31.0 (28.6-33.5)	35.5 (30.7-38.7)	60.2 (55.1-66.7)	102 (86.0-108)	126 (110-145)	834
Age 20-49 years	11-12	35.5 (30.9-40.7)	37.9 (30.2-46.1)	71.0 (57.6-83.6)	108 (83.6-136)	134 (113-145)	522
Age 18-49 years	13-14	33.0 (29.0-37.5)	36.7 (30.9-44.6)	65.7 (59.1-75.9)	108 (85.8-126)	127 (113-157)	583
Age 18-49 years	15-16	32.0 (27.5-37.2)	37.3 (29.1-43.0)	66.7 (55.7-76.5)	105 (82.8-133)	139 (104-157)	457
Age 50+ years	11-12	28.6 (24.2-33.9)	32.1 (23.0-39.7)	60.9 (52.2-72.6)	101 (78.8-137)	141 (95.2-184)	354
Age 50+ years	13-14	25.9 (22.2-30.3)	26.2 (22.4-34.7)	50.1 (42.1-57.4)	80.8 (70.4-96.7)	107 (92.9-122)	374
Age 50+ years	15-16	29.4 (25.6-33.8)	33.2 (27.5-37.4)	55.3 (45.5-62.7)	87.5 (66.0-110)	113 (87.3-124)	377
Males	11-12	36.3 (30.9-42.6)	38.6 (29.6-46.1)	74.0 (59.7-88.1)	111 (85.2-141)	141 (120-160)	527
Males	13-14	35.5 (32.8-38.3)	39.4 (34.8-44.0)	67.0 (58.2-75.4)	107 (86.5-116)	119 (111-144)	512
Males	15-16	34.6 (31.0-38.5)	39.4 (32.7-48.3)	69.5 (62.2-75.9)	107 (98.5-120)	141 (114-150)	487
Females	11-12	28.6 (24.0-34.0)	31.8 (26.8-37.9)	57.4 (46.2-70.2)	90.6 (76.8-112)	132 (96.5-175)	349
Females	13-14	26.3 (21.7-31.9)	26.1 (20.7-36.6)	58.3 (46.1-69.1)	95.8 (73.9-121)	126 (80.7-173)	445
Females	15-16	27.2 (24.6-30.1)	31.4 (25.8-35.5)	54.5 (43.3-60.1)	81.7 (61.9-107)	116 (79.7-154)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.990, 0.800, and 0.800 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Molybdenum_BiomonitoringSummary.html

Urinary Molybdenum in Non-smokers (2011 - 2016)

CAS Number 7439-98-7

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	34.7 (32.4-37.2)	37.6 (34.3-40.5)	63.4 (59.6-68.5)	99.8 (93.1-108)	134 (115-144)	1343
Total population	13-14	31.2 (28.4-34.2)	32.7 (28.4-36.2)	62.7 (55.4-68.5)	94.8 (88.1-101)	128 (113-131)	1487
Total population	15-16	32.2 (29.7-34.8)	36.0 (32.2-39.2)	62.1 (57.0-67.5)	99.0 (93.2-105)	124 (112-137)	1469
Age 20-49 years	11-12	35.4 (31.4-40.0)	40.8 (36.9-45.3)	66.5 (61.1-75.9)	103 (92.9-115)	134 (113-150)	671
Age 18-49 years	13-14	32.0 (28.7-35.8)	33.9 (28.8-40.5)	65.2 (57.5-71.6)	94.2 (88.1-104)	125 (108-132)	778
Age 18-49 years	15-16	32.9 (29.0-37.3)	39.5 (33.7-43.9)	70.4 (62.1-78.7)	105 (96.0-115)	125 (111-149)	749
Age 50+ years	11-12	34.0 (31.7-36.4)	34.2 (31.7-38.8)	57.7 (54.0-64.5)	97.4 (81.6-108)	135 (109-144)	672
Age 50+ years	13-14	30.3 (27.1-33.8)	29.8 (25.4-35.3)	57.1 (48.0-67.9)	95.2 (80.5-109)	129 (113-152)	709
Age 50+ years	15-16	31.3 (28.3-34.7)	33.4 (28.3-38.3)	55.0 (50.6-60.2)	88.5 (76.8-95.7)	115 (93.2-137)	720
Males	11-12	41.5 (38.2-44.9)	44.5 (40.0-51.0)	69.6 (63.7-75.2)	106 (97.4-124)	138 (108-150)	635
Males	13-14	36.1 (32.6-40.0)	38.1 (33.9-43.7)	72.0 (61.8-79.2)	104 (95.2-116)	138 (114-181)	663
Males	15-16	36.4 (33.1-40.0)	41.1 (35.3-45.0)	70.1 (62.1-79.1)	105 (94.8-112)	128 (112-144)	663
Females	11-12	30.2 (27.1-33.6)	31.6 (28.1-35.3)	58.4 (50.0-64.9)	89.9 (80.6-103)	123 (107-156)	708
Females	13-14	27.6 (25.1-30.4)	28.5 (24.6-32.9)	54.1 (47.0-62.6)	82.8 (77.1-88.8)	112 (96.3-129)	824
Females	15-16	29.0 (25.5-33.1)	32.2 (26.6-37.8)	56.4 (50.6-62.2)	94.9 (78.4-105)	116 (103-149)	806

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.990, 0.800, and 0.800 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Molybdenum_BiomonitoringSummary.html

Urinary Molybdenum in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7439-98-7

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	35.9 (34.0-37.9)	36.4 (33.4-38.8)	55.3 (52.6-57.9)	79.6 (73.4-89.5)	104 (91.2-110)	876
Total population	13-14	31.2 (28.8-33.9)	32.2 (29.1-36.3)	49.1 (42.6-54.9)	66.4 (60.8-74.5)	82.3 (74.5-96.7)	956
Total population	15-16	30.8 (28.9-32.9)	32.9 (31.0-34.8)	46.1 (41.7-49.4)	62.4 (57.0-70.5)	80.9 (67.5-98.3)	834
Age 20-49 years	11-12	36.8 (33.8-40.0)	36.4 (32.8-40.5)	53.4 (49.3-57.9)	79.6 (69.2-91.5)	96.0 (89.5-108)	522
Age 18-49 years	13-14	31 (27.9-34.3)	32.6 (28.3-38.0)	49.1 (42.6-54.9)	63.7 (58.2-75.4)	79.2 (66.5-94.7)	582
Age 18-49 years	15-16	29.7 (27.2-32.4)	32.2 (29.0-33.8)	46.7 (40.7-50.0)	59.9 (56.5-65.3)	70.6 (62.4-85.3)	457
Age 50+ years	11-12	34.5 (31.0-38.5)	35.3 (30.0-43.1)	57.0 (52.6-63.5)	80.7 (71.0-108)	108 (87.1-128)	354
Age 50+ years	13-14	31.8 (29.1-34.9)	32.1 (28.8-34.5)	49.9 (41.3-58.2)	69.5 (61.5-80.2)	95.1 (69.1-123)	374
Age 50+ years	15-16	32.7 (30.3-35.3)	34.6 (28.9-37.3)	44.5 (40.4-53.5)	71.7 (54.3-89.9)	93.3 (71.7-113)	377
Males	11-12	34.2 (30.9-37.9)	35.6 (32.7-40.5)	55.5 (48.9-58.5)	73.4 (64.6-79.1)	83.1 (76.1-92.5)	527
Males	13-14	31.5 (28.8-34.4)	32.2 (29.6-37.5)	46.4 (42.6-52.8)	63.6 (58.4-69.3)	75.4 (63.7-84.2)	511
Males	15-16	29.8 (27.9-31.8)	32.9 (29.0-35.7)	46.0 (42.8-47.6)	58.8 (55.7-64.0)	74.3 (61.5-89.9)	487
Females	11-12	38.1 (35.2-41.3)	36.4 (33.0-38.6)	53.5 (51.7-61.1)	96.0 (74.1-108)	119 (96.0-157)	349
Females	13-14	31 (27.5-34.9)	32.5 (27.4-37.0)	50.0 (42.0-58.2)	74.2 (60.5-86.1)	94.7 (71.4-109)	445
Females	15-16	32.1 (29.6-34.9)	32.5 (30.9-34.7)	46.1 (40.3-52.6)	67.7 (56.7-80.9)	93.3 (69.7-111)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Molybdenum_BiomonitoringSummary.html

Urinary Molybdenum in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7439-98-7

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	40.5 (38.8-42.2)	39.5 (37.3-43.4)	60.9 (57.2-63.6)	85.5 (79.9-91.6)	118 (99.1-142)	1342
Total population	13-14	37.2 (34.8-39.8)	37.6 (36.0-39.4)	55.7 (51.1-59.4)	82.7 (74.7-86.6)	105 (93.6-116)	1486
Total population	15-16	36.2 (34.2-38.2)	37.5 (35.0-40.2)	54.9 (51.0-58.4)	79.1 (71.0-85.5)	99.0 (90.7-104)	1467
Age 20-49 years	11-12	38.7 (36.8-40.6)	37.7 (35.2-41.7)	57.9 (52.8-62.1)	77.5 (71.6-85.0)	111 (87.1-148)	670
Age 18-49 years	13-14	35.1 (32.6-37.7)	36.4 (34.6-37.8)	51.3 (48.1-54.3)	71.6 (65.2-76.3)	83.8 (78.4-91.2)	778
Age 18-49 years	15-16	34.3 (32.2-36.6)	35.4 (32.6-37.8)	52.5 (49.1-56.3)	74.8 (66.6-80.4)	93.3 (81.9-99.4)	747
Age 50+ years	11-12	42.5 (39.5-45.7)	41.6 (37.3-46.3)	62.9 (56.2-71.6)	91.9 (85.5-104)	118 (103-148)	672
Age 50+ years	13-14	39.7 (36.5-43.3)	40.1 (36.6-43.5)	59.0 (56.5-67.8)	91.0 (83.8-102)	122 (107-134)	708
Age 50+ years	15-16	38.3 (35.6-41.2)	39.1 (36.3-42.6)	56.9 (51.6-63.2)	84.9 (75.3-91.4)	109 (91.4-123)	720
Males	11-12	37 (33.9-40.4)	36.8 (33.3-42.8)	52.4 (48.8-59.5)	80.6 (69.6-86.7)	88.8 (84.9-114)	634
Males	13-14	34.9 (31.7-38.3)	36.0 (31.2-39.3)	52.8 (48.1-57.8)	79.7 (68.6-88.2)	102 (86.9-122)	662
Males	15-16	33.4 (31.1-36.0)	35.0 (32.4-36.4)	49.4 (43.9-56.9)	70.0 (64.3-77.0)	93.1 (77.6-99.4)	663
Females	11-12	43.4 (40.5-46.6)	42.1 (38.5-45.4)	65.2 (61.2-69.6)	95.1 (84.4-105)	148 (104-167)	708
Females	13-14	39.2 (37.0-41.7)	39.3 (37.5-40.7)	57.7 (52.7-62.0)	83.6 (75.0-88.4)	107 (93.6-123)	824
Females	15-16	38.6 (35.2-42.3)	40.5 (36.1-45.5)	58.2 (52.9-65.1)	83.7 (78.0-89.6)	104 (91.4-126)	804

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Molybdenum_BiomonitoringSummary.html

Urinary Strontium in Smokers (2011 - 2016)

CAS Number 7440-24-6

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	89.8 (77.9-103)	94.5 (77.7-114)	175 (142-209)	271 (250-309)	342 (315-377)	874
Total population	13-14	89.4 (80.6-99.2)	99.9 (90.2-112)	166 (153-181)	264 (222-315)	343 (292-390)	957
Total population	15-16	99.3 (89.8-110)	111 (100-118)	183 (160-206)	282 (246-311)	357 (313-420)	834
Age 20-49 years	11-12	93.3 (82.0-106)	93.2 (80.9-104)	191 (150-220)	277 (245-320)	355 (288-396)	522
Age 18-49 years	13-14	95.8 (84.8-108)	108 (94.3-126)	180 (157-202)	276 (222-327)	348 (294-395)	583
Age 18-49 years	15-16	98.2 (82.4-117)	111 (94.5-125)	189 (153-227)	287 (238-325)	357 (311-454)	457
Age 50+ years	11-12	84.5 (69.1-103)	96.6 (67.0-123)	159 (129-184)	255 (200-309)	338 (307-401)	352
Age 50+ years	13-14	77.3 (65.6-91.0)	80.3 (63.4-101)	143 (125-149)	229 (168-289)	315 (252-479)	374
Age 50+ years	15-16	101 (91.1-112)	110 (96.7-126)	171 (152-199)	268 (215-339)	367 (282-420)	377
Males	11-12	100 (85.1-118)	110 (91.4-125)	185 (155-227)	306 (267-329)	365 (312-396)	526
Males	13-14	96.7 (87.0-107)	107 (94.3-124)	184 (156-209)	271 (222-323)	324 (271-395)	512
Males	15-16	107 (93.9-123)	120 (107-133)	185 (164-214)	311 (250-327)	379 (312-454)	487
Females	11-12	78.3 (65.4-93.8)	77.7 (65.3-101)	150 (110-203)	249 (184-318)	318 (231-525)	348
Females	13-14	82.6 (72.5-94.2)	90.7 (76.8-106)	151 (139-163)	246 (201-348)	360 (267-479)	445
Females	15-16	90.5 (79.7-103)	96.7 (87.3-109)	176 (149-199)	256 (231-292)	339 (282-420)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.50, 2.34, and 2.34 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Strontium in Non-smokers (2011 - 2016)

CAS Number 7440-24-6

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	82.2 (76.2-88.6)	83.3 (77.0-92.0)	156 (151-166)	234 (211-252)	302 (265-353)	1342
Total population	13-14	78.7 (75.1-82.4)	83.0 (78.7-88.3)	138 (129-149)	219 (198-237)	282 (256-315)	1487
Total population	15-16	86.1 (79.7-92.9)	95.9 (87.9-106)	159 (148-172)	230 (219-245)	290 (275-321)	1470
Age 20-49 years	11-12	85.0 (78.0-92.6)	90.4 (79.9-106)	172 (155-190)	246 (219-265)	293 (265-327)	671
Age 18-49 years	13-14	83.4 (75.9-91.7)	91.0 (82.1-96.5)	151 (131-176)	231 (216-254)	297 (253-363)	778
Age 18-49 years	15-16	89.0 (81.5-97.2)	101 (92.1-113)	171 (150-185)	241 (226-274)	304 (276-363)	750
Age 50+ years	11-12	79.3 (72.2-87.1)	77.8 (66.7-89.0)	146 (130-156)	217 (179-276)	325 (234-379)	671
Age 50+ years	13-14	73.7 (67.7-80.2)	77.1 (69.4-83.4)	124 (118-131)	195 (180-216)	269 (234-303)	709
Age 50+ years	15-16	82.9 (72.3-95.0)	92.8 (75.7-105)	152 (137-164)	215 (187-235)	278 (224-321)	720
Males	11-12	92.5 (81.8-105)	97.6 (85.4-108)	160 (141-184)	247 (194-292)	302 (252-379)	634
Males	13-14	86.5 (79.9-93.6)	92.4 (84.2-97.8)	144 (129-176)	220 (193-254)	298 (244-341)	663
Males	15-16	97.8 (90.0-106)	107 (94.4-130)	174 (162-183)	260 (219-282)	299 (278-321)	663
Females	11-12	74.9 (69.1-81.3)	77.0 (66.1-82.2)	153 (139-167)	230 (204-265)	294 (264-346)	708
Females	13-14	72.7 (67.9-77.9)	75.9 (69.3-81.1)	131 (120-143)	216 (186-239)	269 (235-321)	824
Females	15-16	77.5 (70.3-85.5)	86.5 (75.4-97.4)	148 (141-155)	224 (195-234)	268 (240-341)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.50, 2.34, and 2.34 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary Strontium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-24-6

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	98.7 (86.5-112)	97.8 (82.5-117)	168 (140-192)	250 (207-314)	356 (258-481)	874
Total population	13-14	91.5 (82.1-102)	99.1 (89.3-107)	150 (136-170)	213 (189-235)	266 (217-365)	956
Total population	15-16	98.9 (91.1-107)	106 (100-112)	163 (148-176)	243 (195-277)	318 (262-349)	834
Age 20-49 years	11-12	96.7 (85.4-109)	95.3 (82.1-115)	162 (136-187)	236 (204-275)	305 (241-427)	522
Age 18-49 years	13-14	89.8 (79.7-101)	96.8 (85.2-106)	145 (132-162)	208 (183-225)	255 (200-393)	582
Age 18-49 years	15-16	91.2 (80.4-104)	102 (87.7-108)	146 (126-165)	214 (176-282)	282 (212-336)	457
Age 50+ years	11-12	102 (86.3-120)	107 (78.1-117)	175 (140-197)	279 (197-398)	398 (190-811)	352
Age 50+ years	13-14	95 (77.4-117)	105 (87.4-126)	161 (138-179)	232 (192-287)	297 (235-365)	374
Age 50+ years	15-16	112 (102-123)	120 (103-142)	176 (150-195)	259 (198-343)	349 (274-394)	377
Males	11-12	94.4 (83.9-106)	95.4 (79.0-113)	146 (131-171)	222 (185-260)	314 (226-375)	526
Males	13-14	85.8 (75.1-98.0)	94.2 (83.6-105)	144 (128-161)	195 (174-222)	253 (193-365)	511
Males	15-16	92.6 (84.3-102)	102 (84.9-109)	152 (134-167)	214 (176-259)	285 (230-325)	487
Females	11-12	104 (79.2-137)	101 (78.1-143)	187 (123-246)	275 (180-706)	434 (211-939)	348
Females	13-14	97.5 (86.0-111)	105 (92.3-112)	156 (136-180)	226 (193-266)	297 (233-375)	445
Females	15-16	107 (93.8-122)	117 (103-126)	178 (157-191)	261 (210-321)	336 (261-382)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Strontium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-24-6

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	95.7 (89.6-102)	99.7 (92.5-109)	150 (140-164)	235 (214-255)	318 (277-346)	1341
Total population	13-14	94 (89.2-99.0)	100 (92.7-105)	146 (139-154)	218 (191-243)	288 (255-324)	1486
Total population	15-16	96.9 (91.2-103)	101 (95.3-107)	152 (145-162)	207 (195-219)	260 (239-286)	1468
Age 20-49 years	11-12	92.6 (83.7-102)	101 (85.7-115)	139 (128-154)	219 (183-254)	261 (241-311)	670
Age 18-49 years	13-14	91.3 (84.9-98.2)	94.9 (88.9-103)	138 (131-151)	205 (177-235)	268 (238-297)	778
Age 18-49 years	15-16	93 (86.8-99.6)	94.4 (88.1-103)	146 (133-154)	198 (183-226)	266 (214-303)	748
Age 50+ years	11-12	99.2 (89.8-110)	98.3 (92.4-113)	164 (145-200)	258 (220-322)	350 (313-372)	671
Age 50+ years	13-14	97.1 (88.9-106)	104 (93.9-110)	150 (143-161)	235 (193-286)	302 (253-390)	708
Age 50+ years	15-16	101 (91.5-112)	108 (98.7-119)	162 (146-181)	210 (189-234)	259 (215-331)	720
Males	11-12	82.3 (74.1-91.4)	88.9 (80.1-92.5)	130 (119-142)	185 (152-227)	233 (195-311)	633
Males	13-14	83.9 (79.5-88.5)	89.3 (84.7-98.2)	129 (120-140)	176 (162-191)	229 (184-256)	662
Males	15-16	89.8 (83.1-97.1)	92.7 (84.5-98.7)	146 (130-155)	200 (186-207)	243 (210-256)	663
Females	11-12	108 (101-115)	113 (100-126)	179 (156-204)	272 (239-315)	346 (305-372)	708
Females	13-14	103 (95.5-112)	108 (97.5-115)	159 (151-171)	260 (218-298)	336 (294-390)	824
Females	15-16	103 (95.9-111)	109 (102-118)	158 (148-168)	214 (198-249)	280 (238-338)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary Thallium in Smokers (2011 - 2016)

CAS Number 7440-28-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.137 (.126-.149)	.147 (.128-.162)	.230 (.210-.257)	.358 (.282-.419)	.419 (.356-.524)	876
Total population	13-14	.138 (.121-.158)	.150 (.126-.178)	.246 (.220-.273)	.364 (.302-.410)	.435 (.410-.459)	957
Total population	15-16	.146 (.135-.159)	.155 (.135-.175)	.250 (.227-.276)	.360 (.322-.380)	.426 (.389-.463)	834
Age 20-49 years	11-12	.145 (.130-.160)	.160 (.136-.176)	.250 (.213-.308)	.375 (.294-.446)	.440 (.356-.524)	522
Age 18-49 years	13-14	.151 (.132-.173)	.171 (.139-.200)	.267 (.234-.292)	.373 (.316-.429)	.435 (.397-.480)	583
Age 18-49 years	15-16	.160 (.143-.178)	.164 (.144-.194)	.279 (.237-.311)	.380 (.349-.406)	.445 (.392-.521)	457
Age 50+ years	11-12	.126 (.112-.143)	.130 (.112-.157)	.208 (.173-.230)	.303 (.229-.395)	.395 (.256-.535)	354
Age 50+ years	13-14	.115 (.100-.133)	.123 (.101-.136)	.196 (.173-.220)	.302 (.258-.408)	.431 (.362-.477)	374
Age 50+ years	15-16	.128 (.114-.145)	.135 (.120-.167)	.219 (.189-.250)	.289 (.268-.324)	.366 (.315-.426)	377
Males	11-12	.143 (.128-.161)	.150 (.128-.176)	.230 (.216-.265)	.358 (.266-.473)	.465 (.332-.535)	527
Males	13-14	.144 (.125-.165)	.160 (.125-.198)	.253 (.226-.274)	.336 (.299-.405)	.424 (.402-.451)	512
Males	15-16	.152 (.137-.169)	.167 (.136-.186)	.250 (.216-.286)	.341 (.314-.368)	.396 (.363-.440)	487
Females	11-12	.130 (.111-.152)	.136 (.109-.160)	.231 (.172-.286)	.358 (.236-.440)	.389 (.337-.511)	349
Females	13-14	.133 (.109-.164)	.139 (.114-.171)	.243 (.192-.301)	.385 (.288-.459)	.459 (.385-.602)	445
Females	15-16	.140 (.126-.155)	.145 (.119-.175)	.249 (.219-.276)	.375 (.311-.424)	.492 (.397-.554)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.020, 0.018, and 0.018 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Thallium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Thallium_FactSheet.html

Urinary Thallium in Non-smokers (2011 - 2016)

CAS Number 7440-28-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.147 (.137-.157)	.156 (.142-.168)	.247 (.221-.274)	.346 (.316-.377)	.417 (.372-.521)	1343
Total population	13-14	.138 (.131-.146)	.151 (.138-.161)	.239 (.218-.260)	.338 (.318-.356)	.417 (.389-.438)	1487
Total population	15-16	.148 (.136-.162)	.157 (.143-.176)	.254 (.227-.275)	.366 (.319-.394)	.435 (.402-.470)	1470
Age 20-49 years	11-12	.158 (.143-.175)	.173 (.158-.196)	.276 (.247-.318)	.376 (.345-.407)	.438 (.385-.522)	671
Age 18-49 years	13-14	.148 (.138-.159)	.161 (.143-.174)	.254 (.239-.265)	.371 (.340-.395)	.440 (.412-.470)	778
Age 18-49 years	15-16	.163 (.146-.183)	.176 (.158-.197)	.285 (.257-.303)	.388 (.366-.419)	.467 (.426-.538)	750
Age 50+ years	11-12	.135 (.123-.148)	.140 (.125-.153)	.204 (.181-.245)	.292 (.258-.352)	.361 (.298-.545)	672
Age 50+ years	13-14	.128 (.120-.137)	.139 (.131-.150)	.213 (.189-.248)	.312 (.270-.340)	.375 (.326-.419)	709
Age 50+ years	15-16	.133 (.120-.148)	.143 (.121-.155)	.216 (.192-.240)	.311 (.262-.374)	.406 (.356-.435)	720
Males	11-12	.168 (.153-.185)	.173 (.152-.202)	.269 (.235-.304)	.361 (.324-.385)	.412 (.372-.509)	635
Males	13-14	.150 (.138-.162)	.162 (.150-.171)	.242 (.222-.269)	.347 (.310-.386)	.438 (.386-.476)	663
Males	15-16	.161 (.146-.178)	.181 (.160-.207)	.271 (.237-.300)	.369 (.315-.419)	.452 (.394-.521)	663
Females	11-12	.132 (.121-.143)	.140 (.130-.149)	.230 (.198-.258)	.322 (.290-.376)	.431 (.341-.522)	708
Females	13-14	.130 (.121-.139)	.138 (.120-.153)	.235 (.204-.254)	.327 (.304-.348)	.398 (.375-.421)	824
Females	15-16	.139 (.126-.153)	.143 (.125-.156)	.224 (.203-.257)	.356 (.300-.388)	.432 (.382-.488)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.020, 0.018, and 0.018 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Thallium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Thallium_FactSheet.html

Urinary Thallium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-28-0

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.151 (.138-.164)	.153 (.142-.161)	.207 (.184-.227)	.292 (.237-.364)	.365 (.278-.544)	876
Total population	13-14	.142 (.129-.156)	.142 (.133-.152)	.199 (.177-.222)	.280 (.248-.322)	.388 (.297-.410)	956
Total population	15-16	.146 (.136-.156)	.145 (.134-.153)	.210 (.193-.226)	.284 (.250-.318)	.350 (.298-.408)	834
Age 20-49 years	11-12	.150 (.135-.166)	.151 (.140-.166)	.200 (.178-.241)	.286 (.235-.333)	.347 (.286-.587)	522
Age 18-49 years	13-14	.142 (.126-.160)	.140 (.130-.152)	.194 (.174-.219)	.285 (.231-.329)	.392 (.291-.463)	582
Age 18-49 years	15-16	.148 (.139-.158)	.144 (.136-.153)	.209 (.193-.231)	.277 (.236-.318)	.358 (.284-.408)	457
Age 50+ years	11-12	.152 (.138-.168)	.153 (.127-.171)	.222 (.186-.243)	.305 (.228-.416)	.382 (.243-.544)	354
Age 50+ years	13-14	.141 (.129-.155)	.142 (.127-.160)	.201 (.181-.236)	.278 (.260-.313)	.373 (.287-.410)	374
Age 50+ years	15-16	.142 (.126-.161)	.145 (.124-.170)	.211 (.180-.231)	.284 (.242-.345)	.345 (.284-.421)	377
Males	11-12	.135 (.124-.148)	.134 (.121-.146)	.180 (.159-.207)	.241 (.198-.278)	.278 (.237-.375)	527
Males	13-14	.127 (.113-.144)	.133 (.121-.142)	.175 (.155-.190)	.248 (.222-.260)	.283 (.260-.394)	511
Males	15-16	.131 (.119-.145)	.129 (.112-.148)	.183 (.157-.208)	.240 (.204-.277)	.277 (.220-.328)	487
Females	11-12	.173 (.155-.193)	.171 (.162-.188)	.235 (.201-.294)	.336 (.284-.457)	.457 (.294-.593)	349
Females	13-14	.157 (.141-.176)	.156 (.140-.174)	.223 (.191-.260)	.313 (.246-.400)	.392 (.296-.482)	445
Females	15-16	.165 (.152-.179)	.169 (.152-.180)	.242 (.216-.255)	.318 (.276-.402)	.406 (.318-.504)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Thallium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Thallium_FactSheet.html

Urinary Thallium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-28-0

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.171 (.159-.184)	.167 (.156-.181)	.237 (.219-.258)	.342 (.312-.376)	.449 (.373-.510)	1342
Total population	13-14	.165 (.158-.173)	.163 (.153-.171)	.241 (.227-.251)	.344 (.327-.359)	.433 (.405-.457)	1486
Total population	15-16	.167 (.157-.178)	.166 (.152-.176)	.234 (.210-.271)	.336 (.300-.371)	.408 (.362-.481)	1468
Age 20-49 years	11-12	.172 (.157-.189)	.171 (.156-.189)	.235 (.211-.257)	.333 (.289-.388)	.431 (.333-.665)	670
Age 18-49 years	13-14	.162 (.151-.174)	.159 (.143-.176)	.236 (.220-.253)	.333 (.301-.361)	.418 (.361-.467)	778
Age 18-49 years	15-16	.171 (.161-.181)	.170 (.154-.178)	.239 (.213-.267)	.347 (.303-.392)	.435 (.392-.494)	748
Age 50+ years	11-12	.169 (.153-.187)	.165 (.152-.179)	.238 (.209-.282)	.348 (.300-.425)	.476 (.351-.532)	672
Age 50+ years	13-14	.169 (.159-.179)	.165 (.153-.176)	.246 (.224-.264)	.353 (.329-.389)	.436 (.405-.507)	708
Age 50+ years	15-16	.163 (.150-.178)	.160 (.145-.186)	.231 (.204-.280)	.331 (.292-.362)	.391 (.331-.523)	720
Males	11-12	.150 (.137-.164)	.151 (.134-.159)	.209 (.180-.233)	.296 (.235-.333)	.333 (.283-.460)	634
Males	13-14	.145 (.136-.154)	.138 (.130-.145)	.195 (.181-.207)	.291 (.258-.303)	.352 (.307-.404)	662
Males	15-16	.148 (.136-.161)	.145 (.133-.164)	.199 (.178-.232)	.299 (.266-.332)	.348 (.298-.494)	663
Females	11-12	.189 (.177-.202)	.186 (.172-.200)	.266 (.240-.289)	.403 (.345-.436)	.482 (.411-.557)	708
Females	13-14	.184 (.175-.193)	.188 (.174-.198)	.270 (.252-.281)	.389 (.353-.416)	.444 (.430-.482)	824
Females	15-16	.185 (.172-.198)	.183 (.167-.203)	.256 (.237-.283)	.369 (.326-.407)	.444 (.399-.535)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Thallium_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Thallium_FactSheet.html

Urinary Tin in Smokers (2011 - 2016)

CAS Number 7440-31-5

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.580 (.485-.694)	.490 (.400-.600)	1.00 (.800-1.27)	2.50 (1.57-4.09)	4.22 (2.95-6.85)	876
Total population	13-14	.451 (.385-.528)	.410 (.360-.490)	.990 (.770-1.21)	2.20 (1.81-2.65)	4.26 (2.70-5.46)	957
Total population	15-16	.477 (.417-.544)	.450 (.380-.520)	.990 (.830-1.16)	2.19 (1.80-2.44)	3.99 (2.86-5.04)	834
Age 20-49 years	11-12	.573 (.466-.705)	.440 (.360-.610)	.980 (.730-1.52)	2.72 (1.62-4.22)	4.53 (2.95-9.52)	522
Age 18-49 years	13-14	.396 (.331-.473)	.360 (.320-.430)	.780 (.690-1.12)	1.75 (1.35-2.38)	3.02 (1.84-5.46)	583
Age 18-49 years	15-16	.455 (.383-.541)	.420 (.340-.510)	.940 (.730-1.18)	2.29 (1.75-2.93)	4.59 (2.55-12.4)	457
Age 50+ years	11-12	.592 (.499-.702)	.570 (.450-.690)	1.01 (.880-1.23)	2.10 (1.47-3.34)	3.59 (2.24-5.88)	354
Age 50+ years	13-14	.594 (.488-.723)	.560 (.480-.650)	1.30 (.990-1.55)	3.32 (2.32-4.48)	5.50 (2.84-25.6)	374
Age 50+ years	15-16	.512 (.416-.630)	.480 (.390-.590)	1.10 (.690-1.43)	2.15 (1.64-2.29)	3.17 (2.29-4.64)	377
Males	11-12	.546 (.448-.667)	.480 (.390-.580)	.880 (.730-1.12)	2.09 (1.27-3.04)	3.59 (2.24-5.74)	527
Males	13-14	.427 (.334-.544)	.370 (.320-.490)	.790 (.690-1.11)	2.36 (1.34-4.83)	5.46 (2.18-19.6)	512
Males	15-16	.438 (.356-.539)	.420 (.310-.560)	.970 (.640-1.25)	1.84 (1.50-2.29)	3.64 (2.29-4.61)	487
Females	11-12	.626 (.506-.774)	.520 (.400-.660)	1.22 (.850-1.55)	2.94 (1.55-6.85)	6.85 (2.94-12.3)	349
Females	13-14	.477 (.416-.547)	.450 (.380-.550)	1.16 (.840-1.34)	2.12 (1.75-2.60)	3.32 (2.49-4.43)	445
Females	15-16	.526 (.442-.627)	.470 (.410-.550)	.990 (.870-1.19)	2.44 (1.80-3.43)	4.64 (2.30-11.5)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.220, 0.090, and 0.090 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Tin in Non-smokers (2011 - 2016)

CAS Number 7440-31-5

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.591 (.529-.660)	.510 (.450-.580)	1.03 (.880-1.23)	2.65 (2.13-3.44)	4.74 (3.44-6.50)	1343
Total population	13-14	.397 (.344-.459)	.360 (.320-.400)	.860 (.730-1.00)	2.12 (1.61-2.36)	3.20 (2.57-4.15)	1487
Total population	15-16	.454 (.402-.514)	.430 (.360-.520)	.950 (.840-1.08)	2.09 (1.76-2.54)	3.62 (2.67-5.02)	1469
Age 20-49 years	11-12	.492 (.441-.549)	.410 (.370-.490)	.880 (.780-.990)	1.94 (1.41-2.48)	3.28 (2.23-5.54)	671
Age 18-49 years	13-14	.327 (.276-.388)	.300 (.250-.360)	.730 (.540-.890)	1.57 (1.14-1.99)	2.29 (1.83-3.01)	778
Age 18-49 years	15-16	.372 (.336-.411)	.330 (.280-.400)	.780 (.650-.900)	1.78 (1.47-2.42)	3.01 (2.42-4.72)	749
Age 50+ years	11-12	.718 (.608-.849)	.580 (.470-.720)	1.24 (.990-1.67)	3.62 (2.39-4.74)	6.06 (3.62-9.43)	672
Age 50+ years	13-14	.494 (.416-.587)	.400 (.340-.530)	1.06 (.810-1.36)	2.57 (2.22-3.09)	4.46 (3.21-6.37)	709
Age 50+ years	15-16	.567 (.483-.665)	.560 (.450-.670)	1.14 (.970-1.40)	2.44 (1.91-3.17)	3.95 (2.82-6.28)	720
Males	11-12	.613 (.521-.721)	.510 (.470-.580)	.990 (.790-1.26)	3.20 (1.85-4.81)	6.21 (3.20-9.46)	635
Males	13-14	.388 (.336-.448)	.340 (.280-.390)	.800 (.650-.990)	1.83 (1.45-2.31)	3.03 (2.26-4.70)	663
Males	15-16	.439 (.369-.521)	.420 (.320-.540)	.840 (.680-1.11)	1.76 (1.40-2.30)	2.98 (2.00-4.54)	663
Females	11-12	.574 (.506-.651)	.490 (.420-.590)	1.03 (.870-1.28)	2.25 (2.07-3.08)	4.08 (3.10-5.40)	708
Females	13-14	.405 (.342-.481)	.370 (.310-.430)	.900 (.750-1.16)	2.22 (1.67-2.61)	3.30 (2.67-4.15)	824
Females	15-16	.467 (.405-.539)	.440 (.370-.530)	1.03 (.910-1.26)	2.44 (1.88-2.95)	4.19 (2.70-5.39)	806

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.220, 0.090, and 0.090 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary Tin in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-31-5

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.638 (.559-.729)	.557 (.484-.634)	1.04 (.815-1.32)	2.20 (1.86-2.81)	4.15 (2.81-5.52)	876
Total population	13-14	.462 (.400-.533)	.419 (.333-.526)	.823 (.735-.986)	1.73 (1.46-2.41)	3.20 (2.49-4.92)	956
Total population	15-16	.475 (.430-.525)	.391 (.343-.443)	.828 (.735-1.02)	1.68 (1.47-2.19)	3.28 (2.38-4.75)	834
Age 20-49 years	11-12	.594 (.506-.697)	.519 (.433-.650)	.918 (.764-1.30)	2.00 (1.63-2.74)	4.15 (2.38-7.90)	522
Age 18-49 years	13-14	.371 (.318-.433)	.333 (.274-.434)	.670 (.582-.796)	1.27 (.896-1.73)	2.21 (1.33-3.07)	582
Age 18-49 years	15-16	.423 (.381-.469)	.350 (.302-.391)	.741 (.558-.913)	1.50 (1.30-2.27)	3.64 (1.65-5.96)	457
Age 50+ years	11-12	.714 (.605-.842)	.576 (.459-.691)	1.24 (.772-1.52)	2.67 (1.49-3.82)	4.09 (2.74-5.86)	354
Age 50+ years	13-14	.730 (.625-.853)	.646 (.532-.783)	1.35 (1.10-1.59)	3.36 (2.37-5.24)	5.69 (3.20-17.1)	374
Age 50+ years	15-16	.569 (.484-.668)	.514 (.336-.745)	.959 (.828-1.24)	1.89 (1.50-2.50)	3.03 (2.33-3.58)	377
Males	11-12	.516 (.459-.579)	.482 (.403-.576)	.780 (.671-.918)	1.53 (1.18-2.05)	2.20 (1.88-3.11)	527
Males	13-14	.379 (.303-.473)	.319 (.250-.409)	.708 (.546-.818)	1.48 (1.01-2.69)	2.69 (1.60-6.49)	511
Males	15-16	.378 (.320-.446)	.309 (.264-.391)	.639 (.457-.814)	1.47 (1.09-1.79)	1.99 (1.49-2.80)	487
Females	11-12	.835 (.653-1.07)	.673 (.538-.818)	1.40 (.973-2.38)	3.30 (2.20-5.10)	5.14 (3.48-12.3)	349
Females	13-14	.563 (.490-.647)	.550 (.437-.656)	1.00 (.823-1.27)	1.89 (1.59-2.49)	3.39 (2.49-5.50)	445
Females	15-16	.621 (.538-.718)	.506 (.398-.680)	1.08 (.853-1.29)	2.50 (1.42-3.77)	4.24 (2.42-6.07)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Tin in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-31-5

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.691 (.620-.769)	.610 (.552-.678)	1.11 (.975-1.34)	2.50 (1.98-2.99)	4.50 (3.10-5.55)	1342
Total population	13-14	.473 (.417-.537)	.417 (.378-.472)	.889 (.735-1.06)	1.92 (1.78-2.21)	3.19 (2.72-3.65)	1486
Total population	15-16	.511 (.450-.580)	.455 (.408-.507)	.901 (.783-1.05)	1.77 (1.48-2.23)	3.18 (2.46-4.18)	1467
Age 20-49 years	11-12	.539 (.484-.601)	.500 (.442-.550)	.872 (.766-.975)	1.72 (1.20-2.39)	3.04 (1.95-4.43)	670
Age 18-49 years	13-14	.358 (.320-.401)	.333 (.286-.372)	.614 (.567-.697)	1.28 (1.13-1.65)	2.07 (1.78-2.64)	778
Age 18-49 years	15-16	.388 (.352-.427)	.341 (.307-.364)	.649 (.578-.723)	1.28 (1.07-1.53)	2.12 (1.49-3.33)	747
Age 50+ years	11-12	.898 (.782-1.03)	.778 (.653-.895)	1.67 (1.22-1.98)	2.91 (2.52-5.06)	5.58 (4.22-7.26)	672
Age 50+ years	13-14	.647 (.552-.758)	.549 (.482-.643)	1.33 (1.03-1.55)	2.71 (2.02-3.26)	4.00 (2.99-5.70)	708
Age 50+ years	15-16	.693 (.590-.813)	.622 (.493-.770)	1.12 (.919-1.44)	2.46 (1.80-2.94)	4.37 (2.94-7.31)	720
Males	11-12	.550 (.454-.665)	.466 (.403-.565)	.829 (.653-1.32)	2.28 (1.37-4.04)	4.17 (2.29-6.27)	634
Males	13-14	.373 (.324-.429)	.332 (.288-.375)	.640 (.504-.787)	1.54 (1.26-1.84)	2.55 (1.96-3.25)	662
Males	15-16	.403 (.340-.477)	.356 (.303-.429)	.725 (.537-.901)	1.38 (.991-2.23)	2.86 (1.49-3.82)	663
Females	11-12	.825 (.726-.937)	.753 (.625-.867)	1.28 (1.09-1.60)	2.56 (2.23-3.22)	4.50 (3.10-6.07)	708
Females	13-14	.575 (.494-.670)	.529 (.459-.579)	1.13 (.880-1.36)	2.27 (1.83-2.76)	3.63 (2.95-4.16)	824
Females	15-16	.621 (.551-.699)	.520 (.486-.605)	1.03 (.904-1.21)	2.10 (1.65-2.59)	4.37 (2.59-7.31)	804

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary Tungsten in Smokers (2011 - 2016)

CAS Number 7440-33-7

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.074 (.063-.089)	.070 (.060-.083)	.142 (.113-.184)	.285 (.197-.467)	.496 (.258-.838)	866
Total population	13-14	.059 (.052-.066)	.062 (.050-.072)	.128 (.114-.143)	.221 (.197-.247)	.291 (.250-.398)	957
Total population	15-16	.068 (.061-.076)	.069 (.061-.082)	.131 (.118-.153)	.252 (.202-.312)	.397 (.297-.493)	834
Age 20-49 years	11-12	.081 (.064-.103)	.077 (.065-.094)	.154 (.116-.227)	.361 (.182-.611)	.527 (.265-.838)	513
Age 18-49 years	13-14	.065 (.057-.074)	.068 (.057-.083)	.137 (.121-.161)	.230 (.196-.269)	.375 (.260-.465)	583
Age 18-49 years	15-16	.076 (.065-.089)	.081 (.065-.090)	.147 (.118-.199)	.278 (.209-.390)	.470 (.302-.594)	457
Age 50+ years	11-12	.065 (.056-.076)	.063 (.048-.075)	.120 (.088-.165)	.235 (.162-.286)	.298 (.227-.512)	353
Age 50+ years	13-14	.047 (.039-.058)	.049 (.035-.065)	.104 (.083-.126)	.207 (.147-.254)	.256 (.211-.292)	374
Age 50+ years	15-16	.058 (.049-.067)	.061 (.050-.080)	.118 (.095-.131)	.202 (.146-.272)	.297 (.238-.397)	377
Males	11-12	.083 (.065-.106)	.075 (.060-.099)	.164 (.116-.218)	.351 (.183-.703)	.611 (.265-.838)	522
Males	13-14	.064 (.057-.072)	.068 (.057-.082)	.132 (.117-.145)	.214 (.196-.230)	.272 (.230-.380)	512
Males	15-16	.074 (.064-.085)	.083 (.067-.092)	.136 (.115-.170)	.252 (.178-.390)	.390 (.253-.474)	487
Females	11-12	.065 (.054-.078)	.064 (.049-.079)	.131 (.090-.180)	.228 (.175-.312)	.366 (.234-.479)	344
Females	13-14	.054 (.045-.064)	.055 (.039-.069)	.124 (.097-.153)	.236 (.186-.276)	.311 (.256-.483)	445
Females	15-16	.062 (.055-.070)	.061 (.053-.068)	.128 (.104-.154)	.245 (.172-.319)	.397 (.292-.557)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.026, 0.018, and 0.018 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Tungsten_BiomonitoringSummary.html

Urinary Tungsten in Non-smokers (2011 - 2016)

CAS Number 7440-33-7

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.064 (.058-.072)	.058 (.053-.064)	.117 (.099-.140)	.234 (.183-.319)	.364 (.274-.474)	1337
Total population	13-14	.050 (.044-.057)	.048 (.039-.057)	.106 (.087-.123)	.213 (.175-.245)	.343 (.264-.419)	1487
Total population	15-16	.057 (.050-.065)	.057 (.050-.067)	.110 (.098-.128)	.214 (.167-.264)	.320 (.254-.406)	1469
Age 20-49 years	11-12	.072 (.061-.086)	.067 (.055-.082)	.132 (.106-.178)	.283 (.184-.405)	.405 (.277-.743)	668
Age 18-49 years	13-14	.052 (.043-.062)	.050 (.037-.068)	.119 (.098-.142)	.221 (.188-.264)	.350 (.264-.468)	778
Age 18-49 years	15-16	.064 (.054-.075)	.066 (.054-.078)	.135 (.108-.162)	.241 (.188-.297)	.361 (.297-.476)	749
Age 50+ years	11-12	.057 (.052-.063)	.053 (.047-.058)	.098 (.085-.122)	.200 (.167-.225)	.307 (.216-.426)	669
Age 50+ years	13-14	.048 (.041-.056)	.046 (.038-.054)	.095 (.076-.119)	.190 (.138-.259)	.280 (.227-.507)	709
Age 50+ years	15-16	.051 (.044-.059)	.052 (.041-.062)	.090 (.077-.106)	.164 (.124-.268)	.294 (.164-.365)	720
Males	11-12	.073 (.064-.083)	.068 (.057-.080)	.138 (.116-.166)	.271 (.190-.384)	.405 (.246-.628)	632
Males	13-14	.056 (.049-.065)	.053 (.044-.065)	.120 (.097-.157)	.243 (.203-.310)	.379 (.298-.468)	663
Males	15-16	.066 (.056-.077)	.066 (.054-.080)	.125 (.100-.153)	.241 (.167-.302)	.337 (.244-.476)	663
Females	11-12	.058 (.053-.065)	.053 (.047-.059)	.103 (.086-.124)	.220 (.170-.277)	.322 (.237-.472)	705
Females	13-14	.045 (.040-.051)	.045 (.034-.054)	.097 (.080-.109)	.176 (.148-.216)	.280 (.226-.393)	824
Females	15-16	.051 (.044-.059)	.050 (.040-.059)	.101 (.086-.118)	.202 (.154-.268)	.301 (.225-.438)	806

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.026, 0.018, and 0.018 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Tungsten_BiomonitoringSummary.html

Urinary Tungsten in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-33-7

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.082 (.072-.093)	.076 (.069-.088)	.129 (.115-.143)	.238 (.162-.365)	.365 (.247-.633)	866
Total population	13-14	.060 (.054-.067)	.059 (.052-.069)	.107 (.097-.118)	.170 (.149-.191)	.241 (.192-.319)	956
Total population	15-16	.068 (.061-.075)	.063 (.056-.072)	.109 (.095-.124)	.185 (.160-.234)	.267 (.206-.482)	834
Age 20-49 years	11-12	.084 (.070-.101)	.083 (.068-.096)	.136 (.113-.171)	.247 (.140-.391)	.374 (.247-.658)	513
Age 18-49 years	13-14	.061 (.055-.067)	.059 (.051-.069)	.108 (.099-.120)	.162 (.142-.186)	.214 (.186-.277)	582
Age 18-49 years	15-16	.070 (.062-.081)	.063 (.057-.075)	.112 (.093-.129)	.200 (.153-.240)	.279 (.178-.681)	457
Age 50+ years	11-12	.078 (.070-.088)	.074 (.064-.082)	.123 (.106-.138)	.208 (.163-.233)	.262 (.226-.288)	353
Age 50+ years	13-14	.058 (.048-.071)	.057 (.049-.072)	.100 (.084-.123)	.179 (.142-.225)	.281 (.175-.480)	374
Age 50+ years	15-16	.064 (.057-.071)	.062 (.049-.073)	.100 (.084-.121)	.179 (.138-.234)	.267 (.191-.491)	377
Males	11-12	.078 (.064-.095)	.075 (.062-.091)	.123 (.098-.150)	.247 (.129-.391)	.370 (.229-.571)	522
Males	13-14	.057 (.051-.064)	.058 (.048-.071)	.099 (.087-.117)	.162 (.142-.186)	.198 (.186-.254)	511
Males	15-16	.064 (.056-.072)	.062 (.054-.072)	.097 (.083-.115)	.161 (.122-.225)	.234 (.149-.482)	487
Females	11-12	.087 (.072-.103)	.082 (.069-.098)	.139 (.118-.163)	.230 (.193-.313)	.343 (.229-.733)	344
Females	13-14	.063 (.055-.073)	.059 (.050-.076)	.118 (.101-.125)	.175 (.154-.215)	.281 (.198-.364)	445
Females	15-16	.073 (.065-.082)	.065 (.056-.078)	.125 (.107-.148)	.218 (.172-.267)	.289 (.218-.640)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Tungsten_BiomonitoringSummary.html

Urinary Tungsten in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-33-7

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.075 (.068-.084)	.069 (.064-.075)	.126 (.105-.146)	.223 (.174-.275)	.345 (.233-.492)	1336
Total population	13-14	.060 (.053-.067)	.057 (.048-.065)	.105 (.091-.119)	.190 (.162-.227)	.310 (.246-.371)	1486
Total population	15-16	.065 (.057-.073)	.061 (.053-.069)	.103 (.091-.123)	.181 (.150-.221)	.289 (.208-.384)	1467
Age 20-49 years	11-12	.079 (.068-.092)	.074 (.064-.083)	.128 (.106-.168)	.246 (.183-.374)	.391 (.233-.659)	667
Age 18-49 years	13-14	.057 (.050-.065)	.054 (.046-.066)	.100 (.084-.116)	.172 (.155-.204)	.270 (.226-.324)	778
Age 18-49 years	15-16	.067 (.058-.076)	.062 (.053-.072)	.103 (.091-.123)	.201 (.146-.244)	.291 (.221-.401)	747
Age 50+ years	11-12	.072 (.065-.079)	.065 (.062-.074)	.122 (.099-.135)	.192 (.157-.238)	.261 (.206-.366)	669
Age 50+ years	13-14	.063 (.054-.073)	.059 (.049-.070)	.110 (.090-.130)	.224 (.155-.287)	.334 (.251-.701)	708
Age 50+ years	15-16	.062 (.054-.072)	.059 (.051-.070)	.104 (.080-.126)	.170 (.130-.206)	.289 (.172-.425)	720
Males	11-12	.065 (.057-.075)	.062 (.055-.068)	.107 (.088-.130)	.180 (.133-.261)	.261 (.172-.458)	631
Males	13-14	.055 (.047-.063)	.053 (.042-.065)	.099 (.081-.119)	.162 (.133-.223)	.300 (.194-.377)	662
Males	15-16	.060 (.052-.071)	.055 (.047-.065)	.099 (.082-.122)	.177 (.127-.230)	.288 (.177-.497)	663
Females	11-12	.084 (.077-.092)	.076 (.069-.082)	.142 (.120-.164)	.244 (.200-.334)	.391 (.268-.544)	705
Females	13-14	.064 (.058-.071)	.059 (.052-.067)	.112 (.102-.122)	.220 (.172-.251)	.310 (.261-.367)	824
Females	15-16	.068 (.061-.076)	.065 (.056-.074)	.112 (.092-.126)	.184 (.142-.242)	.289 (.195-.331)	804

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Tungsten_BiomonitoringSummary.html

Urinary Uranium in Smokers (2011 - 2016)

CAS Number 7440-61-1

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.007 (.006-.009)	.007 (.006-.008)	.013 (.010-.017)	.024 (.019-.034)	.035 (.026-.057)	876
Total population	13-14	.006 (.005-.007)	.006 (.005-.007)	.012 (.009-.015)	.025 (.017-.039)	.039 (.027-.062)	957
Total population	15-16	.007 (.006-.008)	.007 (.006-.008)	.014 (.010-.019)	.025 (.018-.039)	.041 (.024-.096)	834
Age 20-49 years	11-12	.008 (.006-.009)	.007 (.006-.009)	.013 (.010-.018)	.023 (.018-.034)	.036 (.023-.069)	522
Age 18-49 years	13-14	.006 (.005-.007)	.006 (.005-.007)	.011 (.009-.013)	.024 (.016-.033)	.033 (.026-.054)	583
Age 18-49 years	15-16	.007 (.005-.009)	.007 (.006-.008)	.014 (.009-.021)	.029 (.017-.061)	.048 (.022-.130)	457
Age 50+ years	11-12	.007 (.006-.009)	.007 (.005-.007)	.013 (.008-.017)	.025 (.017-.033)	.034 (.026-.039)	354
Age 50+ years	13-14	.006 (.005-.007)	.005 (.004-.007)	.012 (.008-.017)	.030 (.016-.058)	.048 (.035-.076)	374
Age 50+ years	15-16	.006 (.005-.008)	.007 (.005-.009)	.013 (.011-.019)	.024 (.018-.027)	.027 (.024-.043)	377
Males	11-12	.008 (.006-.009)	.007 (.006-.008)	.013 (.010-.016)	.026 (.017-.040)	.040 (.022-.069)	527
Males	13-14	.006 (.005-.007)	.006 (.005-.008)	.012 (.010-.014)	.023 (.016-.033)	.034 (.024-.054)	512
Males	15-16	.007 (.006-.009)	.007 (.006-.008)	.014 (.010-.019)	.024 (.018-.033)	.036 (.024-.057)	487
Females	11-12	.007 (.006-.009)	.007 (.005-.009)	.013 (.008-.019)	.023 (.018-.027)	.029 (.023-.060)	349
Females	13-14	.006 (.005-.007)	.006 (.005-.007)	.012 (.008-.017)	.027 (.016-.042)	.042 (.030-.076)	445
Females	15-16	.007 (.005-.008)	.006 (.005-.008)	.013 (.010-.021)	.028 (.017-.065)	.047 (.022-.096)	347

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 3.00E-03, 2.00E-03, and 2.00E-03 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Uranium_BiomonitoringSummary.html

Urinary Uranium in Non-smokers (2011 - 2016)

CAS Number 7440-61-1

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.005 (.005-.006)	.005 (.004-.006)	.009 (.007-.012)	.016 (.013-.022)	.025 (.020-.032)	1343
Total population	13-14	.005 (.004-.006)	.004 (.004-.005)	.009 (.007-.011)	.023 (.014-.030)	.035 (.024-.056)	1487
Total population	15-16	.005 (.004-.006)	.005 (.004-.005)	.009 (.007-.012)	.018 (.014-.026)	.031 (.020-.036)	1470
Age 20-49 years	11-12	.005 (.004-.006)	.005 (.004-.006)	.008 (.007-.010)	.015 (.011-.021)	.023 (.016-.031)	671
Age 18-49 years	13-14	.005 (.004-.006)	.004 (.004-.005)	.010 (.008-.012)	.023 (.014-.031)	.034 (.023-.053)	778
Age 18-49 years	15-16	.005 (.004-.006)	.004 (.004-.005)	.009 (.007-.013)	.019 (.013-.031)	.032 (.019-.049)	750
Age 50+ years	11-12	.006 (.005-.007)	.005 (.004-.006)	.011 (.007-.014)	.017 (.014-.025)	.028 (.019-.043)	672
Age 50+ years	13-14	.005 (.004-.006)	.004 (.003-.005)	.009 (.007-.011)	.023 (.013-.034)	.035 (.024-.061)	709
Age 50+ years	15-16	.005 (.004-.006)	.005 (.004-.005)	.009 (.007-.012)	.017 (.014-.025)	.030 (.020-.035)	720
Males	11-12	.006 (.005-.007)	.005 (.004-.007)	.010 (.007-.013)	.016 (.013-.022)	.023 (.016-.040)	635
Males	13-14	.005 (.004-.006)	.004 (.003-.005)	.009 (.007-.013)	.024 (.014-.038)	.038 (.026-.056)	663
Males	15-16	.005 (.005-.006)	.005 (.004-.006)	.010 (.007-.013)	.017 (.014-.026)	.031 (.018-.041)	663
Females	11-12	.005 (.005-.006)	.005 (.004-.006)	.009 (.007-.011)	.017 (.013-.025)	.028 (.020-.038)	708
Females	13-14	.005 (.004-.006)	.004 (.004-.005)	.009 (.007-.011)	.021 (.013-.030)	.033 (.023-.053)	824
Females	15-16	.005 (.004-.006)	.004 (.003-.005)	.008 (.006-.012)	.019 (.014-.026)	.031 (.022-.036)	807

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 3.00E-03, 2.00E-03, and 2.00E-03 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Uranium_BiomonitoringSummary.html

Urinary Uranium in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-61-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.008 (.007-.010)	.007 (.007-.009)	.013 (.011-.016)	.022 (.019-.026)	.031 (.022-.073)	876
Total population	13-14	.006 (.005-.007)	.005 (.004-.007)	.011 (.008-.013)	.020 (.014-.030)	.031 (.021-.052)	956
Total population	15-16	.007 (.005-.009)	.006 (.005-.008)	.011 (.008-.017)	.023 (.014-.042)	.039 (.021-.083)	834
Age 20-49 years	11-12	.008 (.006-.010)	.007 (.006-.009)	.013 (.010-.015)	.022 (.019-.027)	.030 (.021-.083)	522
Age 18-49 years	13-14	.006 (.005-.007)	.005 (.004-.006)	.010 (.007-.011)	.017 (.013-.023)	.026 (.020-.036)	582
Age 18-49 years	15-16	.006 (.005-.009)	.006 (.004-.008)	.010 (.007-.019)	.022 (.012-.047)	.036 (.016-.121)	457
Age 50+ years	11-12	.008 (.007-.010)	.008 (.006-.011)	.014 (.012-.017)	.021 (.019-.027)	.034 (.022-.058)	354
Age 50+ years	13-14	.007 (.005-.009)	.006 (.004-.009)	.013 (.009-.016)	.025 (.015-.052)	.051 (.022-.101)	374
Age 50+ years	15-16	.007 (.006-.009)	.007 (.005-.008)	.012 (.009-.017)	.026 (.016-.039)	.039 (.021-.066)	377
Males	11-12	.007 (.006-.009)	.007 (.005-.009)	.012 (.008-.016)	.020 (.014-.030)	.027 (.019-.083)	527
Males	13-14	.005 (.005-.006)	.005 (.004-.005)	.008 (.006-.011)	.018 (.013-.022)	.025 (.021-.035)	511
Males	15-16	.006 (.005-.008)	.006 (.004-.007)	.010 (.007-.014)	.017 (.010-.028)	.029 (.017-.074)	487
Females	11-12	.009 (.008-.010)	.009 (.007-.010)	.014 (.012-.017)	.025 (.021-.030)	.037 (.024-.058)	349
Females	13-14	.007 (.006-.009)	.006 (.005-.009)	.012 (.009-.015)	.022 (.014-.046)	.043 (.022-.085)	445
Females	15-16	.008 (.006-.010)	.007 (.005-.009)	.013 (.009-.024)	.028 (.015-.054)	.045 (.021-.151)	347

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Uranium_BiomonitoringSummary.html

Urinary Uranium in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 7440-61-1

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.006 (.005-.007)	.006 (.005-.007)	.010 (.008-.013)	.020 (.014-.027)	.028 (.021-.035)	1342
Total population	13-14	.006 (.005-.007)	.005 (.004-.006)	.010 (.008-.012)	.020 (.014-.033)	.037 (.020-.058)	1486
Total population	15-16	.005 (.005-.007)	.005 (.004-.006)	.009 (.007-.012)	.016 (.012-.024)	.027 (.018-.037)	1468
Age 20-49 years	11-12	.006 (.005-.006)	.005 (.005-.006)	.009 (.007-.012)	.019 (.013-.024)	.027 (.020-.029)	670
Age 18-49 years	13-14	.005 (.005-.006)	.005 (.004-.006)	.009 (.007-.011)	.018 (.012-.025)	.028 (.019-.060)	778
Age 18-49 years	15-16	.005 (.004-.006)	.005 (.004-.006)	.008 (.006-.011)	.015 (.010-.026)	.026 (.014-.040)	748
Age 50+ years	11-12	.007 (.006-.008)	.007 (.006-.008)	.012 (.009-.014)	.020 (.015-.032)	.034 (.023-.051)	672
Age 50+ years	13-14	.006 (.005-.008)	.005 (.005-.006)	.011 (.008-.015)	.023 (.014-.042)	.043 (.027-.058)	708
Age 50+ years	15-16	.006 (.005-.007)	.006 (.005-.006)	.009 (.008-.012)	.018 (.013-.025)	.028 (.021-.037)	720
Males	11-12	.005 (.004-.006)	.005 (.004-.006)	.008 (.007-.009)	.013 (.010-.020)	.020 (.013-.029)	634
Males	13-14	.005 (.004-.006)	.004 (.004-.005)	.008 (.006-.010)	.016 (.010-.027)	.027 (.014-.074)	662
Males	15-16	.005 (.004-.006)	.005 (.004-.005)	.008 (.006-.009)	.015 (.010-.019)	.028 (.016-.042)	663
Females	11-12	.008 (.006-.009)	.007 (.006-.008)	.013 (.010-.016)	.022 (.018-.028)	.033 (.027-.040)	708
Females	13-14	.007 (.006-.008)	.006 (.005-.007)	.011 (.009-.014)	.023 (.016-.038)	.042 (.024-.067)	824
Females	15-16	.006 (.005-.007)	.006 (.005-.007)	.010 (.008-.013)	.018 (.013-.025)	.027 (.021-.037)	805

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Uranium_BiomonitoringSummary.html

Perchlorate and Other Anions

Urinary Nitrate in Smokers (2011 - 2016)

CAS Number 84145-82-4

Geometric mean and selected percentiles of urine concentrations (in mg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	47.1 (43.6-50.8)	49.3 (45.4-52.3)	82.8 (70.0-90.9)	121 (107-133)	149 (127-173)	869
Total population	13-14	47.7 (43.8-51.9)	51.1 (45.2-58.0)	82.8 (76.7-90.2)	117 (107-134)	142 (135-155)	947
Total population	15-16	48.7 (45.1-52.5)	52.6 (48.6-58.4)	83.1 (76.8-89.0)	114 (106-126)	142 (128-161)	825
Age 20-49 years	11-12	48.4 (44.2-52.9)	52.2 (46.7-57.4)	82.6 (69.3-94.4)	120 (98.8-145)	150 (123-224)	518
Age 18-49 years	13-14	51.0 (46.1-56.3)	54.9 (49.5-62.4)	89.1 (78.4-99.8)	122 (111-139)	146 (135-183)	577
Age 18-49 years	15-16	49.6 (44.7-55.0)	55.4 (44.9-64.8)	84.2 (75.7-91.6)	114 (103-137)	155 (126-171)	449
Age 50+ years	11-12	45.0 (40.2-50.5)	46.1 (39.4-54.4)	82.8 (64.5-91.7)	121 (102-140)	145 (107-173)	351
Age 50+ years	13-14	41.4 (36.8-46.6)	41.0 (35.4-45.4)	71.4 (63.5-83.5)	106 (87.1-126)	129 (101-248)	370
Age 50+ years	15-16	47.3 (41.9-53.4)	50.5 (42.8-55.5)	82.1 (65.2-95.4)	111 (99.2-126)	135 (123-148)	376
Males	11-12	50.5 (45.7-55.8)	52.2 (46.5-60.2)	88.1 (79.0-98.6)	124 (105-152)	166 (123-192)	525
Males	13-14	49.9 (44.7-55.8)	54.8 (48.3-60.0)	82.4 (74.3-94.8)	118 (106-135)	141 (118-189)	511
Males	15-16	52.1 (47.2-57.6)	54.8 (48.2-62.2)	83.8 (72.6-96.7)	120 (106-132)	146 (128-171)	485
Females	11-12	43.0 (38.3-48.3)	44.2 (38.8-52.2)	69.8 (63.9-81.5)	110 (89.3-145)	145 (107-241)	344
Females	13-14	45.4 (41.1-50.2)	47.0 (40.4-54.5)	82.8 (70.4-93.8)	114 (101-135)	145 (129-179)	436
Females	15-16	44.9 (40.7-49.6)	52.0 (44.8-60.4)	80.4 (72.2-86.0)	111 (96.8-126)	137 (114-169)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Nitrate in Non-smokers (2011 - 2016)

CAS Number 84145-82-4

Geometric mean and selected percentiles of urine concentrations (in mg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	39.2 (36.5-42.0)	41.5 (38.6-44.8)	67.9 (62.8-73.5)	102 (93.7-113)	132 (114-150)	1319
Total population	13-14	38.0 (36.1-40.1)	38.9 (37.3-41.2)	66.9 (61.7-71.9)	99.8 (92.3-107)	128 (116-151)	1477
Total population	15-16	41.6 (39.2-44.2)	45.3 (40.9-49.4)	69.3 (65.9-73.9)	103 (94.9-118)	130 (122-145)	1462
Age 20-49 years	11-12	42.3 (38.2-46.9)	44.5 (41.0-48.0)	71.9 (64.5-80.6)	113 (94.5-120)	138 (114-180)	659
Age 18-49 years	13-14	40.1 (37.3-43.0)	40.8 (37.3-45.3)	69.2 (62.3-77.4)	102 (95.9-108)	132 (111-153)	774
Age 18-49 years	15-16	44.8 (41.4-48.5)	49.5 (44.9-54.3)	72.2 (65.9-80.8)	107 (91.7-125)	137 (123-169)	745
Age 50+ years	11-12	36.0 (32.5-40.0)	38.7 (33.1-44.2)	60.8 (54.0-70.9)	93.7 (83.0-108)	120 (102-148)	660
Age 50+ years	13-14	35.9 (32.6-39.4)	37.6 (32.6-41.5)	65.0 (55.5-71.2)	92.3 (85.6-109)	128 (109-157)	703
Age 50+ years	15-16	38.4 (34.7-42.3)	40.1 (33.2-47.7)	66.7 (62.6-73.0)	102 (88.7-120)	126 (104-144)	717
Males	11-12	45.4 (41.3-49.9)	45.2 (42.1-49.8)	73.3 (65.4-77.5)	108 (89.0-132)	150 (103-178)	628
Males	13-14	41.7 (38.1-45.8)	42.3 (38.2-48.9)	69.6 (60.2-81.6)	101 (88.3-116)	134 (109-156)	661
Males	15-16	45.9 (42.0-50.3)	51.4 (43.5-57.0)	70.6 (65.8-77.3)	114 (91.4-123)	137 (118-162)	660
Females	11-12	34.9 (31.8-38.2)	37.5 (32.2-43.0)	60.8 (55.8-68.9)	99.3 (89.1-113)	119 (112-139)	691
Females	13-14	35.2 (32.8-37.8)	36.9 (31.9-38.9)	65.4 (59.0-68.9)	98.7 (90.1-108)	124 (109-157)	816
Females	15-16	38.4 (35.8-41.1)	39.9 (34.7-43.8)	68.8 (63.8-73.9)	100 (90.3-118)	127 (107-169)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary Nitrate in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 84145-82-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	52 (48.0-56.3)	51.7 (44.4-58.6)	71.7 (64.7-78.8)	91.9 (86.1-108)	133 (95.0-165)	869
Total population	13-14	48.4 (46.1-50.8)	47.5 (45.0-50.1)	65.4 (60.3-70.1)	89.4 (80.6-104)	113 (105-128)	947
Total population	15-16	49.2 (45.9-52.7)	50.2 (46.1-54.6)	67.3 (61.6-73.1)	84.5 (78.3-95.8)	104 (90.6-122)	825
Age 20-49 years	11-12	50.4 (46.0-55.2)	47.7 (42.0-54.5)	65.9 (60.0-73.2)	88.9 (79.2-112)	136 (88.9-187)	518
Age 18-49 years	13-14	47.1 (44.3-50.0)	46.4 (43.0-49.7)	60.3 (55.4-67.3)	83.2 (71.3-107)	107 (86.7-130)	577
Age 18-49 years	15-16	46.8 (43.2-50.6)	48.2 (43.5-52.8)	63.2 (57.2-66.7)	76.1 (71.3-86.6)	95.8 (80.1-112)	449
Age 50+ years	11-12	54.4 (49.6-59.7)	57.2 (49.4-60.9)	80.9 (66.1-86.3)	99.3 (87.2-107)	109 (98.8-144)	351
Age 50+ years	13-14	51.4 (45.9-57.5)	49.4 (45.0-57.0)	72.5 (64.9-76.4)	104 (80.6-118)	119 (101-168)	370
Age 50+ years	15-16	53.1 (48.0-58.6)	53.7 (49.8-61.5)	77.1 (68.9-82.6)	95.5 (84.5-112)	119 (102-164)	376
Males	11-12	47.8 (43.9-52.1)	47.7 (42.1-53.0)	61.8 (58.6-68.8)	87.1 (73.9-95.0)	102 (87.2-133)	525
Males	13-14	44.3 (40.0-48.9)	42.8 (38.9-48.8)	55.9 (51.8-67.1)	83.2 (64.1-106)	108 (89.4-133)	511
Males	15-16	45.3 (41.7-49.3)	45.6 (41.4-50.5)	57.6 (52.0-67.3)	77.1 (67.3-87.9)	90.6 (77.1-113)	485
Females	11-12	57.7 (52.3-63.7)	58.8 (51.1-65.3)	80.9 (71.8-84.8)	104 (88.1-142)	144 (102-241)	344
Females	13-14	53.1 (49.3-57.1)	51.6 (46.5-57.0)	72.2 (66.4-76.2)	99.6 (78.8-113)	116 (106-149)	436
Females	15-16	54.1 (49.1-59.7)	59.1 (53.7-63.3)	74.1 (66.9-81.4)	95.8 (82.9-104)	121 (96.8-146)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Nitrate in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 84145-82-4

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	46 (42.9-49.2)	43.8 (40.9-46.4)	67.4 (59.5-73.6)	106 (90.2-121)	145 (119-166)	1318
Total population	13-14	45.6 (43.3-48.0)	44.5 (41.9-47.5)	65.4 (61.8-70.4)	97.4 (90.5-105)	123 (115-136)	1476
Total population	15-16	47.1 (44.6-49.7)	44.9 (43.3-46.7)	67.5 (63.8-70.6)	96.0 (86.8-109)	133 (112-155)	1460
Age 20-49 years	11-12	46.6 (42.4-51.1)	42.7 (38.7-47.0)	63.8 (54.7-72.5)	107 (84.9-137)	150 (107-173)	658
Age 18-49 years	13-14	44.1 (42.1-46.2)	42.5 (40.0-44.3)	61.1 (56.8-65.0)	93.5 (83.9-102)	120 (105-130)	774
Age 18-49 years	15-16	47 (43.7-50.4)	43.8 (41.5-47.0)	65.1 (58.8-69.7)	95.3 (81.6-107)	127 (107-147)	743
Age 50+ years	11-12	45.4 (41.2-49.9)	45.0 (41.1-50.0)	68.5 (56.6-84.9)	99.4 (85.2-120)	140 (112-151)	660
Age 50+ years	13-14	47.3 (43.3-51.6)	48.4 (42.2-53.1)	71.3 (64.7-79.2)	105 (90.0-117)	135 (112-162)	702
Age 50+ years	15-16	47.2 (43.4-51.3)	46.3 (43.2-51.6)	69.7 (62.7-74.5)	97.2 (88.5-118)	149 (109-182)	717
Males	11-12	40.6 (37.9-43.4)	39.1 (36.4-41.7)	54.6 (51.0-60.9)	84.9 (69.3-98.4)	106 (87.2-120)	627
Males	13-14	40.6 (37.8-43.5)	38.2 (35.3-42.1)	55.7 (50.6-62.8)	79.7 (76.0-86.7)	104 (86.7-123)	660
Males	15-16	42.3 (39.4-45.3)	39.4 (37.0-41.2)	58.8 (53.9-65.2)	83.4 (71.1-103)	109 (88.3-143)	660
Females	11-12	50.7 (45.8-56.1)	47.8 (43.6-53.6)	76.5 (67.7-86.6)	124 (101-151)	154 (137-186)	691
Females	13-14	50.2 (47.3-53.3)	50.3 (46.2-54.1)	72.4 (67.0-77.1)	108 (98.7-120)	139 (120-167)	816
Females	15-16	51.4 (47.5-55.5)	50.6 (46.9-53.4)	71.3 (68.0-78.1)	106 (91.4-136)	149 (119-190)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary Perchlorate in Smokers (2011 - 2016)

CAS Number 14797-73-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	2.53 (2.29-2.81)	2.73 (2.34-3.07)	4.72 (3.91-5.50)	7.64 (7.18-9.44)	10.3 (7.98-15.4)	869
Total population	13-14	2.41 (2.17-2.67)	2.41 (2.03-3.03)	4.53 (4.24-4.79)	7.09 (6.18-8.29)	9.54 (7.92-13.2)	947
Total population	15-16	2.27 (2.06-2.51)	2.26 (2.04-2.45)	3.80 (3.48-4.18)	6.29 (5.61-7.45)	9.85 (6.89-13.5)	825
Age 20-49 years	11-12	2.59 (2.27-2.96)	2.75 (2.34-3.24)	4.72 (3.82-5.77)	8.92 (6.00-10.7)	11.7 (8.84-23.5)	518
Age 18-49 years	13-14	2.52 (2.30-2.75)	2.86 (2.21-3.28)	4.72 (4.48-5.20)	7.28 (6.19-8.29)	9.34 (7.62-12.3)	577
Age 18-49 years	15-16	2.33 (2.06-2.64)	2.29 (2.04-2.61)	3.87 (3.40-4.64)	6.78 (5.16-9.85)	10.6 (6.56-18.3)	449
Age 50+ years	11-12	2.44 (2.05-2.91)	2.59 (1.95-3.39)	4.68 (3.39-6.26)	7.41 (5.64-8.40)	8.60 (7.49-10.7)	351
Age 50+ years	13-14	2.19 (1.82-2.64)	2.13 (1.80-2.42)	3.78 (3.20-4.10)	6.44 (5.02-10.4)	12.5 (9.05-21.9)	370
Age 50+ years	15-16	2.18 (1.83-2.60)	2.21 (1.87-2.55)	3.76 (2.90-4.41)	6.01 (4.56-7.35)	7.65 (6.01-11.5)	376
Males	11-12	2.76 (2.42-3.13)	2.98 (2.51-3.36)	5.45 (4.26-6.32)	8.26 (7.23-10.3)	10.6 (8.26-26.6)	525
Males	13-14	2.45 (2.22-2.69)	2.39 (1.98-3.17)	4.53 (4.24-4.72)	6.63 (5.90-7.20)	9.34 (6.63-12.5)	511
Males	15-16	2.24 (2.01-2.49)	2.37 (2.09-2.56)	3.79 (3.36-4.23)	5.72 (4.83-6.66)	7.45 (6.01-10.4)	485
Females	11-12	2.28 (2.02-2.58)	2.49 (1.99-2.90)	4.08 (3.63-4.63)	7.18 (5.01-9.20)	9.45 (7.60-11.5)	344
Females	13-14	2.37 (2.03-2.76)	2.41 (1.94-2.96)	4.47 (3.78-5.00)	7.72 (6.34-8.66)	11.4 (7.82-17.5)	436
Females	15-16	2.31 (2.04-2.63)	2.17 (1.87-2.54)	3.89 (3.38-4.51)	7.53 (5.44-10.7)	12.7 (6.38-22.7)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.050, 0.050, and 0.050 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Perchlorate_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Perchlorate_FactSheet.html

Urinary Perchlorate in Non-smokers (2011 - 2016)

CAS Number 14797-73-0

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	2.95 (2.75-3.15)	2.96 (2.71-3.22)	5.40 (5.01-5.74)	9.11 (8.34-10.4)	12.8 (11.1-14.8)	1319
Total population	13-14	2.51 (2.34-2.70)	2.44 (2.26-2.69)	4.54 (4.17-4.97)	7.60 (6.91-8.24)	9.90 (8.57-11.5)	1477
Total population	15-16	2.45 (2.31-2.60)	2.43 (2.27-2.61)	4.33 (4.04-4.88)	6.84 (6.21-8.17)	9.58 (8.31-11.1)	1461
Age 20-49 years	11-12	2.87 (2.59-3.18)	2.88 (2.36-3.38)	5.47 (4.83-6.58)	9.11 (7.99-10.9)	12.1 (9.70-16.8)	659
Age 18-49 years	13-14	2.51 (2.32-2.71)	2.42 (2.22-2.76)	4.76 (4.22-5.54)	7.92 (7.06-8.48)	9.90 (8.57-11.8)	774
Age 18-49 years	15-16	2.48 (2.27-2.71)	2.55 (2.30-2.73)	4.48 (3.83-5.16)	7.02 (6.21-8.30)	9.58 (8.43-10.3)	744
Age 50+ years	11-12	3.03 (2.68-3.43)	3.00 (2.54-3.47)	5.21 (4.25-6.12)	9.02 (7.50-11.2)	14.4 (10.3-18.4)	660
Age 50+ years	13-14	2.52 (2.30-2.76)	2.47 (2.25-2.71)	4.25 (3.80-4.66)	7.07 (6.17-8.02)	10.3 (8.21-12.0)	703
Age 50+ years	15-16	2.42 (2.18-2.68)	2.27 (2.03-2.67)	4.22 (3.85-4.77)	6.67 (6.03-8.64)	9.68 (7.47-12.1)	717
Males	11-12	3.32 (3.01-3.66)	3.30 (2.97-3.67)	5.70 (5.04-7.10)	10.4 (8.34-11.1)	13.8 (11.1-18.1)	628
Males	13-14	2.64 (2.37-2.94)	2.79 (2.46-3.08)	4.65 (4.09-5.44)	7.73 (6.46-9.10)	10.2 (8.35-13.4)	661
Males	15-16	2.72 (2.49-2.98)	2.92 (2.59-3.19)	5.00 (4.32-5.24)	7.47 (6.10-8.62)	9.58 (8.14-13.5)	659
Females	11-12	2.68 (2.45-2.94)	2.63 (2.39-2.95)	5.04 (4.02-5.97)	8.46 (7.95-9.48)	12.6 (10.6-15.2)	691
Females	13-14	2.41 (2.22-2.62)	2.25 (2.11-2.44)	4.37 (3.81-5.16)	7.52 (6.76-8.06)	9.19 (8.06-11.4)	816
Females	15-16	2.24 (2.08-2.42)	2.13 (1.97-2.31)	3.93 (3.49-4.48)	6.40 (5.56-7.63)	9.58 (7.44-11.1)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.050, 0.050, and 0.050 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Perchlorate_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Perchlorate_FactSheet.html

Urinary Perchlorate in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 14797-73-0

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	2.8 (2.57-3.05)	2.68 (2.35-2.96)	4.50 (4.08-4.88)	7.32 (6.20-7.61)	9.53 (7.50-13.8)	869
Total population	13-14	2.44 (2.26-2.64)	2.34 (2.16-2.62)	3.65 (3.35-4.11)	5.90 (5.16-7.86)	9.73 (7.86-11.1)	947
Total population	15-16	2.29 (2.05-2.57)	2.24 (1.86-2.65)	3.47 (3.22-3.95)	6.27 (5.03-7.79)	8.74 (6.50-13.1)	825
Age 20-49 years	11-12	2.7 (2.37-3.09)	2.53 (2.18-3.07)	4.45 (3.86-5.14)	7.08 (5.38-9.16)	9.66 (7.08-23.5)	518
Age 18-49 years	13-14	2.32 (2.12-2.54)	2.24 (2.07-2.54)	3.52 (3.24-3.75)	5.60 (4.57-6.00)	7.86 (5.60-10.1)	577
Age 18-49 years	15-16	2.2 (1.95-2.47)	2.12 (1.79-2.49)	3.30 (3.06-3.76)	5.46 (4.67-6.31)	8.00 (5.08-14.4)	449
Age 50+ years	11-12	2.95 (2.65-3.30)	2.73 (2.21-3.16)	4.63 (3.77-5.24)	7.45 (5.11-9.62)	9.03 (7.50-11.6)	351
Age 50+ years	13-14	2.71 (2.37-3.10)	2.62 (2.19-3.07)	4.25 (3.52-4.94)	8.06 (5.62-10.5)	11.6 (8.35-17.1)	370
Age 50+ years	15-16	2.45 (2.14-2.80)	2.51 (1.94-2.97)	3.95 (3.36-4.47)	6.81 (5.03-8.74)	9.07 (6.85-11.9)	376
Males	11-12	2.61 (2.36-2.89)	2.33 (2.11-2.70)	4.27 (3.90-4.72)	7.13 (5.56-7.53)	9.66 (7.13-23.5)	525
Males	13-14	2.17 (1.98-2.38)	2.21 (1.92-2.54)	3.30 (3.04-3.57)	5.16 (4.35-5.77)	7.90 (5.77-10.5)	511
Males	15-16	1.95 (1.75-2.17)	1.93 (1.68-2.33)	3.02 (2.61-3.27)	4.34 (3.40-5.09)	5.67 (4.29-8.74)	485
Females	11-12	3.06 (2.71-3.45)	3.02 (2.73-3.41)	4.73 (4.45-5.18)	7.50 (6.21-8.87)	9.16 (7.50-11.7)	344
Females	13-14	2.76 (2.53-3.01)	2.62 (2.34-2.96)	4.12 (3.61-4.57)	7.57 (5.03-10.1)	10.1 (7.86-12.3)	436
Females	15-16	2.79 (2.41-3.22)	2.80 (2.49-3.16)	4.56 (3.76-5.46)	8.00 (6.00-11.3)	11.9 (6.90-24.3)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Perchlorate_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Perchlorate_FactSheet.html

Urinary Perchlorate in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 14797-73-0

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.45 (3.19-3.74)	3.36 (3.02-3.68)	5.83 (5.49-6.10)	9.81 (8.13-11.8)	15.0 (11.0-18.5)	1318
Total population	13-14	3.01 (2.80-3.24)	2.97 (2.76-3.24)	4.82 (4.52-5.41)	7.55 (6.70-8.35)	10.3 (8.80-11.7)	1476
Total population	15-16	2.77 (2.58-2.97)	2.70 (2.51-2.94)	4.36 (4.07-4.72)	6.59 (5.99-7.15)	8.88 (7.63-10.0)	1459
Age 20-49 years	11-12	3.15 (2.80-3.54)	2.95 (2.53-3.44)	5.60 (4.53-6.36)	9.20 (7.21-11.1)	12.8 (9.81-17.4)	658
Age 18-49 years	13-14	2.76 (2.52-3.01)	2.71 (2.53-2.88)	4.60 (4.02-5.10)	7.33 (6.21-8.44)	9.68 (8.10-11.7)	774
Age 18-49 years	15-16	2.59 (2.38-2.82)	2.54 (2.21-2.89)	4.16 (3.73-4.81)	6.16 (5.60-6.71)	7.57 (6.69-8.88)	742
Age 50+ years	11-12	3.82 (3.37-4.32)	3.66 (3.33-4.06)	6.09 (5.28-6.80)	10.0 (7.86-14.9)	16.9 (11.0-23.6)	660
Age 50+ years	13-14	3.32 (3.08-3.59)	3.36 (2.97-3.73)	5.21 (4.67-5.69)	8.03 (6.81-8.71)	10.6 (9.16-12.7)	702
Age 50+ years	15-16	2.97 (2.72-3.24)	2.91 (2.62-3.15)	4.44 (4.11-5.00)	7.61 (5.99-8.76)	9.57 (7.90-13.0)	717
Males	11-12	2.96 (2.68-3.28)	2.92 (2.55-3.22)	4.65 (4.07-5.35)	7.04 (6.09-9.31)	13.4 (7.21-20.0)	627
Males	13-14	2.56 (2.33-2.83)	2.44 (2.20-2.75)	4.18 (3.66-4.64)	6.50 (5.66-7.48)	8.35 (7.03-11.0)	660
Males	15-16	2.5 (2.28-2.75)	2.43 (2.20-2.68)	3.84 (3.33-4.54)	5.84 (5.27-6.46)	8.00 (6.44-10.0)	659
Females	11-12	3.9 (3.51-4.33)	3.82 (3.17-4.58)	6.48 (6.02-7.49)	10.2 (9.22-12.7)	16.2 (11.8-19.2)	691
Females	13-14	3.44 (3.18-3.71)	3.49 (3.14-3.76)	5.62 (4.77-6.04)	8.16 (7.33-9.35)	11.4 (9.45-13.8)	816
Females	15-16	3 (2.79-3.22)	2.97 (2.74-3.26)	4.77 (4.35-5.27)	7.22 (6.30-8.17)	8.88 (7.90-10.4)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Perchlorate_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Perchlorate_FactSheet.html

Urinary Thiocyanate in Smokers (2011 - 2016)

CAS Number 302-04-5

Geometric mean and selected percentiles of urine concentrations (in mg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.10 (3.58-4.69)	4.60 (3.98-5.37)	7.16 (6.43-8.09)	11.2 (9.43-12.7)	14.6 (12.7-16.2)	869
Total population	13-14	3.93 (3.56-4.33)	4.48 (3.93-4.78)	7.45 (6.70-8.23)	12.5 (10.2-14.0)	15.2 (13.9-17.7)	944
Total population	15-16	3.88 (3.47-4.33)	4.65 (3.91-5.51)	8.28 (7.72-8.57)	11.8 (11.1-13.0)	15.0 (13.7-16.5)	824
Age 20-49 years	11-12	4.18 (3.72-4.69)	4.67 (4.15-5.05)	7.38 (6.43-8.20)	11.7 (10.2-13.3)	15.9 (12.7-17.8)	518
Age 18-49 years	13-14	3.99 (3.46-4.61)	4.72 (3.90-5.32)	7.90 (6.96-8.89)	13.5 (10.8-14.5)	16.0 (14.1-18.0)	575
Age 18-49 years	15-16	3.52 (2.96-4.18)	4.16 (3.53-5.07)	8.33 (7.10-9.77)	12.9 (11.3-14.5)	16.3 (14.3-19.8)	448
Age 50+ years	11-12	3.98 (3.24-4.90)	4.38 (3.37-5.94)	6.90 (5.48-8.14)	9.94 (7.67-13.5)	12.8 (9.50-15.3)	351
Age 50+ years	13-14	3.79 (3.40-4.23)	3.87 (3.41-4.63)	6.53 (5.45-7.58)	9.98 (9.02-12.6)	14.4 (11.5-18.3)	369
Age 50+ years	15-16	4.51 (3.73-5.45)	5.36 (3.91-6.41)	7.88 (6.89-9.02)	10.5 (9.39-12.1)	12.8 (11.1-15.5)	376
Males	11-12	4.03 (3.26-4.98)	4.51 (3.30-6.14)	7.23 (6.43-8.59)	11.1 (8.99-13.4)	14.5 (11.8-17.8)	525
Males	13-14	3.81 (3.31-4.39)	4.63 (3.73-5.19)	7.59 (6.60-8.92)	13.5 (10.7-14.5)	15.6 (14.1-18.5)	508
Males	15-16	3.64 (2.99-4.44)	4.22 (3.40-5.65)	8.64 (7.69-9.70)	12.4 (11.1-14.8)	15.5 (13.7-19.5)	485
Females	11-12	4.19 (3.81-4.61)	4.71 (4.31-5.37)	6.83 (6.12-7.95)	11.3 (8.53-13.1)	15.3 (11.9-18.2)	344
Females	13-14	4.05 (3.61-4.54)	4.30 (3.88-4.78)	7.15 (6.16-8.24)	11.3 (9.40-14.1)	14.5 (11.3-17.7)	436
Females	15-16	4.19 (3.73-4.70)	5.03 (4.06-5.92)	7.93 (7.35-8.33)	10.8 (9.58-12.7)	13.9 (11.7-18.8)	339

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.020, 0.020, and 0.020 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Thiocyanate in Non-smokers (2011 - 2016)

CAS Number 302-04-5

Geometric mean and selected percentiles of urine concentrations (in mg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.795 (.737-.858)	.875 (.819-.929)	1.56 (1.41-1.74)	2.54 (2.23-2.92)	3.23 (2.97-3.57)	1319
Total population	13-14	.791 (.745-.841)	.799 (.737-.861)	1.48 (1.37-1.55)	2.55 (2.31-2.89)	3.67 (2.96-4.47)	1476
Total population	15-16	.817 (.740-.901)	.875 (.762-.979)	1.57 (1.39-1.81)	2.69 (2.48-3.12)	3.78 (3.13-4.54)	1455
Age 20-49 years	11-12	.855 (.777-.940)	.927 (.854-1.00)	1.71 (1.50-1.92)	2.67 (2.29-3.17)	3.43 (3.01-4.36)	659
Age 18-49 years	13-14	.838 (.774-.907)	.862 (.766-.988)	1.54 (1.43-1.73)	2.54 (2.31-2.96)	3.75 (2.96-5.03)	774
Age 18-49 years	15-16	.894 (.816-.981)	.904 (.821-1.02)	1.74 (1.40-1.96)	3.02 (2.30-3.72)	3.92 (3.16-4.66)	741
Age 50+ years	11-12	.736 (.666-.814)	.833 (.726-.897)	1.44 (1.21-1.68)	2.39 (1.94-2.90)	2.92 (2.39-3.86)	660
Age 50+ years	13-14	.742 (.668-.824)	.751 (.668-.843)	1.36 (1.19-1.57)	2.66 (1.96-3.26)	3.67 (2.70-4.81)	702
Age 50+ years	15-16	.739 (.630-.868)	.814 (.687-1.01)	1.47 (1.23-1.76)	2.59 (2.18-3.03)	3.29 (2.60-4.28)	714
Males	11-12	.968 (.865-1.08)	1.01 (.913-1.20)	1.90 (1.57-2.20)	2.79 (2.31-3.25)	3.43 (2.94-4.10)	628
Males	13-14	.938 (.853-1.03)	.911 (.830-1.05)	1.79 (1.55-2.07)	2.96 (2.44-3.81)	4.33 (3.10-5.93)	661
Males	15-16	1.00 (.873-1.16)	1.06 (.923-1.23)	1.86 (1.64-2.23)	3.25 (2.62-4.28)	4.58 (3.54-6.37)	658
Females	11-12	.681 (.600-.773)	.727 (.603-.843)	1.36 (1.21-1.50)	2.27 (1.97-2.54)	3.17 (2.52-3.32)	691
Females	13-14	.687 (.634-.744)	.694 (.621-.779)	1.29 (1.14-1.39)	2.20 (1.91-2.36)	3.10 (2.67-3.75)	815
Females	15-16	.690 (.624-.763)	.723 (.624-.798)	1.31 (1.12-1.52)	2.35 (2.00-2.64)	3.02 (2.48-3.84)	797

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.020, 0.020, and 0.020 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary Thiocyanate in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 302-04-5

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.53 (4.02-5.10)	5.04 (4.38-5.47)	8.28 (7.42-10.0)	14.4 (11.6-15.7)	16.7 (15.3-18.9)	869
Total population	13-14	3.99 (3.57-4.47)	4.37 (3.99-5.00)	7.81 (7.12-8.51)	11.9 (10.4-14.3)	15.6 (13.5-18.6)	944
Total population	15-16	3.91 (3.51-4.36)	4.41 (3.74-5.21)	7.88 (6.97-8.75)	11.8 (10.8-12.8)	15.4 (13.4-16.4)	824
Age 20-49 years	11-12	4.35 (3.87-4.89)	4.84 (3.82-5.47)	7.98 (7.54-8.91)	14.0 (11.1-16.1)	16.7 (14.2-19.9)	518
Age 18-49 years	13-14	3.69 (3.25-4.19)	4.17 (3.75-4.68)	7.40 (6.33-8.43)	11.7 (10.4-13.8)	14.4 (12.9-15.9)	575
Age 18-49 years	15-16	3.30 (2.80-3.90)	3.96 (2.97-4.83)	6.99 (5.55-8.68)	10.4 (8.86-11.7)	11.8 (10.6-15.1)	448
Age 50+ years	11-12	4.81 (4.06-5.71)	5.28 (4.43-6.84)	8.84 (7.11-12.1)	15.3 (10.5-17.2)	16.6 (15.3-18.3)	351
Age 50+ years	13-14	4.71 (4.16-5.34)	4.68 (4.42-5.62)	8.12 (7.37-9.45)	12.9 (10.3-18.4)	18.6 (11.0-22.8)	369
Age 50+ years	15-16	5.05 (4.28-5.96)	5.70 (4.25-6.77)	8.63 (7.78-11.0)	14.8 (11.5-16.2)	17.0 (14.8-24.8)	376
Males	11-12	3.81 (3.28-4.43)	4.20 (3.64-5.06)	7.30 (6.54-7.77)	11.1 (9.41-12.5)	14.3 (12.3-15.6)	525
Males	13-14	3.38 (2.96-3.86)	4.14 (3.13-4.49)	7.12 (6.14-7.87)	11.0 (9.50-11.7)	13.2 (11.7-14.9)	508
Males	15-16	3.17 (2.70-3.72)	3.34 (2.52-4.40)	6.85 (5.39-7.42)	10.2 (8.75-10.9)	12.2 (10.8-16.0)	485
Females	11-12	5.62 (4.64-6.81)	5.82 (4.69-8.05)	11.1 (8.53-14.6)	16.7 (14.0-18.9)	19.2 (16.7-24.0)	344
Females	13-14	4.73 (4.12-5.42)	4.87 (4.08-5.92)	8.19 (7.52-9.75)	13.8 (10.7-17.1)	17.9 (14.2-21.2)	436
Females	15-16	5.03 (4.39-5.76)	5.86 (5.14-6.61)	8.83 (8.26-10.6)	13.9 (11.8-15.4)	15.8 (14.8-17.8)	339

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary Thiocyanate in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 302-04-5

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	.933 (.881-.988)	.976 (.905-1.10)	1.69 (1.54-1.84)	2.70 (2.34-2.99)	3.29 (3.02-3.89)	1318
Total population	13-14	.948 (.882-1.02)	.994 (.908-1.06)	1.68 (1.54-1.80)	2.71 (2.28-3.00)	3.74 (3.13-4.47)	1475
Total population	15-16	.922 (.844-1.01)	.953 (.874-1.08)	1.74 (1.56-1.87)	2.68 (2.40-2.88)	3.60 (3.11-4.10)	1453
Age 20-49 years	11-12	.938 (.864-1.02)	1.01 (.902-1.10)	1.67 (1.46-1.84)	2.51 (2.18-2.91)	3.02 (2.91-3.18)	658
Age 18-49 years	13-14	.922 (.843-1.01)	.950 (.860-1.04)	1.52 (1.37-1.66)	2.33 (2.09-2.57)	3.37 (2.60-4.40)	774
Age 18-49 years	15-16	.934 (.865-1.01)	.898 (.815-1.04)	1.66 (1.50-1.81)	2.54 (2.23-3.15)	3.74 (3.13-4.59)	739
Age 50+ years	11-12	.927 (.852-1.01)	.965 (.830-1.18)	1.72 (1.46-1.99)	2.91 (2.16-3.37)	3.76 (3.16-4.33)	660
Age 50+ years	13-14	.979 (.880-1.09)	1.05 (.890-1.24)	1.85 (1.55-2.08)	2.92 (2.41-3.56)	4.13 (3.14-5.08)	701
Age 50+ years	15-16	.910 (.780-1.06)	1.03 (.881-1.22)	1.85 (1.47-2.14)	2.68 (2.22-3.14)	3.60 (2.78-4.39)	714
Males	11-12	.865 (.782-.956)	.941 (.743-1.09)	1.56 (1.28-1.87)	2.66 (2.09-2.96)	3.37 (2.67-4.05)	627
Males	13-14	.912 (.832-.999)	.983 (.854-1.12)	1.62 (1.47-1.82)	2.75 (2.17-3.19)	4.13 (2.88-5.08)	660
Males	15-16	.923 (.812-1.05)	.944 (.814-1.18)	1.77 (1.50-1.98)	2.81 (2.30-3.27)	3.87 (2.89-5.02)	658
Females	11-12	.990 (.910-1.08)	1.05 (.936-1.17)	1.75 (1.59-1.91)	2.86 (2.41-3.03)	3.29 (2.97-3.96)	691
Females	13-14	.980 (.910-1.05)	1.01 (.923-1.06)	1.71 (1.55-1.81)	2.69 (2.26-3.13)	3.53 (2.94-4.15)	815
Females	15-16	.921 (.836-1.02)	.955 (.874-1.05)	1.73 (1.56-1.86)	2.52 (2.38-2.88)	3.58 (2.88-4.14)	795

[^] Cigarette nonsmokers who used other tobacco products were excluded

Polycyclic Aromatic Hydrocarbon Metabolites

Urinary 2-Hydroxyfluorene in Smokers (2011 - 2012)

CAS Number 2443-58-5

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1140 (1010-1290)	1290 (1080-1430)	2340 (2110-2620)	3950 (3380-4340)	5600 (4460-6100)	870
Age 20-49 years	11-12	1080 (908-1280)	1230 (1060-1410)	2270 (1920-2540)	3430 (2780-4210)	4760 (3840-5650)	520
Age 50+ years	11-12	1240 (1060-1440)	1360 (1030-1810)	2520 (2140-3380)	4700 (3430-6100)	6100 (4570-6960)	350
Males	11-12	1160 (942-1430)	1330 (1010-1580)	2480 (2090-3100)	4200 (3420-5700)	5960 (4090-8170)	524
Females	11-12	1110 (986-1260)	1230 (1100-1360)	2260 (1970-2410)	3380 (2680-4210)	4370 (3750-5100)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyfluorene in Non-smokers (2011 - 2012)

CAS Number 2443-58-5

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	165 (153-178)	158 (147-174)	299 (271-327)	584 (494-623)	766 (622-1100)	1334
Age 20-49 years	11-12	180 (161-203)	176 (156-204)	346 (309-398)	623 (525-692)	910 (665-1420)	667
Age 50+ years	11-12	149 (132-169)	144 (126-162)	257 (216-311)	457 (354-601)	634 (513-915)	667
Males	11-12	197 (172-225)	199 (162-218)	341 (296-399)	622 (494-735)	916 (623-1460)	632
Females	11-12	143 (132-156)	141 (127-148)	272 (232-298)	506 (426-590)	666 (567-1010)	702

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyfluorene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 2443-58-5

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1250 (1160-1350)	1370 (1320-1460)	2230 (2030-2470)	3200 (2950-3540)	3900 (3390-4610)	870
Age 20-49 years	11-12	1120 (1020-1240)	1250 (1090-1340)	1970 (1750-2170)	3080 (2540-3440)	3850 (3210-4390)	520
Age 50+ years	11-12	1490 (1350-1660)	1720 (1430-1960)	2630 (2300-2940)	3540 (2940-3940)	3940 (3250-5170)	350
Males	11-12	1090 (963-1240)	1250 (1030-1370)	1920 (1590-2170)	2820 (2320-3440)	3540 (2800-3970)	524
Females	11-12	1490 (1280-1740)	1750 (1470-1970)	2740 (2110-3080)	3630 (3080-4120)	4610 (3850-5050)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyfluorene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 2443-58-5

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	193 (181-205)	174 (165-184)	267 (250-295)	450 (400-494)	708 (511-920)	1333
Age 20-49 years	11-12	197 (183-213)	177 (166-189)	281 (245-309)	468 (387-565)	798 (505-961)	666
Age 50+ years	11-12	188 (169-209)	168 (145-194)	262 (228-304)	442 (354-503)	653 (454-1020)	667
Males	11-12	176 (156-198)	153 (135-177)	252 (209-284)	427 (318-518)	565 (459-1080)	631
Females	11-12	207 (197-218)	186 (172-200)	289 (256-313)	461 (400-566)	716 (527-920)	702

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyfluorene in Smokers (2011 - 2012)

CAS Number 6344-67-8

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	582 (500-679)	670 (527-800)	1270 (1100-1550)	2130 (1930-2540)	2900 (2370-3250)	870
Age 20-49 years	11-12	556 (459-674)	660 (505-801)	1210 (1060-1410)	2010 (1790-2390)	2690 (2100-3220)	520
Age 50+ years	11-12	626 (503-780)	685 (496-957)	1460 (1080-1730)	2400 (1730-3040)	3040 (2500-3940)	350
Males	11-12	601 (468-772)	684 (494-954)	1550 (1160-1810)	2470 (1880-3040)	3000 (2390-4560)	524
Females	11-12	559 (497-630)	637 (515-759)	1130 (960-1240)	1780 (1510-2050)	2400 (1930-2830)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyfluorene in Non-smokers (2011 - 2012)

CAS Number 6344-67-8

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	58.6 (53.6-64.1)	58.0 (52.0-61.0)	108 (96.0-118)	206 (175-230)	309 (240-414)	1330
Age 20-49 years	11-12	64.9 (57.1-73.8)	62.0 (55.0-74.0)	129 (116-148)	235 (203-289)	352 (273-525)	666
Age 50+ years	11-12	52.4 (45.9-59.9)	53.0 (45.0-59.0)	83.0 (70.0-102)	158 (128-191)	226 (167-355)	664
Males	11-12	70.1 (59.9-82.0)	63.0 (58.0-73.0)	124 (104-155)	227 (176-313)	346 (227-886)	631
Females	11-12	50.8 (45.9-56.2)	52.0 (48.0-56.0)	92.0 (82.0-102)	172 (153-195)	267 (191-347)	699

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyfluorene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 6344-67-8

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	642 (583-706)	767 (688-828)	1210 (1110-1340)	1800 (1470-2050)	2060 (1980-2280)	870
Age 20-49 years	11-12	577 (518-643)	644 (571-745)	1170 (1000-1240)	1760 (1350-2050)	2050 (1720-2330)	520
Age 50+ years	11-12	758 (633-907)	958 (843-1020)	1300 (1100-1640)	1830 (1510-2060)	2060 (1680-2420)	350
Males	11-12	568 (486-664)	641 (568-759)	1100 (971-1200)	1600 (1290-2050)	2050 (1480-2140)	524
Females	11-12	749 (623-900)	936 (796-1070)	1340 (1130-1650)	1970 (1420-2420)	2330 (2000-2450)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyfluorene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 6344-67-8

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	68.5 (63.7-73.7)	59.9 (55.1-66.7)	102 (92.0-107)	181 (152-215)	288 (222-398)	1329
Age 20-49 years	11-12	71 (64.9-77.7)	59.7 (55.7-67.3)	104 (88.8-122)	197 (152-242)	293 (233-420)	665
Age 50+ years	11-12	65.9 (58.1-74.8)	60.6 (50.2-71.6)	95.5 (87.5-107)	170 (143-200)	288 (178-523)	664
Males	11-12	62.7 (54.0-72.7)	52.9 (48.8-60.6)	90.7 (77.8-104)	151 (127-195)	256 (167-642)	630
Females	11-12	73.5 (67.9-79.6)	66.7 (57.9-75.6)	108 (96.0-135)	201 (170-243)	293 (239-345)	699

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 9-Hydroxyfluorene in Smokers (2011 - 2012)

CAS Number 1689-64-1

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	602 (553-656)	658 (570-727)	1190 (993-1350)	1970 (1670-2560)	3110 (2410-3730)	870
Age 20-49 years	11-12	569 (505-641)	624 (516-680)	1090 (906-1210)	1760 (1470-2410)	2610 (2180-3680)	520
Age 50+ years	11-12	659 (567-767)	750 (553-900)	1350 (1110-1480)	2470 (1710-2970)	3460 (2470-4020)	350
Males	11-12	608 (528-700)	663 (461-839)	1190 (961-1420)	2340 (1540-3460)	3460 (2240-4020)	524
Females	11-12	595 (512-692)	642 (529-736)	1180 (903-1410)	1810 (1440-2590)	2590 (1740-3730)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 9-Hydroxyfluorene in Non-smokers (2011 - 2012)

CAS Number 1689-64-1

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	206 (191-223)	203 (185-225)	385 (341-411)	784 (672-893)	1230 (964-1340)	1334
Age 20-49 years	11-12	214 (189-242)	215 (188-257)	409 (373-445)	864 (710-988)	1310 (1080-1340)	667
Age 50+ years	11-12	199 (170-233)	184 (141-243)	343 (307-388)	714 (524-909)	1010 (720-1780)	667
Males	11-12	243 (213-276)	246 (197-285)	436 (389-506)	807 (678-1010)	1280 (1010-1480)	632
Females	11-12	182 (164-201)	183 (158-201)	333 (292-385)	734 (522-885)	1230 (775-1560)	702

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 9-Hydroxyfluorene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 1689-64-1

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	664 (603-730)	665 (614-729)	1170 (1100-1290)	1860 (1600-2110)	2630 (1990-3640)	870
Age 20-49 years	11-12	591 (507-687)	571 (520-626)	1010 (844-1170)	1650 (1320-2100)	2630 (1600-4950)	520
Age 50+ years	11-12	797 (714-889)	878 (802-949)	1350 (1150-1610)	2010 (1610-2570)	2570 (2040-2940)	350
Males	11-12	574 (507-650)	586 (519-670)	1070 (867-1150)	1510 (1330-1860)	2260 (1790-2910)	524
Females	11-12	797 (709-896)	808 (667-943)	1390 (1190-1600)	2010 (1660-2630)	2700 (2010-3890)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 9-Hydroxyfluorene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 1689-64-1

Metabolite of Fluorene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	242 (222-263)	221 (200-245)	367 (330-424)	704 (583-842)	959 (841-1140)	1333
Age 20-49 years	11-12	234 (214-256)	211 (190-236)	363 (326-404)	678 (562-842)	1080 (804-1170)	666
Age 50+ years	11-12	250 (218-286)	230 (193-275)	375 (326-492)	722 (573-917)	924 (796-1080)	667
Males	11-12	217 (195-242)	195 (181-218)	316 (280-368)	676 (415-917)	917 (627-1260)	631
Females	11-12	263 (236-293)	245 (209-288)	407 (354-490)	750 (590-914)	986 (914-1140)	702

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Fluorene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxyphenanthrene in Smokers (2011 - 2012)

CAS Number 2433-56-9

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	196 (177-216)	207 (178-234)	378 (313-433)	580 (526-672)	758 (607-875)	870
Age 20-49 years	11-12	197 (171-226)	210 (172-255)	378 (319-416)	569 (511-630)	716 (580-875)	520
Age 50+ years	11-12	193 (170-219)	194 (153-264)	394 (297-459)	607 (453-809)	772 (525-1170)	350
Males	11-12	193 (167-223)	207 (170-236)	397 (318-453)	594 (507-756)	758 (607-833)	524
Females	11-12	199 (172-230)	208 (173-247)	365 (276-453)	526 (384-790)	733 (526-1170)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxyphenanthrene in Non-smokers (2011 - 2012)

CAS Number 2433-56-9

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	115 (107-123)	112 (104-124)	209 (194-233)	363 (315-432)	544 (443-639)	1334
Age 20-49 years	11-12	119 (106-134)	123 (104-140)	235 (201-253)	425 (334-499)	557 (437-639)	667
Age 50+ years	11-12	111 (96.5-127)	104 (93.0-122)	193 (173-221)	322 (271-400)	498 (340-874)	667
Males	11-12	126 (113-140)	127 (107-141)	221 (195-253)	365 (306-437)	499 (367-851)	632
Females	11-12	107 (97.1-118)	104 (95.0-112)	198 (177-238)	363 (300-461)	557 (432-671)	702

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxyphenanthrene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 2433-56-9

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	215 (202-230)	211 (198-232)	326 (303-350)	491 (420-543)	583 (535-605)	870
Age 20-49 years	11-12	204 (190-220)	203 (180-221)	313 (282-340)	444 (394-485)	518 (467-605)	520
Age 50+ years	11-12	234 (210-260)	231 (210-266)	357 (289-488)	543 (431-583)	583 (543-733)	350
Males	11-12	182 (168-198)	178 (159-204)	282 (242-303)	379 (353-420)	491 (387-528)	524
Females	11-12	266 (243-291)	266 (235-303)	416 (326-500)	543 (500-600)	658 (562-795)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxyphenanthrene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 2433-56-9

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	135 (124-146)	126 (115-134)	200 (180-218)	336 (277-393)	498 (413-655)	1333
Age 20-49 years	11-12	130 (120-142)	123 (111-133)	197 (171-222)	307 (248-393)	473 (351-598)	666
Age 50+ years	11-12	139 (123-157)	129 (112-146)	206 (177-236)	340 (277-444)	504 (413-683)	667
Males	11-12	112 (103-123)	100 (91.3-113)	159 (137-174)	258 (201-368)	413 (269-598)	631
Females	11-12	155 (138-174)	143 (129-164)	223 (206-254)	357 (305-478)	562 (453-831)	702

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyphenanthrene in Smokers (2011 - 2012)

CAS Number 605-55-0

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	111 (102-122)	111 (102-131)	205 (188-227)	334 (297-360)	384 (369-457)	869
Age 20-49 years	11-12	109 (95.4-124)	108 (98.0-128)	202 (167-228)	302 (253-349)	380 (332-489)	520
Age 50+ years	11-12	116 (104-129)	115 (93.0-149)	218 (197-247)	360 (287-374)	412 (366-498)	349
Males	11-12	119 (105-136)	130 (105-154)	224 (198-260)	360 (287-379)	417 (374-489)	524
Females	11-12	102 (89.6-116)	105 (88.0-115)	185 (150-213)	263 (235-310)	353 (297-448)	345

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyphenanthrene in Non-smokers (2011 - 2012)

CAS Number 605-55-0

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	53.7 (50.0-57.7)	52.0 (49.0-57.0)	95.0 (84.0-104)	172 (148-196)	265 (212-303)	1331
Age 20-49 years	11-12	57.9 (52.4-64.0)	59.0 (52.0-67.0)	105 (94.0-115)	183 (165-209)	265 (223-331)	667
Age 50+ years	11-12	49.5 (43.0-57.1)	48.0 (41.0-56.0)	82.0 (68.0-95.0)	141 (114-235)	262 (141-349)	664
Males	11-12	65.3 (57.7-74.0)	65.0 (54.0-76.0)	112 (96.0-126)	202 (168-246)	275 (209-384)	631
Females	11-12	46.0 (42.6-49.8)	47.0 (43.0-49.0)	77.0 (67.0-92.0)	144 (114-184)	243 (166-285)	700

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyphenanthrene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 605-55-0

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	122 (115-130)	125 (116-129)	193 (175-206)	285 (247-321)	365 (307-423)	869
Age 20-49 years	11-12	113 (104-122)	109 (103-117)	178 (155-202)	258 (221-285)	365 (264-538)	520
Age 50+ years	11-12	140 (128-153)	143 (131-158)	207 (188-243)	318 (243-356)	376 (303-442)	349
Males	11-12	113 (104-122)	113 (100-127)	170 (152-186)	264 (206-338)	385 (243-432)	524
Females	11-12	136 (120-154)	142 (126-159)	220 (193-246)	303 (253-334)	356 (307-503)	345

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxyphenanthrene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 605-55-0

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	62.8 (58.3-67.6)	57.6 (54.1-60.8)	92.3 (81.2-101)	154 (123-181)	213 (163-282)	1330
Age 20-49 years	11-12	63.3 (59.4-67.4)	59.4 (54.3-63.5)	92.4 (84.1-100)	145 (114-173)	188 (156-271)	666
Age 50+ years	11-12	62.2 (54.7-70.8)	56.7 (48.7-64.8)	92.3 (74.7-110)	156 (123-203)	218 (156-303)	664
Males	11-12	58.4 (52.6-64.8)	52.8 (48.8-56.7)	86.3 (70.4-103)	145 (110-200)	200 (145-281)	630
Females	11-12	66.5 (60.6-72.9)	62.6 (57.6-68.3)	93.3 (84.6-103)	156 (116-188)	227 (163-298)	700

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyphenanthrene in Smokers (2011 - 2012)

CAS Number 605-87-8

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	137 (120-156)	143 (125-161)	265 (223-337)	517 (444-550)	633 (550-678)	870
Age 20-49 years	11-12	136 (114-162)	143 (119-165)	264 (211-328)	519 (382-593)	649 (563-698)	520
Age 50+ years	11-12	139 (121-159)	147 (114-183)	266 (223-369)	499 (398-550)	633 (497-784)	350
Males	11-12	147 (124-175)	156 (127-201)	324 (260-382)	549 (461-595)	678 (622-784)	524
Females	11-12	125 (108-145)	128 (109-150)	241 (183-269)	380 (297-480)	517 (389-687)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyphenanthrene in Non-smokers (2011 - 2012)

CAS Number 605-87-8

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	48.7 (44.9-52.9)	48.0 (44.0-55.0)	90.0 (81.0-100)	170 (137-195)	231 (195-286)	1333
Age 20-49 years	11-12	53.0 (47.3-59.3)	55.0 (47.0-63.0)	105 (90.0-119)	189 (170-206)	266 (211-325)	667
Age 50+ years	11-12	44.6 (38.3-51.9)	44.0 (35.0-54.0)	78.0 (63.0-91.0)	136 (106-175)	221 (146-282)	666
Males	11-12	58.4 (50.3-67.9)	57.0 (48.0-67.0)	107 (84.0-134)	190 (152-251)	265 (195-475)	632
Females	11-12	42.2 (38.7-46.1)	42.0 (38.0-46.0)	81.0 (68.0-88.0)	136 (116-174)	211 (176-257)	701

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyphenanthrene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 605-87-8

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	151 (142-161)	161 (148-172)	255 (231-276)	369 (348-409)	467 (416-503)	870
Age 20-49 years	11-12	141 (127-157)	148 (129-165)	239 (214-255)	359 (303-410)	416 (366-525)	520
Age 50+ years	11-12	168 (155-181)	186 (160-210)	289 (264-313)	427 (346-460)	474 (406-560)	350
Males	11-12	139 (128-150)	148 (128-162)	229 (214-250)	354 (320-405)	467 (409-474)	524
Females	11-12	168 (145-194)	181 (151-210)	277 (246-327)	398 (360-427)	471 (410-667)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 3-Hydroxyphenanthrene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 605-87-8

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	57.1 (52.9-61.6)	52.2 (48.8-56.8)	83.8 (76.0-95.9)	148 (125-168)	213 (163-300)	1332
Age 20-49 years	11-12	58 (53.9-62.3)	52.2 (48.6-57.8)	83.8 (75.0-95.2)	152 (128-163)	203 (164-250)	666
Age 50+ years	11-12	56.1 (49.1-64.1)	52.2 (44.5-60.3)	83.6 (71.9-105)	148 (117-178)	222 (148-338)	666
Males	11-12	52.2 (46.1-59.2)	47.8 (41.5-53.6)	77.4 (63.7-97.1)	143 (117-163)	188 (140-304)	631
Females	11-12	61.1 (55.6-67.3)	56.8 (51.6-61.6)	87.9 (77.1-105)	150 (127-173)	243 (157-334)	701

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 4-Hydroxyphenanthrene in Smokers (2011 - 2012)

CAS Number 7657-86-7

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	37.9 (35.0-41.0)	42.0 (35.0-46.0)	74.0 (66.0-79.0)	116 (102-137)	148 (134-179)	859
Age 20-49 years	11-12	36.5 (32.6-40.9)	38.0 (31.0-46.0)	72.0 (61.0-79.0)	107 (95.0-128)	147 (117-182)	515
Age 50+ years	11-12	40.1 (35.7-45.1)	46.0 (38.0-50.0)	76.0 (63.0-96.0)	126 (106-148)	158 (124-212)	344
Males	11-12	35.8 (30.9-41.4)	36.0 (31.0-45.0)	74.0 (63.0-85.0)	119 (99.0-148)	150 (126-189)	518
Females	11-12	40.7 (34.7-47.9)	46.0 (35.0-53.0)	74.0 (60.0-82.0)	110 (88.0-146)	147 (115-182)	341

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 4-Hydroxyphenanthrene in Non-smokers (2011 - 2012)

CAS Number 7657-86-7

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	17.6 (16.5-18.8)	16.0 (15.0-17.0)	30.0 (27.0-33.0)	57.0 (45.0-72.0)	84.0 (76.0-99.0)	1330
Age 20-49 years	11-12	19.4 (17.4-21.6)	18.0 (15.0-22.0)	34.0 (30.0-40.0)	64.0 (50.0-78.0)	89.0 (67.0-118)	666
Age 50+ years	11-12	15.9 (14.1-18.0)	14.0 (12.0-17.0)	26.0 (23.0-29.0)	42.0 (34.0-72.0)	81.0 (44.0-134)	664
Males	11-12	19.5 (17.1-22.1)	19.0 (16.0-23.0)	34.0 (29.0-36.0)	63.0 (45.0-81.0)	84.0 (67.0-108)	630
Females	11-12	16.3 (14.9-17.8)	14.0 (12.0-16.0)	26.0 (23.0-31.0)	50.0 (40.0-76.0)	89.0 (69.0-113)	700

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 4-Hydroxyphenanthrene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 7657-86-7

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	41.5 (38.3-45.0)	43.8 (39.6-46.2)	76.5 (63.2-90.1)	124 (105-143)	147 (135-159)	859
Age 20-49 years	11-12	37.9 (34.1-42.0)	39.5 (35.5-44.1)	64.1 (57.4-82.3)	116 (93.3-132)	135 (121-175)	515
Age 50+ years	11-12	48.1 (43.1-53.6)	53.3 (45.0-60.0)	90.1 (77.6-103)	143 (103-158)	154 (127-175)	344
Males	11-12	33.8 (29.8-38.4)	37.3 (33.2-39.6)	59.3 (49.5-70.5)	100 (79.3-112)	122 (100-159)	518
Females	11-12	54 (45.3-64.4)	59.6 (47.3-64.1)	103 (77.1-124)	143 (121-159)	159 (143-228)	341

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 4-Hydroxyphenanthrene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 7657-86-7

Metabolite of Phenanthrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	20.6 (19.2-22.0)	19.9 (18.5-21.1)	30.8 (27.1-34.3)	51.4 (43.5-65.0)	80.5 (54.6-111)	1329
Age 20-49 years	11-12	21.1 (19.5-22.9)	20.5 (19.2-22.1)	31.7 (27.5-36.4)	54.6 (45.1-64.9)	80.5 (54.7-117)	665
Age 50+ years	11-12	20 (17.9-22.3)	18.7 (17.7-21.0)	29.6 (26.3-32.8)	50.5 (39.1-67.0)	79.6 (48.8-111)	664
Males	11-12	17.4 (15.9-19.0)	17.3 (15.4-18.5)	25.4 (23.3-28.4)	41.9 (32.4-52.6)	59.7 (41.8-111)	629
Females	11-12	23.5 (21.4-25.7)	22.4 (20.5-24.4)	34.7 (30.8-38.6)	56.4 (48.8-80.5)	88.8 (56.5-144)	700

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Phenanthrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxypyrene in Smokers (2011 - 2012)

CAS Number 5315-79-7

Metabolite of Pyrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	233 (202-270)	243 (199-295)	478 (383-549)	773 (693-873)	1120 (916-1230)	870
Age 20-49 years	11-12	238 (198-285)	243 (203-302)	461 (367-606)	773 (662-994)	1180 (833-1340)	520
Age 50+ years	11-12	227 (194-266)	232 (162-295)	485 (358-522)	773 (603-1080)	1120 (756-1400)	350
Males	11-12	237 (192-293)	239 (197-321)	518 (415-636)	835 (756-1080)	1230 (1020-1340)	524
Females	11-12	229 (198-263)	243 (194-278)	420 (341-513)	653 (543-828)	873 (685-1180)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Pyrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxypyrene in Non-smokers (2011 - 2012)

CAS Number 5315-79-7

Metabolite of Pyrene

Geometric mean and selected percentiles of urine concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	83.4 (76.3-91.2)	84.0 (77.0-94.0)	152 (136-174)	276 (231-319)	412 (319-482)	1331
Age 20-49 years	11-12	99.7 (86.0-115)	101 (84.0-115)	191 (164-227)	318 (266-411)	450 (365-599)	666
Age 50+ years	11-12	68.7 (61.3-77.0)	71.0 (61.0-86.0)	121 (102-135)	195 (167-222)	311 (209-424)	665
Males	11-12	92.9 (83.3-104)	93.0 (84.0-101)	172 (145-183)	304 (229-424)	450 (323-599)	631
Females	11-12	76.6 (68.6-85.5)	77.0 (66.0-87.0)	140 (124-163)	257 (200-309)	358 (280-447)	700

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 10.0.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Pyrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxypyrene in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 5315-79-7

Metabolite of Pyrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	257 (239-277)	265 (253-283)	429 (394-458)	646 (550-717)	887 (711-996)	870
Age 20-49 years	11-12	247 (223-274)	246 (218-280)	397 (361-465)	647 (537-733)	820 (696-996)	520
Age 50+ years	11-12	274 (247-305)	290 (262-331)	442 (386-498)	646 (524-748)	887 (646-997)	350
Males	11-12	224 (201-250)	218 (204-253)	374 (331-394)	525 (464-662)	804 (558-993)	524
Females	11-12	306 (266-352)	323 (288-376)	466 (413-572)	743 (600-887)	888 (700-1040)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Pyrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxypyrene in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 5315-79-7

Metabolite of Pyrene

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	98.5 (92.6-105)	93.9 (88.4-101)	154 (142-164)	249 (220-280)	364 (301-482)	1330
Age 20-49 years	11-12	109 (101-118)	105 (94.5-119)	167 (150-187)	268 (233-295)	343 (308-422)	665
Age 50+ years	11-12	88 (78.5-98.8)	86.1 (75.0-92.3)	129 (117-146)	224 (185-307)	418 (249-639)	665
Males	11-12	83.4 (75.3-92.2)	82.6 (72.4-86.1)	124 (111-144)	225 (171-298)	331 (250-478)	630
Females	11-12	112 (104-122)	105 (96.0-120)	170 (155-184)	269 (225-310)	418 (329-516)	700

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Pyrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxynaphthalene (1-Naphthol) in Smokers (2011 - 2012)

CAS Number 90-15-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	9.24 (8.04-10.6)	10.6 (8.66-11.9)	19.9 (17.2-22.4)	34.2 (27.4-37.1)	42.6 (35.7-49.0)	870
Age 20-49 years	11-12	8.59 (7.10-10.4)	10.2 (7.89-11.5)	18.6 (15.1-21.7)	27.6 (24.2-35.2)	37.2 (32.3-48.5)	520
Age 50+ years	11-12	10.4 (8.71-12.4)	11.8 (8.02-14.3)	22.7 (18.0-26.0)	38.8 (26.8-43.7)	44.5 (38.8-128)	350
Males	11-12	9.21 (7.34-11.5)	10.9 (8.57-12.4)	21.4 (17.3-24.2)	35.7 (26.6-42.6)	42.6 (31.3-49.0)	524
Females	11-12	9.29 (8.16-10.6)	9.96 (7.89-12.1)	18.5 (16.1-21.1)	28.5 (24.7-35.2)	41.0 (35.1-58.5)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.044.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxynaphthalene (1-Naphthol) in Non-smokers (2011 - 2012)

CAS Number 90-15-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.20 (1.11-1.31)	1.13 (1.00-1.21)	2.36 (2.16-2.51)	5.60 (4.62-6.63)	10.6 (7.49-12.9)	1334
Age 20-49 years	11-12	1.05 (.963-1.14)	.989 (.851-1.13)	2.08 (1.80-2.35)	4.73 (3.43-6.63)	8.63 (6.12-12.9)	667
Age 50+ years	11-12	1.40 (1.21-1.62)	1.26 (1.02-1.57)	2.67 (2.30-3.18)	5.83 (4.61-8.21)	11.7 (9.12-16.0)	667
Males	11-12	1.34 (1.16-1.55)	1.21 (.953-1.52)	2.48 (2.14-2.90)	5.82 (4.67-7.21)	10.5 (6.71-16.0)	632
Females	11-12	1.10 (.937-1.30)	1.02 (.894-1.18)	2.20 (1.85-2.63)	5.33 (3.85-6.79)	11.5 (6.28-13.3)	702

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.044.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxynaphthalene (1-Naphthol) in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 90-15-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	10.2 (9.03-11.5)	12.0 (10.1-13.1)	18.5 (16.4-19.8)	29.4 (24.0-36.4)	39.0 (33.7-47.4)	870
Age 20-49 years	11-12	8.91 (7.72-10.3)	9.86 (8.34-11.9)	15.8 (13.9-19.0)	26.7 (20.7-36.0)	37.2 (30.2-42.0)	520
Age 50+ years	11-12	12.6 (10.5-15.1)	13.5 (13.0-15.6)	20.2 (18.1-24.2)	34.7 (24.3-42.2)	42.2 (31.1-189)	350
Males	11-12	8.69 (7.45-10.1)	9.49 (8.11-12.2)	14.5 (13.2-17.3)	22.4 (19.3-26.6)	32.8 (25.5-38.8)	524
Females	11-12	12.4 (10.2-15.1)	14.8 (13.1-16.1)	21.4 (18.6-28.7)	36.6 (29.3-44.0)	44.0 (36.6-50.3)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 1-Hydroxynaphthalene (1-Naphthol) in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 90-15-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.41 (1.29-1.54)	1.20 (1.08-1.35)	2.50 (2.19-2.91)	5.91 (5.19-7.05)	10.5 (8.60-12.7)	1333
Age 20-49 years	11-12	1.14 (1.04-1.26)	1.02 (.896-1.14)	2.00 (1.81-2.28)	4.07 (3.42-5.19)	7.70 (5.39-9.54)	666
Age 50+ years	11-12	1.76 (1.54-2.01)	1.51 (1.18-1.83)	3.21 (2.50-4.19)	7.65 (5.91-10.6)	15.8 (10.5-19.4)	667
Males	11-12	1.2 (1.05-1.37)	.973 (.796-1.22)	2.03 (1.76-2.45)	4.56 (3.58-6.65)	8.83 (6.19-15.8)	631
Females	11-12	1.59 (1.38-1.84)	1.41 (1.18-1.66)	2.93 (2.36-3.44)	6.65 (5.23-8.54)	12.2 (8.54-16.4)	702

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxynaphthalene (2-Naphthol) in Smokers (2011 - 2012)

CAS Number 135-19-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	12.1 (10.9-13.6)	13.0 (11.7-14.6)	24.1 (20.8-27.7)	36.1 (31.2-43.5)	49.0 (43.6-51.6)	870
Age 20-49 years	11-12	12.0 (10.4-13.8)	13.5 (10.7-15.2)	23.4 (19.8-27.7)	32.7 (29.9-37.9)	43.8 (35.3-51.2)	520
Age 50+ years	11-12	12.4 (10.4-14.8)	12.9 (10.2-16.9)	25.9 (19.7-30.2)	43.7 (36.1-51.1)	54.1 (36.1-85.2)	350
Males	11-12	12.2 (10.2-14.6)	13.2 (11.2-16.3)	26.0 (21.7-28.7)	41.5 (31.5-51.1)	51.6 (36.6-67.3)	524
Females	11-12	12.0 (10.8-13.5)	12.9 (10.7-14.5)	21.2 (17.8-26.0)	35.0 (29.1-37.2)	40.7 (36.1-47.8)	346

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.042.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxynaphthalene (2-Naphthol) in Non-smokers (2011 - 2012)

CAS Number 135-19-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.18 (2.86-3.54)	3.25 (2.81-3.73)	6.49 (5.68-8.02)	13.3 (11.0-15.5)	19.3 (15.6-21.6)	1334
Age 20-49 years	11-12	3.73 (3.18-4.37)	3.95 (3.11-4.60)	8.68 (6.43-10.7)	15.7 (12.0-19.5)	21.1 (16.7-24.7)	667
Age 50+ years	11-12	2.68 (2.35-3.05)	2.62 (2.31-3.25)	5.28 (4.63-6.10)	10.5 (8.51-11.5)	14.7 (11.5-20.0)	667
Males	11-12	3.33 (2.98-3.72)	3.41 (2.78-4.06)	6.13 (5.38-7.76)	11.5 (10.7-14.3)	16.1 (13.5-20.3)	632
Females	11-12	3.07 (2.62-3.59)	3.00 (2.47-3.89)	7.10 (5.49-9.25)	14.2 (11.7-17.3)	20.5 (16.6-23.3)	702

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 is 0.042.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxynaphthalene (2-Naphthol) in Smokers (creatinine corrected, 2011 - 2012)

CAS Number 135-19-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	13.4 (12.4-14.4)	14.3 (13.4-15.1)	21.2 (19.6-22.5)	28.7 (25.8-32.0)	34.7 (30.8-39.4)	870
Age 20-49 years	11-12	12.4 (11.2-13.8)	13.1 (12.0-14.3)	19.4 (17.8-21.1)	28.0 (23.6-31.1)	34.5 (28.6-41.9)	520
Age 50+ years	11-12	15 (13.3-16.9)	17.4 (15.1-18.6)	23.5 (21.4-24.5)	31.4 (25.8-35.7)	35.7 (28.8-41.3)	350
Males	11-12	11.5 (10.4-12.8)	13.0 (11.1-14.2)	18.4 (15.4-19.8)	23.7 (20.1-28.1)	29.0 (23.7-35.7)	524
Females	11-12	16.1 (14.1-18.5)	17.7 (14.7-21.0)	24.4 (21.4-28.5)	33.2 (26.9-39.4)	39.4 (34.3-43.0)	346

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Urinary 2-Hydroxynaphthalene (2-Naphthol) in Non-smokers (creatinine corrected, 2011 - 2012)

CAS Number 135-19-3

Metabolite of Naphthalene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.73 (3.49-3.98)	3.43 (3.13-3.90)	6.61 (5.96-7.43)	12.1 (10.5-12.8)	16.1 (13.6-18.1)	1333
Age 20-49 years	11-12	4.1 (3.66-4.58)	3.83 (3.31-4.50)	7.60 (6.68-9.03)	12.9 (11.9-13.8)	16.6 (14.6-18.9)	666
Age 50+ years	11-12	3.37 (3.02-3.76)	3.18 (2.59-3.57)	5.74 (4.66-6.86)	9.71 (8.84-11.9)	13.3 (12.0-17.7)	667
Males	11-12	2.99 (2.72-3.28)	2.79 (2.48-3.04)	5.09 (4.32-5.77)	8.89 (7.47-9.33)	11.8 (9.33-13.4)	631
Females	11-12	4.44 (4.02-4.90)	4.18 (3.50-5.04)	7.92 (7.22-9.07)	13.6 (12.3-15.8)	18.1 (15.5-20.5)	702

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Naphthalene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html

Heterocyclic Amines

Urinary 3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1) in Smokers (2013 - 2014)

CAS Number 62450-06-0

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	919
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	558
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	499
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	420

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.790.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1) in Non-smokers (2013 - 2014)

CAS Number 62450-06-0

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1446
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	759
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	687
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	791

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.790.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 62450-06-0

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	918
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	557
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	498
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	420

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 62450-06-0

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1445
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	759
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	791

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- α -C) in Smokers (2013 - 2014)

CAS Number 68006-83-7

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.07 (.910-1.25)	1.19 (.900-1.47)	3.20 (2.70-3.90)	5.72 (4.95-7.28)	8.88 (7.28-11.3)	920
Age 18-49 years	13-14	1.03 (.808-1.32)	1.14 (.610-1.53)	3.19 (2.33-4.02)	5.80 (4.62-8.44)	10.6 (6.25-16.9)	561
Age 50+ years	13-14	1.15 (.951-1.39)	1.43 (.890-1.94)	3.29 (2.73-3.98)	5.41 (4.70-6.64)	7.52 (5.49-9.62)	359
Males	13-14	1.10 (.906-1.35)	1.29 (.800-1.58)	3.34 (2.82-3.98)	6.23 (4.68-9.45)	10.4 (6.64-15.3)	498
Females	13-14	1.03 (.853-1.25)	1.16 (.770-1.57)	3.08 (2.34-3.86)	5.48 (4.87-7.26)	8.26 (6.82-9.62)	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.330.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- α -C) in Non-smokers (2013 - 2014)

CAS Number 68006-83-7

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	.430 (<LOD-.580)	1444
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	.540 (<LOD-.880)	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	684
Males	13-14	*	<LOD	<LOD	<LOD	.520 (<LOD-.880)	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	790

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.330.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- α -C) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 68006-83-7

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.13 (.951-1.35)	1.27 (.972-1.58)	3.95 (2.97-4.86)	7.89 (6.16-9.56)	10.0 (8.75-12.5)	919
Age 18-49 years	13-14	0.995 (.774-1.28)	1.10 (.662-1.52)	3.19 (2.33-4.89)	7.52 (5.76-9.53)	10.0 (8.59-11.9)	560
Age 50+ years	13-14	1.49 (1.25-1.79)	1.85 (1.38-2.49)	4.75 (3.93-5.88)	8.07 (6.16-10.0)	10.0 (7.94-16.6)	359
Males	13-14	0.998 (.823-1.21)	1.13 (.807-1.46)	3.18 (2.56-4.10)	7.11 (5.27-9.29)	9.67 (7.67-15.4)	497
Females	13-14	1.29 (1.04-1.59)	1.39 (1.05-2.04)	4.69 (3.72-5.70)	8.11 (6.80-10.0)	10.8 (8.63-16.6)	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA- α -C) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 68006-83-7

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	1.28 (<LOD-1.64)	1443
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	1.21 (<LOD-1.29)	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	683
Males	13-14	*	<LOD	<LOD	<LOD	1.00 (<LOD-1.29)	653
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	790

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP) in Smokers (2013 - 2014)

CAS Number 105650-23-5

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	1.44 (1.01-1.98)	6.38 (5.21-7.94)	15.3 (9.07-26.2)	921
Age 18-49 years	13-14	*	.360 (<LOD-.480)	1.49 (.990-2.52)	6.93 (4.59-11.9)	17.7 (8.70-36.7)	561
Age 50+ years	13-14	*	<LOD	1.22 (.670-2.30)	6.15 (2.77-7.94)	9.10 (6.15-34.2)	360
Males	13-14	*	<LOD	1.44 (1.00-1.88)	6.06 (3.83-7.94)	13.2 (7.68-23.9)	499
Females	13-14	*	<LOD	1.45 (.850-2.77)	6.93 (3.99-14.8)	20.1 (7.10-42.6)	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.340.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP) in Non-smokers (2013 - 2014)

CAS Number 105650-23-5

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	.530 (.450-.590)	2.30 (1.83-2.92)	8.27 (6.70-10.6)	17.0 (14.2-21.1)	1446
Age 18-49 years	13-14	.949 (.844-1.07)	.600 (.510-.730)	2.35 (1.95-3.04)	9.67 (7.10-13.2)	18.6 (13.8-33.1)	759
Age 50+ years	13-14	*	.430 (<LOD-.560)	2.04 (1.26-3.32)	7.39 (4.94-11.3)	14.9 (11.3-21.1)	687
Males	13-14	1.06 (.915-1.24)	.720 (.590-.880)	3.22 (2.19-4.53)	10.4 (6.77-15.9)	20.0 (13.9-37.7)	654
Females	13-14	*	.390 (<LOD-.510)	1.73 (1.29-2.12)	6.97 (4.82-9.20)	14.2 (8.62-26.6)	792

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.340.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 105650-23-5

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	1.51 (1.26-1.84)	5.39 (3.49-7.64)	12.2 (7.66-15.4)	920
Age 18-49 years	13-14	*	.534 (<LOD-.649)	1.58 (1.20-1.84)	5.65 (2.99-9.05)	12.2 (6.77-15.6)	560
Age 50+ years	13-14	*	<LOD	1.50 (1.06-2.74)	5.39 (3.57-10.2)	12.3 (6.26-18.5)	360
Males	13-14	*	<LOD	1.44 (1.04-1.80)	4.84 (2.99-7.07)	11.3 (5.65-15.4)	498
Females	13-14	*	<LOD	1.71 (1.09-2.51)	6.79 (3.32-10.6)	12.3 (7.59-15.3)	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 105650-23-5

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	.754 (.702-.802)	2.49 (1.98-3.08)	9.66 (7.78-11.9)	18.5 (13.9-27.6)	1445
Age 18-49 years	13-14	1.05 (.935-1.19)	.770 (.669-.889)	2.38 (1.96-3.13)	10.2 (6.69-12.9)	19.5 (13.5-30.3)	759
Age 50+ years	13-14	*	.749 (<LOD-.857)	2.52 (1.71-3.86)	9.66 (7.27-12.2)	18.3 (12.2-27.1)	686
Males	13-14	1.04 (.908-1.20)	.749 (.663-.881)	2.91 (1.77-4.62)	10.1 (6.56-13.5)	18.3 (11.9-32.1)	653
Females	13-14	*	.774 (<LOD-.857)	2.18 (1.85-2.73)	9.49 (6.88-13.7)	19.1 (12.2-31.7)	792

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Amino-9H-pyrido[2,3-b]indole (A- α -C) in Smokers (2013 - 2014)

CAS Number 26148-68-5

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	19.7 (15.7-24.7)	27.3 (22.6-32.1)	60.9 (53.0-68.8)	97.7 (88.1-128)	149 (107-206)	918
Age 18-49 years	13-14	18.3 (13.2-25.5)	26.1 (17.4-35.0)	63.5 (51.0-74.6)	107 (83.4-155)	159 (128-226)	558
Age 50+ years	13-14	23.0 (19.1-27.6)	30.9 (21.9-42.2)	57.4 (47.6-70.2)	91.4 (78.1-104)	120 (94.8-139)	360
Males	13-14	18.0 (13.2-24.6)	25.6 (17.0-35.4)	56.3 (47.5-66.2)	104 (82.0-132)	157 (107-227)	499
Females	13-14	21.6 (16.7-28.0)	28.0 (20.3-40.4)	62.7 (55.5-74.6)	96.0 (83.2-128)	139 (97.7-205)	419

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.620.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-9H-pyrido[2,3-b]indole (A- α -C) in Non-smokers (2013 - 2014)

CAS Number 26148-68-5

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	1.13 (.960-1.34)	3.38 (2.63-4.59)	8.39 (5.40-10.8)	1444
Age 18-49 years	13-14	*	<LOD	1.41 (1.11-1.63)	4.71 (3.32-5.75)	10.7 (6.54-15.7)	759
Age 50+ years	13-14	*	<LOD	.950 (.700-1.27)	2.30 (1.56-3.76)	5.20 (3.72-8.39)	685
Males	13-14	*	<LOD	1.43 (1.13-1.68)	4.44 (2.71-6.29)	10.2 (5.75-15.3)	653
Females	13-14	*	<LOD	.920 (.800-1.15)	2.64 (1.87-3.91)	5.77 (4.05-9.50)	791

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.620.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Amino-9H-pyrido[2,3-b]indole (A- α -C) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 26148-68-5

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	20.9 (16.3-26.8)	29.9 (23.3-34.7)	69.3 (59.7-80.4)	122 (96.3-161)	175 (125-253)	917
Age 18-49 years	13-14	17.7 (12.9-24.3)	23.6 (17.0-32.6)	66.2 (49.5-75.4)	122 (88.2-167)	175 (127-255)	557
Age 50+ years	13-14	29.6 (23.5-37.2)	39.6 (34.2-50.3)	80.0 (65.0-91.4)	131 (98.3-163)	181 (109-259)	360
Males	13-14	16.3 (12.0-22.2)	22.7 (16.7-32.2)	56.4 (41.5-69.9)	99.4 (82.2-127)	152 (102-267)	498
Females	13-14	27.1 (20.4-36.0)	37.5 (29.8-47.5)	84.6 (68.1-102)	146 (91.0-186)	182 (146-259)	419

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-9H-pyrido[2,3-b]indole (A- α -C) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 26148-68-5

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	1.63 (1.45-1.88)	4.17 (3.14-5.21)	8.65 (5.82-11.6)	1443
Age 18-49 years	13-14	*	<LOD	1.78 (1.52-2.00)	4.39 (3.08-5.75)	11.0 (5.82-13.1)	759
Age 50+ years	13-14	*	<LOD	1.53 (1.26-1.91)	3.78 (2.58-5.94)	7.77 (4.89-10.7)	684
Males	13-14	*	<LOD	1.42 (1.26-1.65)	4.40 (3.03-5.57)	9.03 (5.50-14.9)	652
Females	13-14	*	<LOD	1.84 (1.53-2.15)	4.00 (2.96-4.89)	7.85 (4.89-11.6)	791

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Amino-3-methyl-3H-imidazo[4,5-f]quinolone (IQ) in Smokers (2013 - 2014)

CAS Number 76180-96-6

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	921
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	561
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	360
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	499
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.370.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-3-methyl-3H-imidazo[4,5-f]quinolone (IQ) in Non-smokers (2013 - 2014)

CAS Number 76180-96-6

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1447
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	687
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.370.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Amino-3-methyl-3H-imidazo[4,5-f]quinolone (IQ) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 76180-96-6

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	920
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	560
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	360
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	498
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-3-methyl-3H-imidazo[4,5-f]quinolone (IQ) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 76180-96-6

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1446
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1) in Smokers (2013 - 2014)

CAS Number 67730-11-4

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	922
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	561
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	500
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.310.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1) in Non-smokers (2013 - 2014)

CAS Number 67730-11-4

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1447
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	687
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.310.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 67730-11-4

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	921
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	560
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	499
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 67730-11-4

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1446
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Aminodipyrido[1,2-a:3',2'-d] imidazole (GLU-P-2) in Smokers (2013 - 2014)

CAS Number 67730-10-3

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	920
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	560
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	360
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	498
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.830.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminodipyrido[1,2-a:3',2'-d] imidazole (GLU-P-2) in Non-smokers (2013 - 2014)

CAS Number 67730-10-3

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1447
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	687
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.830.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Aminodipyrido[1,2-a:3',2'-d] imidazole (GLU-P-2) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 67730-10-3

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	919
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	559
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	360
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	497
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminodipyrido[1,2-a:3',2'-d] imidazole (GLU-P-2) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 67730-10-3

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1446
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	792

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 1-Methyl-9H-pyrido[3,4-b]indole (Harman) in Smokers (2013 - 2014)

CAS Number 486-84-0

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	203 (181-228)	198 (172-229)	351 (301-425)	714 (563-886)	1010 (876-1380)	921
Age 18-49 years	13-14	204 (171-242)	201 (168-238)	340 (290-376)	714 (502-921)	1020 (757-1860)	560
Age 50+ years	13-14	202 (178-229)	193 (162-229)	433 (295-519)	713 (553-937)	959 (759-1190)	361
Males	13-14	200 (172-233)	178 (152-212)	350 (276-452)	756 (520-996)	1190 (821-1800)	500
Females	13-14	206 (178-239)	223 (184-254)	351 (295-439)	714 (554-893)	931 (821-1080)	421

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 4.59.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Methyl-9H-pyrido[3,4-b]indole (Harman) in Non-smokers (2013 - 2014)

CAS Number 486-84-0

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	129 (120-139)	115 (107-124)	233 (211-260)	541 (449-607)	811 (748-1060)	1447
Age 18-49 years	13-14	115 (107-124)	104 (94.8-110)	203 (178-227)	404 (355-470)	751 (538-913)	760
Age 50+ years	13-14	147 (133-162)	135 (118-148)	286 (237-342)	628 (541-760)	914 (683-1380)	687
Males	13-14	137 (121-155)	120 (108-144)	243 (202-310)	539 (386-642)	782 (608-1230)	655
Females	13-14	123 (111-136)	108 (95.4-119)	224 (190-268)	546 (412-734)	853 (683-1280)	792

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 4.59.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 1-Methyl-9H-pyrido[3,4-b]indole (Harman) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 486-84-0

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	215 (200-230)	209 (186-230)	388 (347-412)	665 (578-718)	895 (713-1110)	920
Age 18-49 years	13-14	197 (175-221)	185 (160-224)	345 (311-389)	595 (468-713)	829 (608-1100)	559
Age 50+ years	13-14	260 (226-299)	245 (206-287)	440 (357-568)	695 (589-1040)	1050 (718-1310)	361
Males	13-14	181 (160-203)	166 (145-195)	328 (276-389)	589 (451-836)	870 (589-1200)	499
Females	13-14	257 (243-272)	244 (225-273)	418 (382-457)	713 (640-785)	895 (756-1100)	421

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Methyl-9H-pyrido[3,4-b]indole (Harman) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 486-84-0

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	156 (146-167)	136 (124-153)	283 (257-306)	605 (514-714)	1100 (958-1220)	1446
Age 18-49 years	13-14	128 (117-140)	116 (100-129)	225 (182-253)	449 (389-495)	780 (524-1030)	760
Age 50+ years	13-14	196 (178-216)	181 (152-213)	356 (294-400)	835 (652-1050)	1250 (1020-1720)	686
Males	13-14	135 (122-149)	120 (103-138)	238 (202-285)	481 (375-652)	850 (648-1030)	654
Females	13-14	178 (158-199)	153 (131-191)	319 (282-378)	742 (580-958)	1270 (836-1720)	792

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2) in Smokers (2013 - 2014)

CAS Number 62450-07-1

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	1.11 (.780-1.37)	922
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	1.09 (.820-1.37)	561
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	1.17 (<LOD-1.79)	361
Males	13-14	*	<LOD	<LOD	<LOD	1.17 (<LOD-1.79)	500
Females	13-14	*	<LOD	<LOD	<LOD	1.09 (.640-1.47)	422

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.630.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2) in Non-smokers (2013 - 2014)

CAS Number 62450-07-1

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1446
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	686
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	655
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	791

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.630.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 62450-07-1

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	1.96 (1.62-2.54)	921
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	1.67 (1.41-2.37)	560
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	2.50 (<LOD-3.55)	361
Males	13-14	*	<LOD	<LOD	<LOD	1.61 (<LOD-2.05)	499
Females	13-14	*	<LOD	<LOD	<LOD	2.37 (1.80-3.64)	422

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 62450-07-1

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1445
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	685
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	791

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 9H-Pyrido[3,4-b]indole (Norharman) in Smokers (2013 - 2014)

CAS Number 244-63-3

Geometric mean and selected percentiles of concentrations (in ng/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	468 (417-525)	475 (403-524)	846 (738-969)	1430 (1210-1740)	1920 (1420-2350)	905
Age 18-49 years	13-14	458 (389-538)	464 (374-540)	838 (664-1000)	1400 (1020-1840)	1980 (1400-2350)	551
Age 50+ years	13-14	490 (444-542)	482 (401-550)	961 (732-1090)	1520 (1250-1870)	1870 (1420-2470)	354
Males	13-14	476 (404-559)	475 (384-528)	838 (617-1080)	1530 (1020-2040)	2000 (1480-2770)	498
Females	13-14	460 (405-521)	464 (382-559)	887 (771-1020)	1400 (1140-1660)	1870 (1400-2280)	407

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 12.6.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 9H-Pyrido[3,4-b]indole (Norharman) in Non-smokers (2013 - 2014)

CAS Number 244-63-3

Geometric mean and selected percentiles of concentrations (in ng/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	309 (293-326)	304 (283-330)	586 (528-621)	1030 (931-1090)	1460 (1230-1700)	1436
Age 18-49 years	13-14	284 (265-303)	288 (258-310)	528 (467-581)	901 (758-1030)	1240 (1040-1420)	755
Age 50+ years	13-14	341 (311-374)	330 (303-369)	673 (561-784)	1120 (966-1490)	1720 (1230-2150)	681
Males	13-14	357 (326-389)	356 (319-401)	654 (580-777)	1150 (962-1350)	1610 (1230-2090)	648
Females	13-14	274 (256-294)	275 (250-295)	533 (455-592)	901 (777-1040)	1330 (1050-1530)	788

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 12.6.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 9H-Pyrido[3,4-b]indole (Norharman) in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 244-63-3

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	498 (454-546)	505 (448-547)	829 (714-965)	1350 (1150-1590)	1810 (1580-2270)	904
Age 18-49 years	13-14	444 (390-505)	455 (376-519)	736 (602-859)	1150 (905-1490)	1550 (1230-1810)	550
Age 50+ years	13-14	634 (564-714)	603 (515-732)	1100 (867-1330)	1780 (1440-2120)	2570 (2010-3080)	354
Males	13-14	429 (371-498)	429 (388-484)	672 (536-950)	1130 (827-1630)	1550 (1150-2150)	497
Females	13-14	583 (541-629)	597 (535-637)	931 (809-1160)	1590 (1330-1780)	2200 (1700-2590)	407

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 9H-Pyrido[3,4-b]indole (Norharman) in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 244-63-3

Geometric mean and selected percentiles of concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	375 (353-398)	359 (338-388)	675 (604-733)	1070 (944-1220)	1420 (1230-1700)	1435
Age 18-49 years	13-14	317 (295-342)	315 (276-347)	526 (462-585)	876 (790-944)	1140 (970-1300)	755
Age 50+ years	13-14	454 (411-501)	446 (400-522)	836 (724-899)	1250 (1080-1490)	1750 (1370-2280)	680
Males	13-14	348 (325-373)	343 (305-375)	606 (529-685)	970 (856-1230)	1330 (996-1740)	647
Females	13-14	399 (368-433)	381 (347-415)	724 (620-803)	1120 (1000-1250)	1580 (1280-1890)	788

[^] Cigarette nonsmokers who used other tobacco products were excluded

Volatile Organic Compounds (VOC)

Blood 1,1,1-Trichloroethane (Methyl chloroform) in Smokers (2013 - 2016)

CAS Number 71-55-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	829
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	458
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	371
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	496
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	333

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.010 and 0.010 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood 1,1,1-Trichloroethane (Methyl chloroform) in Non-smokers (2013 - 2016)

CAS Number 71-55-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2123
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2080
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1044
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1036
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	935
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1145

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.010 and 0.010 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood 1,1,1,2-Tetrachloroethane in Smokers (2013 - 2016)

CAS Number 79-34-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	925
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	832
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	555
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	461
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	370
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	371
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	494
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	498
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	431
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	334

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood 1,1,1,2-Tetrachloroethane in Non-smokers (2013 - 2016)

CAS Number 79-34-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2095
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2079
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1098
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1044
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	997
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1035
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	923
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	935
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1172
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1144

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood 1,2,3-Trichloropropane in Smokers (2013 - 2016)

CAS Number 96-18-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	944
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	820
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	560
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	455
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	384
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	365
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	505
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	489
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	439
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	331

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood 1,2,3-Trichloropropane in Non-smokers (2013 - 2016)

CAS Number 96-18-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2106
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2046
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1101
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1032
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1005
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1014
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	933
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	918
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1173
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1128

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood 1,2-Dibromoethane in Smokers (2013 - 2016)

CAS Number 106-93-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	790
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	442
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	348
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	477
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	313

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.015 and 0.015 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood 1,2-Dibromoethane in Non-smokers (2013 - 2016)

CAS Number 106-93-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2122
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2021
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1109
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1015
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1006
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	908
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1181
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1113

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.015 and 0.015 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood 1,2-Dichlorobenzene (o-Dichlorobenzene) in Smokers (2013 - 2016)

CAS Number 95-50-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	938
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	812
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	555
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	448
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	383
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	364
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	503
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	487
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	435
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	325

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,2-Dichlorobenzene (o-Dichlorobenzene) in Non-smokers (2013 - 2016)

CAS Number 95-50-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2084
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2028
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1089
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1017
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	995
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1011
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	923
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	910
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1161
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1118

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,2-Dichloroethane (Ethylene dichloride) in Smokers (2013 - 2016)

CAS Number 107-06-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	951
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	817
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	456
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	384
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	508
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	493
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	324

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.010 and 0.010 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood 1,2-Dichloroethane (Ethylene dichloride) in Non-smokers (2013 - 2016)

CAS Number 107-06-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2122
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2059
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1034
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1012
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1025
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	923
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1181
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1136

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.010 and 0.010 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood 1,3-Dichlorobenzene (m-Dichlorobenzene) in Smokers (2013 - 2016)

CAS Number 95-50-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	942
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	821
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	560
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	454
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	382
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	367
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	504
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	496
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	438
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	325

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,3-Dichlorobenzene (m-Dichlorobenzene) in Non-smokers (2013 - 2016)

CAS Number 95-50-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2108
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2052
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1101
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1031
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1007
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1021
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	932
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	922
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1176
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1130

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,4-Dichlorobenzene (Paradichlorobenzene) in Smokers (2013 - 2016)

CAS Number 106-46-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.079 (.055-.117)	.321 (.200-.566)	1.33 (.491-3.80)	939
Total population	15-16	*	<LOD	.105 (.066-.183)	.438 (.257-.880)	1.79 (.609-4.33)	826
Age 18-49 years	13-14	*	<LOD	.069 (.050-.099)	.241 (.149-.378)	.954 (.345-2.12)	557
Age 18-49 years	15-16	*	<LOD	.098 (.053-.194)	.390 (.179-1.30)	1.87 (.817-5.03)	459
Age 50+ years	13-14	*	<LOD	.114 (.047-.235)	.541 (.248-1.59)	2.11 (.541-4.10)	382
Age 50+ years	15-16	*	<LOD	.106 (.069-.224)	.438 (.265-.609)	1.30 (.574-2.58)	367
Males	13-14	*	<LOD	.096 (.066-.122)	.402 (.190-.640)	1.64 (.583-4.08)	503
Males	15-16	*	<LOD	.107 (.068-.201)	.438 (.214-1.12)	1.60 (.574-4.11)	494
Females	13-14	*	<LOD	.067 (.043-.129)	.297 (.187-.498)	.949 (.378-2.77)	436
Females	15-16	*	<LOD	.097 (.055-.194)	.460 (.265-.960)	1.79 (.488-6.69)	332

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,4-Dichlorobenzene (Paradichlorobenzene) in Non-smokers (2013 - 2016)

CAS Number 106-46-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.073 (.052-.100)	.311 (.192-.479)	.963 (.512-2.08)	2106
Total population	15-16	*	<LOD	.096 (.062-.165)	.384 (.240-.749)	1.18 (.589-2.60)	2072
Age 18-49 years	13-14	*	<LOD	.084 (.054-.131)	.337 (.177-.594)	1.19 (.531-3.50)	1099
Age 18-49 years	15-16	*	<LOD	.099 (.065-.186)	.524 (.257-1.31)	1.78 (.924-3.55)	1039
Age 50+ years	13-14	*	<LOD	.062 (.046-.081)	.292 (.181-.400)	.761 (.428-1.94)	1007
Age 50+ years	15-16	*	<LOD	.088 (.057-.157)	.316 (.191-.589)	.664 (.384-1.68)	1033
Males	13-14	*	<LOD	.078 (.060-.093)	.331 (.181-.462)	.696 (.462-1.67)	931
Males	15-16	*	<LOD	.093 (.064-.134)	.376 (.253-.861)	1.61 (.749-3.20)	932
Females	13-14	*	<LOD	.070 (.043-.110)	.294 (.176-.591)	1.32 (.591-3.06)	1175
Females	15-16	*	<LOD	.096 (.057-.181)	.384 (.206-.685)	.963 (.505-2.65)	1140

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood 1,4-Dioxane in Smokers (2013 - 2016)

CAS Number 123-91-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	922
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	796
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	553
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	440
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	369
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	356
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	493
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	475
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	429
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	321

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.500 and 0.500 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood 1,4-Dioxane in Non-smokers (2013 - 2016)

CAS Number 123-91-1

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2069
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1994
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1084
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1006
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	985
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	988
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	914
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	903
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1155
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1091

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.500 and 0.500 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood 2,5-Dimethylfuran in Smokers (2013 - 2016)

CAS Number 625-86-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.073 (.063-.084)	.089 (.077-.103)	.157 (.142-.174)	.234 (.204-.261)	.294 (.248-.325)	951
Total population	15-16	.078 (.067-.090)	.102 (.090-.115)	.177 (.162-.197)	.275 (.258-.291)	.343 (.310-.374)	831
Age 18-49 years	13-14	.065 (.054-.078)	.083 (.067-.098)	.154 (.130-.176)	.241 (.207-.262)	.295 (.248-.325)	567
Age 18-49 years	15-16	.058 (.044-.076)	.075 (.053-.104)	.153 (.125-.182)	.248 (.203-.289)	.316 (.251-.412)	460
Age 50+ years	13-14	.091 (.077-.106)	.105 (.088-.116)	.161 (.150-.178)	.222 (.192-.277)	.279 (.222-.338)	384
Age 50+ years	15-16	.125 (.112-.141)	.140 (.122-.154)	.231 (.176-.257)	.314 (.275-.343)	.361 (.314-.581)	371
Males	13-14	.067 (.057-.078)	.082 (.070-.098)	.161 (.132-.180)	.257 (.206-.295)	.310 (.272-.346)	509
Males	15-16	.070 (.059-.083)	.096 (.077-.111)	.165 (.147-.189)	.264 (.236-.316)	.347 (.300-.410)	499
Females	13-14	.080 (.066-.097)	.095 (.079-.111)	.155 (.134-.178)	.215 (.195-.244)	.253 (.225-.295)	442
Females	15-16	.088 (.075-.104)	.110 (.089-.133)	.191 (.163-.226)	.284 (.242-.315)	.321 (.285-.354)	332

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.011 and 0.011 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/2,5-Dimethylfuran_BiomonitoringSummary.html

Blood 2,5-Dimethylfuran in Non-smokers (2013 - 2016)

CAS Number 625-86-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2122
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2081
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1044
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1012
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1037
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	940
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	937
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1144

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.011 and 0.011 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/2,5-Dimethylfuran_BiomonitoringSummary.html

Blood Benzene in Smokers (2013 - 2016)

CAS Number 71-43-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.139 (.121-.159)	.167 (.145-.188)	.279 (.243-.311)	.413 (.371-.436)	.500 (.439-.558)	915
Total population	15-16	.153 (.135-.174)	.178 (.163-.198)	.308 (.280-.338)	.455 (.395-.535)	.642 (.510-.826)	824
Age 18-49 years	13-14	.125 (.105-.149)	.155 (.121-.176)	.263 (.229-.311)	.414 (.367-.439)	.498 (.427-.558)	542
Age 18-49 years	15-16	.121 (.096-.153)	.144 (.111-.178)	.261 (.213-.336)	.407 (.347-.503)	.602 (.425-.826)	456
Age 50+ years	13-14	.168 (.144-.196)	.195 (.167-.219)	.304 (.249-.327)	.388 (.362-.443)	.525 (.427-.633)	373
Age 50+ years	15-16	.224 (.196-.256)	.224 (.198-.261)	.372 (.303-.395)	.541 (.395-.796)	.796 (.503-1.37)	368
Males	13-14	.132 (.113-.153)	.158 (.127-.182)	.281 (.233-.339)	.436 (.403-.498)	.549 (.458-.650)	493
Males	15-16	.142 (.123-.164)	.169 (.145-.185)	.287 (.243-.346)	.477 (.395-.625)	.741 (.602-1.01)	494
Females	13-14	.146 (.122-.174)	.170 (.149-.208)	.275 (.234-.315)	.368 (.327-.430)	.444 (.388-.498)	422
Females	15-16	.168 (.145-.194)	.188 (.169-.213)	.330 (.280-.354)	.453 (.379-.523)	.541 (.415-.796)	330

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Blood Benzene in Non-smokers (2013 - 2016)

CAS Number 71-43-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	.029 (<LOD-.051)	.081 (.036-.144)	2049
Total population	15-16	*	<LOD	.028 (<LOD-.036)	.050 (.042-.058)	.067 (.058-.080)	2045
Age 18-49 years	13-14	*	<LOD	<LOD	.033 (<LOD-.061)	.090 (.037-.148)	1077
Age 18-49 years	15-16	*	<LOD	.029 (<LOD-.039)	.053 (.043-.067)	.078 (.057-.130)	1031
Age 50+ years	13-14	*	<LOD	<LOD	.027 (<LOD-.050)	.075 (.029-.125)	972
Age 50+ years	15-16	*	<LOD	.027 (<LOD-.036)	.047 (.039-.054)	.062 (.051-.071)	1014
Males	13-14	*	<LOD	<LOD	.032 (<LOD-.073)	.108 (.036-.148)	910
Males	15-16	*	<LOD	.029 (<LOD-.038)	.051 (.041-.057)	.070 (.057-.086)	924
Females	13-14	*	<LOD	<LOD	.027 (<LOD-.052)	.060 (.036-.107)	1139
Females	15-16	*	<LOD	.026 (<LOD-.035)	.050 (.039-.062)	.065 (.054-.089)	1121

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Blood Benzonitrile in Smokers (2015 - 2016)

CAS Number 100-47-0

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	<LOD	.221 (.177-.281)	.320 (.228-.494)	823
Age 18-49 years	15-16	*	<LOD	<LOD	.231 (.177-.292)	.367 (.242-.516)	456
Age 50+ years	15-16	*	<LOD	<LOD	.198 (.156-.290)	.282 (.198-.658)	367
Males	15-16	*	<LOD	.150 (<LOD-.169)	.255 (.195-.381)	.438 (.281-.658)	494
Females	15-16	*	<LOD	<LOD	.188 (.163-.218)	.248 (.198-.327)	329

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 0.150.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Benzonitrile in Non-smokers (2015 - 2016)

CAS Number 100-47-0

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2039
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1027
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1012
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	918
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1121

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 0.150.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Bromodichloromethane in Smokers (2013 - 2016)

CAS Number 75-27-4

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	8.00 (<LOD-10.0)	11.0 (8.00-15.0)	932
Total population	15-16	*	<LOD	<LOD	11.0 (<LOD-18.0)	15.0 (10.0-21.0)	827
Age 18-49 years	13-14	*	<LOD	<LOD	8.00 (<LOD-10.0)	11.0 (8.00-13.0)	554
Age 18-49 years	15-16	*	<LOD	<LOD	11.0 (<LOD-18.0)	17.0 (11.0-21.0)	459
Age 50+ years	13-14	*	<LOD	<LOD	7.00 (<LOD-10.0)	12.0 (7.00-18.0)	378
Age 50+ years	15-16	*	<LOD	<LOD	10.0 (<LOD-15.0)	14.0 (8.00-34.0)	368
Males	13-14	*	<LOD	<LOD	8.00 (<LOD-11.0)	11.0 (7.00-18.0)	497
Males	15-16	*	<LOD	<LOD	11.0 (<LOD-21.0)	15.0 (9.00-29.0)	494
Females	13-14	*	<LOD	<LOD	7.00 (<LOD-9.00)	10.0 (8.00-12.0)	435
Females	15-16	*	<LOD	<LOD	9.00 (<LOD-16.0)	15.0 (9.00-21.0)	333

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 6.00 and 6.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Bromodichloromethane in Non-smokers (2013 - 2016)

CAS Number 75-27-4

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	7.00 (<LOD-8.00)	9.00 (7.00-12.0)	2093
Total population	15-16	*	<LOD	<LOD	9.00 (6.00-13.0)	13.0 (9.00-21.0)	2079
Age 18-49 years	13-14	*	<LOD	<LOD	7.00 (<LOD-8.00)	10.0 (8.00-12.0)	1095
Age 18-49 years	15-16	*	<LOD	<LOD	10.0 (6.00-15.0)	16.0 (11.0-20.0)	1041
Age 50+ years	13-14	*	<LOD	<LOD	6.00 (<LOD-8.00)	9.00 (7.00-12.0)	998
Age 50+ years	15-16	*	<LOD	<LOD	7.00 (<LOD-11.0)	11.0 (6.00-25.0)	1038
Males	13-14	*	<LOD	<LOD	7.00 (<LOD-9.00)	10.0 (9.00-12.0)	927
Males	15-16	*	<LOD	<LOD	9.00 (6.00-14.0)	16.0 (10.0-21.0)	936
Females	13-14	*	<LOD	<LOD	6.00 (<LOD-8.00)	9.00 (7.00-11.0)	1166
Females	15-16	*	<LOD	<LOD	9.00 (<LOD-12.0)	12.0 (8.00-21.0)	1143

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 6.00 and 6.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Chlorobenzene (Monochlorobenzene) in Smokers (2013 - 2016)

CAS Number 108-90-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	821
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	458
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	363
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	494
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.011 and 0.011 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood Chlorobenzene (Monochlorobenzene) in Non-smokers (2013 - 2016)

CAS Number 108-90-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2122
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2079
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1109
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1044
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1035
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	940
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	935
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1144

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.011 and 0.011 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Chlorobenzenes_BiomonitoringSummary.html

Blood Chloroethane in Smokers (2013 - 2016)

CAS Number 75-00-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	949
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	823
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	565
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	455
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	384
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	368
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	508
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	492
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	441
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	331

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.045 and 0.045 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Chloroethane in Non-smokers (2013 - 2016)

CAS Number 75-00-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2119
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2057
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1028
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1009
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1029
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	937
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	928
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1129

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.045 and 0.045 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Cyclohexane in Smokers (2013 - 2016)

CAS Number 110-82-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	899
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	814
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	533
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	452
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	366
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	362
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	475
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	488
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	424
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	326

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.020 and 0.020 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Cyclohexane in Non-smokers (2013 - 2016)

CAS Number 110-82-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1991
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1989
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1036
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	998
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	955
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	991
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	891
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	898
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1100
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1091

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.020 and 0.020 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Dibromochloromethane (Chlorodibromomethane) in Smokers (2013 - 2016)

CAS Number 124-48-1

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	7.00 (<LOD-11.0)	948
Total population	15-16	*	<LOD	<LOD	9.00 (<LOD-16.0)	15.0 (<LOD-27.0)	831
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	7.00 (<LOD-10.0)	565
Age 18-49 years	15-16	*	<LOD	<LOD	9.00 (<LOD-19.0)	15.0 (<LOD-27.0)	459
Age 50+ years	13-14	*	<LOD	<LOD	5.00 (<LOD-9.00)	10.0 (5.00-13.0)	383
Age 50+ years	15-16	*	<LOD	<LOD	7.00 (<LOD-16.0)	12.0 (<LOD-23.0)	372
Males	13-14	*	<LOD	<LOD	5.00 (<LOD-7.00)	8.00 (6.00-13.0)	505
Males	15-16	*	<LOD	<LOD	9.00 (<LOD-21.0)	16.0 (5.00-23.0)	498
Females	13-14	*	<LOD	<LOD	<LOD	7.00 (<LOD-10.0)	443
Females	15-16	*	<LOD	<LOD	7.00 (<LOD-12.0)	11.0 (<LOD-20.0)	333

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 5.00 and 5.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Dibromochloromethane (Chlorodibromomethane) in Non-smokers (2013 - 2016)

CAS Number 124-48-1

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	7.00 (6.00-8.00)	2118
Total population	15-16	*	<LOD	<LOD	6.00 (<LOD-12.0)	10.0 (5.00-22.0)	2085
Age 18-49 years	13-14	*	<LOD	<LOD	5.00 (<LOD-7.00)	8.00 (6.00-12.0)	1109
Age 18-49 years	15-16	*	<LOD	<LOD	7.00 (<LOD-17.0)	13.0 (5.00-27.0)	1046
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	6.00 (<LOD-7.00)	1009
Age 50+ years	15-16	*	<LOD	<LOD	5.00 (<LOD-9.00)	9.00 (5.00-18.0)	1039
Males	13-14	*	<LOD	<LOD	<LOD	7.00 (6.00-9.00)	941
Males	15-16	*	<LOD	<LOD	6.00 (<LOD-11.0)	11.0 (6.00-20.0)	938
Females	13-14	*	<LOD	<LOD	<LOD	7.00 (5.00-9.00)	1177
Females	15-16	*	<LOD	<LOD	6.00 (<LOD-13.0)	10.0 (5.00-25.0)	1147

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 5.00 and 5.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Dichloromethane (Methylene chloride) in Smokers (2013 - 2016)

CAS Number 75-09-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	928
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	820
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	555
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	451
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	373
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	369
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	498
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	492
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	430
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	328

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.250 and 0.250 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Dichloromethane (Methylene chloride) in Non-smokers (2013 - 2016)

CAS Number 75-09-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2085
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2037
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1088
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1023
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	997
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1014
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	924
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	914
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1161
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1123

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.250 and 0.250 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Diethyl Ether in Smokers (2013 - 2016)

CAS Number 60-29-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	901
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	812
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	535
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	449
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	366
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	363
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	481
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	485
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	420
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Diethyl Ether in Non-smokers (2013 - 2016)

CAS Number 60-29-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2017
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2053
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1060
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1027
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	957
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1026
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	897
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	926
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1120
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1127

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Ethyl Acetate in Smokers (2013 - 2016)

CAS Number 141-78-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	939
Total population	15-16	*	<LOD	<LOD	<LOD	.316 (<LOD-4.64)	802
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	559
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	.316 (<LOD-4.64)	441
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	.541 (<LOD-4.08)	380
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	1.02 (<LOD-12.4)	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	503
Males	15-16	*	<LOD	<LOD	<LOD	.694 (<LOD-5.76)	479
Females	13-14	*	<LOD	<LOD	<LOD	.224 (<LOD-6.39)	436
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	323

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.158 and 0.158 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Ethyl Acetate in Non-smokers (2013 - 2016)

CAS Number 141-78-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2080
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1996
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1088
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1008
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	992
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	988
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	919
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	902
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1161
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1094

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.158 and 0.158 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette nonsmokers who used other tobacco products were excluded

Blood Ethylbenzene in Smokers (2013 - 2016)

CAS Number 100-41-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.062 (.056-.068)	.063 (.059-.070)	.104 (.094-.115)	.150 (.137-.165)	.189 (.165-.199)	921
Total population	15-16	.068 (.060-.076)	.075 (.068-.084)	.117 (.105-.132)	.167 (.148-.194)	.202 (.174-.251)	830
Age 18-49 years	13-14	.059 (.052-.066)	.060 (.055-.068)	.104 (.092-.119)	.151 (.136-.173)	.189 (.164-.209)	546
Age 18-49 years	15-16	.056 (.046-.068)	.062 (.048-.077)	.105 (.088-.128)	.160 (.122-.196)	.196 (.162-.233)	459
Age 50+ years	13-14	.067 (.060-.075)	.070 (.062-.080)	.103 (.090-.115)	.147 (.132-.152)	.192 (.151-.197)	375
Age 50+ years	15-16	.091 (.079-.106)	.095 (.085-.101)	.135 (.121-.152)	.183 (.154-.202)	.222 (.179-.375)	371
Males	13-14	.062 (.055-.069)	.062 (.055-.072)	.113 (.097-.132)	.170 (.146-.194)	.199 (.189-.217)	490
Males	15-16	.065 (.057-.075)	.073 (.064-.080)	.122 (.101-.135)	.172 (.146-.207)	.220 (.167-.332)	498
Females	13-14	.061 (.054-.069)	.064 (.060-.073)	.094 (.084-.108)	.136 (.124-.149)	.156 (.147-.169)	431
Females	15-16	.071 (.061-.082)	.079 (.068-.091)	.114 (.104-.133)	.164 (.146-.185)	.198 (.155-.269)	332

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Blood Ethylbenzene in Non-smokers (2013 - 2016)

CAS Number 100-41-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	.035 (.025-.047)	.054 (.043-.075)	2031
Total population	15-16	*	<LOD	<LOD	.034 (.029-.041)	.056 (.045-.073)	2062
Age 18-49 years	13-14	*	<LOD	<LOD	.031 (<LOD-.040)	.050 (.037-.079)	1058
Age 18-49 years	15-16	*	<LOD	<LOD	.038 (.029-.050)	.060 (.043-.087)	1036
Age 50+ years	13-14	*	<LOD	<LOD	.040 (<LOD-.059)	.059 (.045-.082)	973
Age 50+ years	15-16	*	<LOD	<LOD	.031 (.026-.042)	.052 (.034-.075)	1026
Males	13-14	*	<LOD	<LOD	.039 (.031-.048)	.057 (.048-.076)	901
Males	15-16	*	<LOD	<LOD	.039 (.031-.052)	.061 (.045-.089)	927
Females	13-14	*	<LOD	<LOD	.031 (<LOD-.047)	.052 (.035-.077)	1130
Females	15-16	*	<LOD	<LOD	.030 (.025-.038)	.052 (.035-.069)	1135

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Blood Furan in Smokers (2013 - 2016)

CAS Number 110-00-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.051 (.046-.056)	.055 (.046-.063)	.092 (.082-.104)	.139 (.126-.152)	.172 (.146-.205)	951
Total population	15-16	.054 (.048-.059)	.057 (.049-.066)	.106 (.092-.116)	.158 (.141-.171)	.190 (.164-.230)	833
Age 18-49 years	13-14	.047 (.041-.054)	.048 (.037-.061)	.087 (.075-.103)	.142 (.133-.155)	.176 (.148-.202)	566
Age 18-49 years	15-16	.045 (.038-.054)	.043 (.032-.058)	.090 (.072-.111)	.146 (.115-.164)	.172 (.158-.206)	461
Age 50+ years	13-14	.058 (.051-.065)	.061 (.053-.072)	.103 (.089-.112)	.136 (.118-.165)	.170 (.131-.226)	385
Age 50+ years	15-16	.071 (.065-.079)	.075 (.067-.090)	.124 (.110-.130)	.171 (.155-.201)	.211 (.163-.251)	372
Males	13-14	.048 (.043-.055)	.050 (.038-.061)	.090 (.077-.107)	.162 (.122-.182)	.194 (.162-.215)	508
Males	15-16	.050 (.045-.056)	.052 (.044-.061)	.096 (.078-.116)	.143 (.121-.172)	.183 (.151-.244)	499
Females	13-14	.053 (.046-.062)	.056 (.048-.066)	.094 (.075-.115)	.125 (.116-.141)	.148 (.138-.156)	443
Females	15-16	.058 (.052-.066)	.062 (.053-.075)	.115 (.099-.127)	.164 (.149-.179)	.201 (.161-.235)	334

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Furan in Non-smokers (2013 - 2016)

CAS Number 110-00-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2123
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2086
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1046
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1040
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	938
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1148

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Heptane in Smokers (2013 - 2016)

CAS Number 142-82-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	923
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	804
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	549
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	443
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	374
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	492
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	480
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	431
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	324

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.100 and 0.100 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Heptane in Non-smokers (2013 - 2016)

CAS Number 142-82-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2053
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2015
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1071
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1017
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	982
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	998
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	911
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	902
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1142
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1113

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.100 and 0.100 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Hexane in Smokers (2013 - 2016)

CAS Number 110-54-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	881
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	782
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	520
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	434
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	361
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	348
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	470
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	468
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	411
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	314

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.122 and 0.122 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Hexane in Non-smokers (2013 - 2016)

CAS Number 110-54-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1939
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1901
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1003
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	946
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	936
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	955
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	866
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	857
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1073
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1044

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.122 and 0.122 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Isobutyronitrile in Smokers (2015 - 2016)

CAS Number 78-82-0

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	.059 (.055-.066)	.094 (.083-.114)	.143 (.114-.242)	814
Age 18-49 years	15-16	*	<LOD	.052 (.040-.064)	.084 (.065-.123)	.133 (.087-.242)	453
Age 50+ years	15-16	*	.046 (<LOD-.054)	.071 (.063-.075)	.114 (.083-.128)	.173 (.111-.357)	361
Males	15-16	*	<LOD	.059 (.052-.072)	.098 (.078-.148)	.203 (.121-.291)	486
Females	15-16	*	<LOD	.060 (.053-.071)	.094 (.074-.114)	.123 (.093-.252)	328

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 0.040.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Isobutyronitrile in Non-smokers (2015 - 2016)

CAS Number 78-82-0

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2027
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1023
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1004
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	918
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1109

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 0.040.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Isopropylbenzene in Smokers (2013 - 2016)

CAS Number 98-82-8

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	817
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	457
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	360
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	491
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	326

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Isopropylbenzene in Non-smokers (2013 - 2016)

CAS Number 98-82-8

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2123
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2070
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1038
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1032
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	933
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1137

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Methyl-tert-Butyl Ether (MTBE) in Smokers (2013 - 2016)

CAS Number 1634-04-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	900
Total population	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-17.0)	745
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	538
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-15.0)	418
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	362
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-24.0)	327
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	490
Males	15-16	*	<LOD	<LOD	<LOD	14.0 (<LOD-20.0)	444
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	410
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	301

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 10.0 and 10.0 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/MTBE_BiomonitoringSummary.html

Blood Methyl-tert-Butyl Ether (MTBE) in Non-smokers (2013 - 2016)

CAS Number 1634-04-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2020
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1954
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1050
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	987
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	970
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	967
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	892
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	877
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1128
Females	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-13.0)	1077

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 10.0 and 10.0 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/MTBE_BiomonitoringSummary.html

Blood Methylcyclopentane in Smokers (2013 - 2016)

CAS Number 96-37-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	935
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	793
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	557
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	440
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	378
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	353
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	497
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	474
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	438
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	319

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.020 and 0.020 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Methylcyclopentane in Non-smokers (2013 - 2016)

CAS Number 96-37-7

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2087
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1949
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1089
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	981
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	998
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	968
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	932
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	880
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1155
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1069

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.020 and 0.020 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Nitrobenzene in Smokers (2013 - 2016)

CAS Number 98-95-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	939
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	821
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	563
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	454
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	376
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	367
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	503
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	492
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	436
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	329

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.320 and 0.320 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Nitrobenzene_BiomonitoringSummary.html

Blood Nitrobenzene in Non-smokers (2013 - 2016)

CAS Number 98-95-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2113
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2051
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1108
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1035
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1005
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1016
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	934
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	924
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1179
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1127

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.320 and 0.320 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Nitrobenzene_BiomonitoringSummary.html

Blood Octane in Smokers (2013 - 2016)

CAS Number 111-65-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	938
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	809
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	556
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	448
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	382
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	361
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	500
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	487
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	438
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	322

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.100 and 0.100 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Octane in Non-smokers (2013 - 2016)

CAS Number 111-65-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2059
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2027
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1081
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1024
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	978
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1003
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	914
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	905
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1145
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1122

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.100 and 0.100 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Tetrachloroethene (Perchloroethylene) in Smokers (2013 - 2016)

CAS Number 127-18-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	.070 (<LOD-.943)	884
Total population	15-16	*	<LOD	<LOD	<LOD	.056 (<LOD-.087)	833
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	.048 (<LOD-.096)	525
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	.080 (<LOD-.135)	461
Age 50+ years	13-14	*	<LOD	<LOD	.061 (<LOD-1.56)	1.20 (<LOD-5.11)	359
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	372
Males	13-14	*	<LOD	<LOD	.049 (<LOD-.070)	.102 (.049-.979)	472
Males	15-16	*	<LOD	<LOD	<LOD	.080 (<LOD-.135)	499
Females	13-14	*	<LOD	<LOD	<LOD	.049 (<LOD-1.56)	412
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	334

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.048 and 0.048 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Tetrachloroethene (Perchloroethylene) in Non-smokers (2013 - 2016)

CAS Number 127-18-4

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	.083 (.067-.104)	1972
Total population	15-16	*	<LOD	<LOD	<LOD	.084 (<LOD-.123)	2086
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	.074 (.050-.111)	1023
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	.071 (<LOD-.109)	1046
Age 50+ years	13-14	*	<LOD	<LOD	.051 (<LOD-.078)	.086 (.066-.146)	949
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	.102 (<LOD-.195)	1040
Males	13-14	*	<LOD	<LOD	.050 (<LOD-.063)	.099 (.066-.162)	877
Males	15-16	*	<LOD	<LOD	<LOD	.085 (<LOD-.120)	938
Females	13-14	*	<LOD	<LOD	<LOD	.078 (.051-.103)	1095
Females	15-16	*	<LOD	<LOD	<LOD	.084 (<LOD-.155)	1148

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.048 and 0.048 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Tetrachloromethane (Carbon tetrachloride) in Smokers (2013 - 2016)

CAS Number 56-23-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	824
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	456
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	368
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	494
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	330

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 5.00E-03 and 5.00E-03 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood Tetrachloromethane (Carbon tetrachloride) in Non-smokers (2013 - 2016)

CAS Number 56-23-5

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2119
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2074
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1108
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1039
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1011
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1035
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	939
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	931
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1180
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1143

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 5.00E-03 and 5.00E-03 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/OtherHalogenatedSolvents_BiomonitoringSummary.html

Blood Tetrahydrofuran in Smokers (2013 - 2016)

CAS Number 109-99-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	912
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	808
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	543
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	445
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	369
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	363
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	486
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	481
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	426
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.125 and 0.125 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Tetrahydrofuran in Non-smokers (2013 - 2016)

CAS Number 109-99-9

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2033
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2016
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1060
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	973
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1003
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	902
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	901
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1131
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1115

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.125 and 0.125 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Toluene in Smokers (2013 - 2016)

CAS Number 108-88-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.383 (.343-.428)	.422 (.363-.498)	.685 (.619-.734)	1.01 (.913-1.09)	1.19 (1.10-1.31)	913
Total population	15-16	.405 (.354-.464)	.456 (.412-.513)	.763 (.696-.847)	1.17 (.990-1.35)	1.50 (1.24-2.04)	822
Age 18-49 years	13-14	.355 (.310-.405)	.388 (.322-.471)	.670 (.567-.797)	1.01 (.875-1.09)	1.19 (1.09-1.31)	543
Age 18-49 years	15-16	.318 (.253-.398)	.366 (.266-.475)	.669 (.540-.772)	.974 (.836-1.24)	1.32 (1.06-1.71)	455
Age 50+ years	13-14	.442 (.389-.501)	.499 (.408-.542)	.701 (.631-.743)	1.02 (.913-1.12)	1.17 (1.08-1.31)	370
Age 50+ years	15-16	.601 (.520-.695)	.609 (.517-.668)	.898 (.756-1.04)	1.39 (1.03-3.08)	2.20 (1.17-7.61)	367
Males	13-14	.376 (.337-.418)	.400 (.364-.460)	.729 (.650-.826)	1.10 (1.01-1.20)	1.31 (1.19-1.60)	494
Males	15-16	.389 (.331-.458)	.430 (.375-.491)	.748 (.635-.897)	1.24 (.953-1.71)	1.72 (1.17-3.08)	495
Females	13-14	.390 (.333-.457)	.446 (.340-.541)	.646 (.581-.718)	.902 (.807-.996)	1.05 (.953-1.14)	419
Females	15-16	.427 (.361-.505)	.484 (.433-.569)	.772 (.709-.844)	1.12 (.932-1.24)	1.32 (1.06-1.66)	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Blood Toluene in Non-smokers (2013 - 2016)

CAS Number 108-88-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.064 (.059-.070)	.058 (.055-.062)	.086 (.078-.095)	.147 (.127-.188)	.241 (.201-.338)	2058
Total population	15-16	.070 (.061-.081)	.061 (.053-.074)	.101 (.085-.120)	.182 (.147-.234)	.312 (.235-.382)	2080
Age 18-49 years	13-14	.064 (.059-.070)	.057 (.054-.061)	.085 (.079-.094)	.147 (.126-.197)	.243 (.207-.388)	1072
Age 18-49 years	15-16	.071 (.062-.082)	.063 (.053-.075)	.101 (.085-.118)	.200 (.148-.262)	.343 (.239-.413)	1042
Age 50+ years	13-14	.064 (.058-.072)	.059 (.054-.065)	.088 (.077-.100)	.147 (.123-.191)	.230 (.188-.307)	986
Age 50+ years	15-16	.069 (.059-.082)	.060 (.051-.074)	.102 (.083-.122)	.164 (.140-.219)	.264 (.188-.361)	1038
Males	13-14	.069 (.063-.074)	.061 (.057-.065)	.092 (.085-.100)	.173 (.139-.213)	.244 (.215-.346)	911
Males	15-16	.076 (.065-.088)	.065 (.055-.081)	.108 (.088-.138)	.202 (.162-.278)	.323 (.253-.479)	937
Females	13-14	.061 (.054-.068)	.056 (.051-.060)	.082 (.072-.094)	.135 (.109-.174)	.225 (.147-.395)	1147
Females	15-16	.066 (.057-.076)	.059 (.052-.069)	.096 (.080-.112)	.158 (.127-.205)	.264 (.184-.374)	1143

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.025 and 0.025 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Blood Tribromomethane (Bromoform) in Smokers (2013 - 2016)

CAS Number 75-25-2

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	939
Total population	15-16	*	<LOD	<LOD	8.00 (<LOD-13.0)	13.0 (10.0-16.0)	813
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	9.00 (<LOD-11.0)	557
Age 18-49 years	15-16	*	<LOD	<LOD	10.0 (<LOD-14.0)	13.0 (8.00-23.0)	449
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	382
Age 50+ years	15-16	*	<LOD	<LOD	8.00 (<LOD-11.0)	11.0 (<LOD-28.0)	364
Males	13-14	*	<LOD	<LOD	<LOD	9.00 (<LOD-11.0)	504
Males	15-16	*	<LOD	<LOD	10.0 (<LOD-17.0)	13.0 (9.00-17.0)	486
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	435
Females	15-16	*	<LOD	<LOD	8.00 (<LOD-13.0)	11.0 (<LOD-28.0)	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 8.00 and 8.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Tribromomethane (Bromoform) in Non-smokers (2013 - 2016)

CAS Number 75-25-2

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	8.00 (<LOD-10.0)	2094
Total population	15-16	*	<LOD	<LOD	<LOD	9.00 (<LOD-16.0)	2061
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	9.00 (<LOD-12.0)	1093
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-16.0)	1033
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1001
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	8.00 (<LOD-18.0)	1028
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	927
Males	15-16	*	<LOD	<LOD	<LOD	8.00 (<LOD-16.0)	928
Females	13-14	*	<LOD	<LOD	<LOD	9.00 (<LOD-11.0)	1167
Females	15-16	*	<LOD	<LOD	<LOD	10.0 (<LOD-15.0)	1133

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 8.00 and 8.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Trichloroethene (Trichloroethylene) in Smokers (2013 - 2016)

CAS Number 79-01-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	923
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	833
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	551
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	461
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	372
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	372
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	492
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	499
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	431
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	334

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.012 and 0.012 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Trichloroethene (Trichloroethylene) in Non-smokers (2013 - 2016)

CAS Number 79-01-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2054
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2086
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1076
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1046
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	978
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1040
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	910
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	938
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1144
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1148

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.012 and 0.012 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Blood Trichloromethane (Chloroform) in Smokers (2013 - 2016)

CAS Number 67-66-3

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	9.00 (<LOD-12.0)	18.0 (15.0-24.0)	32.0 (27.0-39.0)	51.0 (38.0-62.0)	926
Total population	15-16	11.8 (10.9-12.8)	9.00 (8.00-11.0)	19.0 (16.0-22.0)	35.0 (28.0-42.0)	53.0 (36.0-70.0)	803
Age 18-49 years	13-14	*	9.00 (<LOD-12.0)	17.0 (14.0-22.0)	30.0 (25.0-36.0)	49.0 (33.0-62.0)	550
Age 18-49 years	15-16	12.0 (10.9-13.1)	10.0 (8.00-12.0)	19.0 (16.0-22.0)	36.0 (29.0-40.0)	52.0 (31.0-77.0)	447
Age 50+ years	13-14	*	9.00 (<LOD-15.0)	20.0 (15.0-27.0)	35.0 (25.0-51.0)	52.0 (37.0-77.0)	376
Age 50+ years	15-16	*	9.00 (8.00-11.0)	19.0 (14.0-22.0)	35.0 (22.0-65.0)	65.0 (28.0-79.0)	356
Males	13-14	*	<LOD	16.0 (13.0-22.0)	30.0 (24.0-38.0)	53.0 (36.0-62.0)	493
Males	15-16	11.9 (10.5-13.4)	10.0 (8.00-13.0)	19.0 (16.0-23.0)	34.0 (23.0-52.0)	53.0 (34.0-70.0)	484
Females	13-14	11.9 (9.58-14.8)	11.0 (<LOD-15.0)	21.0 (14.0-27.0)	34.0 (25.0-44.0)	45.0 (32.0-84.0)	433
Females	15-16	11.7 (10.7-12.9)	9.00 (8.00-11.0)	18.0 (15.0-20.0)	37.0 (24.0-43.0)	62.0 (26.0-147)	319

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 8.00 and 8.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Trichloromethane (Chloroform) in Non-smokers (2013 - 2016)

CAS Number 67-66-3

Geometric mean and selected percentiles of whole blood concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	8.00 (<LOD-10.0)	16.0 (14.0-19.0)	26.0 (23.0-34.0)	40.0 (32.0-48.0)	2080
Total population	15-16	*	9.00 (8.00-11.0)	17.0 (15.0-20.0)	30.0 (27.0-34.0)	47.0 (41.0-55.0)	2007
Age 18-49 years	13-14	*	<LOD	15.0 (13.0-17.0)	26.0 (22.0-32.0)	40.0 (30.0-51.0)	1087
Age 18-49 years	15-16	*	9.00 (<LOD-11.0)	16.0 (14.0-20.0)	30.0 (27.0-35.0)	47.0 (39.0-52.0)	1020
Age 50+ years	13-14	*	9.00 (<LOD-11.0)	17.0 (15.0-19.0)	27.0 (23.0-36.0)	40.0 (34.0-43.0)	993
Age 50+ years	15-16	11.4 (10.2-12.8)	9.00 (8.00-11.0)	17.0 (13.0-22.0)	30.0 (24.0-40.0)	48.0 (36.0-65.0)	987
Males	13-14	*	<LOD	16.0 (14.0-19.0)	26.0 (22.0-36.0)	38.0 (28.0-50.0)	924
Males	15-16	*	9.00 (<LOD-11.0)	17.0 (15.0-19.0)	32.0 (27.0-41.0)	54.0 (42.0-63.0)	908
Females	13-14	*	8.00 (<LOD-10.0)	16.0 (14.0-18.0)	27.0 (23.0-34.0)	41.0 (33.0-50.0)	1156
Females	15-16	*	9.00 (8.00-10.0)	16.0 (14.0-21.0)	29.0 (27.0-32.0)	42.0 (34.0-55.0)	1099

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 8.00 and 8.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood *aaa*-Trifluorotoluene in Smokers (2013 - 2016)

CAS Number 98-08-8

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	952
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	829
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	567
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	461
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	385
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	368
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	509
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	495
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	443
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	334

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood *aaa*-Trifluorotoluene in Non-smokers (2013 - 2016)

CAS Number 98-08-8

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2123
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2075
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1110
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1042
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	1013
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1033
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	933
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1182
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1142

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.040 and 0.040 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood Vinyl Bromide in Smokers (2013 - 2016)

CAS Number 593-60-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	941
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	830
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	559
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	461
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	382
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	369
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	505
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	497
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	436
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	333

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.045 and 0.045 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Blood Vinyl Bromide in Non-smokers (2013 - 2016)

CAS Number 593-60-2

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	2088
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	2065
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	1093
Age 18-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	1039
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	995
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	1026
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	923
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	928
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	1165
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	1137

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.045 and 0.045 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Blood m-/p-Xylene in Smokers (2013 - 2016)

CAS Number 108-38-3 or 106-42-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.157 (.142-.173)	.165 (.148-.181)	.258 (.239-.280)	.361 (.340-.386)	.460 (.410-.501)	946
Total population	15-16	.174 (.151-.200)	.188 (.169-.211)	.289 (.264-.325)	.414 (.360-.479)	.582 (.425-.787)	830
Age 18-49 years	13-14	.150 (.134-.169)	.158 (.138-.175)	.258 (.225-.288)	.368 (.332-.395)	.476 (.401-.516)	562
Age 18-49 years	15-16	.146 (.118-.181)	.158 (.127-.193)	.267 (.223-.321)	.391 (.316-.561)	.544 (.391-.787)	461
Age 50+ years	13-14	.169 (.150-.191)	.177 (.156-.199)	.257 (.235-.280)	.359 (.310-.410)	.447 (.385-.518)	384
Age 50+ years	15-16	.231 (.198-.269)	.226 (.204-.258)	.318 (.282-.360)	.448 (.369-.602)	.619 (.423-1.86)	369
Males	13-14	.163 (.146-.182)	.165 (.148-.186)	.288 (.255-.308)	.410 (.368-.472)	.516 (.443-.569)	506
Males	15-16	.173 (.145-.208)	.184 (.166-.218)	.302 (.257-.347)	.423 (.347-.611)	.619 (.414-.895)	498
Females	13-14	.151 (.134-.171)	.165 (.145-.182)	.239 (.208-.260)	.325 (.286-.340)	.382 (.340-.439)	440
Females	15-16	.174 (.150-.202)	.193 (.167-.217)	.281 (.258-.308)	.400 (.327-.464)	.467 (.390-.741)	332

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.034 and 0.034 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Blood m-/p-Xylene in Non-smokers (2013 - 2016)

CAS Number 108-38-3 or 106-42-3

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	.041 (.035-.047)	.065 (.057-.077)	.124 (.089-.163)	.187 (.154-.248)	2098
Total population	15-16	*	.038 (<LOD-.045)	.064 (.055-.081)	.124 (.101-.164)	.213 (.155-.278)	2086
Age 18-49 years	13-14	*	.040 (<LOD-.045)	.063 (.055-.070)	.102 (.085-.147)	.166 (.136-.248)	1099
Age 18-49 years	15-16	*	.039 (.034-.046)	.063 (.055-.079)	.143 (.101-.202)	.230 (.168-.293)	1046
Age 50+ years	13-14	.050 (.043-.059)	.043 (.036-.051)	.070 (.057-.090)	.144 (.091-.187)	.198 (.158-.286)	999
Age 50+ years	15-16	*	.038 (<LOD-.046)	.066 (.053-.084)	.113 (.099-.139)	.185 (.121-.305)	1040
Males	13-14	.050 (.045-.056)	.045 (.039-.050)	.070 (.063-.084)	.149 (.101-.169)	.203 (.168-.250)	930
Males	15-16	.049 (.042-.057)	.041 (.035-.051)	.072 (.058-.092)	.153 (.105-.208)	.237 (.156-.403)	938
Females	13-14	*	.039 (<LOD-.046)	.062 (.051-.075)	.105 (.077-.160)	.164 (.111-.302)	1168
Females	15-16	*	.037 (<LOD-.043)	.060 (.051-.071)	.114 (.091-.138)	.188 (.130-.272)	1148

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.034 and 0.034 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Blood o-Xylene in Smokers (2013 - 2016)

CAS Number 95-47-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.035 (.033-.038)	.036 (.032-.039)	.053 (.049-.058)	.075 (.067-.082)	.091 (.082-.107)	952
Total population	15-16	.039 (.035-.044)	.039 (.034-.044)	.059 (.054-.065)	.080 (.069-.095)	.106 (.080-.171)	827
Age 18-49 years	13-14	.034 (.032-.037)	.034 (.029-.039)	.053 (.047-.058)	.077 (.066-.084)	.091 (.082-.107)	567
Age 18-49 years	15-16	.034 (.030-.040)	.032 (.027-.039)	.055 (.045-.067)	.075 (.065-.098)	.098 (.071-.171)	457
Age 50+ years	13-14	.038 (.033-.042)	.037 (.032-.043)	.053 (.049-.058)	.071 (.066-.085)	.089 (.071-.114)	385
Age 50+ years	15-16	.049 (.041-.057)	.046 (.042-.052)	.064 (.056-.072)	.086 (.075-.111)	.115 (.084-.635)	370
Males	13-14	.037 (.034-.040)	.036 (.033-.041)	.058 (.053-.065)	.082 (.073-.094)	.102 (.083-.170)	509
Males	15-16	.039 (.034-.045)	.038 (.034-.045)	.060 (.051-.067)	.082 (.067-.115)	.115 (.081-.230)	494
Females	13-14	.034 (.030-.038)	.035 (.030-.039)	.049 (.043-.055)	.065 (.059-.070)	.078 (.068-.091)	443
Females	15-16	.040 (.034-.046)	.040 (.032-.046)	.058 (.053-.064)	.079 (.071-.084)	.088 (.076-.137)	333

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Blood o-Xylene in Non-smokers (2013 - 2016)

CAS Number 95-47-6

Geometric mean and selected percentiles of whole blood concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	.034 (.027-.049)	.051 (.042-.073)	2123
Total population	15-16	*	<LOD	<LOD	.035 (.028-.046)	.059 (.040-.081)	2071
Age 18-49 years	13-14	*	<LOD	<LOD	.030 (.026-.039)	.048 (.035-.070)	1110
Age 18-49 years	15-16	*	<LOD	<LOD	.037 (.026-.051)	.060 (.041-.082)	1041
Age 50+ years	13-14	*	<LOD	<LOD	.039 (.029-.051)	.057 (.046-.085)	1013
Age 50+ years	15-16	*	<LOD	<LOD	.033 (.028-.044)	.058 (.034-.097)	1030
Males	13-14	*	<LOD	<LOD	.038 (.030-.050)	.059 (.046-.075)	941
Males	15-16	*	<LOD	<LOD	.040 (.028-.060)	.060 (.039-.131)	934
Females	13-14	*	<LOD	<LOD	.032 (<LOD-.048)	.048 (.035-.075)	1182
Females	15-16	*	<LOD	<LOD	.032 (.025-.040)	.051 (.037-.071)	1137

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 and 15-16 are 0.024 and 0.024 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Volatile Organic Compound (VOC) Metabolites

Urinary N-Acetyl-S-(2-carboxyethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 51868-61-2

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	206 (182-232)	224 (190-250)	398 (358-452)	722 (593-894)	1000 (821-1240)	869
Total population	13-14	189 (169-212)	199 (178-221)	401 (352-438)	653 (573-716)	850 (731-992)	911
Total population	15-16	223 (201-247)	236 (206-267)	437 (404-470)	675 (589-767)	901 (725-973)	804
Age 20-49 years	11-12	184 (158-214)	200 (171-235)	356 (304-406)	634 (563-697)	842 (692-1070)	518
Age 20-49 years	13-14	181 (154-213)	190 (176-213)	379 (314-444)	605 (503-715)	774 (617-1060)	545
Age 20-49 years	15-16	195 (171-222)	210 (184-240)	375 (318-429)	601 (525-693)	727 (623-961)	428
Age 50+ years	11-12	245 (201-298)	251 (190-344)	501 (395-579)	911 (542-1240)	1230 (894-1710)	351
Age 50+ years	13-14	214 (191-239)	217 (185-262)	441 (363-505)	731 (619-881)	925 (754-1190)	366
Age 50+ years	15-16	274 (229-328)	287 (221-377)	476 (447-568)	775 (650-925)	942 (765-1210)	376
Males	11-12	218 (182-261)	236 (191-267)	427 (372-507)	827 (589-1060)	1230 (894-1410)	525
Males	13-14	185 (152-227)	188 (157-243)	401 (325-458)	653 (573-754)	878 (719-1060)	507
Males	15-16	229 (191-275)	228 (189-305)	448 (412-534)	727 (667-828)	942 (794-1070)	485
Females	11-12	191 (166-220)	198 (162-260)	372 (307-453)	657 (514-818)	874 (692-1060)	344
Females	13-14	193 (174-214)	202 (176-229)	401 (347-438)	653 (555-678)	774 (668-925)	434
Females	15-16	215 (199-233)	236 (204-251)	410 (343-467)	599 (496-704)	764 (614-918)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.96, 6.96, and 6.96 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-carboxyethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 51868-61-2

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	73.0 (67.3-79.3)	78.6 (72.5-86.4)	144 (133-157)	241 (216-279)	338 (291-414)	1318
Total population	13-14	67.3 (61.4-73.9)	68.5 (59.7-77.9)	138 (130-150)	236 (217-256)	327 (276-373)	1358
Total population	15-16	80.8 (73.3-89.2)	88.1 (78.1-96.8)	149 (133-171)	235 (209-248)	357 (275-399)	1401
Age 20-49 years	11-12	66.5 (58.8-75.3)	74.2 (65.7-84.1)	135 (117-147)	235 (205-260)	305 (253-351)	659
Age 20-49 years	13-14	66.3 (60.6-72.5)	64.6 (52.4-78.5)	136 (123-155)	239 (208-264)	328 (264-381)	662
Age 20-49 years	15-16	75.8 (67.1-85.7)	81.5 (70.5-93.7)	140 (124-159)	210 (189-238)	291 (235-376)	684
Age 50+ years	11-12	80.8 (73.1-89.3)	85.4 (73.9-97.7)	158 (135-175)	278 (216-333)	424 (292-489)	659
Age 50+ years	13-14	68.2 (59.1-78.7)	70.7 (58.7-91.3)	138 (123-154)	226 (205-261)	318 (261-396)	696
Age 50+ years	15-16	86.6 (76.1-98.5)	94.4 (77.0-103)	156 (133-187)	248 (206-357)	402 (252-531)	717
Males	11-12	98.1 (89.3-108)	98.6 (87.1-116)	174 (151-198)	298 (259-338)	414 (322-457)	628
Males	13-14	79.9 (70.2-90.8)	83.9 (66.4-105)	153 (139-169)	244 (219-272)	340 (284-369)	654
Males	15-16	97.2 (88.1-107)	105 (93.5-115)	177 (148-196)	251 (225-355)	426 (333-515)	660
Females	11-12	57.9 (51.4-65.1)	60.5 (48.9-73.9)	122 (106-140)	203 (175-230)	267 (230-314)	690
Females	13-14	58.3 (52.7-64.6)	58.6 (51.6-67.8)	125 (106-143)	223 (186-261)	297 (261-392)	801
Females	15-16	69.5 (62.0-78.0)	73.4 (64.8-84.8)	132 (112-149)	205 (187-235)	268 (241-347)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.96, 6.96, and 6.96 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-carboxyethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 51868-61-2

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	227 (209-247)	236 (208-265)	381 (343-416)	575 (476-698)	785 (623-906)	869
Total population	13-14	193 (170-219)	211 (179-252)	336 (309-380)	509 (443-611)	682 (613-739)	910
Total population	15-16	225 (210-240)	228 (210-241)	372 (337-392)	554 (496-632)	700 (586-812)	804
Age 20-49 years	11-12	192 (175-211)	188 (169-206)	332 (297-367)	459 (412-527)	627 (488-845)	518
Age 20-49 years	13-14	167 (144-195)	174 (147-200)	298 (258-334)	451 (370-495)	602 (471-682)	544
Age 20-49 years	15-16	184 (167-204)	186 (167-203)	276 (240-314)	444 (351-546)	573 (479-697)	428
Age 50+ years	11-12	296 (253-347)	305 (242-353)	475 (373-551)	698 (515-906)	906 (553-1380)	351
Age 50+ years	13-14	265 (242-291)	293 (262-313)	406 (382-474)	653 (546-768)	795 (696-849)	366
Age 50+ years	15-16	308 (281-337)	323 (262-363)	474 (415-524)	658 (551-774)	806 (666-1070)	376
Males	11-12	207 (182-235)	207 (185-234)	341 (296-390)	488 (409-592)	614 (513-785)	525
Males	13-14	165 (141-194)	165 (137-204)	311 (279-343)	459 (385-570)	639 (508-768)	506
Males	15-16	199 (181-220)	203 (182-233)	323 (296-339)	449 (386-561)	575 (439-726)	485
Females	11-12	257 (224-294)	270 (231-321)	429 (396-491)	695 (491-871)	871 (692-979)	344
Females	13-14	225 (198-256)	252 (213-283)	370 (320-422)	578 (471-645)	712 (617-772)	434
Females	15-16	260 (233-290)	246 (221-290)	434 (386-496)	649 (526-738)	776 (649-1070)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-carboxyethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 51868-61-2

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	85.6 (79.9-91.8)	83.5 (77.6-92.1)	132 (122-142)	192 (174-227)	257 (232-285)	1317
Total population	13-14	80.6 (73.7-88.1)	79.9 (72.2-89.6)	127 (114-144)	194 (178-213)	272 (237-367)	1357
Total population	15-16	91.4 (85.5-97.6)	89.4 (79.8-97.6)	138 (128-149)	213 (197-233)	263 (233-289)	1399
Age 20-49 years	11-12	73 (67.3-79.1)	71.6 (68.0-77.9)	111 (97.1-128)	165 (145-177)	188 (175-214)	658
Age 20-49 years	13-14	74.1 (68.2-80.5)	75.0 (66.9-80.3)	114 (101-126)	173 (158-199)	241 (199-271)	662
Age 20-49 years	15-16	80.2 (75.4-85.3)	78.2 (70.2-87.0)	115 (104-123)	172 (151-193)	213 (183-244)	682
Age 50+ years	11-12	102 (92.8-111)	96.9 (92.2-104)	153 (137-172)	251 (205-284)	322 (277-373)	659
Age 50+ years	13-14	89.3 (78.9-101)	87.5 (75.3-99.4)	141 (122-162)	229 (192-252)	372 (252-442)	695
Age 50+ years	15-16	106 (96.3-118)	104 (92.3-121)	163 (145-191)	243 (215-271)	289 (263-358)	717
Males	11-12	87.5 (80.8-94.8)	82.4 (73.5-95.8)	128 (115-140)	201 (168-255)	277 (203-326)	627
Males	13-14	77.6 (68.4-88.0)	77.8 (70.5-89.3)	117 (101-138)	178 (155-217)	241 (192-289)	653
Males	15-16	89.4 (83.4-95.9)	83.7 (74.0-93.3)	130 (121-138)	197 (170-240)	264 (215-356)	660
Females	11-12	84.2 (77.1-91.9)	87.3 (75.9-94.5)	133 (120-147)	190 (174-219)	248 (212-291)	690
Females	13-14	83.2 (76.4-90.5)	80.2 (70.7-92.7)	133 (117-152)	213 (184-234)	330 (237-428)	801
Females	15-16	93 (85.4-101)	93.1 (81.4-104)	146 (128-163)	217 (196-236)	251 (233-289)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3-hydroxypropyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 23127-40-4

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	821 (727-927)	831 (720-1030)	1760 (1520-2070)	2920 (2640-3180)	3760 (3370-4290)	869
Total population	13-14	717 (613-838)	757 (647-912)	1470 (1260-1860)	2760 (2300-3110)	3480 (2810-4100)	908
Total population	15-16	947 (835-1070)	1110 (986-1150)	1990 (1640-2250)	3150 (2550-3970)	4430 (3340-5580)	764
Age 20-49 years	11-12	764 (637-915)	809 (606-986)	1620 (1330-2070)	2710 (2350-3020)	3480 (3020-3750)	518
Age 20-49 years	13-14	698 (567-858)	745 (591-957)	1430 (1210-1860)	2710 (2130-3280)	3480 (2720-4330)	544
Age 20-49 years	15-16	796 (665-952)	863 (706-1100)	1760 (1540-2040)	3240 (2120-4570)	4430 (3240-5580)	405
Age 50+ years	11-12	919 (776-1090)	1020 (771-1290)	2050 (1660-2400)	3560 (2840-4240)	4290 (3560-4600)	351
Age 50+ years	13-14	776 (671-897)	805 (685-1000)	1560 (1230-2180)	2800 (2490-3030)	3460 (2810-3680)	364
Age 50+ years	15-16	1220 (1020-1450)	1280 (1080-1590)	2240 (1760-2660)	3050 (2790-3640)	4430 (3450-5830)	359
Males	11-12	866 (718-1040)	868 (708-1160)	1910 (1580-2350)	3020 (2670-3190)	4290 (3020-4600)	525
Males	13-14	678 (545-842)	718 (577-891)	1470 (1320-1770)	2720 (2250-2990)	3270 (2840-3880)	504
Males	15-16	978 (820-1170)	1120 (910-1330)	2200 (1760-2530)	3300 (2730-4430)	4740 (3150-6480)	458
Females	11-12	767 (696-846)	801 (699-942)	1580 (1320-2010)	2710 (2180-3560)	3560 (2710-4240)	344
Females	13-14	759 (652-883)	792 (677-956)	1470 (1140-1970)	2720 (2150-3460)	3490 (2610-4640)	433
Females	15-16	910 (778-1060)	1020 (853-1170)	1760 (1470-2120)	2920 (2120-4430)	3970 (3260-5020)	324

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 13.0, 13.0, and 13.0 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3-hydroxypropyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 23127-40-4

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	171 (159-184)	174 (161-190)	313 (293-335)	534 (466-651)	779 (687-920)	1318
Total population	13-14	172 (157-187)	165 (149-180)	322 (289-354)	587 (505-671)	846 (699-1080)	1356
Total population	15-16	197 (178-218)	198 (176-224)	370 (329-401)	629 (576-685)	910 (817-1040)	1310
Age 20-49 years	11-12	183 (162-206)	190 (163-220)	328 (298-366)	558 (438-671)	771 (616-1050)	659
Age 20-49 years	13-14	184 (165-206)	178 (158-199)	341 (297-382)	601 (501-681)	846 (678-1250)	662
Age 20-49 years	15-16	209 (183-238)	222 (194-246)	385 (350-446)	688 (569-800)	906 (789-1160)	643
Age 50+ years	11-12	160 (142-180)	161 (140-175)	291 (238-355)	529 (395-702)	794 (640-971)	659
Age 50+ years	13-14	159 (141-180)	154 (130-183)	301 (259-343)	580 (483-668)	857 (668-1040)	694
Age 50+ years	15-16	184 (162-209)	177 (157-209)	329 (279-400)	600 (496-674)	910 (632-1460)	667
Males	11-12	220 (203-238)	224 (210-238)	349 (301-375)	634 (528-682)	823 (671-949)	628
Males	13-14	204 (181-231)	194 (166-235)	348 (312-386)	587 (512-700)	885 (633-1290)	656
Males	15-16	251 (226-280)	268 (224-304)	420 (370-526)	698 (597-853)	1040 (817-1460)	622
Females	11-12	141 (126-157)	140 (118-155)	283 (244-313)	495 (395-651)	771 (515-1120)	690
Females	13-14	148 (132-166)	135 (112-160)	280 (239-340)	581 (465-668)	839 (706-1040)	798
Females	15-16	161 (142-183)	151 (130-183)	291 (243-349)	566 (441-679)	800 (679-910)	742

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 13.0, 13.0, and 13.0 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3-hydroxypropyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 23127-40-4

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	907 (833-987)	930 (817-1090)	1780 (1590-1990)	2830 (2290-3290)	3690 (2940-4720)	869
Total population	13-14	729 (611-871)	796 (645-945)	1490 (1130-1870)	2520 (1950-3010)	3070 (2620-3820)	907
Total population	15-16	960 (867-1060)	1070 (985-1130)	1830 (1500-2120)	2880 (2490-3380)	4000 (3230-5000)	764
Age 20-49 years	11-12	796 (699-906)	815 (663-955)	1420 (1290-1710)	2440 (2100-3120)	3560 (2810-4280)	518
Age 20-49 years	13-14	644 (530-782)	697 (543-854)	1140 (960-1640)	2200 (1870-2700)	2900 (2330-3670)	543
Age 20-49 years	15-16	757 (625-917)	800 (622-983)	1420 (1130-2000)	2500 (1940-3020)	3130 (2410-5000)	405
Age 50+ years	11-12	1110 (987-1250)	1260 (1080-1460)	2210 (1920-2290)	3050 (2290-3900)	3900 (2830-5520)	351
Age 50+ years	13-14	968 (826-1130)	1090 (945-1330)	1860 (1550-2120)	2810 (2240-3700)	3820 (2660-4580)	364
Age 50+ years	15-16	1370 (1200-1560)	1480 (1260-1630)	2060 (1810-2680)	3550 (2870-4400)	4960 (3810-5250)	359
Males	11-12	820 (736-914)	801 (707-952)	1420 (1260-1670)	2290 (1950-2870)	3370 (2310-4000)	525
Males	13-14	601 (500-722)	651 (512-852)	1190 (1020-1490)	1960 (1720-2260)	2730 (2120-2900)	503
Males	15-16	851 (754-961)	921 (786-1060)	1640 (1430-1840)	2550 (1950-3020)	3150 (2650-3870)	458
Females	11-12	1030 (853-1240)	1170 (1020-1330)	2250 (1810-2500)	3110 (2500-4110)	4250 (2930-5740)	344
Females	13-14	889 (722-1100)	917 (728-1140)	1780 (1310-2250)	2870 (2160-3720)	3710 (3010-4180)	433
Females	15-16	1110 (951-1290)	1190 (1080-1310)	2060 (1500-2630)	3550 (2650-4600)	5000 (3370-5460)	324

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3-hydroxypropyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 23127-40-4

Metabolite of Acrolein

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	201 (189-214)	184 (171-197)	298 (283-316)	510 (446-564)	692 (576-812)	1317
Total population	13-14	202 (184-222)	183 (170-203)	303 (280-340)	551 (478-646)	905 (652-1220)	1355
Total population	15-16	224 (209-239)	206 (193-219)	317 (284-349)	562 (480-700)	933 (691-1170)	1308
Age 20-49 years	11-12	201 (183-220)	180 (163-197)	298 (269-342)	519 (424-626)	678 (546-863)	658
Age 20-49 years	13-14	202 (183-223)	181 (161-208)	299 (270-340)	538 (438-688)	876 (657-940)	662
Age 20-49 years	15-16	225 (210-242)	207 (197-219)	313 (279-364)	531 (448-701)	789 (597-1070)	641
Age 50+ years	11-12	201 (179-226)	190 (171-211)	298 (246-350)	499 (399-606)	710 (550-902)	659
Age 50+ years	13-14	206 (183-231)	184 (167-208)	310 (280-360)	578 (459-703)	1020 (602-1960)	693
Age 50+ years	15-16	224 (204-245)	204 (177-226)	317 (274-351)	596 (407-792)	1030 (596-1370)	667
Males	11-12	197 (184-210)	186 (169-199)	287 (245-318)	451 (392-527)	606 (529-675)	627
Males	13-14	197 (177-220)	184 (171-206)	289 (260-329)	462 (369-580)	688 (511-904)	655
Males	15-16	231 (215-249)	205 (189-226)	319 (282-387)	540 (454-700)	789 (596-977)	622
Females	11-12	205 (188-222)	183 (164-211)	315 (284-355)	544 (457-647)	778 (622-902)	690
Females	13-14	206 (182-233)	178 (159-205)	323 (271-392)	602 (489-905)	1080 (678-1700)	798
Females	15-16	217 (196-241)	204 (184-220)	310 (264-340)	564 (436-711)	1040 (618-1300)	740

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-carbamoylethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	110 (92.8-130)	113 (84.6-144)	219 (194-256)	384 (291-507)	507 (358-679)	869
Total population	13-14	121 (103-143)	124 (107-148)	239 (208-271)	400 (320-564)	613 (405-1000)	853
Total population	15-16	118 (107-131)	124 (109-143)	215 (198-234)	356 (310-438)	571 (417-738)	804
Age 20-49 years	11-12	118 (93.4-149)	129 (99.8-158)	254 (195-305)	420 (316-540)	540 (401-752)	518
Age 20-49 years	13-14	134 (109-165)	138 (114-174)	255 (213-323)	491 (359-681)	727 (464-1000)	512
Age 20-49 years	15-16	115 (97.1-135)	127 (104-149)	235 (209-268)	440 (341-528)	629 (497-761)	428
Age 50+ years	11-12	97.9 (79.7-120)	84.7 (75.3-138)	201 (138-251)	292 (243-370)	407 (324-528)	351
Age 50+ years	13-14	101 (86.6-117)	102 (79.1-114)	200 (157-226)	307 (253-354)	383 (318-451)	341
Age 50+ years	15-16	121 (106-139)	122 (99.1-153)	197 (166-220)	298 (230-356)	364 (282-658)	376
Males	11-12	122 (96.1-154)	131 (99.7-164)	256 (212-292)	445 (333-540)	540 (422-752)	525
Males	13-14	130 (101-166)	141 (104-180)	253 (210-309)	476 (329-607)	625 (529-878)	469
Males	15-16	128 (108-153)	149 (120-168)	241 (218-270)	390 (311-487)	571 (405-758)	485
Females	11-12	96.2 (84.8-109)	90.0 (79.5-122)	194 (153-226)	304 (254-378)	401 (313-445)	344
Females	13-14	113 (97.1-132)	112 (104-127)	210 (179-255)	366 (282-461)	511 (346-1230)	410
Females	15-16	107 (96.1-119)	109 (95.9-122)	178 (155-199)	319 (236-497)	574 (288-758)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.20, 2.20, and 2.20 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoylethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	36.5 (34.0-39.3)	37.3 (34.7-40.6)	64.8 (61.4-68.9)	112 (100-125)	162 (141-188)	1318
Total population	13-14	37.3 (34.2-40.7)	37.1 (34.6-41.2)	75.8 (67.4-83.5)	127 (119-140)	181 (148-219)	1312
Total population	15-16	43.0 (39.8-46.4)	42.8 (38.3-46.9)	83.3 (73.9-92.1)	142 (124-157)	195 (171-238)	1401
Age 20-49 years	11-12	38.9 (34.1-44.4)	41.2 (34.7-47.0)	73.0 (63.8-78.5)	131 (106-163)	193 (152-285)	659
Age 20-49 years	13-14	40.1 (36.2-44.5)	41.8 (36.9-45.6)	85.7 (76.7-93.1)	137 (119-162)	186 (161-231)	644
Age 20-49 years	15-16	47.1 (41.5-53.4)	47.0 (39.9-57.1)	87.8 (75.6-102)	161 (136-186)	224 (184-286)	684
Age 50+ years	11-12	34.1 (31.6-36.8)	35.3 (32.5-38.8)	59.7 (54.8-64.3)	94.0 (79.3-117)	129 (104-145)	659
Age 50+ years	13-14	33.8 (29.8-38.2)	33.6 (30.3-39.7)	64.9 (55.4-77.0)	121 (102-144)	174 (120-227)	668
Age 50+ years	15-16	38.8 (35.2-42.8)	37.0 (32.1-42.8)	75.2 (61.1-89.9)	120 (105-148)	171 (136-214)	717
Males	11-12	45.8 (42.8-49.0)	47.6 (40.4-53.0)	76.9 (72.3-82.2)	129 (112-142)	162 (142-189)	628
Males	13-14	42.6 (37.7-48.1)	44.4 (37.1-49.5)	85.4 (73.4-94.8)	136 (117-152)	183 (152-227)	626
Males	15-16	51.4 (46.4-56.9)	55.2 (44.9-60.9)	93.8 (79.6-108)	171 (127-202)	250 (202-326)	660
Females	11-12	30.6 (27.2-34.3)	30.7 (29.2-33.4)	55.5 (49.1-59.9)	100 (84.0-117)	164 (108-285)	690
Females	13-14	33.5 (30.3-37.1)	33.4 (30.2-37.7)	68.7 (60.0-80.5)	127 (103-144)	183 (137-227)	779
Females	15-16	37.2 (33.8-40.9)	36.3 (31.2-40.2)	73.7 (60.8-85.3)	129 (105-152)	164 (144-187)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.20, 2.20, and 2.20 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoyl-ethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	121 (107-137)	129 (115-142)	180 (161-199)	248 (214-325)	343 (248-432)	869
Total population	13-14	125 (105-150)	127 (108-158)	209 (178-240)	304 (258-337)	355 (327-453)	853
Total population	15-16	119 (110-129)	115 (110-120)	187 (163-212)	287 (226-308)	360 (295-515)	804
Age 20-49 years	11-12	123 (105-144)	131 (116-148)	186 (153-230)	280 (221-364)	367 (278-434)	518
Age 20-49 years	13-14	126 (104-152)	125 (102-158)	220 (175-256)	319 (295-349)	419 (335-516)	512
Age 20-49 years	15-16	109 (94.5-125)	106 (94.2-116)	177 (141-222)	287 (217-339)	373 (295-515)	428
Age 50+ years	11-12	118 (102-137)	124 (98.6-149)	175 (146-200)	235 (176-282)	272 (235-353)	351
Age 50+ years	13-14	126 (105-153)	131 (112-167)	195 (178-221)	269 (223-318)	318 (266-371)	341
Age 50+ years	15-16	136 (125-148)	123 (117-134)	190 (169-212)	283 (214-360)	360 (260-583)	376
Males	11-12	115 (99.3-134)	121 (100-142)	176 (154-188)	233 (191-353)	353 (230-432)	525
Males	13-14	117 (94.8-144)	124 (99.2-146)	196 (157-236)	297 (235-346)	355 (298-454)	469
Males	15-16	112 (99.2-126)	107 (100-115)	166 (143-190)	287 (197-346)	371 (302-583)	485
Females	11-12	129 (110-152)	135 (117-161)	188 (161-235)	270 (230-337)	340 (259-391)	344
Females	13-14	135 (112-162)	142 (114-177)	217 (188-256)	319 (284-349)	371 (328-502)	410
Females	15-16	129 (118-141)	123 (114-135)	207 (179-218)	292 (250-308)	360 (288-496)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoylethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	42.8 (40.5-45.4)	42.1 (39.2-45.3)	61.6 (58.9-63.8)	90.0 (79.5-104)	118 (105-134)	1317
Total population	13-14	44.7 (40.6-49.2)	43.1 (39.4-48.0)	69.3 (62.6-77.3)	106 (92.9-125)	153 (128-193)	1311
Total population	15-16	48.6 (46.4-50.9)	45.5 (43.8-47.0)	69.5 (63.3-76.0)	112 (103-120)	152 (126-171)	1399
Age 20-49 years	11-12	42.8 (39.1-46.8)	41.3 (36.9-44.8)	61.2 (56.7-64.7)	93.8 (76.8-113)	128 (103-159)	658
Age 20-49 years	13-14	44.4 (40.4-48.8)	42.1 (38.5-46.4)	69.1 (62.6-77.4)	106 (92.9-124)	152 (119-193)	644
Age 20-49 years	15-16	49.8 (45.8-54.1)	46.2 (44.7-49.4)	70.0 (63.6-78.9)	115 (90.9-143)	165 (120-230)	682
Age 50+ years	11-12	42.9 (39.5-46.6)	43.5 (38.9-48.5)	62.3 (56.7-66.2)	88.1 (72.9-105)	113 (90.4-155)	659
Age 50+ years	13-14	44.9 (39.7-50.8)	44.4 (38.1-50.3)	69.3 (60.5-79.6)	106 (89.7-138)	159 (120-229)	667
Age 50+ years	15-16	47.7 (45.0-50.5)	43.8 (41.2-47.4)	68.1 (62.9-75.8)	107 (93.4-119)	145 (115-215)	717
Males	11-12	40.9 (38.5-43.5)	39.5 (35.7-43.4)	61.2 (55.3-66.0)	82.5 (76.7-90.9)	109 (100-122)	627
Males	13-14	41.4 (37.3-46.1)	41.2 (36.1-46.9)	65.8 (59.7-71.9)	98.5 (87.5-106)	137 (104-178)	625
Males	15-16	47.3 (44.4-50.4)	41.8 (38.5-45.3)	67.7 (58.3-79.4)	115 (102-127)	156 (134-183)	660
Females	11-12	44.4 (41.0-48.2)	44.8 (40.0-47.7)	62.3 (57.7-65.4)	96.8 (79.2-117)	131 (98.1-175)	690
Females	13-14	47.6 (42.8-53.0)	44.9 (40.6-50.3)	74.6 (61.8-84.0)	118 (96.7-152)	188 (134-236)	779
Females	15-16	49.8 (46.4-53.4)	48.0 (44.1-53.2)	70.0 (63.8-76.8)	108 (92.9-123)	144 (109-186)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	17.2 (15.2-19.4)	15.8 (13.6-19.7)	30.3 (26.2-35.3)	53.0 (39.0-69.3)	76.2 (53.3-82.0)	869
Total population	13-14	17.3 (15.6-19.3)	17.5 (15.7-19.2)	30.2 (26.2-33.9)	51.2 (40.9-66.4)	78.0 (55.2-122)	915
Total population	15-16	15.9 (14.4-17.6)	15.0 (12.7-17.1)	27.4 (24.8-30.6)	41.5 (36.2-55.6)	65.1 (51.5-78.8)	804
Age 20-49 years	11-12	18.1 (15.5-21.2)	18.0 (13.6-21.9)	31.4 (25.2-40.3)	57.1 (43.0-73.9)	77.4 (55.3-94.7)	518
Age 20-49 years	13-14	18.7 (16.2-21.5)	19.1 (16.6-22.1)	31.4 (27.0-35.4)	56.5 (41.6-78.0)	88.4 (58.1-125)	547
Age 20-49 years	15-16	16.0 (14.1-18.2)	15.0 (11.9-17.9)	27.7 (24.1-33.0)	50.9 (35.2-66.5)	75.0 (56.3-89.9)	428
Age 50+ years	11-12	15.8 (13.0-19.2)	14.7 (10.6-18.9)	27.1 (19.9-37.1)	46.6 (34.7-68.7)	74.5 (40.0-88.9)	351
Age 50+ years	13-14	14.9 (13.1-16.8)	13.3 (11.0-15.9)	27.4 (21.8-31.5)	42.4 (31.6-54.8)	58.9 (41.8-122)	368
Age 50+ years	15-16	15.7 (13.8-17.8)	14.7 (12.2-18.3)	26.4 (21.7-30.8)	38.4 (34.2-46.6)	50.1 (38.4-57.4)	376
Males	11-12	18.0 (15.0-21.6)	17.1 (13.3-22.4)	33.0 (25.2-40.3)	53.0 (38.8-73.9)	77.4 (53.0-94.7)	525
Males	13-14	17.9 (15.4-20.8)	18.4 (14.6-22.9)	31.4 (26.6-37.7)	55.0 (43.2-66.5)	82.1 (62.4-97.6)	510
Males	15-16	16.6 (14.4-19.3)	16.8 (13.4-20.8)	29.9 (24.8-34.7)	48.3 (36.0-57.5)	67.0 (50.1-82.4)	485
Females	11-12	16.2 (14.3-18.4)	14.1 (13.1-17.0)	28.3 (23.6-31.9)	51.7 (31.8-76.2)	74.5 (39.6-97.6)	344
Females	13-14	16.8 (14.9-19.0)	16.9 (15.1-18.6)	29.0 (24.0-32.6)	44.6 (35.2-65.8)	75.1 (42.4-132)	435
Females	15-16	15.1 (13.8-16.6)	13.2 (11.5-15.3)	24.8 (21.3-27.6)	41.5 (33.0-57.4)	66.3 (45.0-79.8)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 9.40, 9.40, and 9.40 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	11.6 (10.8-12.2)	17.9 (16.2-20.4)	25.0 (20.7-30.3)	1318
Total population	13-14	*	<LOD	11.4 (10.3-12.1)	19.6 (17.0-23.0)	27.1 (23.8-32.0)	1373
Total population	15-16	*	<LOD	11.9 (10.7-13.1)	19.9 (18.0-22.2)	26.5 (24.5-31.2)	1401
Age 20-49 years	11-12	*	<LOD	12.4 (11.1-14.4)	19.9 (16.2-26.9)	29.3 (20.8-42.0)	659
Age 20-49 years	13-14	*	<LOD	11.9 (10.5-13.1)	20.8 (18.8-24.1)	27.8 (24.7-33.0)	674
Age 20-49 years	15-16	*	<LOD	12.2 (10.5-14.2)	22.2 (18.4-25.6)	31.2 (25.1-37.6)	684
Age 50+ years	11-12	*	<LOD	10.8 (9.65-11.9)	16.8 (13.4-19.0)	20.7 (16.3-29.1)	659
Age 50+ years	13-14	*	<LOD	10.7 (<LOD-12.1)	17.7 (13.9-24.3)	25.8 (18.3-33.9)	699
Age 50+ years	15-16	*	<LOD	11.4 (9.84-13.9)	18.0 (15.0-20.4)	23.8 (19.2-29.1)	717
Males	11-12	*	<LOD	12.5 (11.7-13.8)	18.4 (16.2-21.3)	22.9 (19.0-30.3)	628
Males	13-14	*	<LOD	11.7 (10.7-12.9)	20.0 (16.0-25.6)	28.7 (25.0-32.3)	658
Males	15-16	*	<LOD	13.1 (11.2-15.2)	22.3 (18.4-25.4)	31.0 (25.1-42.7)	660
Females	11-12	*	<LOD	10.6 (9.53-11.6)	16.7 (14.3-20.7)	26.9 (18.8-33.7)	690
Females	13-14	*	<LOD	11.1 (9.88-11.9)	19.1 (16.0-23.0)	26.7 (21.0-35.2)	814
Females	15-16	*	<LOD	10.8 (9.78-12.5)	18.3 (15.4-20.7)	24.5 (19.9-30.0)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 9.40, 9.40, and 9.40 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	19 (17.1-21.1)	19.1 (16.6-22.2)	28.0 (25.1-32.9)	39.1 (35.6-42.0)	45.2 (42.0-48.2)	869
Total population	13-14	17.6 (15.5-20.1)	17.5 (15.0-20.9)	26.6 (22.9-30.2)	38.4 (34.0-45.1)	51.2 (44.4-58.3)	914
Total population	15-16	16.1 (14.8-17.4)	16.1 (14.7-17.4)	23.2 (21.1-26.5)	33.7 (31.0-38.6)	47.5 (35.1-58.0)	804
Age 20-49 years	11-12	18.9 (17.0-21.0)	19.3 (17.1-21.0)	28.4 (24.8-33.3)	41.0 (35.8-44.3)	48.2 (41.0-55.4)	518
Age 20-49 years	13-14	17.2 (14.9-19.9)	16.6 (14.1-20.8)	26.4 (22.3-31.4)	38.4 (33.4-47.5)	49.8 (45.0-55.4)	546
Age 20-49 years	15-16	15.2 (13.5-17.0)	14.6 (12.4-16.6)	22.4 (19.2-28.0)	32.3 (28.9-38.6)	42.0 (32.3-67.7)	428
Age 50+ years	11-12	19.1 (16.3-22.3)	18.5 (15.4-23.4)	27.7 (23.2-33.9)	38.1 (28.8-42.0)	42.0 (33.5-54.2)	351
Age 50+ years	13-14	18.4 (16.1-21.0)	18.8 (16.7-21.2)	26.7 (22.9-30.8)	38.3 (32.6-46.0)	55.7 (38.3-69.4)	368
Age 50+ years	15-16	17.6 (16.2-19.0)	17.7 (16.1-19.0)	24.5 (22.6-26.5)	35.2 (30.6-42.2)	51.2 (35.2-58.0)	376
Males	11-12	17 (15.0-19.4)	16.6 (15.2-18.9)	25.2 (21.0-28.4)	35.9 (30.5-39.1)	43.0 (39.1-47.1)	525
Males	13-14	15.9 (14.1-17.8)	15.5 (13.6-17.9)	23.3 (21.0-26.7)	36.2 (30.1-42.4)	46.1 (40.4-52.0)	509
Males	15-16	14.5 (12.9-16.2)	14.0 (12.3-15.7)	20.1 (17.7-22.9)	29.3 (22.4-42.0)	38.6 (30.4-54.0)	485
Females	11-12	21.8 (19.2-24.8)	22.8 (19.8-25.7)	33.2 (26.6-38.7)	42.0 (35.0-49.4)	47.5 (42.0-56.4)	344
Females	13-14	19.6 (16.9-22.8)	20.5 (16.6-23.6)	28.9 (23.0-36.9)	39.1 (35.1-51.2)	55.7 (44.0-67.7)	435
Females	15-16	18.2 (17.0-19.5)	18.5 (17.5-20.7)	27.7 (25.2-30.2)	37.1 (33.3-47.5)	53.5 (35.2-66.4)	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 81690-92-8

Metabolite of Acrylamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	15.9 (14.5-16.6)	24.6 (22.2-26.6)	31.7 (26.6-41.6)	1317
Total population	13-14	*	<LOD	16.2 (14.1-18.5)	26.1 (22.9-29.4)	35.0 (30.2-39.1)	1372
Total population	15-16	*	<LOD	16.0 (14.8-17.1)	24.6 (21.5-26.6)	31.7 (26.6-36.9)	1399
Age 20-49 years	11-12	*	<LOD	16.1 (14.1-18.0)	26.6 (20.2-36.9)	39.1 (28.9-51.2)	658
Age 20-49 years	13-14	*	<LOD	15.0 (13.6-17.1)	24.6 (20.8-27.2)	30.2 (26.6-35.0)	674
Age 20-49 years	15-16	*	<LOD	15.8 (13.5-17.5)	23.8 (21.5-26.6)	28.9 (26.6-33.3)	682
Age 50+ years	11-12	*	<LOD	15.8 (13.7-17.1)	23.8 (20.2-24.6)	27.7 (24.6-30.2)	659
Age 50+ years	13-14	*	<LOD	17.1 (<LOD-19.6)	27.7 (22.9-36.9)	47.5 (28.7-60.5)	698
Age 50+ years	15-16	*	<LOD	16.2 (14.5-18.0)	24.6 (20.1-31.7)	32.1 (24.6-40.1)	717
Males	11-12	*	<LOD	11.9 (10.9-12.8)	17.1 (15.1-19.8)	22.9 (19.0-26.6)	627
Males	13-14	*	<LOD	13.3 (12.3-13.9)	19.4 (17.5-20.3)	23.1 (20.3-27.7)	657
Males	15-16	*	<LOD	12.6 (11.6-14.8)	21.8 (19.6-23.1)	28.4 (22.9-33.3)	660
Females	11-12	*	<LOD	18.5 (16.9-20.2)	27.7 (24.6-36.9)	41.6 (28.9-51.2)	690
Females	13-14	*	<LOD	19.4 (15.5-22.9)	30.2 (26.6-36.9)	39.1 (35.0-50.3)	814
Females	15-16	*	<LOD	18.0 (16.2-19.6)	26.6 (21.5-28.9)	33.3 (27.7-41.6)	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Acrylamide_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Acrylamide_FactSheet.html

Urinary N-Acetyl-S-(2-cyanoethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 74514-75-3

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	115 (95.2-140)	141 (118-172)	274 (233-310)	480 (439-542)	705 (519-792)	869
Total population	13-14	95.1 (74.5-122)	118 (97.7-147)	247 (198-303)	453 (391-520)	599 (523-737)	873
Total population	15-16	96.7 (78.5-119)	134 (118-148)	241 (217-270)	399 (344-484)	573 (454-663)	804
Age 20-49 years	11-12	108 (81.9-143)	139 (105-190)	261 (220-290)	484 (371-590)	708 (505-888)	518
Age 20-49 years	13-14	91.4 (66.6-125)	118 (89.9-153)	251 (193-317)	498 (412-533)	662 (520-991)	522
Age 20-49 years	15-16	75.8 (54.7-105)	118 (98.4-135)	234 (208-263)	402 (318-565)	593 (458-739)	428
Age 50+ years	11-12	127 (100-162)	146 (117-186)	305 (218-350)	468 (384-652)	705 (443-846)	351
Age 50+ years	13-14	110 (89.1-135)	121 (101-148)	238 (190-301)	391 (310-498)	509 (417-565)	351
Age 50+ years	15-16	139 (116-167)	162 (136-178)	248 (210-294)	395 (315-469)	488 (444-663)	376
Males	11-12	124 (93.8-165)	166 (131-192)	306 (250-376)	551 (467-646)	745 (542-846)	525
Males	13-14	85.8 (60.0-123)	111 (79.7-149)	254 (201-310)	486 (397-550)	663 (507-874)	480
Males	15-16	95.8 (67.9-135)	148 (118-174)	267 (229-334)	458 (386-545)	611 (484-806)	485
Females	11-12	105 (87.2-126)	127 (114-144)	233 (197-277)	360 (290-471)	504 (402-699)	344
Females	13-14	106 (85.3-131)	119 (101-147)	234 (188-299)	412 (327-520)	533 (469-620)	418
Females	15-16	97.8 (81.1-118)	119 (107-135)	198 (170-256)	355 (292-427)	492 (390-616)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-cyanoethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 74514-75-3

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.55 (1.40-1.71)	1.34 (1.22-1.47)	2.36 (2.20-2.51)	4.82 (3.70-6.84)	16.6 (8.95-23.7)	1318
Total population	13-14	1.67 (1.48-1.88)	1.29 (1.17-1.42)	2.42 (2.11-2.68)	6.40 (4.63-10.6)	39.9 (14.9-64.9)	1351
Total population	15-16	1.37 (1.16-1.61)	1.08 (.927-1.18)	2.18 (1.89-2.56)	6.64 (3.94-15.9)	34.0 (14.5-82.5)	1401
Age 20-49 years	11-12	1.74 (1.45-2.08)	1.46 (1.24-1.67)	2.52 (2.28-2.97)	7.59 (4.81-13.3)	20.3 (8.55-79.9)	659
Age 20-49 years	13-14	1.85 (1.61-2.12)	1.39 (1.25-1.57)	2.68 (2.37-3.31)	9.88 (6.27-21.5)	47.8 (21.5-82.9)	661
Age 20-49 years	15-16	1.46 (1.19-1.78)	1.13 (.974-1.25)	2.18 (1.87-2.73)	10.0 (3.54-38.5)	47.3 (14.5-123)	684
Age 50+ years	11-12	1.37 (1.21-1.54)	1.23 (1.07-1.36)	2.20 (1.88-2.44)	3.65 (3.08-4.36)	6.84 (3.80-19.9)	659
Age 50+ years	13-14	1.44 (1.25-1.65)	1.20 (1.08-1.38)	2.01 (1.81-2.42)	4.64 (3.46-6.62)	12.2 (5.12-89.1)	690
Age 50+ years	15-16	1.27 (1.03-1.57)	1.01 (.814-1.22)	2.17 (1.73-2.75)	5.07 (2.92-21.6)	21.6 (5.78-82.5)	717
Males	11-12	1.90 (1.62-2.23)	1.62 (1.44-1.85)	2.96 (2.44-3.24)	5.97 (3.73-15.4)	19.9 (8.83-25.5)	628
Males	13-14	1.89 (1.64-2.18)	1.44 (1.29-1.63)	2.83 (2.35-3.46)	8.87 (6.28-13.8)	40.2 (18.2-76.0)	651
Males	15-16	1.71 (1.44-2.02)	1.33 (1.13-1.53)	2.73 (2.06-3.44)	12.1 (5.86-20.5)	72.3 (18.2-157)	660
Females	11-12	1.31 (1.11-1.56)	1.20 (1.03-1.29)	1.94 (1.78-2.16)	3.85 (3.01-5.31)	10.8 (4.82-56.0)	690
Females	13-14	1.50 (1.26-1.79)	1.16 (1.07-1.35)	2.15 (1.98-2.46)	5.75 (3.55-13.1)	42.2 (8.20-109)	797
Females	15-16	1.14 (.948-1.38)	.883 (.756-1.03)	1.97 (1.58-2.33)	4.33 (3.00-12.0)	21.6 (6.42-54.1)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-cyanoethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 74514-75-3

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	127 (109-148)	166 (148-181)	261 (237-292)	409 (346-457)	537 (442-622)	869
Total population	13-14	98.9 (75.7-129)	132 (104-168)	238 (194-291)	401 (343-466)	516 (446-609)	872
Total population	15-16	97.7 (80.8-118)	141 (129-151)	213 (189-251)	345 (281-410)	426 (373-493)	804
Age 20-49 years	11-12	113 (91.4-139)	146 (127-163)	236 (220-274)	396 (309-442)	550 (408-657)	518
Age 20-49 years	13-14	85.9 (63.0-117)	115 (87.1-141)	227 (170-291)	403 (339-465)	525 (426-640)	521
Age 20-49 years	15-16	71.9 (51.8-99.7)	108 (86.6-134)	196 (154-233)	324 (252-410)	417 (330-472)	428
Age 50+ years	11-12	154 (126-188)	195 (167-229)	300 (249-342)	442 (356-484)	537 (458-622)	351
Age 50+ years	13-14	139 (110-175)	175 (144-186)	256 (222-303)	401 (332-485)	511 (381-719)	351
Age 50+ years	15-16	156 (138-176)	169 (156-186)	238 (196-293)	379 (302-414)	429 (377-579)	376
Males	11-12	118 (97.2-143)	147 (125-167)	233 (215-261)	359 (323-435)	462 (408-622)	525
Males	13-14	77.7 (55.9-108)	110 (78.3-140)	208 (168-269)	343 (272-426)	443 (343-474)	479
Males	15-16	83.4 (62.3-112)	125 (108-139)	197 (174-214)	307 (251-358)	417 (325-523)	485
Females	11-12	141 (109-182)	200 (162-229)	295 (255-342)	448 (330-565)	565 (442-657)	344
Females	13-14	126 (98.7-162)	149 (115-185)	267 (215-335)	473 (371-525)	569 (481-681)	418
Females	15-16	118 (97.8-142)	154 (140-166)	241 (195-281)	382 (284-429)	431 (392-497)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-cyanoethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 74514-75-3

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.82 (1.65-1.99)	1.49 (1.36-1.62)	2.34 (2.04-2.64)	4.79 (3.89-6.06)	13.5 (8.27-20.6)	1317
Total population	13-14	2.01 (1.77-2.28)	1.53 (1.42-1.68)	2.72 (2.39-3.08)	7.88 (5.03-10.3)	32.2 (13.0-68.5)	1350
Total population	15-16	1.55 (1.35-1.77)	1.16 (1.10-1.24)	1.86 (1.62-2.24)	6.20 (3.23-17.5)	32.2 (17.5-79.3)	1399
Age 20-49 years	11-12	1.91 (1.65-2.22)	1.53 (1.31-1.71)	2.51 (2.18-2.77)	6.53 (4.43-10.0)	23.6 (7.54-67.8)	658
Age 20-49 years	13-14	2.07 (1.80-2.38)	1.51 (1.36-1.71)	2.85 (2.39-3.59)	9.05 (6.18-14.8)	36.3 (14.1-80.1)	661
Age 20-49 years	15-16	1.54 (1.28-1.84)	1.11 (.992-1.21)	1.77 (1.51-2.04)	7.04 (3.28-23.9)	58.6 (12.3-115)	682
Age 50+ years	11-12	1.72 (1.55-1.91)	1.48 (1.32-1.62)	2.19 (1.88-2.64)	3.82 (2.95-5.46)	7.95 (4.24-22.4)	659
Age 50+ years	13-14	1.9 (1.61-2.24)	1.53 (1.37-1.72)	2.59 (2.33-2.90)	5.46 (3.64-10.1)	14.7 (6.39-120)	689
Age 50+ years	15-16	1.56 (1.30-1.88)	1.20 (1.14-1.31)	1.96 (1.61-2.58)	4.95 (3.03-18.7)	25.6 (6.20-79.3)	717
Males	11-12	1.7 (1.49-1.94)	1.36 (1.21-1.54)	2.03 (1.76-2.57)	5.46 (3.12-10.0)	13.7 (7.56-40.4)	627
Males	13-14	1.86 (1.64-2.11)	1.39 (1.21-1.55)	2.53 (2.27-2.83)	7.74 (5.88-11.4)	36.3 (14.1-73.3)	650
Males	15-16	1.57 (1.37-1.80)	1.13 (.994-1.21)	1.75 (1.53-2.12)	7.35 (4.82-23.6)	79.3 (23.6-94.8)	660
Females	11-12	1.91 (1.65-2.21)	1.57 (1.47-1.73)	2.57 (2.19-2.90)	4.60 (3.43-6.17)	11.8 (5.29-45.4)	690
Females	13-14	2.15 (1.79-2.58)	1.65 (1.49-1.83)	2.92 (2.44-3.54)	8.24 (4.45-12.0)	32.2 (10.3-135)	797
Females	15-16	1.53 (1.30-1.80)	1.18 (1.11-1.32)	1.91 (1.65-2.38)	4.32 (2.95-10.5)	21.5 (4.87-77.4)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxyethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 15060-26-1

Metabolite of Acrylonitrile, Ethylene oxide, and Vinyl chloride

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	2.51 (2.21-2.85)	2.50 (2.02-2.89)	5.28 (4.30-6.46)	10.5 (7.92-14.8)	16.9 (12.5-20.9)	869
Total population	13-14	2.12 (1.88-2.40)	2.01 (1.66-2.24)	4.80 (3.92-5.42)	8.40 (7.34-9.33)	13.5 (9.81-15.6)	888
Total population	15-16	2.42 (2.18-2.68)	2.41 (1.99-2.77)	4.73 (4.18-5.71)	9.32 (8.33-10.9)	14.4 (11.4-17.1)	804
Age 20-49 years	11-12	2.66 (2.31-3.06)	2.75 (2.30-3.10)	5.26 (4.28-6.54)	10.5 (7.63-15.8)	16.9 (12.5-18.9)	518
Age 20-49 years	13-14	2.20 (1.88-2.57)	2.09 (1.73-2.44)	4.95 (3.66-6.07)	8.45 (7.03-10.2)	14.1 (9.49-17.4)	530
Age 20-49 years	15-16	2.48 (2.16-2.85)	2.53 (2.17-3.00)	5.06 (4.25-6.09)	10.4 (8.45-14.0)	16.1 (11.9-19.7)	428
Age 50+ years	11-12	2.30 (1.77-2.99)	2.02 (1.35-2.98)	5.28 (3.14-7.60)	11.2 (6.50-22.7)	18.2 (8.11-37.5)	351
Age 50+ years	13-14	1.96 (1.71-2.25)	1.73 (1.47-2.10)	4.50 (3.59-4.92)	7.87 (5.72-11.2)	12.0 (9.37-14.3)	358
Age 50+ years	15-16	2.34 (1.99-2.75)	2.29 (1.63-2.80)	4.29 (3.28-5.82)	8.31 (6.61-10.3)	11.2 (8.96-14.6)	376
Males	11-12	2.25 (1.84-2.74)	1.99 (1.53-2.61)	4.51 (3.22-6.15)	11.9 (6.92-16.9)	16.9 (10.6-23.1)	525
Males	13-14	1.90 (1.64-2.19)	1.69 (1.51-2.09)	4.07 (3.47-4.88)	7.85 (6.56-9.49)	12.9 (8.87-14.5)	498
Males	15-16	2.25 (1.89-2.69)	2.32 (1.64-2.93)	4.76 (3.48-6.09)	8.96 (6.61-11.2)	12.4 (9.17-18.4)	485
Females	11-12	2.89 (2.53-3.30)	3.10 (2.65-3.64)	6.04 (4.76-6.83)	10.1 (7.93-13.3)	15.2 (10.5-20.5)	344
Females	13-14	2.38 (2.09-2.71)	2.17 (1.93-2.68)	5.19 (4.37-5.95)	8.88 (7.62-11.1)	14.1 (9.81-16.8)	419
Females	15-16	2.62 (2.38-2.88)	2.53 (2.31-2.85)	4.55 (4.05-5.95)	10.4 (8.33-13.5)	16.7 (11.4-19.3)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.791, 0.791, and 0.791 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxyethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 15060-26-1

Metabolite of Acrylonitrile, Ethylene oxide, and Vinyl chloride

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	1.27 (1.14-1.43)	2.12 (1.85-2.44)	2.98 (2.57-3.70)	1318
Total population	13-14	*	<LOD	1.02 (.927-1.15)	1.85 (1.65-2.10)	2.72 (2.38-3.06)	1355
Total population	15-16	*	<LOD	1.21 (1.09-1.35)	2.18 (1.93-2.41)	3.28 (2.49-3.83)	1401
Age 20-49 years	11-12	*	<LOD	1.38 (1.18-1.58)	2.46 (1.99-2.83)	3.76 (2.69-5.01)	659
Age 20-49 years	13-14	*	<LOD	1.32 (1.14-1.43)	2.17 (1.95-2.52)	3.06 (2.52-3.64)	664
Age 20-49 years	15-16	*	<LOD	1.49 (1.25-1.68)	2.34 (2.02-2.88)	3.43 (2.84-3.93)	684
Age 50+ years	11-12	*	<LOD	1.17 (.904-1.45)	1.79 (1.53-2.26)	2.41 (2.09-3.34)	659
Age 50+ years	13-14	*	<LOD	.810 (<LOD-.975)	1.41 (1.22-1.66)	2.10 (1.55-2.78)	691
Age 50+ years	15-16	*	<LOD	.968 (.851-1.17)	1.82 (1.42-2.29)	2.82 (2.00-4.47)	717
Males	11-12	*	<LOD	1.19 (.994-1.51)	2.02 (1.77-2.32)	2.50 (2.26-3.64)	628
Males	13-14	*	<LOD	1.02 (.833-1.18)	1.75 (1.41-2.10)	2.30 (2.01-2.79)	652
Males	15-16	*	<LOD	1.14 (.970-1.27)	2.08 (1.75-2.38)	3.04 (2.22-3.85)	660
Females	11-12	*	<LOD	1.31 (1.15-1.43)	2.17 (1.63-2.88)	3.34 (2.53-4.80)	690
Females	13-14	*	<LOD	1.08 (.951-1.25)	2.09 (1.81-2.44)	3.12 (2.54-3.85)	800
Females	15-16	*	<LOD	1.34 (1.10-1.52)	2.27 (1.94-2.78)	3.46 (2.68-4.22)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.791, 0.791, and 0.791 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxyethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 15060-26-1

Metabolite of Acrylonitrile, Ethylene oxide, and Vinyl chloride

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	2.77 (2.44-3.15)	2.88 (2.24-3.39)	5.57 (4.40-7.16)	10.5 (8.12-11.7)	15.5 (10.7-18.4)	869
Total population	13-14	2.17 (1.85-2.53)	2.11 (1.67-2.54)	4.33 (3.63-5.25)	8.23 (6.79-10.0)	11.3 (10.0-13.3)	887
Total population	15-16	2.44 (2.22-2.68)	2.43 (2.15-2.86)	4.61 (4.06-5.56)	8.38 (6.81-10.6)	12.0 (9.51-14.5)	804
Age 20-49 years	11-12	2.77 (2.53-3.03)	2.96 (2.12-3.73)	5.56 (4.99-6.25)	9.42 (8.12-10.8)	12.5 (10.5-20.9)	518
Age 20-49 years	13-14	2.03 (1.72-2.39)	1.95 (1.59-2.31)	4.02 (3.05-4.97)	7.49 (5.96-10.0)	11.2 (8.88-12.5)	529
Age 20-49 years	15-16	2.35 (2.02-2.74)	2.41 (2.00-2.86)	4.51 (3.91-5.59)	8.64 (6.54-11.5)	12.2 (8.64-18.8)	428
Age 50+ years	11-12	2.78 (2.12-3.63)	2.72 (2.06-3.37)	5.80 (3.38-10.2)	11.0 (6.72-17.6)	15.9 (7.73-20.7)	351
Age 50+ years	13-14	2.44 (2.00-2.97)	2.54 (1.68-3.67)	5.06 (4.21-6.19)	9.60 (7.35-11.2)	13.3 (10.0-17.0)	358
Age 50+ years	15-16	2.63 (2.32-2.98)	2.53 (2.17-3.09)	4.69 (3.96-5.96)	8.09 (6.24-11.8)	11.9 (8.42-14.1)	376
Males	11-12	2.13 (1.84-2.46)	2.02 (1.75-2.59)	4.29 (3.72-5.03)	7.70 (5.83-9.06)	9.42 (7.73-11.5)	525
Males	13-14	1.69 (1.48-1.91)	1.54 (1.36-1.74)	3.32 (2.75-4.00)	6.47 (4.96-9.60)	10.8 (7.69-12.5)	497
Males	15-16	1.96 (1.70-2.26)	2.00 (1.75-2.22)	3.67 (2.87-4.54)	6.69 (4.79-8.32)	8.85 (6.79-14.1)	485
Females	11-12	3.87 (3.13-4.78)	4.00 (3.05-4.78)	7.45 (5.71-10.3)	15.2 (10.2-17.6)	17.6 (10.8-25.6)	344
Females	13-14	2.81 (2.26-3.49)	2.61 (1.94-4.10)	5.34 (4.10-7.06)	9.56 (7.87-11.0)	11.9 (10.0-16.3)	419
Females	15-16	3.16 (2.82-3.54)	3.11 (2.68-3.75)	5.62 (4.78-6.55)	11.0 (8.09-12.2)	13.0 (11.0-18.6)	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxyethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 15060-26-1

Metabolite of Acrylonitrile, Ethylene oxide, and Vinyl chloride

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	1.70 (1.54-1.95)	2.86 (2.43-3.15)	3.98 (3.25-4.30)	1317
Total population	13-14	*	<LOD	1.55 (1.43-1.64)	2.63 (2.33-2.94)	3.48 (2.98-4.30)	1354
Total population	15-16	*	<LOD	1.60 (1.54-1.72)	2.59 (2.38-2.80)	3.53 (3.11-4.30)	1399
Age 20-49 years	11-12	*	<LOD	1.81 (1.55-2.09)	3.02 (2.43-3.40)	4.03 (3.30-4.31)	658
Age 20-49 years	13-14	*	<LOD	1.56 (1.40-1.78)	2.54 (2.21-2.81)	3.11 (2.66-4.13)	664
Age 20-49 years	15-16	*	<LOD	1.68 (1.55-1.80)	2.66 (2.33-3.11)	4.07 (2.94-4.59)	682
Age 50+ years	11-12	*	<LOD	1.64 (1.43-1.92)	2.58 (2.15-3.11)	3.84 (2.95-5.08)	659
Age 50+ years	13-14	*	<LOD	1.47 (<LOD-1.64)	2.78 (2.24-3.29)	3.73 (3.03-5.08)	690
Age 50+ years	15-16	*	<LOD	1.55 (1.36-1.75)	2.49 (2.24-2.90)	3.29 (2.80-3.76)	717
Males	11-12	*	<LOD	1.27 (1.13-1.43)	2.03 (1.64-2.36)	2.64 (2.15-3.34)	627
Males	13-14	*	<LOD	1.22 (1.10-1.29)	1.83 (1.64-2.07)	2.65 (2.15-3.03)	651
Males	15-16	*	<LOD	1.22 (1.09-1.35)	1.93 (1.80-2.07)	2.66 (2.00-3.27)	660
Females	11-12	*	<LOD	2.07 (1.86-2.41)	3.30 (2.86-3.99)	4.30 (3.49-5.19)	690
Females	13-14	*	<LOD	1.91 (1.64-2.16)	3.06 (2.66-3.44)	4.30 (3.48-5.08)	800
Females	15-16	*	<LOD	1.93 (1.72-2.24)	2.93 (2.59-3.42)	4.30 (3.53-4.66)	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(phenyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 4775-80-8

Metabolite of Benzene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	.631 (<LOD-.757)	1.23 (1.09-1.36)	2.07 (1.68-2.86)	3.11 (1.93-3.78)	869
Total population	13-14	*	<LOD	.970 (.826-1.12)	1.91 (1.24-2.46)	2.99 (2.20-3.32)	892
Total population	15-16	*	.622 (<LOD-.670)	1.37 (1.09-1.60)	2.65 (1.82-3.26)	3.43 (2.84-4.18)	804
Age 20-49 years	11-12	*	.644 (<LOD-.710)	1.25 (1.06-1.43)	2.25 (1.69-3.05)	3.11 (1.84-3.93)	518
Age 20-49 years	13-14	*	<LOD	1.03 (.884-1.20)	2.03 (1.47-2.68)	3.27 (2.03-4.82)	536
Age 20-49 years	15-16	*	.637 (<LOD-.785)	1.42 (1.15-1.67)	2.65 (1.80-3.10)	3.15 (2.78-3.31)	428
Age 50+ years	11-12	*	.627 (<LOD-.908)	1.14 (.919-1.43)	1.78 (1.43-3.24)	3.32 (1.74-4.03)	351
Age 50+ years	13-14	*	<LOD	.844 (.672-1.01)	1.34 (1.01-1.82)	2.21 (1.23-3.27)	356
Age 50+ years	15-16	*	<LOD	1.28 (.882-1.65)	2.66 (1.66-3.97)	4.20 (2.25-6.39)	376
Males	11-12	*	.699 (<LOD-.908)	1.35 (1.13-1.53)	2.80 (1.55-3.58)	3.58 (2.25-4.03)	525
Males	13-14	*	<LOD	1.00 (.766-1.20)	1.93 (1.24-3.27)	3.27 (1.73-3.94)	495
Males	15-16	*	.687 (<LOD-.807)	1.35 (1.08-1.72)	2.65 (1.85-3.23)	3.47 (2.83-4.20)	485
Females	11-12	*	<LOD	1.05 (.926-1.25)	1.70 (1.42-2.07)	2.21 (1.78-2.67)	344
Females	13-14	*	<LOD	.938 (.773-1.09)	1.68 (1.12-2.45)	2.45 (2.02-3.33)	426
Females	15-16	*	<LOD	1.44 (.940-1.61)	2.62 (1.54-3.31)	3.26 (2.75-4.37)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.600, 0.600, and 0.600 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Benzene_FactSheet.html

Urinary N-Acetyl-S-(phenyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 4775-80-8

Metabolite of Benzene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	.956 (.888-1.07)	1.82 (1.56-2.30)	3.04 (2.18-3.79)	1318
Total population	13-14	*	<LOD	.798 (<LOD-.979)	1.42 (1.16-1.72)	1.94 (1.51-2.69)	1335
Total population	15-16	*	<LOD	1.01 (.903-1.13)	1.76 (1.60-2.13)	2.73 (2.31-3.45)	1401
Age 20-49 years	11-12	*	<LOD	1.00 (.929-1.26)	2.16 (1.75-2.75)	3.20 (2.41-3.76)	659
Age 20-49 years	13-14	*	<LOD	.865 (.699-1.04)	1.51 (1.24-1.84)	2.20 (1.56-3.27)	650
Age 20-49 years	15-16	*	<LOD	1.07 (.940-1.24)	1.93 (1.58-2.41)	2.83 (2.25-4.06)	684
Age 50+ years	11-12	*	<LOD	.911 (.779-1.05)	1.51 (1.24-2.44)	2.84 (1.43-3.79)	659
Age 50+ years	13-14	*	<LOD	.688 (<LOD-.910)	1.32 (1.03-1.68)	1.84 (1.42-2.39)	685
Age 50+ years	15-16	*	<LOD	.920 (.824-1.08)	1.70 (1.46-2.25)	2.62 (1.80-3.71)	717
Males	11-12	*	.628 (<LOD-.779)	1.12 (.949-1.28)	1.77 (1.46-2.75)	3.20 (1.73-5.62)	628
Males	13-14	*	<LOD	.910 (.668-1.14)	1.51 (1.25-1.86)	2.19 (1.64-3.54)	643
Males	15-16	*	.640 (<LOD-.780)	1.09 (.919-1.37)	1.85 (1.58-2.45)	2.82 (2.11-4.37)	660
Females	11-12	*	<LOD	.844 (.666-.986)	1.85 (1.37-2.44)	2.84 (1.83-3.50)	690
Females	13-14	*	<LOD	.715 (<LOD-.940)	1.29 (.997-1.70)	1.84 (1.36-2.45)	787
Females	15-16	*	<LOD	.950 (.773-1.13)	1.76 (1.49-2.18)	2.62 (1.97-3.45)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.600, 0.600, and 0.600 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Benzene_FactSheet.html

Urinary N-Acetyl-S-(phenyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 4775-80-8

Metabolite of Benzene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	.827 (<LOD-.922)	1.33 (1.18-1.52)	2.11 (1.70-2.45)	2.53 (2.27-2.83)	869
Total population	13-14	*	<LOD	1.11 (.949-1.34)	1.85 (1.55-2.23)	2.42 (2.07-3.14)	892
Total population	15-16	*	.800 (<LOD-.922)	1.35 (1.18-1.62)	2.05 (1.72-2.34)	2.55 (2.12-3.26)	804
Age 20-49 years	11-12	*	.771 (<LOD-.886)	1.26 (1.03-1.65)	2.11 (1.63-2.49)	2.63 (2.11-3.36)	518
Age 20-49 years	13-14	*	<LOD	1.06 (.886-1.33)	1.77 (1.49-2.21)	2.29 (2.05-3.14)	536
Age 20-49 years	15-16	*	.791 (<LOD-.922)	1.33 (1.01-1.64)	1.86 (1.69-2.19)	2.27 (2.10-2.54)	428
Age 50+ years	11-12	*	.942 (<LOD-1.06)	1.37 (1.21-1.54)	2.13 (1.63-2.36)	2.53 (2.23-2.82)	351
Age 50+ years	13-14	*	<LOD	1.22 (.972-1.51)	1.93 (1.55-2.42)	2.42 (1.93-3.72)	356
Age 50+ years	15-16	*	<LOD	1.40 (1.20-1.68)	2.21 (1.81-2.99)	3.03 (2.36-4.44)	376
Males	11-12	*	.744 (<LOD-.865)	1.19 (.942-1.54)	2.03 (1.54-2.49)	2.53 (1.93-3.11)	525
Males	13-14	*	<LOD	.922 (.757-1.29)	1.61 (1.12-2.06)	2.07 (1.61-3.04)	495
Males	15-16	*	.685 (<LOD-.818)	1.18 (.898-1.46)	1.77 (1.50-2.12)	2.12 (1.78-2.74)	485
Females	11-12	*	<LOD	1.41 (1.25-1.63)	2.12 (1.77-2.44)	2.64 (2.23-3.03)	344
Females	13-14	*	<LOD	1.25 (1.03-1.51)	2.00 (1.70-2.42)	2.89 (2.21-3.88)	426
Females	15-16	*	<LOD	1.63 (1.33-1.86)	2.23 (2.10-2.54)	2.99 (2.36-3.53)	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Benzene_FactSheet.html

Urinary N-Acetyl-S-(phenyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 4775-80-8

Metabolite of Benzene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	1.29 (1.15-1.41)	2.07 (1.82-2.55)	3.26 (2.55-4.15)	1317
Total population	13-14	*	<LOD	1.17 (<LOD-1.34)	2.02 (1.77-2.31)	2.72 (2.36-3.60)	1334
Total population	15-16	*	<LOD	1.33 (1.21-1.41)	2.03 (1.77-2.29)	2.75 (2.49-3.03)	1399
Age 20-49 years	11-12	*	<LOD	1.32 (1.15-1.57)	2.36 (1.86-2.91)	3.26 (2.65-4.90)	658
Age 20-49 years	13-14	*	<LOD	1.18 (.922-1.41)	1.93 (1.70-2.23)	2.49 (2.10-3.09)	650
Age 20-49 years	15-16	*	<LOD	1.30 (1.15-1.49)	2.03 (1.77-2.36)	2.92 (2.17-3.53)	682
Age 50+ years	11-12	*	<LOD	1.25 (1.06-1.46)	1.93 (1.67-2.36)	2.83 (1.98-4.81)	659
Age 50+ years	13-14	*	<LOD	1.15 (<LOD-1.33)	2.23 (1.72-2.49)	3.44 (2.42-3.93)	684
Age 50+ years	15-16	*	<LOD	1.35 (1.17-1.46)	2.03 (1.70-2.36)	2.65 (2.21-3.09)	717
Males	11-12	*	.642 (<LOD-.740)	1.06 (.922-1.15)	1.79 (1.42-2.23)	2.53 (1.91-3.48)	627
Males	13-14	*	<LOD	.942 (.861-1.03)	1.57 (1.34-1.85)	2.36 (1.85-3.03)	642
Males	15-16	*	.673 (<LOD-.771)	1.06 (.966-1.26)	1.80 (1.56-2.02)	2.36 (2.02-2.58)	660
Females	11-12	*	<LOD	1.51 (1.26-1.70)	2.36 (1.93-3.21)	3.86 (2.73-4.81)	690
Females	13-14	*	<LOD	1.34 (<LOD-1.51)	2.27 (2.02-2.49)	3.25 (2.49-3.92)	787
Females	15-16	*	<LOD	1.49 (1.32-1.66)	2.12 (1.98-2.65)	3.04 (2.52-3.53)	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Benzene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Benzene_FactSheet.html

Urinary N-Acetyl-S-(n-propyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 4775-80-8

Metabolite of 1-Bromopropane

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.88 (3.24-4.65)	3.05 (2.48-3.87)	9.15 (6.24-13.8)	25.4 (18.2-46.7)	64.2 (29.9-105)	862
Total population	13-14	3.21 (2.80-3.67)	2.47 (2.08-3.08)	7.27 (6.15-9.20)	20.1 (14.2-27.7)	38.4 (25.2-47.1)	907
Total population	15-16	3.72 (3.31-4.18)	3.34 (2.86-3.78)	7.90 (6.49-9.85)	17.9 (15.9-23.6)	33.2 (20.9-53.9)	786
Age 20-49 years	11-12	4.11 (3.31-5.10)	3.45 (2.73-4.44)	9.79 (6.13-16.4)	28.1 (16.1-64.2)	58.9 (28.1-105)	516
Age 20-49 years	13-14	3.71 (3.04-4.53)	2.93 (2.05-4.40)	9.42 (7.23-12.4)	25.3 (15.2-40.3)	40.6 (28.7-66.2)	539
Age 20-49 years	15-16	4.09 (3.48-4.82)	3.75 (2.91-4.78)	8.35 (6.47-12.3)	19.0 (15.8-29.5)	39.7 (19.0-80.9)	418
Age 50+ years	11-12	3.54 (2.57-4.89)	2.68 (2.08-3.89)	7.66 (4.63-15.4)	25.1 (18.2-47.3)	68.7 (21.4-163)	346
Age 50+ years	13-14	2.38 (2.12-2.68)	2.06 (1.40-2.54)	4.72 (3.68-6.44)	11.4 (7.28-15.9)	19.5 (13.7-24.5)	368
Age 50+ years	15-16	3.20 (2.68-3.83)	2.87 (1.94-3.52)	7.22 (4.70-9.85)	16.9 (13.8-20.6)	27.3 (19.9-44.1)	368
Males	11-12	4.16 (3.15-5.51)	3.17 (2.24-5.01)	10.6 (5.72-18.6)	29.9 (18.2-51.5)	91.2 (29.9-163)	520
Males	13-14	3.43 (2.97-3.97)	2.88 (2.16-3.59)	9.34 (6.45-12.7)	21.0 (13.7-28.1)	35.4 (21.1-45.3)	503
Males	15-16	3.84 (3.31-4.47)	3.60 (2.90-4.70)	8.41 (6.54-10.3)	19.0 (15.5-22.5)	33.1 (21.8-40.7)	475
Females	11-12	3.56 (3.14-4.03)	2.95 (2.25-3.87)	8.19 (5.94-10.3)	22.9 (14.6-28.4)	47.3 (25.1-68.7)	342
Females	13-14	2.99 (2.41-3.71)	2.38 (1.66-3.46)	6.15 (5.10-6.75)	15.2 (10.4-20.3)	47.0 (15.8-106)	434
Females	15-16	3.57 (2.96-4.32)	2.96 (2.21-3.92)	7.66 (5.68-11.2)	16.9 (9.21-40.8)	40.8 (18.3-82.9)	332

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.20, 1.20, and 1.20 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(n-propyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 4775-80-8

Metabolite of 1-Bromopropane

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.78 (4.19-5.45)	4.38 (3.75-5.19)	12.5 (10.4-15.2)	30.0 (24.6-38.9)	56.1 (34.7-78.6)	1276
Total population	13-14	3.52 (3.07-4.02)	2.99 (2.47-3.61)	8.32 (6.89-10.5)	23.5 (18.1-28.9)	41.0 (31.5-53.2)	1372
Total population	15-16	3.98 (3.51-4.51)	3.44 (2.84-4.17)	9.14 (7.34-11.0)	24.6 (19.1-27.7)	34.1 (30.3-41.2)	1367
Age 20-49 years	11-12	5.18 (4.41-6.08)	4.82 (3.68-6.06)	13.3 (10.2-17.6)	32.4 (23.9-44.4)	64.4 (33.4-96.3)	644
Age 20-49 years	13-14	3.87 (3.20-4.68)	3.21 (2.53-4.20)	9.19 (6.58-14.2)	28.5 (19.5-40.1)	46.6 (37.2-59.6)	672
Age 20-49 years	15-16	5.06 (4.51-5.67)	4.96 (4.20-5.43)	11.0 (9.14-13.4)	29.8 (20.5-33.2)	38.5 (32.4-50.1)	661
Age 50+ years	11-12	4.38 (3.45-5.56)	4.17 (3.08-5.22)	10.5 (8.49-15.7)	27.4 (18.6-39.2)	43.7 (27.4-72.9)	632
Age 50+ years	13-14	3.21 (2.81-3.68)	2.60 (2.11-3.24)	7.57 (6.56-9.13)	19.4 (14.8-25.6)	31.9 (22.9-51.2)	700
Age 50+ years	15-16	3.11 (2.62-3.68)	2.46 (1.82-3.41)	6.66 (5.09-9.16)	17.3 (13.8-22.8)	27.1 (23.6-40.4)	706
Males	11-12	5.26 (4.47-6.20)	4.82 (3.99-5.98)	12.5 (10.2-15.2)	33.3 (24.4-45.7)	60.9 (29.8-96.3)	607
Males	13-14	4.00 (3.22-4.96)	3.31 (2.61-4.49)	10.2 (7.60-13.8)	29.9 (19.1-40.1)	47.5 (32.3-61.2)	657
Males	15-16	4.32 (3.58-5.21)	3.73 (2.96-5.09)	10.5 (8.62-13.3)	26.0 (19.9-28.3)	33.0 (27.3-46.1)	644
Females	11-12	4.43 (3.79-5.16)	4.20 (3.26-5.31)	12.3 (9.84-16.6)	28.7 (20.8-39.3)	43.7 (33.1-69.4)	669
Females	13-14	3.16 (2.70-3.70)	2.59 (1.99-3.40)	7.26 (5.83-8.35)	19.0 (14.8-23.5)	30.3 (23.5-41.6)	814
Females	15-16	3.72 (3.19-4.34)	3.25 (2.34-4.13)	8.14 (6.79-10.3)	22.0 (16.0-30.3)	37.3 (30.3-45.3)	783

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 1.20, 1.20, and 1.20 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(n-propyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 4775-80-8

Metabolite of 1-Bromopropane

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.29 (3.71-4.95)	4.16 (3.29-5.00)	8.54 (7.85-9.58)	27.2 (16.9-38.5)	61.7 (35.1-87.5)	862
Total population	13-14	3.26 (2.97-3.59)	2.81 (2.58-3.17)	6.92 (5.65-8.77)	16.2 (11.5-23.1)	31.0 (22.5-40.3)	906
Total population	15-16	3.76 (3.30-4.28)	3.66 (3.16-4.08)	8.03 (6.15-10.4)	16.6 (13.8-23.8)	33.7 (23.2-42.9)	786
Age 20-49 years	11-12	4.29 (3.66-5.02)	4.38 (3.33-5.00)	8.82 (7.75-11.6)	26.0 (16.3-38.2)	47.7 (27.2-87.5)	516
Age 20-49 years	13-14	3.42 (2.87-4.08)	3.07 (2.40-4.05)	7.47 (5.66-9.51)	16.5 (11.0-28.6)	31.2 (21.0-40.3)	538
Age 20-49 years	15-16	3.88 (3.34-4.51)	3.80 (3.27-4.15)	8.03 (5.70-11.7)	17.4 (14.0-30.1)	35.1 (18.8-50.4)	418
Age 50+ years	11-12	4.29 (3.15-5.86)	3.86 (2.36-6.06)	7.85 (5.72-12.2)	36.1 (11.0-71.6)	71.6 (32.2-92.8)	346
Age 50+ years	13-14	2.96 (2.45-3.56)	2.55 (1.82-3.74)	5.65 (4.70-6.44)	13.5 (9.58-21.6)	25.4 (17.0-51.8)	368
Age 50+ years	15-16	3.6 (2.98-4.35)	3.33 (2.50-5.00)	8.03 (6.15-10.4)	14.4 (13.4-21.0)	33.3 (19.3-43.7)	368
Males	11-12	3.94 (3.15-4.91)	3.86 (2.58-5.31)	8.24 (6.22-11.0)	26.0 (13.5-43.0)	62.0 (22.3-87.5)	520
Males	13-14	3.05 (2.60-3.58)	2.63 (2.16-3.40)	7.47 (5.51-9.65)	14.5 (11.3-21.6)	26.6 (15.3-36.0)	502
Males	15-16	3.31 (2.75-4.00)	3.21 (2.50-4.08)	6.74 (5.54-8.71)	14.4 (10.7-18.4)	30.1 (13.8-44.1)	475
Females	11-12	4.78 (3.89-5.86)	4.47 (2.95-6.06)	8.71 (7.55-11.6)	30.3 (12.0-61.7)	51.3 (37.2-92.8)	342
Females	13-14	3.49 (2.99-4.08)	3.07 (2.57-3.70)	6.44 (5.47-7.83)	19.4 (10.6-36.2)	40.3 (22.1-64.6)	434
Females	15-16	4.36 (3.66-5.20)	4.12 (3.45-5.11)	9.07 (5.80-14.3)	19.4 (14.6-33.3)	38.8 (21.9-54.4)	332

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(n-propyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 4775-80-8

Metabolite of 1-Bromopropane

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	5.59 (4.95-6.31)	5.31 (4.47-6.00)	14.0 (12.6-16.5)	36.0 (26.4-46.1)	51.8 (40.0-65.2)	1275
Total population	13-14	4.22 (3.73-4.76)	4.10 (3.48-4.71)	9.76 (8.81-11.4)	24.6 (20.8-30.4)	40.0 (32.4-53.3)	1371
Total population	15-16	4.52 (3.98-5.13)	4.13 (3.70-4.66)	10.1 (8.35-12.2)	22.2 (19.3-25.7)	35.7 (27.8-47.4)	1365
Age 20-49 years	11-12	5.72 (5.05-6.48)	5.31 (4.32-6.54)	15.3 (12.8-21.1)	36.4 (29.2-48.8)	52.6 (41.6-67.1)	643
Age 20-49 years	13-14	4.32 (3.63-5.13)	4.00 (3.27-4.92)	10.3 (8.45-13.4)	24.8 (20.8-30.9)	38.6 (30.8-53.3)	672
Age 20-49 years	15-16	5.34 (4.67-6.10)	5.04 (4.34-5.77)	12.1 (9.43-13.4)	24.2 (20.3-32.4)	39.0 (30.4-53.4)	659
Age 50+ years	11-12	5.45 (4.30-6.92)	5.14 (4.08-6.59)	12.6 (9.63-17.8)	32.7 (21.3-44.4)	49.9 (32.7-71.8)	632
Age 50+ years	13-14	4.24 (3.72-4.84)	4.20 (3.44-4.71)	9.44 (7.65-12.0)	23.8 (19.0-31.8)	40.9 (30.5-58.4)	699
Age 50+ years	15-16	3.85 (3.24-4.59)	3.57 (2.83-4.13)	7.78 (5.67-12.2)	19.5 (14.1-23.6)	30.1 (22.2-42.4)	706
Males	11-12	4.68 (4.04-5.42)	4.28 (3.53-5.47)	12.2 (9.32-13.8)	31.0 (19.7-36.7)	46.1 (32.7-61.5)	606
Males	13-14	3.89 (3.21-4.71)	3.91 (2.76-4.92)	9.42 (7.78-11.7)	23.8 (17.2-30.1)	35.1 (26.0-53.3)	656
Males	15-16	4.01 (3.39-4.74)	3.82 (3.08-4.72)	8.73 (6.70-11.3)	17.4 (13.4-25.9)	26.6 (20.6-33.7)	644
Females	11-12	6.43 (5.32-7.78)	6.39 (4.70-8.20)	16.4 (12.7-24.7)	37.1 (29.3-50.3)	60.9 (43.8-80.0)	669
Females	13-14	4.51 (3.89-5.23)	4.17 (3.50-4.75)	9.50 (7.61-13.3)	24.2 (19.8-33.0)	40.3 (31.6-58.4)	814
Females	15-16	4.98 (4.20-5.91)	4.25 (3.72-5.31)	11.5 (9.20-13.1)	23.9 (21.8-35.1)	50.3 (32.2-79.6)	781

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 144889-50-9

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	350 (316-388)	370 (324-420)	618 (556-703)	981 (886-1100)	1260 (985-1600)	869
Total population	13-14	360 (327-397)	418 (372-450)	636 (570-695)	902 (838-979)	1130 (957-1510)	914
Total population	15-16	431 (400-466)	470 (429-513)	701 (660-761)	1010 (905-1140)	1260 (1110-1530)	734
Age 20-49 years	11-12	357 (316-404)	392 (329-443)	614 (545-723)	979 (815-1100)	1260 (912-1600)	518
Age 20-49 years	13-14	376 (333-423)	438 (383-472)	641 (559-707)	901 (829-998)	1170 (957-1510)	548
Age 20-49 years	15-16	413 (372-458)	467 (389-549)	691 (647-761)	972 (860-1140)	1220 (973-1620)	390
Age 50+ years	11-12	340 (296-391)	354 (287-427)	629 (497-754)	981 (870-1220)	1280 (981-1510)	351
Age 50+ years	13-14	340 (306-376)	357 (294-431)	612 (556-702)	931 (818-1000)	1130 (908-1600)	366
Age 50+ years	15-16	458 (409-514)	475 (425-565)	725 (653-804)	1050 (854-1250)	1350 (1050-1640)	344
Males	11-12	391 (342-447)	411 (373-463)	706 (575-815)	1220 (870-1510)	1510 (1100-1830)	525
Males	13-14	375 (318-442)	449 (354-490)	655 (576-726)	886 (804-979)	1100 (949-1300)	508
Males	15-16	465 (411-526)	517 (463-601)	765 (698-838)	1150 (873-1400)	1400 (1130-1770)	443
Females	11-12	305 (269-347)	281 (243-366)	568 (461-629)	834 (661-971)	976 (910-1010)	344
Females	13-14	346 (320-373)	373 (318-422)	591 (527-655)	934 (832-1020)	1170 (961-1510)	436
Females	15-16	395 (358-435)	427 (358-477)	647 (561-725)	959 (786-1080)	1140 (969-1410)	311

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.25, 5.25, and 5.25 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 144889-50-9

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	238 (221-257)	266 (238-283)	429 (409-451)	606 (573-640)	758 (689-812)	1318
Total population	13-14	223 (206-240)	244 (221-262)	397 (375-424)	636 (564-679)	753 (707-813)	1375
Total population	15-16	292 (274-312)	323 (299-335)	501 (470-550)	686 (619-778)	859 (769-1030)	1244
Age 20-49 years	11-12	233 (206-264)	258 (226-310)	437 (398-478)	620 (549-664)	746 (655-798)	659
Age 20-49 years	13-14	219 (205-234)	240 (219-259)	390 (354-422)	582 (531-686)	750 (623-817)	674
Age 20-49 years	15-16	282 (251-316)	318 (291-363)	495 (459-556)	654 (583-768)	810 (670-916)	609
Age 50+ years	11-12	244 (226-263)	271 (237-282)	422 (369-455)	596 (531-670)	790 (620-849)	659
Age 50+ years	13-14	223 (198-252)	250 (211-278)	407 (372-456)	651 (584-697)	779 (707-817)	701
Age 50+ years	15-16	301 (275-329)	323 (287-348)	517 (463-573)	755 (620-892)	1000 (794-1080)	635
Males	11-12	296 (269-326)	331 (282-386)	478 (439-516)	639 (578-721)	790 (664-877)	628
Males	13-14	257 (232-284)	277 (241-304)	439 (395-491)	658 (565-711)	766 (707-883)	660
Males	15-16	332 (303-364)	370 (334-415)	537 (493-577)	755 (599-856)	856 (741-1030)	585
Females	11-12	200 (182-221)	219 (193-236)	354 (329-388)	562 (519-607)	738 (613-828)	690
Females	13-14	198 (180-217)	210 (189-236)	368 (336-407)	618 (524-676)	733 (651-806)	814
Females	15-16	263 (239-290)	276 (239-321)	471 (419-539)	654 (613-734)	961 (688-1160)	716

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.25, 5.25, and 5.25 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 144889-50-9

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	387 (363-412)	381 (364-403)	496 (453-555)	679 (594-741)	786 (717-853)	869
Total population	13-14	366 (332-403)	386 (363-402)	489 (448-535)	641 (595-696)	768 (713-889)	913
Total population	15-16	431 (410-454)	422 (397-471)	559 (522-615)	713 (639-788)	842 (721-949)	734
Age 20-49 years	11-12	372 (347-399)	357 (339-382)	469 (439-519)	681 (584-743)	777 (700-850)	518
Age 20-49 years	13-14	345 (311-383)	366 (330-387)	456 (423-502)	598 (557-663)	715 (634-774)	547
Age 20-49 years	15-16	385 (354-419)	392 (345-412)	506 (422-562)	637 (546-720)	721 (617-791)	390
Age 50+ years	11-12	411 (378-447)	408 (376-453)	521 (474-601)	668 (576-805)	833 (658-898)	351
Age 50+ years	13-14	423 (384-466)	425 (410-451)	538 (495-578)	754 (600-889)	913 (768-1050)	366
Age 50+ years	15-16	514 (483-547)	506 (472-537)	634 (594-688)	842 (685-1040)	949 (791-1580)	344
Males	11-12	370 (345-396)	369 (341-403)	470 (443-503)	610 (532-738)	777 (612-898)	525
Males	13-14	333 (294-377)	345 (329-373)	456 (416-486)	567 (527-624)	737 (586-908)	507
Males	15-16	400 (383-419)	397 (367-412)	515 (475-548)	672 (635-703)	760 (688-892)	443
Females	11-12	409 (378-443)	388 (360-450)	540 (474-622)	685 (645-741)	806 (718-893)	344
Females	13-14	404 (368-443)	406 (384-433)	512 (456-578)	696 (616-754)	822 (699-1020)	436
Females	15-16	471 (432-513)	473 (415-526)	587 (545-648)	756 (637-911)	911 (739-1060)	311

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 144889-50-9

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	279 (267-292)	276 (262-288)	357 (342-370)	461 (436-472)	534 (478-574)	1317
Total population	13-14	267 (245-290)	273 (250-297)	359 (335-384)	478 (438-520)	565 (496-670)	1374
Total population	15-16	330 (319-342)	329 (315-343)	413 (400-430)	502 (477-523)	570 (538-656)	1242
Age 20-49 years	11-12	256 (240-272)	249 (234-268)	321 (298-340)	399 (361-447)	498 (431-549)	658
Age 20-49 years	13-14	244 (222-267)	250 (231-272)	319 (298-338)	423 (364-475)	490 (417-567)	674
Age 20-49 years	15-16	300 (290-310)	296 (286-303)	364 (347-374)	446 (415-464)	510 (452-548)	607
Age 50+ years	11-12	307 (290-324)	301 (282-330)	394 (369-425)	491 (465-534)	566 (507-632)	659
Age 50+ years	13-14	295 (263-330)	301 (268-341)	398 (363-449)	512 (469-615)	650 (537-879)	700
Age 50+ years	15-16	367 (349-387)	369 (343-398)	452 (433-469)	541 (506-600)	650 (567-790)	635
Males	11-12	264 (251-278)	256 (243-272)	342 (321-365)	429 (404-446)	493 (429-633)	627
Males	13-14	250 (228-274)	255 (229-280)	327 (305-366)	452 (391-488)	541 (468-624)	659
Males	15-16	307 (293-321)	303 (289-320)	373 (355-407)	456 (430-479)	500 (469-532)	585
Females	11-12	292 (276-308)	288 (274-308)	367 (348-388)	474 (450-524)	549 (498-578)	690
Females	13-14	282 (258-308)	290 (264-315)	376 (353-406)	492 (449-532)	610 (507-786)	814
Females	15-16	351 (335-367)	347 (331-367)	437 (407-456)	540 (495-570)	644 (541-804)	714

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-cysteine in Smokers (2011 - 2016)

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	885
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	800
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	528
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	427
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	357
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	.805 (<LOD-.930)	373
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	493
Males	15-16	*	<LOD	<LOD	<LOD	.701 (<LOD-.830)	483
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	338

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-cysteine in Non-smokers (2011 - 2016)

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1353
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1389
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	664
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	680
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	689
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	709
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	651
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	657
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	799
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	793

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	884
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	800
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	527
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	427
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	357
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	1.90 (<LOD-2.48)	373
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	492
Males	15-16	*	<LOD	<LOD	<LOD	1.60 (<LOD-2.15)	483
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	422
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	338

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1352
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1387
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	664
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	678
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	688
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	709
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	650
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	657
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	799
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	791

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 159092-64-5

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	1.03 (.868-1.19)	2.67 (2.20-3.61)	6.15 (5.12-7.79)	8.99 (7.71-10.0)	869
Total population	13-14	*	.956 (.720-1.18)	2.58 (2.15-3.21)	5.22 (4.43-6.73)	8.16 (5.64-12.6)	905
Total population	15-16	1.48 (1.30-1.68)	1.27 (1.07-1.45)	3.27 (2.64-4.31)	6.87 (5.26-8.68)	9.87 (7.90-12.8)	804
Age 20-49 years	11-12	*	.834 (<LOD-1.11)	2.61 (2.00-3.31)	6.01 (3.99-8.50)	8.95 (6.22-9.94)	518
Age 20-49 years	13-14	*	.793 (<LOD-1.18)	2.49 (1.93-3.28)	5.12 (4.43-6.59)	7.85 (5.43-10.7)	540
Age 20-49 years	15-16	*	1.13 (.792-1.37)	3.04 (2.29-4.12)	6.59 (4.32-8.42)	8.65 (7.25-12.8)	428
Age 50+ years	11-12	1.47 (1.24-1.73)	1.29 (1.07-1.55)	3.09 (2.21-4.92)	7.56 (5.22-8.91)	9.43 (7.79-12.4)	351
Age 50+ years	13-14	1.35 (1.21-1.52)	1.15 (.956-1.37)	2.88 (2.42-3.32)	6.04 (4.16-7.90)	8.32 (5.53-17.3)	365
Age 50+ years	15-16	1.73 (1.39-2.15)	1.53 (1.04-2.25)	4.26 (2.61-5.75)	7.26 (5.82-11.0)	11.1 (7.15-15.6)	376
Males	11-12	*	.966 (.754-1.21)	2.62 (1.82-4.86)	6.22 (4.87-8.91)	9.43 (7.67-10.1)	525
Males	13-14	*	.771 (<LOD-1.40)	2.37 (1.88-3.19)	4.96 (3.62-7.05)	7.90 (5.02-12.6)	504
Males	15-16	1.51 (1.24-1.83)	1.21 (.839-2.04)	3.27 (2.48-4.67)	6.80 (4.66-11.0)	11.0 (6.73-13.3)	485
Females	11-12	*	1.07 (.707-1.29)	2.74 (2.31-3.79)	6.07 (4.50-7.71)	8.14 (6.55-11.1)	344
Females	13-14	1.31 (1.21-1.41)	1.13 (.907-1.24)	2.82 (2.15-3.82)	5.57 (4.43-6.97)	8.19 (5.14-12.9)	431
Females	15-16	1.44 (1.25-1.67)	1.19 (1.03-1.43)	3.04 (2.05-4.37)	6.87 (4.93-8.34)	8.79 (7.73-12.0)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 159092-64-5

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1369
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1401
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	671
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	684
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	698
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	658
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	810
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 159092-64-5

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	1.46 (1.18-1.74)	3.07 (2.72-3.75)	5.76 (4.74-7.06)	7.84 (5.68-11.0)	869
Total population	13-14	*	1.26 (1.08-1.50)	2.75 (2.25-3.24)	4.59 (3.71-5.78)	6.76 (5.33-8.01)	904
Total population	15-16	1.49 (1.32-1.68)	1.59 (1.31-1.89)	3.32 (2.88-3.91)	5.52 (4.77-6.70)	7.08 (6.19-9.63)	804
Age 20-49 years	11-12	*	1.21 (<LOD-1.56)	2.86 (2.34-3.41)	5.33 (4.08-6.45)	7.06 (6.01-9.68)	518
Age 20-49 years	13-14	*	1.10 (<LOD-1.24)	2.15 (1.75-2.81)	3.81 (3.08-5.31)	5.59 (4.04-7.96)	539
Age 20-49 years	15-16	*	1.31 (1.06-1.75)	2.91 (2.25-3.46)	5.13 (3.94-6.19)	6.63 (5.24-8.12)	428
Age 50+ years	11-12	1.77 (1.48-2.13)	1.63 (1.27-2.06)	3.75 (3.01-4.67)	6.67 (4.42-9.12)	7.87 (4.74-15.0)	351
Age 50+ years	13-14	1.69 (1.44-1.98)	1.92 (1.57-2.25)	3.53 (3.25-3.72)	6.12 (4.36-7.30)	8.09 (6.12-9.97)	365
Age 50+ years	15-16	1.94 (1.60-2.35)	1.95 (1.37-2.88)	4.13 (2.99-5.20)	6.93 (5.02-8.89)	9.05 (6.94-12.3)	376
Males	11-12	*	1.18 (.952-1.52)	2.68 (1.90-3.25)	4.83 (3.70-5.65)	6.32 (4.86-9.12)	525
Males	13-14	*	1.01 (<LOD-1.23)	2.16 (1.68-2.81)	3.72 (3.11-4.83)	5.83 (3.72-8.39)	503
Males	15-16	1.31 (1.12-1.53)	1.37 (1.15-1.64)	2.86 (2.15-3.46)	4.86 (3.58-6.07)	6.63 (4.94-7.46)	485
Females	11-12	*	1.83 (1.22-2.81)	4.00 (3.06-5.52)	6.88 (5.30-8.60)	8.60 (6.73-13.9)	344
Females	13-14	1.54 (1.31-1.80)	1.55 (1.24-1.93)	3.25 (2.63-3.57)	5.33 (4.46-6.12)	6.95 (5.59-7.96)	431
Females	15-16	1.74 (1.48-2.04)	1.82 (1.30-2.39)	4.00 (3.20-4.58)	6.38 (4.86-8.09)	8.12 (6.94-11.9)	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 159092-64-5

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1368
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1399
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	671
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	682
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	697
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	657
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	810
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 159092-65-6

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	28.4 (25.3-31.9)	31.9 (27.4-38.6)	61.2 (52.5-70.4)	97.1 (87.6-107)	124 (109-133)	869
Total population	13-14	25.6 (21.4-30.8)	28.3 (22.9-36.4)	56.3 (48.0-64.9)	90.8 (77.7-106)	119 (99.3-144)	890
Total population	15-16	22.2 (19.3-25.6)	27.0 (24.4-28.9)	51.1 (45.1-56.4)	78.2 (67.3-90.3)	103 (86.4-125)	804
Age 20-49 years	11-12	25.9 (21.9-30.6)	28.2 (23.2-37.4)	54.8 (45.4-62.6)	86.3 (72.7-98.9)	109 (94.4-138)	518
Age 20-49 years	13-14	25.0 (20.2-30.8)	27.4 (22.4-36.6)	55.2 (46.4-67.6)	91.7 (74.5-106)	112 (98.9-143)	532
Age 20-49 years	15-16	18.5 (14.9-23.1)	24.4 (18.4-28.8)	43.8 (35.8-51.2)	78.2 (55.3-95.5)	104 (78.2-131)	428
Age 50+ years	11-12	32.7 (26.7-40.2)	40.4 (31.4-46.3)	77.7 (55.7-92.1)	108 (87.2-130)	133 (99.8-193)	351
Age 50+ years	13-14	27.9 (23.0-33.7)	29.1 (22.3-37.0)	60.3 (45.7-66.7)	88.1 (74.9-123)	127 (79.9-184)	358
Age 50+ years	15-16	29.5 (24.8-35.1)	32.3 (24.0-40.5)	59.3 (51.1-64.9)	78.7 (71.0-89.9)	95.8 (87.2-140)	376
Males	11-12	28.4 (23.3-34.7)	31.4 (23.2-41.1)	68.1 (49.2-78.6)	106 (89.0-129)	133 (107-171)	525
Males	13-14	24.5 (19.6-30.5)	26.5 (21.3-36.8)	56.6 (46.5-64.4)	91.7 (70.4-117)	127 (91.7-156)	492
Males	15-16	21.8 (17.4-27.4)	26.9 (19.9-32.7)	55.0 (45.1-64.9)	83.7 (64.7-105)	105 (86.4-134)	485
Females	11-12	28.3 (25.4-31.5)	34.1 (28.2-40.0)	57.6 (47.7-63.1)	87.2 (75.4-98.9)	108 (89.9-125)	344
Females	13-14	26.9 (22.6-31.9)	29.2 (24.0-35.5)	55.2 (44.6-69.0)	87.6 (77.7-106)	115 (94.4-131)	427
Females	15-16	22.7 (20.4-25.2)	27.0 (24.0-29.9)	45.1 (38.2-51.2)	70.7 (62.8-86.3)	95.4 (75.1-125)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.600, 0.600, and 0.600 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 159092-65-6

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	3.93 (3.60-4.30)	4.03 (3.78-4.39)	7.23 (6.72-7.74)	11.6 (10.5-13.0)	14.9 (13.4-17.7)	1318
Total population	13-14	4.30 (3.90-4.74)	4.20 (3.75-4.59)	7.37 (6.67-8.26)	12.5 (10.9-15.9)	20.9 (15.4-28.8)	1297
Total population	15-16	3.21 (2.93-3.51)	3.37 (3.08-3.68)	5.80 (5.40-6.27)	10.4 (8.69-11.7)	14.2 (12.6-16.3)	1401
Age 20-49 years	11-12	3.99 (3.45-4.63)	4.24 (3.59-4.92)	7.33 (6.57-8.66)	12.6 (10.5-14.7)	20.5 (13.5-25.8)	659
Age 20-49 years	13-14	4.26 (3.83-4.75)	4.16 (3.47-4.68)	7.79 (6.62-8.92)	14.0 (11.5-18.1)	22.4 (15.6-31.5)	638
Age 20-49 years	15-16	3.22 (2.88-3.60)	3.51 (3.19-3.86)	5.71 (5.30-6.35)	10.4 (8.42-11.8)	13.6 (12.0-16.7)	684
Age 50+ years	11-12	3.87 (3.52-4.26)	3.96 (3.65-4.46)	7.23 (6.16-7.84)	10.7 (9.56-12.1)	13.6 (11.5-14.9)	659
Age 50+ years	13-14	4.26 (3.75-4.83)	4.26 (3.70-4.71)	7.21 (6.21-8.35)	11.3 (9.60-15.9)	17.9 (12.0-28.8)	659
Age 50+ years	15-16	3.18 (2.87-3.52)	3.25 (2.94-3.60)	5.85 (5.37-6.39)	10.5 (7.89-12.6)	14.3 (12.6-17.4)	717
Males	11-12	4.99 (4.58-5.43)	5.17 (4.59-5.80)	7.84 (7.23-8.66)	12.9 (10.7-14.6)	15.8 (14.3-20.7)	628
Males	13-14	4.81 (4.26-5.44)	4.68 (4.26-5.39)	8.30 (7.33-9.37)	13.9 (11.4-16.5)	20.9 (16.5-30.1)	630
Males	15-16	3.81 (3.38-4.29)	4.16 (3.65-4.66)	6.59 (5.91-7.25)	11.6 (9.62-13.1)	16.3 (13.3-18.5)	660
Females	11-12	3.26 (2.83-3.77)	3.29 (2.85-3.77)	6.46 (5.74-7.28)	10.6 (9.11-12.4)	13.5 (11.7-19.9)	690
Females	13-14	3.91 (3.45-4.43)	3.75 (3.20-4.23)	6.72 (5.84-7.87)	12.3 (10.3-17.3)	21.5 (13.1-33.3)	764
Females	15-16	2.79 (2.53-3.07)	2.84 (2.53-3.19)	5.23 (4.63-5.64)	8.95 (7.60-10.8)	12.6 (11.4-14.3)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.600, 0.600, and 0.600 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 159092-65-6

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	31.3 (28.1-34.9)	35.2 (29.7-40.0)	63.9 (53.2-70.3)	95.0 (81.1-114)	124 (102-150)	869
Total population	13-14	26.2 (21.0-32.6)	30.3 (24.2-36.9)	53.7 (43.9-65.5)	87.0 (65.3-110)	110 (88.6-141)	889
Total population	15-16	22.4 (19.4-25.9)	28.3 (25.1-31.4)	45.2 (41.0-49.2)	64.4 (56.2-80.2)	87.7 (68.2-119)	804
Age 20-49 years	11-12	27 (23.4-31.1)	29.9 (24.3-35.3)	51.4 (42.9-64.8)	84.1 (71.8-95.0)	106 (85.3-137)	518
Age 20-49 years	13-14	23 (18.4-28.6)	25.5 (19.9-32.0)	45.4 (36.2-58.4)	77.5 (58.3-103)	105 (84.2-126)	531
Age 20-49 years	15-16	17.6 (13.7-22.5)	22.3 (16.6-26.9)	37.7 (31.5-45.3)	59.6 (44.1-74.0)	74.0 (58.4-123)	428
Age 50+ years	11-12	39.6 (33.1-47.3)	45.4 (35.4-57.4)	75.5 (67.7-86.7)	115 (83.5-153)	126 (86.7-180)	351
Age 50+ years	13-14	35 (27.7-44.1)	43.0 (33.1-49.7)	64.7 (53.6-81.7)	101 (73.4-140)	128 (101-174)	358
Age 50+ years	15-16	33.1 (29.5-37.2)	34.9 (31.0-42.3)	52.2 (47.7-60.7)	76.5 (64.2-87.7)	94.2 (84.5-116)	376
Males	11-12	26.9 (23.7-30.6)	29.6 (25.3-34.6)	50.0 (40.0-58.7)	76.7 (71.6-85.0)	99.0 (79.3-118)	525
Males	13-14	21.7 (17.7-26.5)	24.9 (18.6-30.0)	45.4 (34.5-55.6)	76.9 (55.2-89.0)	91.4 (76.9-127)	491
Males	15-16	19 (15.9-22.6)	24.9 (20.6-27.2)	39.8 (34.9-44.0)	55.7 (47.8-64.2)	65.6 (53.5-90.3)	485
Females	11-12	38 (30.8-46.8)	45.2 (35.4-57.4)	74.7 (65.3-91.2)	118 (89.0-150)	150 (118-180)	344
Females	13-14	31.7 (24.6-41.0)	36.1 (28.0-46.8)	59.2 (46.8-81.8)	97.4 (67.1-121)	114 (98.7-164)	427
Females	15-16	27.3 (23.5-31.8)	32.3 (29.1-34.8)	51.9 (44.4-58.2)	79.4 (62.0-110)	123 (77.4-156)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 159092-65-6

Metabolite of 1,3-Butadiene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	4.62 (4.26-5.00)	4.43 (3.89-4.89)	7.04 (6.42-7.41)	10.4 (9.25-11.6)	13.5 (11.9-16.3)	1317
Total population	13-14	4.96 (4.39-5.61)	4.67 (4.11-5.39)	7.55 (6.57-8.72)	11.9 (9.94-15.6)	16.5 (13.3-26.3)	1296
Total population	15-16	3.63 (3.34-3.93)	3.37 (3.21-3.66)	5.28 (4.97-5.65)	8.30 (7.63-8.89)	11.5 (9.56-13.0)	1399
Age 20-49 years	11-12	4.39 (3.90-4.94)	4.18 (3.42-4.99)	7.04 (5.83-7.64)	10.2 (8.70-12.8)	14.8 (10.8-22.4)	658
Age 20-49 years	13-14	4.55 (4.04-5.13)	4.12 (3.65-4.78)	7.10 (6.17-8.29)	12.9 (9.99-15.1)	16.4 (14.5-18.7)	638
Age 20-49 years	15-16	3.4 (3.09-3.75)	3.07 (2.90-3.37)	5.10 (4.50-5.61)	7.88 (7.22-9.15)	12.3 (9.36-18.6)	682
Age 50+ years	11-12	4.87 (4.49-5.29)	4.50 (4.05-5.16)	7.04 (6.44-8.00)	10.8 (8.95-12.0)	12.5 (11.5-14.1)	659
Age 50+ years	13-14	5.43 (4.67-6.32)	5.09 (4.29-6.00)	7.83 (6.54-9.13)	11.5 (9.77-16.0)	17.0 (11.5-51.8)	658
Age 50+ years	15-16	3.91 (3.54-4.32)	3.69 (3.34-4.05)	5.56 (5.09-5.90)	8.58 (7.32-9.56)	11.0 (8.73-13.6)	717
Males	11-12	4.46 (4.16-4.77)	4.11 (3.81-4.57)	6.68 (6.11-7.36)	10.1 (8.69-11.6)	12.1 (11.0-14.0)	627
Males	13-14	4.53 (3.94-5.20)	4.35 (3.71-5.22)	6.96 (5.95-7.85)	10.6 (9.57-13.4)	15.1 (12.2-17.4)	629
Males	15-16	3.5 (3.13-3.92)	3.23 (3.04-3.44)	4.97 (4.52-5.35)	7.90 (6.89-8.81)	12.3 (8.69-17.0)	660
Females	11-12	4.74 (4.22-5.34)	4.52 (3.89-5.33)	7.18 (6.24-7.96)	11.1 (9.04-13.5)	14.0 (11.8-21.5)	690
Females	13-14	5.36 (4.65-6.18)	4.81 (4.29-5.52)	8.06 (6.63-9.43)	13.4 (10.2-16.7)	18.1 (13.4-49.6)	764
Females	15-16	3.73 (3.46-4.02)	3.51 (3.26-3.82)	5.50 (5.09-5.82)	8.46 (7.71-9.21)	11.2 (9.61-12.2)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Thioxothiazolidine-4-carboxylic acid in Smokers (2011 - 2014)

CAS Number 20933-67-9

Metabolite of Carbon disulfide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	22.4 (17.2-25.1)	46.1 (37.0-62.7)	89.0 (60.1-161)	869
Total population	13-14	*	<LOD	19.1 (15.0-25.3)	47.4 (32.8-70.8)	91.6 (55.4-128)	916
Age 20-49 years	11-12	*	<LOD	20.7 (14.1-24.6)	41.6 (28.1-64.9)	83.8 (52.2-146)	518
Age 20-49 years	13-14	*	<LOD	20.5 (15.0-27.3)	47.4 (29.2-86.9)	96.6 (48.8-129)	548
Age 50+ years	11-12	*	<LOD	25.1 (16.4-32.7)	60.1 (34.1-89.0)	89.0 (58.2-415)	351
Age 50+ years	13-14	*	<LOD	17.0 (13.5-21.3)	55.4 (34.8-70.3)	85.3 (49.1-125)	368
Males	11-12	*	<LOD	22.3 (15.2-34.1)	46.0 (37.0-60.8)	83.2 (52.2-161)	525
Males	13-14	*	<LOD	19.0 (15.1-25.6)	48.2 (30.7-89.4)	102 (48.8-209)	510
Females	11-12	*	<LOD	22.7 (14.1-25.1)	46.2 (30.0-69.4)	89.0 (36.7-419)	344
Females	13-14	*	<LOD	19.3 (14.5-24.3)	46.1 (28.0-83.4)	85.3 (44.0-126)	436

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 and 13-14 are 11.2 and 11.2 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Thioxothiazolidine-4-carboxylic acid in Non-smokers (2011 - 2014)

CAS Number 20933-67-9

Metabolite of Carbon disulfide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	18.0 (14.3-21.7)	53.5 (37.8-69.5)	114 (76.9-145)	1318
Total population	13-14	*	<LOD	18.8 (17.3-20.7)	55.3 (41.7-70.9)	127 (93.1-155)	1375
Age 20-49 years	11-12	*	<LOD	18.5 (12.4-26.1)	56.8 (36.8-91.6)	115 (70.0-159)	659
Age 20-49 years	13-14	*	<LOD	18.4 (13.6-23.5)	46.2 (32.0-96.9)	127 (65.9-151)	674
Age 50+ years	11-12	*	<LOD	17.5 (12.4-22.5)	47.6 (32.8-59.0)	114 (59.0-178)	659
Age 50+ years	13-14	*	<LOD	19.3 (16.0-27.4)	57.9 (41.3-88.4)	126 (74.4-237)	701
Males	11-12	*	<LOD	26.4 (19.5-30.5)	73.7 (51.9-121)	159 (96.4-198)	628
Males	13-14	*	<LOD	22.3 (19.2-28.2)	59.8 (36.3-124)	130 (63.9-201)	660
Females	11-12	*	<LOD	13.2 (<LOD-17.3)	35.7 (26.7-44.7)	73.1 (49.8-103)	690
Females	13-14	*	<LOD	16.0 (13.6-18.2)	47.1 (34.4-76.5)	121 (79.5-153)	814

Limit of detection (LOD, see Data Analysis section) for Survey year 11-12 and 13-14 are 11.2 and 11.2 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Thioxothiazolidine-4-carboxylic acid in Smokers (creatinine corrected, 2011 - 2014)

CAS Number 20933-67-9

Metabolite of Carbon disulfide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	27.2 (23.2-32.9)	57.9 (46.5-71.7)	88.1 (71.7-141)	869
Total population	13-14	*	<LOD	24.9 (20.8-28.8)	53.2 (39.9-65.6)	73.8 (65.0-107)	915
Age 20-49 years	11-12	*	<LOD	25.2 (20.4-32.9)	51.3 (43.8-57.9)	91.3 (57.6-169)	518
Age 20-49 years	13-14	*	<LOD	21.9 (18.8-28.1)	47.8 (35.9-65.6)	68.3 (58.0-107)	547
Age 50+ years	11-12	*	<LOD	30.4 (23.2-49.8)	71.7 (35.9-87.8)	88.1 (71.7-220)	351
Age 50+ years	13-14	*	<LOD	28.3 (23.2-33.2)	61.7 (39.5-82.2)	90.0 (61.7-187)	368
Males	11-12	*	<LOD	24.7 (18.0-32.9)	49.8 (43.9-60.6)	78.7 (57.5-141)	525
Males	13-14	*	<LOD	21.3 (16.1-28.1)	46.5 (30.4-68.2)	75.7 (52.6-139)	509
Females	11-12	*	<LOD	31.6 (23.2-51.3)	71.7 (41.6-87.8)	88.1 (57.6-344)	344
Females	13-14	*	<LOD	28.1 (21.9-34.3)	61.7 (39.9-71.8)	73.8 (64.6-126)	436

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Thioxothiazolidine-4-carboxylic acid in Non-smokers (creatinine corrected, 2011 - 2014)

CAS Number 20933-67-9

Metabolite of Carbon disulfide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	27.5 (23.2-29.9)	60.8 (50.8-76.3)	110 (84.5-164)	1317
Total population	13-14	*	<LOD	29.8 (27.2-32.9)	71.8 (60.9-78.3)	126 (89.4-179)	1374
Age 20-49 years	11-12	*	<LOD	27.5 (21.0-35.4)	60.8 (44.9-94.8)	103 (66.0-154)	658
Age 20-49 years	13-14	*	<LOD	25.5 (22.9-30.4)	52.4 (40.9-76.3)	100 (63.5-171)	674
Age 50+ years	11-12	*	<LOD	27.2 (23.1-29.3)	56.7 (41.6-75.4)	144 (71.8-223)	659
Age 50+ years	13-14	*	<LOD	34.9 (29.1-43.9)	79.0 (68.5-96.9)	156 (89.4-223)	700
Males	11-12	*	<LOD	23.2 (20.3-29.9)	55.9 (44.3-79.1)	116 (58.4-230)	627
Males	13-14	*	<LOD	23.5 (19.9-30.0)	64.4 (40.9-84.3)	93.8 (74.1-194)	659
Females	11-12	*	<LOD	29.3 (<LOD-32.9)	61.7 (44.2-96.7)	104 (80.5-161)	690
Females	13-14	*	<LOD	32.9 (29.6-37.6)	71.8 (60.8-83.6)	134 (100-187)	814

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 33164-70-4

Metabolite of Crotonaldehyde

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1760 (1550-1990)	2000 (1600-2360)	3880 (3340-4370)	6980 (5940-7570)	7910 (7610-8720)	869
Total population	13-14	1490 (1270-1750)	1600 (1290-1980)	3320 (2910-4030)	5510 (4940-6320)	7680 (6120-9100)	852
Total population	15-16	1760 (1580-1970)	2000 (1810-2090)	3850 (3290-4350)	6460 (5290-7600)	7990 (6750-11400)	804
Age 20-49 years	11-12	1590 (1330-1900)	1680 (1270-2250)	3570 (2730-4250)	6060 (4580-7110)	7790 (6310-8880)	518
Age 20-49 years	13-14	1400 (1130-1730)	1460 (1100-1980)	3250 (2780-3870)	5320 (4570-6120)	6740 (5450-9100)	509
Age 20-49 years	15-16	1430 (1210-1700)	1510 (1200-1940)	3160 (2840-3570)	6320 (4390-7530)	7950 (6220-12700)	428
Age 50+ years	11-12	2050 (1700-2470)	2480 (1860-2890)	4450 (3520-5410)	7540 (6690-7830)	8720 (7500-9650)	351
Age 50+ years	13-14	1780 (1530-2080)	1890 (1540-2140)	3550 (2930-4810)	6110 (4940-7990)	8120 (6100-11300)	343
Age 50+ years	15-16	2420 (2060-2840)	2510 (2020-3090)	4600 (3850-5330)	6700 (5340-7990)	8270 (6930-12900)	376
Males	11-12	1780 (1450-2170)	2050 (1320-2660)	4100 (3390-4460)	7050 (5460-7790)	8410 (7680-9120)	525
Males	13-14	1400 (1110-1760)	1430 (1010-2090)	3310 (2950-3660)	5650 (4390-7150)	8450 (5960-11100)	470
Males	15-16	1840 (1530-2220)	2040 (1550-2680)	4390 (3320-5330)	6970 (5340-7990)	7990 (6680-12900)	485
Females	11-12	1730 (1570-1910)	2000 (1640-2250)	3700 (3090-4200)	6510 (4570-7700)	7910 (6960-8880)	344
Females	13-14	1590 (1370-1850)	1600 (1340-2020)	3310 (2560-4380)	5340 (4630-6310)	6670 (5860-8410)	407
Females	15-16	1670 (1540-1820)	1890 (1590-2020)	3320 (2840-3830)	5660 (4570-6660)	7990 (5980-9430)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.00, 3.00, and 3.00 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 33164-70-4

Metabolite of Crotonaldehyde

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	338 (320-358)	342 (317-370)	594 (538-638)	930 (845-1030)	1360 (984-2120)	1318
Total population	13-14	309 (281-340)	313 (281-346)	550 (501-611)	967 (854-1160)	1500 (1220-1830)	1361
Total population	15-16	339 (311-370)	356 (323-391)	577 (538-636)	1010 (866-1140)	1380 (1200-1660)	1401
Age 20-49 years	11-12	336 (305-372)	342 (297-397)	623 (525-683)	949 (834-1050)	1200 (970-2270)	659
Age 20-49 years	13-14	300 (276-326)	296 (270-333)	521 (484-583)	920 (737-1120)	1650 (976-2250)	666
Age 20-49 years	15-16	322 (285-363)	347 (290-396)	565 (510-636)	885 (751-1080)	1260 (1080-1520)	684
Age 50+ years	11-12	341 (313-370)	342 (291-411)	575 (492-649)	891 (809-1070)	1460 (904-2120)	659
Age 50+ years	13-14	320 (278-367)	322 (278-391)	574 (501-691)	1010 (884-1240)	1500 (1240-1780)	695
Age 50+ years	15-16	359 (328-394)	367 (334-409)	586 (536-669)	1130 (1010-1200)	1490 (1350-2030)	717
Males	11-12	408 (383-436)	422 (366-460)	659 (619-697)	992 (880-1110)	1390 (1030-1890)	628
Males	13-14	353 (305-408)	362 (292-419)	630 (508-706)	1010 (888-1250)	1650 (1100-2470)	655
Males	15-16	397 (362-436)	422 (362-475)	623 (573-699)	1070 (796-1330)	1380 (1180-2150)	660
Females	11-12	292 (265-321)	284 (248-323)	509 (473-568)	888 (721-1030)	1240 (851-2710)	690
Females	13-14	277 (252-304)	274 (243-312)	505 (460-547)	884 (741-1110)	1460 (1100-1950)	805
Females	15-16	299 (270-331)	295 (258-332)	531 (485-577)	942 (773-1120)	1410 (1120-1660)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 2.00, 3.00, and 3.00 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 33164-70-4

Metabolite of Crotonaldehyde

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1940 (1730-2170)	2170 (1850-2440)	3930 (3500-4700)	6290 (5650-7250)	7880 (6740-9140)	869
Total population	13-14	1540 (1280-1850)	1770 (1430-2190)	3310 (2630-3980)	5360 (4570-6170)	6830 (5640-8380)	851
Total population	15-16	1780 (1610-1960)	2150 (1910-2340)	3480 (3020-3760)	5410 (4340-6700)	7010 (6360-8110)	804
Age 20-49 years	11-12	1660 (1420-1940)	1710 (1440-2070)	3400 (2700-4110)	5830 (5250-6560)	7630 (6450-8530)	518
Age 20-49 years	13-14	1300 (1060-1600)	1450 (1080-1810)	2610 (2190-3270)	4970 (3530-5960)	6170 (5100-7590)	508
Age 20-49 years	15-16	1360 (1140-1620)	1480 (1170-1800)	2720 (2290-3330)	4340 (3710-5480)	6450 (4330-8080)	428
Age 50+ years	11-12	2480 (2140-2870)	2890 (2410-3430)	4850 (3920-5710)	6780 (5710-8670)	8380 (5840-12500)	351
Age 50+ years	13-14	2240 (1900-2640)	2550 (2080-3050)	4360 (3810-4630)	6130 (4740-6830)	7000 (6080-9900)	343
Age 50+ years	15-16	2710 (2430-3030)	2840 (2560-3280)	4140 (3600-4780)	6700 (5380-7590)	8590 (6960-9650)	376
Males	11-12	1680 (1480-1920)	1820 (1350-2250)	3230 (2640-3770)	5810 (4260-6270)	7250 (5810-8790)	525
Males	13-14	1240 (1020-1510)	1470 (1060-1840)	2580 (2300-2920)	4550 (3380-5390)	5590 (4290-9050)	469
Males	15-16	1600 (1430-1790)	1910 (1570-2250)	3160 (2740-3600)	4380 (3770-5580)	6210 (4230-7180)	485
Females	11-12	2320 (1900-2840)	2810 (2270-3310)	5210 (3870-5830)	6930 (5830-8530)	9140 (7200-10500)	344
Females	13-14	1920 (1570-2350)	2080 (1630-2720)	3920 (3000-4810)	5960 (4730-6830)	6850 (6400-8480)	407
Females	15-16	2020 (1780-2280)	2340 (2150-2490)	3760 (3070-4340)	6620 (5070-8080)	8520 (6620-12600)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 33164-70-4

Metabolite of Crotonaldehyde

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	397 (367-428)	362 (326-399)	521 (484-563)	803 (706-977)	1230 (974-1480)	1317
Total population	13-14	370 (331-414)	338 (311-368)	532 (487-613)	986 (851-1170)	1510 (1140-2030)	1360
Total population	15-16	384 (360-409)	343 (322-374)	498 (452-549)	797 (677-960)	1150 (936-1590)	1399
Age 20-49 years	11-12	369 (328-415)	316 (288-357)	483 (412-582)	770 (641-1130)	1330 (760-3180)	658
Age 20-49 years	13-14	334 (294-380)	296 (274-325)	461 (404-517)	923 (593-1300)	1470 (817-2270)	666
Age 20-49 years	15-16	341 (322-361)	302 (280-326)	429 (391-461)	691 (573-822)	1120 (899-1430)	682
Age 50+ years	11-12	429 (401-459)	396 (362-429)	536 (495-595)	826 (720-938)	1080 (938-1310)	659
Age 50+ years	13-14	421 (372-477)	390 (353-456)	640 (542-735)	1060 (868-1370)	1550 (1170-2270)	694
Age 50+ years	15-16	442 (410-476)	389 (370-419)	573 (514-632)	870 (698-1070)	1260 (970-2560)	717
Males	11-12	364 (343-386)	333 (302-364)	484 (433-530)	742 (623-938)	1020 (838-1300)	627
Males	13-14	345 (302-394)	325 (289-356)	485 (430-594)	904 (668-1080)	1170 (984-1670)	654
Males	15-16	365 (336-397)	326 (304-350)	461 (401-549)	733 (606-1040)	1070 (754-1860)	660
Females	11-12	424 (385-468)	378 (345-412)	539 (487-605)	881 (720-1110)	1330 (961-2250)	690
Females	13-14	393 (353-437)	348 (312-381)	571 (512-695)	1060 (854-1510)	1630 (1160-2270)	805
Females	15-16	400 (369-433)	356 (332-388)	510 (455-570)	845 (691-957)	1260 (899-1740)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Aminothiazoline-4-carboxylic acid in Smokers (2011 - 2016)

CAS Number 2150-55-2

Metabolite of Cyanide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	118 (103-136)	128 (112-144)	238 (197-290)	439 (339-514)	610 (487-758)	869
Total population	13-14	126 (110-144)	134 (114-160)	275 (223-330)	489 (426-554)	736 (517-894)	851
Total population	15-16	137 (119-157)	150 (132-167)	312 (251-372)	538 (465-605)	726 (625-867)	804
Age 20-49 years	11-12	115 (99.3-134)	126 (107-148)	227 (190-252)	430 (311-524)	551 (439-683)	518
Age 20-49 years	13-14	128 (110-150)	152 (118-172)	286 (228-342)	491 (436-531)	758 (502-894)	509
Age 20-49 years	15-16	138 (111-172)	158 (126-196)	337 (246-425)	519 (445-650)	691 (559-969)	428
Age 50+ years	11-12	123 (95.9-157)	134 (99.3-175)	264 (172-327)	487 (317-689)	721 (451-991)	351
Age 50+ years	13-14	117 (101-136)	114 (89.6-140)	239 (187-302)	457 (352-607)	712 (458-957)	342
Age 50+ years	15-16	137 (112-166)	141 (108-169)	293 (208-350)	542 (394-697)	791 (576-934)	376
Males	11-12	94.4 (79.4-112)	100 (81.4-126)	191 (165-234)	307 (247-359)	381 (294-635)	525
Males	13-14	95.1 (78.2-116)	106 (87.7-124)	190 (154-257)	353 (275-474)	491 (317-637)	482
Males	15-16	105 (87.3-126)	123 (87.0-147)	225 (171-290)	399 (337-558)	590 (503-811)	485
Females	11-12	157 (134-184)	162 (143-189)	327 (238-439)	558 (439-744)	755 (536-997)	344
Females	13-14	169 (139-206)	181 (149-225)	362 (294-457)	663 (471-826)	894 (693-1170)	396
Females	15-16	187 (160-219)	204 (167-251)	424 (332-465)	604 (501-715)	867 (661-1070)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 15.0, 15.0, and 15.0 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminothiazoline-4-carboxylic acid in Non-smokers (2011 - 2016)

CAS Number 2150-55-2

Metabolite of Cyanide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	96.0 (87.0-106)	103 (92.9-112)	191 (170-220)	327 (293-364)	442 (378-508)	1318
Total population	13-14	88.9 (81.1-97.4)	91.2 (81.4-99.2)	189 (164-210)	345 (303-377)	449 (397-515)	1323
Total population	15-16	100 (87.6-115)	108 (87.7-127)	212 (184-248)	353 (297-435)	514 (421-624)	1401
Age 20-49 years	11-12	93.0 (81.3-106)	101 (82.4-111)	189 (160-226)	323 (272-408)	478 (342-543)	659
Age 20-49 years	13-14	95.7 (85.9-107)	95.0 (85.4-114)	203 (176-228)	382 (334-421)	491 (432-554)	650
Age 20-49 years	15-16	109 (93.6-127)	116 (105-131)	236 (188-288)	391 (315-499)	524 (413-712)	684
Age 50+ years	11-12	99.3 (89.9-110)	108 (94.6-125)	192 (176-220)	331 (292-364)	414 (356-501)	659
Age 50+ years	13-14	81.4 (70.6-93.8)	80.8 (69.1-101)	173 (146-209)	303 (255-352)	390 (344-458)	673
Age 50+ years	15-16	90.1 (75.8-107)	88.2 (72.8-124)	195 (172-227)	337 (266-392)	464 (349-649)	717
Males	11-12	78.6 (69.4-89.0)	80.4 (69.2-94.6)	144 (131-175)	265 (217-386)	414 (285-524)	628
Males	13-14	69.5 (60.7-79.7)	72.1 (61.7-82.3)	154 (134-173)	295 (245-345)	377 (337-429)	629
Males	15-16	79.2 (67.4-93.2)	81.7 (63.7-98.6)	186 (137-216)	293 (247-390)	435 (336-573)	660
Females	11-12	112 (99.0-127)	127 (104-149)	226 (194-257)	342 (315-375)	478 (404-521)	690
Females	13-14	109 (98.9-119)	105 (95.0-121)	220 (193-248)	397 (319-459)	529 (457-606)	785
Females	15-16	121 (106-139)	134 (112-152)	248 (195-288)	394 (343-502)	550 (448-747)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 15.0, 15.0, and 15.0 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Aminothiazoline-4-carboxylic acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 2150-55-2

Metabolite of Cyanide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	130 (119-143)	133 (115-155)	248 (225-285)	412 (366-449)	516 (440-623)	869
Total population	13-14	125 (112-140)	132 (104-152)	248 (232-280)	418 (363-483)	598 (465-703)	851
Total population	15-16	138 (124-154)	147 (120-172)	286 (253-317)	464 (397-494)	608 (523-667)	804
Age 20-49 years	11-12	120 (108-133)	128 (113-151)	225 (208-252)	344 (285-406)	412 (366-514)	518
Age 20-49 years	13-14	117 (102-133)	125 (103-145)	239 (223-274)	377 (347-452)	542 (447-598)	509
Age 20-49 years	15-16	131 (111-155)	143 (106-179)	260 (208-319)	385 (366-452)	523 (419-684)	428
Age 50+ years	11-12	148 (125-176)	140 (102-185)	327 (247-399)	477 (422-623)	635 (449-925)	351
Age 50+ years	13-14	142 (127-160)	137 (107-175)	272 (230-301)	537 (377-703)	733 (589-988)	342
Age 50+ years	15-16	153 (131-179)	148 (114-202)	317 (267-379)	511 (405-667)	667 (503-738)	376
Males	11-12	89.4 (79.9-100)	91.1 (81.1-101)	151 (133-167)	268 (210-326)	390 (286-477)	525
Males	13-14	84.1 (72.3-97.9)	90.2 (74.7-100)	151 (134-185)	261 (214-344)	397 (258-632)	482
Males	15-16	91.1 (79.8-104)	86.3 (73.7-99.6)	166 (125-202)	267 (222-327)	400 (289-503)	485
Females	11-12	210 (192-231)	224 (207-258)	363 (307-411)	510 (440-575)	674 (450-925)	344
Females	13-14	193 (169-219)	222 (190-237)	347 (290-381)	550 (427-598)	694 (562-988)	396
Females	15-16	226 (195-261)	247 (205-297)	375 (366-419)	558 (470-659)	722 (576-806)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminothiazoline-4-carboxylic acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 2150-55-2

Metabolite of Cyanide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	113 (103-123)	123 (112-135)	217 (196-237)	350 (316-372)	418 (372-489)	1317
Total population	13-14	107 (96.4-118)	122 (107-139)	210 (194-236)	355 (286-414)	492 (393-559)	1322
Total population	15-16	113 (103-125)	123 (111-135)	218 (196-239)	344 (302-404)	472 (427-534)	1399
Age 20-49 years	11-12	102 (92.7-112)	112 (98.0-127)	194 (170-218)	315 (260-350)	374 (340-411)	658
Age 20-49 years	13-14	106 (95.2-118)	125 (107-145)	204 (190-221)	321 (278-375)	437 (393-515)	650
Age 20-49 years	15-16	115 (104-128)	123 (110-133)	216 (189-247)	336 (285-404)	481 (378-562)	682
Age 50+ years	11-12	125 (113-138)	132 (118-148)	240 (220-280)	372 (333-415)	489 (418-546)	659
Age 50+ years	13-14	109 (94.7-125)	120 (97.6-145)	219 (194-256)	378 (292-493)	528 (404-610)	672
Age 50+ years	15-16	111 (96.5-127)	121 (99.5-145)	221 (190-249)	346 (290-446)	466 (392-518)	717
Males	11-12	70.1 (61.0-80.5)	69.0 (57.4-80.9)	126 (109-153)	228 (180-284)	322 (254-411)	627
Males	13-14	67.9 (60.4-76.2)	72.1 (62.2-84.3)	125 (116-151)	219 (192-246)	283 (247-333)	628
Males	15-16	72.9 (63.8-83.3)	72.3 (58.3-90.3)	133 (111-157)	245 (174-330)	349 (224-481)	660
Females	11-12	163 (148-180)	170 (154-188)	274 (236-309)	377 (353-418)	478 (400-546)	690
Females	13-14	155 (138-173)	175 (159-190)	263 (225-304)	431 (357-512)	549 (468-682)	785
Females	15-16	162 (148-178)	179 (155-196)	260 (238-289)	427 (348-472)	558 (466-635)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 103974-29-4

Metabolite of N,N-Dimethylformamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	459 (400-527)	471 (407-573)	855 (746-1030)	1440 (1210-1790)	2050 (1570-2320)	869
Total population	13-14	423 (358-499)	472 (397-533)	838 (690-969)	1360 (1110-1630)	1730 (1400-2110)	908
Total population	15-16	385 (336-441)	418 (365-484)	813 (660-922)	1200 (1070-1390)	1580 (1340-1700)	779
Age 20-49 years	11-12	426 (368-492)	454 (387-534)	808 (704-950)	1260 (1120-1490)	1520 (1240-2050)	518
Age 20-49 years	13-14	409 (336-498)	445 (375-523)	808 (683-938)	1320 (1070-1640)	1720 (1280-2110)	545
Age 20-49 years	15-16	322 (270-382)	351 (306-418)	669 (564-792)	1130 (927-1360)	1470 (1130-1650)	419
Age 50+ years	11-12	517 (420-638)	552 (397-693)	944 (765-1220)	2010 (1470-2290)	2490 (1500-3590)	351
Age 50+ years	13-14	470 (404-546)	507 (409-597)	909 (631-1060)	1420 (1110-1720)	1750 (1370-2460)	363
Age 50+ years	15-16	516 (448-596)	521 (411-675)	922 (782-1140)	1290 (1140-1620)	1700 (1390-1930)	360
Males	11-12	462 (376-568)	475 (363-614)	944 (750-1120)	1570 (1180-2050)	2050 (1400-2550)	525
Males	13-14	388 (307-491)	424 (333-513)	788 (668-969)	1240 (1100-1400)	1630 (1320-1980)	506
Males	15-16	373 (299-466)	394 (335-528)	830 (600-1040)	1200 (1040-1600)	1610 (1200-1930)	476
Females	11-12	456 (410-507)	466 (401-595)	808 (686-950)	1280 (1050-1650)	1660 (1440-2260)	344
Females	13-14	462 (400-533)	502 (434-569)	847 (690-976)	1440 (1050-1850)	1880 (1360-2570)	432
Females	15-16	399 (366-436)	418 (373-450)	735 (656-880)	1250 (986-1370)	1500 (1300-1650)	324

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.26, 6.26, and 6.26 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 103974-29-4

Metabolite of N,N-Dimethylformamide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	124 (116-132)	130 (120-140)	248 (226-262)	401 (350-466)	526 (451-621)	1318
Total population	13-14	108 (97.7-119)	113 (103-125)	215 (192-240)	361 (335-398)	472 (410-578)	1370
Total population	15-16	111 (102-120)	112 (99.7-129)	222 (199-249)	360 (305-396)	473 (400-548)	1377
Age 20-49 years	11-12	109 (96.3-124)	114 (102-124)	219 (186-251)	370 (302-429)	526 (355-661)	659
Age 20-49 years	13-14	100 (90.7-111)	105 (90.7-123)	197 (176-219)	335 (305-363)	436 (369-524)	672
Age 20-49 years	15-16	102 (92.0-113)	103 (90.0-117)	206 (178-243)	314 (267-376)	421 (333-505)	679
Age 50+ years	11-12	142 (131-154)	145 (140-159)	284 (242-324)	422 (373-470)	526 (470-687)	659
Age 50+ years	13-14	118 (106-132)	120 (109-136)	237 (195-271)	380 (336-451)	506 (390-657)	698
Age 50+ years	15-16	123 (109-140)	118 (110-138)	240 (200-278)	380 (333-473)	530 (385-652)	698
Males	11-12	143 (131-156)	150 (132-174)	254 (234-283)	395 (333-442)	512 (422-594)	628
Males	13-14	114 (102-128)	117 (103-135)	220 (186-255)	362 (317-424)	472 (415-548)	657
Males	15-16	125 (115-136)	127 (105-152)	238 (209-269)	376 (314-452)	534 (413-718)	644
Females	11-12	111 (101-122)	111 (103-123)	226 (202-262)	404 (333-491)	552 (451-702)	690
Females	13-14	103 (92.3-115)	106 (95.8-117)	197 (174-242)	363 (319-417)	500 (398-613)	811
Females	15-16	101 (88.6-114)	103 (84.1-117)	200 (162-245)	332 (271-395)	434 (360-530)	793

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.26, 6.26, and 6.26 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 103974-29-4

Metabolite of N,N-Dimethylformamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	507 (446-577)	536 (487-637)	853 (741-1000)	1190 (1080-1370)	1450 (1230-1650)	869
Total population	13-14	431 (357-521)	472 (377-599)	742 (639-924)	1150 (973-1380)	1410 (1190-1760)	907
Total population	15-16	386 (343-435)	445 (388-478)	658 (605-762)	1000 (847-1090)	1190 (1010-1350)	779
Age 20-49 years	11-12	443 (391-503)	477 (373-564)	718 (628-870)	1080 (941-1310)	1340 (1150-1800)	518
Age 20-49 years	13-14	378 (313-456)	405 (326-499)	675 (541-820)	1080 (823-1330)	1340 (1020-1660)	544
Age 20-49 years	15-16	306 (256-365)	333 (271-396)	557 (460-626)	788 (640-946)	1010 (794-1330)	419
Age 50+ years	11-12	626 (530-738)	693 (585-831)	1060 (845-1150)	1270 (1130-1580)	1540 (1200-1810)	351
Age 50+ years	13-14	586 (492-698)	629 (559-698)	956 (745-1060)	1300 (1100-1550)	1570 (1280-2760)	363
Age 50+ years	15-16	571 (529-617)	576 (495-652)	848 (750-975)	1140 (1000-1310)	1310 (1100-1500)	360
Males	11-12	437 (373-513)	467 (369-574)	718 (593-833)	1050 (807-1350)	1340 (938-1820)	525
Males	13-14	346 (287-418)	374 (317-449)	636 (547-723)	924 (745-1050)	1140 (969-1330)	505
Males	15-16	325 (282-376)	371 (302-446)	585 (480-645)	777 (696-840)	955 (777-1110)	476
Females	11-12	612 (528-709)	692 (583-813)	1060 (916-1150)	1340 (1150-1580)	1580 (1380-1810)	344
Females	13-14	540 (438-666)	574 (460-689)	934 (699-1190)	1380 (1120-1570)	1580 (1340-2130)	432
Females	15-16	478 (424-538)	496 (466-559)	829 (717-956)	1180 (1000-1350)	1350 (1210-1500)	324

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 103974-29-4

Metabolite of N,N-Dimethylformamide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	145 (137-155)	147 (136-159)	245 (221-265)	369 (353-397)	442 (397-541)	1317
Total population	13-14	129 (115-145)	136 (124-148)	230 (200-257)	342 (311-394)	462 (394-511)	1369
Total population	15-16	125 (117-134)	130 (122-143)	201 (185-223)	301 (264-363)	391 (351-452)	1375
Age 20-49 years	11-12	120 (109-132)	122 (113-133)	196 (178-219)	305 (246-379)	391 (319-442)	658
Age 20-49 years	13-14	112 (95.6-130)	115 (97.8-135)	185 (158-235)	294 (243-362)	419 (314-483)	672
Age 20-49 years	15-16	108 (99.4-118)	108 (96.6-121)	170 (154-196)	254 (218-281)	311 (267-427)	677
Age 50+ years	11-12	179 (165-194)	175 (152-202)	308 (262-336)	422 (369-449)	541 (431-673)	659
Age 50+ years	13-14	155 (138-173)	160 (137-191)	261 (236-286)	390 (338-422)	513 (402-665)	697
Age 50+ years	15-16	151 (138-166)	158 (146-170)	236 (210-261)	365 (275-413)	413 (363-537)	698
Males	11-12	128 (117-139)	135 (118-147)	200 (187-227)	315 (261-358)	379 (331-484)	627
Males	13-14	111 (99.6-124)	120 (106-131)	196 (168-222)	281 (245-315)	335 (314-411)	656
Males	15-16	114 (107-122)	120 (108-126)	182 (167-198)	269 (248-318)	389 (295-431)	644
Females	11-12	161 (150-173)	160 (146-176)	274 (248-313)	413 (363-440)	479 (424-655)	690
Females	13-14	146 (127-168)	145 (131-165)	253 (221-298)	396 (347-458)	487 (407-629)	811
Females	15-16	135 (121-149)	143 (122-160)	212 (186-248)	315 (266-376)	391 (345-512)	791

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary Phenylglyoxylic acid in Smokers (2011 - 2016)

CAS Number 611-73-4

Metabolite of Ethylbenzene and Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	308 (270-350)	344 (298-387)	560 (471-655)	900 (765-1040)	1140 (900-1530)	869
Total population	13-14	304 (273-339)	307 (281-341)	581 (517-617)	869 (720-1060)	1130 (939-1450)	891
Total population	15-16	338 (301-379)	369 (336-395)	590 (542-638)	840 (736-1020)	1090 (881-1410)	802
Age 20-49 years	11-12	306 (260-361)	355 (298-412)	585 (460-687)	900 (731-1060)	1100 (900-1330)	518
Age 20-49 years	13-14	309 (269-355)	332 (281-373)	590 (502-629)	887 (692-1070)	1110 (939-1450)	533
Age 20-49 years	15-16	317 (275-366)	364 (311-410)	567 (528-611)	781 (732-862)	1020 (796-1330)	426
Age 50+ years	11-12	310 (266-362)	324 (254-419)	527 (462-664)	864 (664-1290)	1280 (774-1730)	351
Age 50+ years	13-14	297 (258-342)	278 (256-323)	540 (498-616)	845 (688-993)	1150 (803-1880)	358
Age 50+ years	15-16	375 (315-447)	374 (316-444)	612 (488-732)	925 (702-1330)	1160 (861-4680)	376
Males	11-12	338 (274-417)	390 (313-437)	624 (501-796)	1060 (810-1330)	1330 (901-1730)	525
Males	13-14	319 (273-374)	332 (281-388)	617 (540-662)	924 (771-1100)	1280 (939-1810)	492
Males	15-16	362 (304-431)	395 (347-447)	657 (590-732)	959 (775-1200)	1280 (874-1770)	483
Females	11-12	273 (248-301)	297 (248-347)	478 (446-566)	755 (660-819)	899 (778-994)	344
Females	13-14	289 (262-319)	283 (265-312)	520 (466-581)	820 (616-1070)	1070 (688-1260)	426
Females	15-16	311 (283-343)	331 (292-373)	488 (430-545)	742 (630-864)	955 (772-1190)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.0, 12.0, and 12.0 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Phenylglyoxylic acid in Non-smokers (2011 - 2016)

CAS Number 611-73-4

Metabolite of Ethylbenzene and Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	159 (146-174)	184 (168-197)	298 (269-321)	420 (388-459)	559 (473-644)	1318
Total population	13-14	147 (135-161)	157 (143-168)	275 (251-301)	408 (385-465)	555 (465-614)	1337
Total population	15-16	177 (166-189)	189 (174-207)	331 (297-358)	476 (441-509)	569 (530-648)	1401
Age 20-49 years	11-12	158 (139-180)	186 (161-211)	312 (274-359)	448 (393-551)	622 (514-726)	659
Age 20-49 years	13-14	148 (139-159)	156 (142-171)	267 (246-301)	407 (389-421)	499 (438-575)	662
Age 20-49 years	15-16	173 (156-193)	189 (163-216)	352 (302-371)	488 (425-539)	574 (521-723)	684
Age 50+ years	11-12	160 (145-177)	181 (161-198)	278 (240-312)	402 (369-431)	486 (420-588)	659
Age 50+ years	13-14	144 (127-163)	157 (139-179)	284 (243-310)	440 (367-546)	571 (465-755)	675
Age 50+ years	15-16	181 (164-200)	188 (162-219)	317 (278-351)	465 (419-521)	552 (477-695)	717
Males	11-12	190 (168-216)	215 (189-248)	337 (304-371)	458 (413-523)	562 (508-630)	628
Males	13-14	167 (146-191)	177 (156-202)	297 (261-353)	429 (396-503)	564 (454-629)	645
Males	15-16	199 (184-216)	222 (200-250)	358 (320-401)	477 (441-530)	562 (522-629)	660
Females	11-12	138 (125-153)	146 (135-169)	242 (221-284)	392 (347-438)	551 (406-722)	690
Females	13-14	132 (120-147)	140 (124-155)	259 (224-290)	393 (357-455)	534 (412-668)	790
Females	15-16	161 (146-177)	162 (152-181)	294 (268-330)	447 (414-521)	585 (521-698)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.0, 12.0, and 12.0 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Phenylglyoxylic acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 611-73-4

Metabolite of Ethylbenzene and Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	340 (306-378)	362 (310-397)	518 (469-573)	681 (586-774)	786 (699-959)	869
Total population	13-14	307 (268-353)	312 (270-371)	457 (397-524)	633 (565-740)	833 (683-958)	890
Total population	15-16	341 (314-370)	353 (326-372)	483 (453-522)	672 (573-717)	797 (697-876)	802
Age 20-49 years	11-12	319 (285-357)	335 (279-383)	481 (416-536)	630 (559-707)	751 (630-841)	518
Age 20-49 years	13-14	284 (248-326)	290 (247-341)	426 (366-502)	581 (530-667)	758 (628-901)	532
Age 20-49 years	15-16	300 (264-341)	316 (282-353)	416 (375-474)	563 (483-697)	710 (556-839)	426
Age 50+ years	11-12	375 (332-424)	390 (374-428)	576 (470-681)	726 (583-874)	874 (716-1120)	351
Age 50+ years	13-14	365 (311-430)	373 (312-431)	506 (448-587)	782 (616-948)	965 (794-1430)	358
Age 50+ years	15-16	421 (381-464)	421 (378-449)	542 (506-588)	747 (652-832)	863 (715-1600)	376
Males	11-12	320 (283-362)	336 (285-389)	481 (404-528)	600 (536-717)	731 (583-874)	525
Males	13-14	282 (248-320)	287 (253-321)	415 (387-466)	608 (515-742)	787 (628-986)	491
Males	15-16	314 (284-348)	331 (312-355)	450 (420-498)	572 (528-686)	710 (577-876)	483
Females	11-12	366 (310-434)	381 (302-471)	576 (471-677)	726 (617-841)	841 (716-1120)	344
Females	13-14	337 (285-398)	342 (273-424)	495 (410-565)	638 (581-764)	887 (681-1090)	426
Females	15-16	375 (346-407)	369 (349-392)	520 (478-552)	717 (633-800)	825 (753-905)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Phenylglyoxylic acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 611-73-4

Metabolite of Ethylbenzene and Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	187 (173-201)	195 (179-209)	255 (242-270)	329 (313-357)	397 (358-426)	1317
Total population	13-14	175 (158-194)	183 (164-202)	251 (231-272)	341 (305-419)	483 (376-595)	1336
Total population	15-16	200 (190-212)	208 (197-220)	275 (260-291)	336 (322-357)	388 (359-419)	1399
Age 20-49 years	11-12	173 (161-187)	177 (163-198)	235 (226-251)	303 (276-329)	366 (314-426)	658
Age 20-49 years	13-14	164 (147-184)	170 (153-187)	226 (204-250)	309 (274-359)	416 (321-477)	662
Age 20-49 years	15-16	183 (171-197)	186 (176-193)	258 (227-284)	322 (305-359)	387 (334-419)	682
Age 50+ years	11-12	202 (187-218)	210 (195-227)	278 (260-291)	357 (329-379)	407 (360-452)	659
Age 50+ years	13-14	189 (169-211)	202 (177-224)	272 (255-299)	393 (320-517)	543 (399-885)	674
Age 50+ years	15-16	223 (210-237)	229 (219-243)	292 (273-308)	355 (326-377)	395 (357-450)	717
Males	11-12	170 (155-186)	173 (158-194)	228 (218-239)	304 (264-347)	360 (314-400)	627
Males	13-14	162 (143-183)	170 (148-196)	229 (214-250)	309 (258-364)	401 (312-583)	644
Males	15-16	183 (175-192)	191 (183-200)	252 (232-265)	317 (278-331)	355 (319-388)	660
Females	11-12	201 (185-218)	207 (200-226)	274 (252-291)	349 (315-402)	413 (366-482)	690
Females	13-14	187 (167-208)	185 (172-207)	270 (242-300)	392 (319-468)	504 (399-718)	790
Females	15-16	215 (201-231)	218 (205-234)	294 (275-308)	357 (336-375)	424 (388-456)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Ethylbenzene_BiomonitoringSummary.html

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary N-Acetyl-S-(2-hydroxypropyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 923-43-3

Metabolite of Propylene oxide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	57.4 (51.7-63.8)	60.2 (50.8-67.8)	118 (103-129)	198 (160-225)	269 (225-322)	869
Total population	13-14	53.5 (47.5-60.2)	56.1 (52.3-59.6)	103 (87.5-126)	169 (138-216)	249 (187-421)	908
Total population	15-16	62.5 (56.2-69.5)	60.3 (53.8-72.3)	122 (105-135)	200 (166-253)	279 (236-346)	804
Age 20-49 years	11-12	54.5 (47.8-62.1)	58.0 (49.4-64.6)	109 (87.0-129)	169 (149-197)	235 (197-272)	518
Age 20-49 years	13-14	54.8 (48.1-62.5)	58.2 (50.5-65.0)	112 (90.3-129)	172 (136-239)	273 (190-428)	541
Age 20-49 years	15-16	57.8 (50.0-66.8)	58.4 (50.0-70.1)	115 (100-136)	188 (161-249)	272 (204-314)	428
Age 50+ years	11-12	62.4 (49.0-79.5)	61.3 (44.0-94.1)	124 (100-169)	228 (150-398)	314 (212-760)	351
Age 50+ years	13-14	51.7 (43.2-61.9)	54.4 (43.8-66.2)	96.5 (76.9-112)	165 (123-204)	216 (154-447)	367
Age 50+ years	15-16	70.4 (58.3-85.0)	67.9 (52.2-84.2)	126 (93.8-157)	236 (158-335)	335 (236-517)	376
Males	11-12	59.4 (50.9-69.3)	61.3 (53.8-72.8)	120 (94.7-140)	202 (148-244)	270 (216-398)	525
Males	13-14	52.4 (44.9-61.0)	53.7 (45.9-62.4)	101 (79.3-122)	172 (133-232)	249 (192-362)	504
Males	15-16	66.6 (55.9-79.3)	67.9 (56.0-84.2)	127 (105-156)	202 (163-272)	272 (196-517)	485
Females	11-12	55.0 (48.8-62.0)	54.7 (46.6-64.0)	118 (101-127)	179 (155-219)	266 (181-375)	344
Females	13-14	54.6 (48.2-61.9)	58.0 (50.2-67.3)	106 (89.7-126)	165 (136-211)	239 (163-501)	433
Females	15-16	57.9 (51.5-65.0)	52.7 (46.8-65.4)	101 (87.6-134)	191 (160-249)	283 (237-352)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.30, 5.30, and 5.30 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxypropyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 923-43-3

Metabolite of Propylene oxide

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	29.3 (26.3-32.7)	27.0 (24.2-30.8)	51.3 (45.1-60.2)	109 (94.7-130)	286 (171-392)	1318
Total population	13-14	23.3 (20.8-26.2)	21.5 (19.0-24.4)	41.1 (35.7-51.0)	87.3 (77.1-106)	165 (114-200)	1351
Total population	15-16	28.2 (25.5-31.1)	26.2 (24.3-28.0)	50.6 (46.2-55.7)	101 (80.1-124)	202 (124-358)	1401
Age 20-49 years	11-12	31.4 (27.6-35.7)	29.7 (25.3-33.5)	58.0 (47.8-68.4)	114 (91.9-178)	250 (130-443)	659
Age 20-49 years	13-14	24.1 (21.2-27.4)	22.1 (18.5-26.4)	41.8 (34.9-52.4)	85.4 (69.5-113)	172 (112-203)	665
Age 20-49 years	15-16	28.5 (25.0-32.4)	27.8 (25.0-30.5)	51.8 (44.8-56.7)	91.8 (69.3-116)	154 (110-310)	684
Age 50+ years	11-12	27.2 (22.8-32.5)	24.8 (20.9-29.7)	46.8 (37.9-57.4)	105 (73.3-171)	293 (113-569)	659
Age 50+ years	13-14	22.2 (18.8-26.1)	20.3 (18.1-23.7)	40.9 (34.2-53.4)	87.5 (70.2-109)	154 (98.5-257)	686
Age 50+ years	15-16	27.7 (24.2-31.6)	24.3 (22.6-26.6)	50.2 (39.9-60.6)	106 (83.1-144)	250 (120-1010)	717
Males	11-12	32.5 (28.2-37.6)	31.2 (26.2-35.8)	51.3 (42.1-65.7)	93.0 (73.9-119)	199 (111-334)	628
Males	13-14	26.3 (23.0-30.1)	23.3 (20.5-26.6)	43.2 (36.4-59.1)	98.5 (78.8-126)	179 (114-279)	650
Males	15-16	32.9 (29.3-36.8)	32.3 (30.0-35.4)	54.0 (48.0-62.0)	100 (86.7-123)	171 (115-310)	660
Females	11-12	27.0 (23.2-31.5)	22.9 (19.1-27.3)	51.3 (42.5-64.0)	126 (95.7-191)	313 (178-498)	690
Females	13-14	21.1 (18.4-24.2)	20.2 (16.8-23.4)	39.2 (33.3-48.7)	83.7 (63.9-108)	135 (104-219)	799
Females	15-16	24.8 (21.8-28.3)	21.4 (19.3-24.4)	43.9 (35.6-53.7)	104 (69.3-170)	247 (107-528)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.30, 5.30, and 5.30 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxypropyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 923-43-3

Metabolite of Propylene oxide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	63.4 (56.6-71.1)	63.6 (54.5-71.8)	110 (91.4-129)	181 (148-218)	251 (191-337)	869
Total population	13-14	54.2 (46.6-63.0)	55.6 (45.7-64.5)	97.8 (79.0-119)	149 (137-167)	218 (181-241)	907
Total population	15-16	63.1 (58.0-68.6)	63.2 (54.0-72.2)	105 (92.9-120)	160 (137-188)	213 (172-250)	804
Age 20-49 years	11-12	56.8 (52.4-61.5)	55.6 (45.9-65.5)	104 (82.4-118)	160 (133-207)	218 (164-267)	518
Age 20-49 years	13-14	50.2 (43.3-58.1)	50.7 (41.4-60.7)	92.6 (72.8-105)	136 (116-162)	190 (138-267)	540
Age 20-49 years	15-16	54.8 (48.4-62.0)	54.6 (47.5-65.8)	97.2 (82.6-107)	140 (119-172)	175 (140-235)	428
Age 50+ years	11-12	75.4 (60.2-94.3)	72.5 (58.0-84.7)	123 (92.9-171)	214 (144-337)	322 (155-793)	351
Age 50+ years	13-14	64.1 (53.2-77.2)	65.7 (53.2-81.4)	120 (95.2-139)	181 (136-241)	239 (163-280)	367
Age 50+ years	15-16	79 (67.9-91.9)	78.0 (58.5-98.5)	123 (98.2-152)	177 (141-250)	251 (183-308)	376
Males	11-12	56.3 (49.3-64.3)	54.7 (45.1-66.8)	86.5 (75.2-110)	139 (116-196)	201 (144-251)	525
Males	13-14	46 (40.2-52.7)	45.0 (38.6-53.1)	78.8 (65.7-95.0)	134 (117-155)	185 (155-216)	503
Males	15-16	57.9 (51.3-65.3)	56.3 (51.4-65.8)	96.7 (82.3-100)	140 (116-164)	175 (141-210)	485
Females	11-12	73.8 (62.9-86.6)	74.7 (64.6-91.4)	139 (108-169)	216 (160-284)	284 (195-337)	344
Females	13-14	63.8 (53.5-76.1)	67.3 (53.6-81.9)	113 (93.8-136)	162 (143-197)	231 (179-267)	433
Females	15-16	69.8 (61.7-78.9)	69.5 (60.0-84.6)	119 (100-141)	172 (140-241)	241 (183-274)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxypropyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 923-43-3

Metabolite of Propylene oxide

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	34.4 (30.9-38.3)	28.5 (26.6-30.9)	50.2 (43.2-56.1)	101 (82.6-136)	291 (167-527)	1317
Total population	13-14	27.8 (24.5-31.6)	24.6 (21.4-27.3)	41.1 (35.6-46.0)	86.8 (64.6-131)	193 (140-260)	1350
Total population	15-16	31.9 (29.2-34.8)	25.8 (24.5-27.6)	43.3 (39.7-47.8)	95.6 (69.3-146)	205 (128-422)	1399
Age 20-49 years	11-12	34.5 (31.1-38.2)	28.6 (27.2-30.9)	52.6 (46.9-59.2)	102 (79.3-167)	217 (105-516)	658
Age 20-49 years	13-14	26.8 (23.1-31.0)	23.5 (20.7-27.2)	40.8 (34.4-45.4)	74.3 (58.5-117)	161 (86.4-288)	665
Age 20-49 years	15-16	30.1 (27.0-33.7)	25.8 (23.4-28.6)	43.2 (38.9-47.9)	79.8 (61.9-97.3)	147 (90.2-258)	682
Age 50+ years	11-12	34.3 (28.8-40.8)	28.4 (25.2-31.9)	45.9 (40.6-54.2)	99.2 (70.4-190)	366 (99.2-1050)	659
Age 50+ years	13-14	29 (24.2-34.8)	25.1 (21.0-28.8)	41.2 (34.3-54.2)	101 (67.6-193)	207 (118-367)	685
Age 50+ years	15-16	34.1 (30.6-37.9)	25.9 (24.3-29.4)	43.9 (39.0-52.4)	128 (69.3-226)	345 (128-894)	717
Males	11-12	29 (26.0-32.4)	26.7 (24.2-29.2)	41.3 (34.2-46.9)	66.6 (53.6-98.0)	128 (82.3-240)	627
Males	13-14	25.4 (22.0-29.3)	22.9 (19.8-26.3)	37.5 (33.8-40.7)	75.2 (53.9-101)	161 (86.4-261)	649
Males	15-16	30.2 (27.4-33.3)	25.1 (23.4-26.9)	42.0 (35.1-47.2)	79.8 (56.1-103)	162 (92.1-471)	660
Females	11-12	39.3 (32.6-47.3)	30.9 (26.5-35.0)	60.0 (48.9-73.4)	163 (93.7-224)	516 (167-1240)	690
Females	13-14	30 (25.8-34.9)	25.4 (22.1-28.1)	44.8 (35.4-57.1)	108 (71.3-162)	238 (138-351)	799
Females	15-16	33.3 (29.6-37.4)	26.5 (24.6-29.0)	46.4 (40.7-51.5)	119 (66.4-191)	262 (147-422)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(1-phenyl-2-hydroxyethyl)-L-cysteine + N-Acetyl-S-(2-phenyl-2-hydroxyethyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 69278-53-1, 14510-10-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.18 (.989-1.40)	.979 (.731-1.22)	2.20 (1.62-2.86)	4.34 (3.20-6.16)	6.21 (4.96-8.76)	869
Total population	13-14	1.26 (1.13-1.40)	1.21 (1.07-1.35)	2.31 (2.01-2.71)	4.55 (3.77-5.10)	5.86 (5.01-7.45)	892
Total population	15-16	1.55 (1.39-1.72)	1.51 (1.38-1.64)	2.99 (2.35-3.36)	4.87 (4.05-5.39)	5.96 (4.97-9.29)	787
Age 20-49 years	11-12	1.13 (.944-1.34)	.903 (.706-1.14)	2.04 (1.32-2.93)	4.72 (3.02-6.16)	6.26 (4.37-13.2)	518
Age 20-49 years	13-14	1.21 (1.07-1.36)	1.12 (.860-1.30)	2.30 (1.95-2.70)	4.20 (3.37-5.01)	5.55 (4.80-7.40)	535
Age 20-49 years	15-16	1.45 (1.26-1.65)	1.42 (1.12-1.59)	2.95 (2.21-3.24)	4.61 (4.05-5.24)	5.68 (4.90-6.77)	419
Age 50+ years	11-12	1.26 (1.02-1.55)	1.22 (.813-1.44)	2.50 (1.63-3.20)	4.22 (3.20-6.02)	6.02 (4.10-6.96)	351
Age 50+ years	13-14	1.41 (1.15-1.73)	1.34 (1.11-1.57)	2.34 (1.84-3.19)	5.10 (3.01-7.45)	7.29 (4.15-13.9)	357
Age 50+ years	15-16	1.72 (1.45-2.03)	1.77 (1.48-1.86)	3.04 (2.21-3.68)	4.96 (3.62-6.12)	6.59 (4.93-15.1)	368
Males	11-12	1.29 (1.02-1.62)	1.11 (.706-1.44)	2.71 (1.86-3.26)	5.41 (3.44-6.75)	6.86 (4.72-17.2)	525
Males	13-14	1.33 (1.15-1.54)	1.26 (1.01-1.51)	2.34 (1.95-3.01)	4.85 (3.66-5.59)	6.33 (5.01-8.37)	497
Males	15-16	1.68 (1.44-1.97)	1.68 (1.45-1.85)	3.24 (2.43-4.05)	5.27 (4.29-6.37)	6.77 (5.02-12.3)	472
Females	11-12	*	.898 (<LOD-1.11)	1.70 (1.32-2.20)	3.57 (2.59-4.75)	5.22 (3.26-9.12)	344
Females	13-14	1.19 (1.06-1.34)	1.14 (.818-1.38)	2.30 (1.90-2.54)	3.99 (3.28-4.89)	5.54 (4.32-7.40)	425
Females	15-16	1.40 (1.24-1.59)	1.43 (1.22-1.54)	2.58 (2.00-3.10)	3.82 (3.25-4.83)	5.08 (4.04-6.59)	334

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary N-Acetyl-S-(1-phenyl-2-hydroxyethyl)-L-cysteine + N-Acetyl-S-(2-phenyl-2-hydroxyethyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 69278-53-1, 14510-10-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	.713 (<LOD-.832)	1.39 (1.25-1.65)	1.91 (1.70-2.24)	1318
Total population	13-14	*	<LOD	.760 (<LOD-.990)	1.57 (1.30-1.76)	2.05 (1.83-2.42)	1341
Total population	15-16	*	<LOD	1.03 (.935-1.11)	1.76 (1.63-1.98)	2.52 (2.02-2.98)	1374
Age 20-49 years	11-12	*	<LOD	.795 (<LOD-.889)	1.60 (1.36-1.81)	2.08 (1.81-2.70)	659
Age 20-49 years	13-14	*	<LOD	.773 (<LOD-1.00)	1.54 (1.21-1.80)	1.97 (1.64-2.49)	653
Age 20-49 years	15-16	*	<LOD	1.06 (.961-1.27)	1.89 (1.62-2.06)	2.50 (2.02-3.15)	669
Age 50+ years	11-12	*	<LOD	<LOD	1.28 (.997-1.65)	1.75 (1.32-1.93)	659
Age 50+ years	13-14	*	<LOD	.747 (<LOD-1.05)	1.60 (1.24-1.85)	2.26 (1.75-2.82)	688
Age 50+ years	15-16	*	<LOD	.968 (.871-1.11)	1.74 (1.60-1.90)	2.71 (1.90-2.98)	705
Males	11-12	*	<LOD	.795 (<LOD-.906)	1.66 (1.23-1.91)	2.03 (1.87-2.61)	628
Males	13-14	*	<LOD	.870 (<LOD-1.07)	1.62 (1.18-1.98)	2.17 (1.73-3.00)	642
Males	15-16	*	<LOD	1.17 (1.01-1.42)	1.87 (1.62-2.03)	2.26 (2.02-2.52)	643
Females	11-12	*	<LOD	<LOD	1.31 (1.07-1.58)	1.75 (1.39-2.16)	690
Females	13-14	*	<LOD	<LOD	1.56 (1.24-1.82)	1.86 (1.72-2.39)	794
Females	15-16	*	<LOD	.931 (.845-1.03)	1.71 (1.47-1.97)	2.91 (2.00-3.56)	790

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.700, 0.700, and 0.700 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary N-Acetyl-S-(1-phenyl-2-hydroxyethyl)-L-cysteine + N-Acetyl-S-(2-phenyl-2-hydroxyethyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 69278-53-1, 14510-10-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	1.3 (1.16-1.46)	1.26 (1.10-1.43)	2.35 (1.92-2.70)	3.59 (3.09-4.21)	4.88 (4.06-6.42)	869
Total population	13-14	1.27 (1.15-1.41)	1.21 (1.09-1.39)	2.20 (1.89-2.39)	3.49 (2.98-3.84)	4.26 (3.67-5.73)	891
Total population	15-16	1.56 (1.44-1.69)	1.52 (1.39-1.66)	2.43 (2.14-2.52)	3.79 (3.24-4.46)	5.75 (4.22-7.07)	787
Age 20-49 years	11-12	1.17 (1.01-1.36)	1.13 (.927-1.39)	2.03 (1.82-2.42)	3.30 (2.77-4.50)	4.95 (3.43-7.53)	518
Age 20-49 years	13-14	1.11 (.986-1.24)	1.06 (.990-1.20)	1.84 (1.55-2.27)	2.88 (2.38-3.49)	3.81 (2.97-4.58)	534
Age 20-49 years	15-16	1.36 (1.20-1.56)	1.34 (1.15-1.51)	2.08 (1.80-2.40)	3.37 (2.75-3.79)	4.46 (3.54-5.88)	419
Age 50+ years	11-12	1.52 (1.33-1.73)	1.41 (1.23-1.64)	2.73 (2.03-3.10)	4.02 (3.29-4.64)	4.88 (4.02-7.03)	351
Age 50+ years	13-14	1.75 (1.47-2.09)	1.61 (1.32-2.00)	2.77 (2.18-3.49)	4.19 (3.65-5.73)	6.22 (4.13-8.81)	357
Age 50+ years	15-16	1.93 (1.75-2.13)	1.85 (1.61-2.14)	2.82 (2.43-3.29)	4.54 (3.67-5.83)	6.52 (4.42-9.25)	368
Males	11-12	1.22 (1.05-1.41)	1.10 (1.01-1.27)	1.96 (1.67-2.52)	3.43 (2.75-4.33)	5.07 (3.43-9.42)	525
Males	13-14	1.18 (1.04-1.34)	1.09 (.982-1.29)	1.93 (1.61-2.36)	3.21 (2.58-3.75)	4.11 (3.13-6.22)	496
Males	15-16	1.46 (1.31-1.63)	1.40 (1.26-1.53)	2.27 (2.01-2.46)	3.68 (2.80-5.58)	5.96 (3.79-8.88)	472
Females	11-12	*	1.45 (<LOD-1.65)	2.52 (2.15-2.78)	4.02 (3.01-4.64)	4.88 (4.02-7.09)	344
Females	13-14	1.38 (1.24-1.54)	1.32 (1.19-1.51)	2.32 (2.03-2.53)	3.65 (3.09-3.88)	4.34 (3.67-5.73)	425
Females	15-16	1.68 (1.50-1.87)	1.68 (1.50-1.82)	2.58 (2.25-2.79)	3.91 (2.95-5.06)	5.33 (3.79-7.92)	334

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary N-Acetyl-S-(1-phenyl-2-hydroxyethyl)-L-cysteine + N-Acetyl-S-(2-phenyl-2-hydroxyethyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 69278-53-1, 14510-10-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	1.21 (<LOD-1.27)	1.98 (1.77-2.15)	2.74 (2.25-3.48)	1317
Total population	13-14	*	<LOD	1.27 (<LOD-1.46)	2.19 (1.90-2.49)	2.97 (2.67-3.81)	1340
Total population	15-16	*	<LOD	1.38 (1.30-1.42)	2.06 (1.96-2.15)	2.64 (2.48-2.95)	1372
Age 20-49 years	11-12	*	<LOD	1.21 (<LOD-1.38)	1.98 (1.65-2.62)	2.91 (2.25-3.81)	658
Age 20-49 years	13-14	*	<LOD	1.21 (<LOD-1.40)	1.83 (1.62-2.15)	2.37 (2.06-2.75)	653
Age 20-49 years	15-16	*	<LOD	1.30 (1.23-1.41)	1.97 (1.82-2.14)	2.61 (2.17-3.13)	667
Age 50+ years	11-12	*	<LOD	<LOD	1.83 (1.76-2.06)	2.36 (2.02-3.54)	659
Age 50+ years	13-14	*	<LOD	1.38 (<LOD-1.65)	2.67 (2.16-3.27)	4.00 (2.75-5.04)	687
Age 50+ years	15-16	*	<LOD	1.41 (1.30-1.60)	2.08 (1.90-2.48)	2.75 (2.25-3.30)	705
Males	11-12	*	<LOD	.952 (<LOD-1.05)	1.38 (1.24-1.71)	1.98 (1.55-2.65)	627
Males	13-14	*	<LOD	1.05 (<LOD-1.10)	1.56 (1.38-2.02)	2.60 (1.65-3.54)	641
Males	15-16	*	<LOD	1.13 (1.00-1.23)	1.77 (1.60-2.06)	2.28 (1.96-2.75)	643
Females	11-12	*	<LOD	<LOD	2.15 (1.98-2.75)	3.30 (2.46-4.13)	690
Females	13-14	*	<LOD	<LOD	2.48 (2.16-2.82)	3.30 (2.75-4.33)	794
Females	15-16	*	<LOD	1.52 (1.41-1.60)	2.18 (2.00-2.48)	3.09 (2.61-3.36)	788

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Mandelic acid in Smokers (2011 - 2016)

CAS Number 90-64-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	240 (208-276)	238 (210-300)	422 (386-508)	761 (614-871)	1030 (823-1250)	869
Total population	13-14	227 (199-258)	227 (212-258)	426 (361-481)	721 (589-913)	978 (810-1220)	893
Total population	15-16	256 (230-286)	270 (237-307)	463 (439-496)	726 (646-871)	1020 (818-1310)	801
Age 20-49 years	11-12	238 (198-287)	243 (204-319)	425 (386-517)	767 (578-931)	1030 (789-1380)	518
Age 20-49 years	13-14	235 (199-277)	244 (213-281)	434 (370-481)	731 (569-992)	1020 (810-1220)	535
Age 20-49 years	15-16	242 (209-280)	257 (213-306)	463 (439-496)	705 (620-835)	934 (798-1110)	425
Age 50+ years	11-12	242 (213-275)	223 (200-284)	410 (381-508)	761 (563-863)	1030 (814-1090)	351
Age 50+ years	13-14	217 (193-243)	212 (187-240)	408 (310-506)	681 (551-821)	888 (698-1390)	358
Age 50+ years	15-16	286 (241-338)	292 (256-352)	459 (416-549)	829 (581-1060)	1300 (757-2680)	376
Males	11-12	260 (213-317)	270 (223-321)	543 (398-632)	863 (702-1090)	1250 (966-1380)	525
Males	13-14	236 (189-294)	229 (200-290)	435 (359-547)	753 (569-1000)	1040 (766-1350)	497
Males	15-16	271 (231-317)	305 (263-362)	495 (439-568)	842 (623-1030)	1110 (785-1730)	483
Females	11-12	216 (192-244)	219 (188-243)	386 (327-410)	567 (428-730)	740 (589-914)	344
Females	13-14	217 (199-237)	221 (194-245)	407 (343-458)	710 (491-966)	966 (693-1270)	425
Females	15-16	240 (211-273)	231 (211-261)	448 (383-476)	649 (577-807)	835 (699-1120)	339

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.0, 12.0, and 12.0 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Mandelic acid in Non-smokers (2011 - 2016)

CAS Number 90-64-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	109 (98.1-121)	118 (103-133)	200 (165-228)	301 (269-329)	392 (346-449)	1318
Total population	13-14	97.9 (88.9-108)	103 (95.9-111)	176 (165-192)	293 (270-322)	375 (340-408)	1323
Total population	15-16	110 (103-117)	122 (109-132)	204 (187-223)	299 (283-321)	365 (339-401)	1399
Age 20-49 years	11-12	116 (100-135)	129 (110-153)	221 (191-248)	327 (270-376)	429 (353-488)	659
Age 20-49 years	13-14	103 (94.1-112)	111 (101-119)	183 (170-200)	289 (272-326)	379 (337-455)	650
Age 20-49 years	15-16	114 (102-127)	130 (117-144)	220 (197-242)	318 (287-346)	399 (338-463)	683
Age 50+ years	11-12	101 (92.8-111)	110 (95.0-124)	165 (146-200)	287 (219-316)	357 (301-416)	659
Age 50+ years	13-14	92.1 (81.7-104)	95.9 (84.9-107)	168 (149-197)	298 (241-329)	366 (325-407)	673
Age 50+ years	15-16	105 (95.0-115)	112 (96.7-126)	188 (167-207)	292 (250-321)	331 (299-365)	716
Males	11-12	134 (122-147)	141 (119-159)	217 (190-252)	319 (267-357)	407 (329-559)	628
Males	13-14	110 (96.4-125)	120 (100-139)	191 (169-220)	312 (272-337)	378 (351-439)	636
Males	15-16	124 (114-135)	143 (125-156)	221 (192-249)	298 (288-323)	371 (322-407)	658
Females	11-12	92.4 (81.0-105)	100 (84.0-118)	166 (146-207)	292 (236-346)	381 (316-434)	690
Females	13-14	89.1 (79.6-99.7)	93.4 (80.2-102)	167 (144-187)	286 (245-327)	376 (325-444)	782
Females	15-16	99.3 (91.5-108)	103 (95.2-117)	190 (170-207)	299 (262-331)	360 (342-405)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.0, 12.0, and 12.0 respectively.

[^] Cigarette non-smokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Mandelic acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 90-64-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	265 (242-290)	266 (242-277)	407 (369-441)	598 (526-671)	742 (650-850)	869
Total population	13-14	228 (196-266)	233 (195-285)	358 (312-413)	520 (426-633)	723 (536-955)	892
Total population	15-16	259 (237-282)	269 (251-286)	384 (366-409)	538 (467-610)	658 (581-757)	801
Age 20-49 years	11-12	248 (225-274)	255 (225-272)	378 (362-414)	571 (510-670)	710 (634-768)	518
Age 20-49 years	13-14	215 (181-255)	215 (185-254)	342 (288-408)	486 (408-633)	633 (494-781)	534
Age 20-49 years	15-16	229 (198-265)	234 (204-276)	349 (323-379)	454 (399-497)	538 (467-666)	425
Age 50+ years	11-12	292 (264-323)	277 (258-319)	440 (369-468)	598 (491-761)	821 (576-988)	351
Age 50+ years	13-14	268 (230-313)	285 (220-321)	400 (323-464)	591 (447-862)	834 (570-1110)	358
Age 50+ years	15-16	320 (292-352)	308 (285-327)	442 (387-508)	610 (520-751)	751 (600-1220)	376
Males	11-12	246 (220-276)	239 (205-272)	372 (343-414)	613 (471-694)	715 (670-812)	525
Males	13-14	205 (169-250)	196 (173-252)	335 (274-405)	486 (391-691)	604 (467-955)	496
Males	15-16	235 (211-262)	233 (212-266)	347 (314-406)	562 (406-707)	666 (516-915)	483
Females	11-12	290 (250-336)	283 (260-341)	459 (366-512)	557 (514-743)	743 (557-821)	344
Females	13-14	254 (222-291)	254 (215-299)	373 (315-428)	569 (442-705)	750 (588-862)	425
Females	15-16	290 (260-323)	299 (273-317)	409 (375-442)	520 (467-619)	633 (520-751)	339

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary Mandelic acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 90-64-2

Metabolite of Styrene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	128 (119-137)	124 (115-133)	168 (157-186)	245 (221-273)	306 (276-347)	1317
Total population	13-14	116 (103-131)	119 (107-135)	170 (156-190)	253 (223-290)	332 (274-449)	1322
Total population	15-16	124 (121-128)	123 (119-127)	166 (161-174)	227 (216-237)	288 (258-311)	1397
Age 20-49 years	11-12	128 (118-138)	124 (116-133)	167 (155-188)	229 (208-276)	306 (263-347)	658
Age 20-49 years	13-14	113 (98.7-130)	117 (105-131)	168 (152-191)	237 (204-286)	306 (271-373)	650
Age 20-49 years	15-16	121 (116-126)	119 (115-125)	162 (149-172)	218 (204-241)	267 (246-299)	681
Age 50+ years	11-12	128 (118-139)	125 (110-139)	169 (150-202)	255 (220-290)	303 (258-398)	659
Age 50+ years	13-14	120 (108-134)	122 (107-140)	174 (156-194)	256 (228-318)	367 (256-764)	672
Age 50+ years	15-16	129 (124-134)	129 (121-133)	174 (163-185)	233 (216-257)	305 (257-328)	716
Males	11-12	120 (113-126)	114 (105-124)	156 (141-166)	208 (189-239)	275 (241-306)	627
Males	13-14	105 (93.9-118)	108 (95.1-122)	151 (131-168)	206 (179-258)	295 (224-400)	635
Males	15-16	114 (109-120)	115 (110-119)	148 (138-162)	207 (179-230)	246 (208-284)	658
Females	11-12	134 (123-147)	132 (122-145)	188 (169-202)	273 (229-304)	328 (299-383)	690
Females	13-14	126 (110-144)	130 (114-146)	191 (168-217)	279 (235-332)	356 (283-558)	782
Females	15-16	133 (127-139)	132 (124-142)	178 (168-192)	240 (223-269)	306 (276-336)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Styrene_BiomonitoringSummary.html

Factsheet: https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html

Urinary N-Acetyl-S-(trichlorovinyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 111348-61-9

Metabolite of Tetrachloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	913
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	804
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	546
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	428
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	367
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	376
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	508
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	485
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	435
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 3.00, 3.00, and 3.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(trichlorovinyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 111348-61-9

Metabolite of Tetrachloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1362
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1401
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	666
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	684
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	696
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	654
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	806
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 3.00, 3.00, and 3.00 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(trichlorovinyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 111348-61-9

Metabolite of Tetrachloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	912
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	804
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	545
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	428
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	367
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	376
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	507
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	485
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	435
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(trichlorovinyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 111348-61-9

Metabolite of Tetrachloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1361
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1399
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	666
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	682
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	695
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	653
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	806
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(benzyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 19542-77-9

Metabolite of Toluene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	6.14 (5.50-6.87)	5.97 (5.33-6.87)	12.2 (9.69-16.1)	24.6 (17.5-32.1)	38.7 (29.9-54.4)	869
Total population	13-14	7.10 (6.54-7.72)	6.72 (5.98-7.36)	14.5 (12.6-16.6)	35.9 (27.1-41.0)	55.0 (40.7-84.6)	912
Total population	15-16	7.12 (6.30-8.04)	6.94 (6.08-7.72)	13.4 (11.2-17.0)	27.7 (21.4-36.9)	48.4 (34.0-68.5)	803
Age 20-49 years	11-12	6.22 (5.41-7.16)	6.04 (5.05-7.26)	12.3 (9.43-16.9)	26.9 (16.9-40.5)	40.5 (29.9-54.5)	518
Age 20-49 years	13-14	7.49 (6.68-8.40)	6.91 (6.14-7.57)	15.0 (12.2-17.9)	37.5 (27.1-42.6)	54.6 (39.0-73.5)	544
Age 20-49 years	15-16	7.11 (5.96-8.49)	6.86 (5.50-7.93)	12.9 (10.6-17.2)	29.7 (20.6-34.3)	43.7 (30.4-89.4)	428
Age 50+ years	11-12	6.02 (5.17-7.02)	5.92 (5.08-7.28)	12.0 (8.37-17.3)	22.5 (17.5-27.9)	33.5 (25.4-46.5)	351
Age 50+ years	13-14	6.66 (5.74-7.73)	6.02 (5.16-7.78)	14.2 (10.0-18.4)	34.5 (21.0-45.5)	59.6 (23.7-327)	368
Age 50+ years	15-16	7.30 (5.94-8.97)	6.94 (5.90-8.19)	13.7 (10.1-20.3)	26.9 (16.8-51.5)	48.4 (26.9-59.1)	375
Males	11-12	6.63 (5.73-7.67)	7.09 (5.94-7.95)	13.9 (11.1-16.9)	26.9 (17.3-35.1)	35.1 (29.9-44.4)	525
Males	13-14	6.51 (5.64-7.51)	6.38 (5.45-7.29)	12.6 (11.1-15.0)	24.6 (20.2-35.7)	48.9 (32.3-59.6)	508
Males	15-16	7.37 (6.13-8.87)	7.19 (5.48-8.53)	13.4 (10.4-20.1)	27.1 (17.9-54.8)	54.8 (28.0-94.5)	484
Females	11-12	5.58 (4.81-6.47)	5.33 (4.66-5.80)	10.6 (7.02-14.3)	20.8 (14.8-33.5)	40.5 (24.2-60.3)	344
Females	13-14	7.77 (6.90-8.75)	7.07 (5.61-8.28)	16.5 (13.2-20.4)	38.6 (31.5-52.4)	68.2 (38.2-238)	434
Females	15-16	6.83 (5.92-7.89)	6.70 (5.18-7.56)	12.7 (9.80-17.5)	30.4 (18.9-34.0)	43.2 (30.4-82.0)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Urinary N-Acetyl-S-(benzyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 19542-77-9

Metabolite of Toluene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	6.50 (5.98-7.07)	6.41 (6.00-6.97)	12.2 (10.2-14.4)	23.3 (19.7-29.1)	38.6 (29.9-54.9)	1318
Total population	13-14	6.06 (5.46-6.74)	6.21 (5.37-6.70)	11.7 (10.5-13.8)	25.7 (21.6-29.4)	39.0 (35.6-41.3)	1364
Total population	15-16	6.02 (5.45-6.65)	5.84 (5.40-6.38)	11.5 (9.60-13.1)	21.0 (19.2-23.6)	29.9 (25.7-36.6)	1401
Age 20-49 years	11-12	6.65 (5.81-7.61)	6.31 (5.39-8.17)	12.4 (10.4-16.2)	28.4 (20.2-34.2)	43.6 (33.3-60.1)	659
Age 20-49 years	13-14	6.31 (5.64-7.06)	6.24 (5.26-6.96)	11.9 (10.7-13.8)	26.0 (20.2-30.5)	38.9 (30.5-53.4)	668
Age 20-49 years	15-16	5.78 (4.94-6.75)	5.52 (4.59-6.46)	11.4 (9.09-15.0)	22.0 (17.7-25.4)	31.6 (23.8-43.6)	684
Age 50+ years	11-12	6.35 (5.78-6.97)	6.53 (5.89-7.21)	11.1 (9.86-13.4)	20.6 (18.0-25.3)	34.2 (25.5-39.7)	659
Age 50+ years	13-14	5.87 (5.12-6.73)	6.07 (5.21-6.69)	11.7 (9.66-14.7)	24.4 (18.0-36.0)	39.1 (29.5-55.1)	696
Age 50+ years	15-16	6.27 (5.66-6.96)	6.13 (5.67-6.77)	11.6 (9.45-12.8)	20.8 (18.7-23.0)	28.2 (23.0-39.5)	717
Males	11-12	6.97 (6.22-7.82)	6.74 (6.13-7.65)	12.3 (10.1-14.8)	22.8 (18.2-31.2)	39.7 (25.0-86.2)	628
Males	13-14	5.80 (5.03-6.68)	5.90 (5.18-6.65)	10.3 (8.85-11.9)	24.4 (17.1-28.9)	37.3 (25.7-50.5)	658
Males	15-16	6.59 (5.84-7.44)	6.24 (5.48-7.21)	12.8 (9.98-15.6)	22.1 (20.0-24.1)	29.9 (24.0-41.4)	660
Females	11-12	6.15 (5.47-6.93)	6.18 (5.39-6.96)	12.1 (9.54-16.1)	25.3 (19.1-29.7)	37.0 (29.7-51.6)	690
Females	13-14	6.30 (5.63-7.05)	6.33 (5.12-7.17)	13.4 (10.8-15.4)	27.1 (20.5-32.8)	38.5 (32.8-50.4)	805
Females	15-16	5.59 (5.01-6.25)	5.64 (4.74-6.23)	10.9 (8.59-12.8)	19.9 (15.5-25.3)	29.3 (24.4-38.0)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Urinary N-Acetyl-S-(benzyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 19542-77-9

Metabolite of Toluene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	6.78 (6.39-7.19)	6.02 (5.70-6.38)	11.2 (9.43-12.6)	19.7 (16.5-20.6)	26.2 (22.6-36.2)	869
Total population	13-14	7.2 (6.44-8.04)	6.41 (5.67-7.27)	11.6 (10.1-13.7)	27.9 (19.2-32.9)	47.2 (28.8-72.9)	911
Total population	15-16	7.2 (6.59-7.87)	6.30 (5.55-6.99)	11.8 (9.65-15.2)	24.8 (19.3-27.1)	32.7 (27.3-41.2)	803
Age 20-49 years	11-12	6.48 (5.95-7.06)	5.84 (5.41-6.53)	9.33 (8.50-11.3)	20.4 (13.9-21.0)	25.5 (20.5-40.0)	518
Age 20-49 years	13-14	6.87 (6.09-7.74)	5.95 (5.26-7.26)	9.90 (9.24-12.0)	25.6 (17.2-32.4)	42.3 (28.0-65.1)	543
Age 20-49 years	15-16	6.74 (5.90-7.71)	5.55 (4.81-6.30)	10.6 (7.79-14.5)	24.8 (15.9-30.0)	31.3 (26.2-62.8)	428
Age 50+ years	11-12	7.28 (6.56-8.08)	6.12 (5.79-7.71)	14.3 (10.2-15.3)	19.5 (15.5-23.6)	29.3 (22.6-47.7)	351
Age 50+ years	13-14	8.26 (6.92-9.86)	6.90 (5.89-8.33)	14.3 (11.2-17.9)	29.4 (20.7-51.5)	60.5 (22.9-241)	368
Age 50+ years	15-16	8.23 (7.23-9.37)	7.46 (6.42-8.71)	14.0 (10.2-17.9)	25.6 (17.9-32.4)	34.0 (26.1-52.9)	375
Males	11-12	6.28 (5.77-6.83)	5.78 (5.36-6.26)	9.33 (8.50-11.2)	17.9 (15.2-20.4)	22.2 (20.4-27.5)	525
Males	13-14	5.74 (5.13-6.41)	4.98 (4.50-5.73)	8.72 (7.60-9.33)	19.2 (13.8-28.4)	31.6 (21.4-43.0)	507
Males	15-16	6.43 (5.67-7.29)	5.29 (4.92-6.23)	10.0 (7.47-14.5)	18.7 (15.2-27.3)	32.2 (19.9-54.3)	484
Females	11-12	7.48 (6.45-8.68)	6.55 (5.44-7.52)	13.0 (10.2-15.2)	21.0 (16.5-28.3)	40.0 (25.3-51.8)	344
Females	13-14	9.08 (8.05-10.2)	8.11 (7.27-9.18)	14.4 (12.4-15.8)	30.8 (22.8-54.7)	66.6 (29.0-114)	434
Females	15-16	8.24 (7.25-9.36)	7.26 (6.29-8.36)	13.3 (11.2-17.1)	26.3 (24.8-30.0)	34.1 (27.2-55.6)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Urinary N-Acetyl-S-(benzyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 19542-77-9

Metabolite of Toluene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	7.63 (7.06-8.25)	6.87 (6.31-7.58)	12.8 (11.3-14.4)	23.8 (19.3-28.1)	39.6 (29.7-51.4)	1317
Total population	13-14	7.23 (6.48-8.07)	6.83 (6.10-7.46)	13.2 (11.6-14.7)	25.9 (21.7-31.8)	41.3 (34.9-48.8)	1363
Total population	15-16	6.81 (6.42-7.22)	6.27 (5.86-6.70)	10.7 (10.0-11.3)	19.5 (16.2-21.3)	27.6 (23.9-34.1)	1399
Age 20-49 years	11-12	7.31 (6.71-7.97)	6.48 (5.95-7.22)	12.0 (10.9-13.7)	22.2 (18.3-25.7)	36.4 (24.5-49.1)	658
Age 20-49 years	13-14	7 (6.18-7.92)	6.34 (5.46-7.47)	12.6 (10.6-14.7)	23.6 (20.5-27.5)	35.2 (28.8-42.9)	668
Age 20-49 years	15-16	6.11 (5.57-6.69)	5.75 (5.27-6.16)	9.40 (8.07-10.3)	16.0 (13.4-19.6)	25.9 (16.3-37.1)	682
Age 50+ years	11-12	7.99 (7.26-8.79)	7.47 (6.59-8.01)	13.6 (11.5-16.0)	26.1 (18.2-37.3)	44.1 (31.0-55.5)	659
Age 50+ years	13-14	7.69 (6.69-8.85)	7.10 (6.36-7.84)	13.9 (11.7-16.3)	29.7 (21.7-44.3)	50.4 (35.2-81.2)	695
Age 50+ years	15-16	7.72 (7.28-8.18)	7.03 (6.52-7.61)	11.8 (10.6-13.4)	21.4 (19.0-23.5)	30.9 (24.1-39.2)	717
Males	11-12	6.23 (5.67-6.85)	5.76 (5.28-6.09)	8.96 (8.07-10.5)	17.4 (14.2-23.4)	32.0 (19.0-44.0)	627
Males	13-14	5.65 (4.95-6.44)	5.32 (4.65-6.34)	9.23 (8.16-10.9)	16.4 (14.5-21.7)	25.3 (20.9-31.8)	657
Males	15-16	6.06 (5.63-6.53)	5.40 (4.96-6.05)	10.2 (8.58-10.9)	17.0 (13.3-19.8)	23.5 (19.6-30.9)	660
Females	11-12	8.95 (7.99-10.0)	8.11 (7.24-9.19)	15.3 (13.1-17.6)	26.1 (23.0-31.8)	44.7 (31.0-55.3)	690
Females	13-14	8.88 (7.93-9.95)	7.95 (7.16-9.42)	16.1 (13.5-18.7)	32.4 (25.9-38.7)	50.3 (37.8-64.4)	805
Females	15-16	7.48 (6.99-8.01)	6.87 (6.29-7.09)	11.1 (10.2-12.0)	21.4 (16.5-23.9)	32.5 (25.0-40.8)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Toluene_BiomonitoringSummary.html

Urinary N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 2148-31-4

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	866
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	778
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	514
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	412
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	352
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	366
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	476
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	472
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	416
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	325

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.6, 12.6, and 12.6 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 2148-31-4

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1282
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1344
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	636
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	657
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	646
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	687
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	616
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	632
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	772

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 12.6, 12.6, and 12.6 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 2148-31-4

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	865
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	778
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	513
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	412
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	352
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	366
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	475
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	472
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	416
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	325

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 2148-31-4

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1281
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1342
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	636
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	655
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	645
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	687
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	615
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	632
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	760
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	770

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 126543-43-9

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	882
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	733
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	524
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	386
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	358
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	347
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	495
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	448
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	416
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	305

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.50, 4.70, and 13.9 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 126543-43-9

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1333
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1325
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	649
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	641
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	684
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	684
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	645
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	625
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	784
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	757

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 6.50, 4.70, and 13.9 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 126543-43-9

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	881
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	733
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	523
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	386
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	358
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	347
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	494
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	448
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	416
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	305

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 126543-43-9

Metabolite of Trichloroethene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1332
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1323
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	649
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	639
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	683
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	684
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	644
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	625
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	784
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	755

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/HalogenatedSolvents_BiomonitoringSummary.html

Urinary N-Acetyl-S-(dimethylphenyl)-L-cysteine in Smokers (2011 - 2016)

CAS Number 581076-69-9, 581076-70-2, 581076-72-4

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	841
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	804
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	500
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	428
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	341
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	376
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	471
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	485
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	398
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary N-Acetyl-S-(dimethylphenyl)-L-cysteine in Non-smokers (2011 - 2016)

CAS Number 581076-69-9, 581076-70-2, 581076-72-4

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1318
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1299
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1401
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	637
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	684
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	662
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	628
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	624
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	767
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 0.500, 0.500, and 0.500 respectively.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary N-Acetyl-S-(dimethylphenyl)-L-cysteine in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 581076-69-9, 581076-70-2, 581076-72-4

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	869
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	840
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	804
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	518
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	499
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	428
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	351
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	341
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	376
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	525
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	470
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	485
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	344
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	398
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary N-Acetyl-S-(dimethylphenyl)-L-cysteine in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 581076-69-9, 581076-70-2, 581076-72-4

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	*	<LOD	<LOD	<LOD	<LOD	1317
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1298
Total population	15-16	*	<LOD	<LOD	<LOD	<LOD	1399
Age 20-49 years	11-12	*	<LOD	<LOD	<LOD	<LOD	658
Age 20-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	637
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	<LOD	682
Age 50+ years	11-12	*	<LOD	<LOD	<LOD	<LOD	659
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	661
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	<LOD	717
Males	11-12	*	<LOD	<LOD	<LOD	<LOD	627
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	623
Males	15-16	*	<LOD	<LOD	<LOD	<LOD	660
Females	11-12	*	<LOD	<LOD	<LOD	<LOD	690
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	767
Females	15-16	*	<LOD	<LOD	<LOD	<LOD	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 2-Methylhippuric acid in Smokers (2011 - 2016)

CAS Number 42013-20-7

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	97.5 (85.1-112)	105 (94.5-116)	180 (163-203)	276 (238-327)	396 (322-426)	869
Total population	13-14	83.6 (68.0-103)	90.0 (71.2-110)	159 (137-192)	277 (211-358)	377 (286-534)	849
Total population	15-16	95.2 (84.8-107)	107 (91.9-121)	178 (158-200)	286 (241-344)	395 (313-538)	804
Age 20-49 years	11-12	93.0 (79.0-110)	105 (92.6-113)	170 (155-192)	276 (232-304)	351 (276-434)	518
Age 20-49 years	13-14	85.3 (67.3-108)	93.8 (70.8-115)	164 (137-200)	286 (211-373)	411 (260-587)	506
Age 20-49 years	15-16	86.8 (75.6-99.5)	106 (86.3-119)	171 (156-200)	269 (228-314)	371 (277-448)	428
Age 50+ years	11-12	105 (87.1-126)	104 (84.6-140)	192 (168-216)	300 (235-398)	423 (348-477)	351
Age 50+ years	13-14	81.8 (69.1-96.7)	84.1 (65.0-107)	149 (126-176)	266 (192-315)	346 (258-613)	343
Age 50+ years	15-16	112 (92.0-135)	112 (88.5-141)	179 (145-231)	320 (209-469)	443 (312-1150)	376
Males	11-12	104 (83.4-131)	113 (95.7-148)	198 (168-232)	290 (243-396)	398 (300-475)	525
Males	13-14	82.7 (63.5-108)	88.6 (65.4-120)	170 (142-202)	310 (216-414)	414 (286-701)	478
Males	15-16	95.3 (77.5-117)	109 (83.6-137)	186 (160-213)	310 (221-402)	448 (291-640)	485
Females	11-12	89.3 (80.2-99.5)	94.6 (89.1-104)	160 (133-179)	242 (204-303)	353 (242-434)	344
Females	13-14	84.5 (71.3-100)	90.0 (71.4-108)	144 (122-180)	249 (190-309)	315 (211-475)	399
Females	15-16	95.0 (84.0-107)	106 (85.2-121)	162 (144-187)	259 (213-338)	355 (245-496)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.00, 5.00, and 5.00 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 2-Methylhippuric acid in Non-smokers (2011 - 2016)

CAS Number 42013-20-7

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	26.2 (23.2-29.5)	25.1 (21.4-27.9)	55.9 (48.6-64.4)	116 (95.0-144)	171 (135-227)	1318
Total population	13-14	23.7 (20.5-27.5)	21.7 (19.0-28.3)	53.2 (44.9-61.1)	115 (93.4-128)	152 (136-172)	1225
Total population	15-16	25.4 (22.3-28.9)	24.6 (21.3-28.9)	56.1 (47.0-70.7)	120 (97.0-145)	177 (145-220)	1401
Age 20-49 years	11-12	28.7 (24.6-33.5)	26.0 (21.9-31.5)	62.3 (49.3-74.9)	127 (95.2-158)	188 (134-251)	659
Age 20-49 years	13-14	24.8 (21.7-28.4)	22.5 (19.8-27.7)	53.9 (48.1-63.3)	115 (95.4-127)	150 (127-173)	591
Age 20-49 years	15-16	27.2 (24.5-30.3)	26.0 (23.7-29.6)	65.3 (48.1-75.5)	127 (104-145)	183 (143-256)	684
Age 50+ years	11-12	23.6 (20.1-27.8)	23.9 (18.4-28.5)	49.7 (39.4-62.3)	107 (77.8-148)	170 (118-224)	659
Age 50+ years	13-14	22.4 (18.7-26.7)	21.5 (16.9-29.3)	51.2 (41.2-59.7)	113 (80.7-147)	154 (120-195)	634
Age 50+ years	15-16	23.4 (19.2-28.7)	23.3 (19.4-28.3)	50.9 (40.0-67.9)	120 (74.9-152)	152 (123-227)	717
Males	11-12	31.3 (24.4-40.1)	27.4 (20.9-34.9)	65.3 (43.5-88.9)	158 (90.2-206)	206 (129-408)	628
Males	13-14	28.5 (23.6-34.3)	29.2 (22.2-35.0)	57.8 (46.9-76.2)	129 (98.6-149)	165 (139-221)	599
Males	15-16	29.4 (24.7-34.9)	27.9 (22.4-38.6)	68.3 (49.9-84.4)	121 (112-145)	177 (145-227)	660
Females	11-12	22.7 (19.6-26.3)	22.7 (20.0-26.0)	51.1 (39.8-59.6)	99.8 (79.8-114)	138 (107-171)	690
Females	13-14	20.3 (17.2-24.0)	19.7 (16.0-23.3)	48.8 (35.9-59.7)	98.2 (78.5-118)	145 (115-171)	711
Females	15-16	22.6 (20.0-25.5)	23.1 (20.2-24.7)	50.5 (40.6-57.1)	119 (77.9-157)	175 (128-260)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 5.00, 5.00, and 5.00 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 2-Methylhippuric acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 42013-20-7

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	108 (97.3-119)	113 (98.8-130)	195 (175-214)	330 (255-376)	388 (338-459)	869
Total population	13-14	83.8 (65.9-107)	90.5 (70.8-117)	150 (123-198)	264 (188-366)	352 (263-515)	848
Total population	15-16	96.1 (85.8-108)	103 (94.4-113)	171 (151-193)	256 (225-325)	392 (276-458)	804
Age 20-49 years	11-12	96.9 (87.3-108)	94.8 (85.1-107)	189 (163-204)	324 (239-348)	378 (333-453)	518
Age 20-49 years	13-14	76.5 (60.6-96.5)	83.0 (68.2-111)	145 (120-182)	228 (187-293)	307 (263-394)	505
Age 20-49 years	15-16	82.2 (68.6-98.6)	83.4 (72.0-108)	152 (124-186)	235 (190-268)	277 (224-557)	428
Age 50+ years	11-12	127 (110-147)	137 (123-155)	206 (182-245)	332 (252-398)	423 (330-486)	351
Age 50+ years	13-14	102 (79.6-131)	104 (86.1-128)	177 (126-279)	332 (170-652)	460 (255-886)	343
Age 50+ years	15-16	125 (110-142)	116 (104-139)	198 (165-225)	345 (237-415)	415 (345-483)	376
Males	11-12	98.9 (82.7-118)	99.3 (83.6-121)	171 (127-214)	303 (200-376)	376 (333-423)	525
Males	13-14	73.7 (57.6-94.4)	79.3 (60.7-103)	146 (115-187)	250 (189-323)	340 (263-515)	477
Males	15-16	82.9 (69.9-98.4)	96.2 (79.4-108)	146 (127-172)	236 (194-265)	277 (225-557)	485
Females	11-12	120 (98.4-146)	140 (104-166)	229 (187-270)	330 (270-398)	438 (330-495)	344
Females	13-14	95.9 (74.6-123)	101 (76.3-128)	163 (122-227)	288 (164-460)	368 (229-568)	399
Females	15-16	115 (102-129)	116 (91.3-134)	193 (171-215)	327 (238-414)	417 (301-496)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 2-Methylhippuric acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 42013-20-7

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	30.7 (27.5-34.3)	29.0 (25.8-33.5)	60.6 (53.7-68.4)	123 (98.9-137)	168 (134-232)	1317
Total population	13-14	28.2 (24.1-33.2)	28.0 (24.2-34.6)	60.1 (53.4-68.1)	112 (95.5-126)	163 (119-223)	1224
Total population	15-16	28.8 (25.4-32.6)	27.3 (22.7-31.1)	59.9 (51.7-70.0)	116 (93.5-151)	184 (132-236)	1399
Age 20-49 years	11-12	31.6 (28.0-35.8)	30.0 (26.7-34.7)	60.6 (47.5-69.5)	100 (85.9-140)	173 (100-292)	658
Age 20-49 years	13-14	26.8 (22.6-31.8)	26.7 (21.5-33.1)	56.3 (47.8-60.3)	95.5 (78.6-114)	162 (108-218)	591
Age 20-49 years	15-16	28.9 (25.0-33.5)	28.1 (21.4-33.9)	59.9 (51.0-68.3)	116 (89.5-159)	177 (125-233)	682
Age 50+ years	11-12	29.8 (25.9-34.2)	28.0 (21.8-35.2)	60.8 (51.8-72.3)	133 (110-142)	162 (146-204)	659
Age 50+ years	13-14	29.9 (24.9-35.8)	29.6 (25.3-37.4)	66.6 (54.0-80.0)	119 (103-135)	166 (123-299)	633
Age 50+ years	15-16	28.8 (24.6-33.8)	25.3 (20.4-32.2)	59.7 (48.6-76.5)	114 (84.9-161)	184 (109-310)	717
Males	11-12	28 (22.7-34.7)	26.8 (22.1-33.5)	56.3 (42.1-75.9)	100 (84.3-136)	159 (100-307)	627
Males	13-14	27.9 (23.7-32.9)	28.0 (24.2-33.7)	57.8 (50.3-63.2)	112 (88.2-122)	158 (114-290)	598
Males	15-16	27 (23.1-31.6)	26.2 (20.8-32.0)	57.4 (51.0-70.0)	98.4 (82.7-125)	139 (93.5-216)	660
Females	11-12	33 (29.6-36.8)	30.9 (26.7-36.6)	62.6 (55.1-69.5)	133 (109-140)	180 (146-207)	690
Females	13-14	28.5 (23.3-34.8)	27.6 (21.6-37.3)	61.1 (50.0-70.5)	113 (87.9-142)	169 (126-223)	711
Females	15-16	30.3 (26.6-34.6)	27.8 (23.0-31.6)	60.3 (50.8-74.9)	151 (91.7-192)	207 (159-266)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 3-and 4-Methylhippuric acid in Smokers (2011 - 2016)

CAS Number 27115-49-7 or 27115-50-0

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	676 (583-784)	730 (599-868)	1310 (1160-1560)	2170 (1970-2410)	2860 (2400-3580)	869
Total population	13-14	595 (521-679)	622 (535-729)	1190 (1090-1340)	2070 (1800-2530)	2840 (2330-3260)	913
Total population	15-16	638 (548-744)	676 (614-757)	1270 (1130-1420)	2170 (1860-2580)	2810 (2300-4560)	804
Age 20-49 years	11-12	629 (520-760)	730 (565-879)	1260 (1110-1410)	1940 (1700-2380)	2650 (2190-3010)	518
Age 20-49 years	13-14	599 (511-703)	628 (521-777)	1230 (1090-1410)	2040 (1650-2640)	2930 (2200-3410)	548
Age 20-49 years	15-16	563 (466-680)	623 (536-738)	1220 (1000-1380)	2150 (1720-2450)	2770 (2260-4380)	428
Age 50+ years	11-12	758 (640-898)	731 (590-1050)	1440 (1140-1970)	2420 (1940-3930)	3610 (2430-4490)	351
Age 50+ years	13-14	599 (523-687)	607 (502-695)	1170 (844-1530)	2110 (1700-2630)	2730 (2150-3120)	365
Age 50+ years	15-16	787 (653-948)	802 (637-948)	1320 (1150-1710)	2290 (1900-2800)	3150 (2290-6150)	376
Males	11-12	726 (576-915)	868 (599-1070)	1500 (1190-1810)	2290 (1900-2960)	3170 (2100-3940)	525
Males	13-14	601 (489-737)	622 (470-830)	1290 (1100-1610)	2330 (1800-2820)	2970 (2510-3610)	507
Males	15-16	647 (504-830)	743 (566-969)	1350 (1130-1720)	2240 (1850-2770)	2920 (2240-6950)	485
Females	11-12	619 (545-702)	649 (590-801)	1110 (994-1210)	1990 (1670-2400)	2430 (2060-2860)	344
Females	13-14	589 (538-645)	624 (544-680)	1130 (1010-1190)	1770 (1530-2410)	2620 (1710-3120)	436
Females	15-16	628 (555-711)	636 (576-726)	1200 (878-1320)	2010 (1410-2480)	2680 (2030-4560)	340

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 8.00, 8.00, and 8.00 respectively.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 3-and 4-Methylhippuric acid in Non-smokers (2011 - 2016)

CAS Number 27115-49-7 or 27115-50-0

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	173 (158-189)	165 (143-192)	372 (313-462)	824 (701-979)	1370 (1040-1560)	1318
Total population	13-14	160 (139-184)	154 (130-179)	380 (328-445)	822 (684-976)	1130 (897-1400)	1367
Total population	15-16	162 (145-181)	155 (140-173)	345 (291-435)	769 (642-934)	1130 (988-1300)	1401
Age 20-49 years	11-12	172 (147-201)	159 (136-202)	376 (298-469)	844 (690-1040)	1330 (921-1630)	659
Age 20-49 years	13-14	164 (142-190)	158 (130-191)	378 (312-475)	794 (680-961)	1090 (846-1380)	671
Age 20-49 years	15-16	165 (147-185)	156 (135-193)	384 (305-483)	849 (699-1050)	1180 (988-1450)	684
Age 50+ years	11-12	174 (151-200)	169 (134-208)	361 (291-506)	789 (609-1070)	1370 (1020-1590)	659
Age 50+ years	13-14	155 (132-182)	146 (128-178)	387 (330-445)	853 (626-1020)	1130 (853-1590)	696
Age 50+ years	15-16	157 (133-186)	155 (129-180)	317 (258-396)	698 (502-904)	1020 (871-1200)	717
Males	11-12	200 (162-247)	186 (143-227)	396 (293-615)	949 (690-1370)	1560 (1200-1660)	628
Males	13-14	184 (155-219)	188 (146-235)	410 (344-488)	853 (693-1010)	1120 (880-1700)	655
Males	15-16	187 (160-218)	171 (149-228)	419 (309-504)	782 (643-1020)	1130 (926-1450)	660
Females	11-12	154 (135-175)	150 (131-168)	353 (273-467)	730 (609-897)	1190 (895-1420)	690
Females	13-14	143 (122-167)	134 (102-161)	361 (302-455)	782 (629-961)	1130 (810-1380)	810
Females	15-16	144 (130-160)	142 (128-157)	319 (257-396)	788 (583-926)	1120 (926-1300)	802

Limit of detection (LOD, see Data Analysis section) for Survey years 11-12, 13-14, and 15-16 are 8.00, 8.00, and 8.00 respectively.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 3-and 4-Methylhippuric acid in Smokers (creatinine corrected, 2011 - 2016)

CAS Number 27115-49-7 or 27115-50-0

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	747 (672-831)	820 (772-870)	1320 (1150-1540)	2000 (1700-2220)	2260 (2060-2500)	869
Total population	13-14	605 (517-709)	667 (576-790)	1060 (909-1250)	1600 (1360-1990)	2130 (1720-2630)	912
Total population	15-16	645 (556-747)	705 (643-749)	1120 (944-1320)	1740 (1410-2110)	2270 (1710-3480)	804
Age 20-49 years	11-12	655 (582-737)	695 (607-822)	1190 (1080-1360)	2000 (1540-2110)	2220 (2050-2490)	518
Age 20-49 years	13-14	552 (473-644)	626 (503-733)	967 (834-1150)	1520 (1270-1820)	2020 (1800-2280)	547
Age 20-49 years	15-16	533 (427-667)	587 (477-676)	965 (783-1170)	1420 (1140-2090)	2090 (1330-4170)	428
Age 50+ years	11-12	916 (809-1040)	950 (831-1090)	1550 (1210-1700)	2050 (1700-2470)	2470 (1960-2890)	351
Age 50+ years	13-14	747 (631-883)	806 (686-892)	1220 (986-1440)	1750 (1400-2630)	2630 (1500-3370)	365
Age 50+ years	15-16	882 (789-987)	857 (746-951)	1310 (1080-1580)	2020 (1600-2270)	2360 (1960-3860)	376
Males	11-12	687 (573-825)	716 (584-902)	1120 (965-1380)	1770 (1400-2080)	2110 (1890-2380)	525
Males	13-14	534 (449-634)	609 (471-736)	986 (842-1170)	1480 (1240-1930)	2140 (1670-2470)	506
Males	15-16	563 (460-689)	668 (588-725)	995 (836-1140)	1520 (1120-2320)	1960 (1230-5560)	485
Females	11-12	830 (703-979)	971 (773-1160)	1600 (1300-1810)	2120 (1990-2290)	2500 (2080-3080)	344
Females	13-14	688 (586-808)	733 (637-840)	1140 (914-1390)	1730 (1390-2050)	2090 (1810-2620)	436
Females	15-16	758 (670-856)	735 (643-912)	1250 (1050-1420)	1950 (1610-2140)	2270 (1940-2850)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary 3-and 4-Methylhippuric acid in Non-smokers (creatinine corrected, 2011 - 2016)

CAS Number 27115-49-7 or 27115-50-0

Metabolite of Xylene

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	11-12	203 (189-217)	166 (149-186)	403 (342-463)	770 (723-853)	1060 (958-1210)	1317
Total population	13-14	192 (166-222)	168 (141-210)	429 (342-495)	758 (670-877)	1040 (878-1390)	1366
Total population	15-16	183 (163-206)	157 (138-178)	380 (305-451)	656 (559-794)	988 (738-1170)	1399
Age 20-49 years	11-12	189 (169-210)	155 (139-184)	384 (310-447)	642 (540-767)	784 (721-1020)	658
Age 20-49 years	13-14	182 (155-214)	156 (130-197)	389 (319-461)	652 (593-758)	917 (704-1410)	671
Age 20-49 years	15-16	175 (152-201)	149 (119-175)	382 (290-469)	688 (555-889)	988 (714-1220)	682
Age 50+ years	11-12	219 (197-243)	169 (149-193)	460 (342-590)	966 (803-1060)	1300 (1030-1610)	659
Age 50+ years	13-14	206 (175-241)	179 (148-222)	459 (352-628)	871 (716-964)	1090 (889-1460)	695
Age 50+ years	15-16	193 (170-220)	171 (143-197)	371 (287-451)	640 (561-829)	1000 (685-1310)	717
Males	11-12	179 (151-212)	147 (121-181)	342 (231-472)	647 (530-765)	867 (691-1140)	627
Males	13-14	179 (152-210)	156 (135-183)	402 (294-468)	655 (575-793)	871 (704-1160)	654
Males	15-16	172 (149-198)	164 (137-188)	348 (280-402)	598 (478-671)	906 (617-1020)	660
Females	11-12	224 (207-242)	182 (162-206)	447 (384-538)	858 (770-1030)	1290 (974-1470)	690
Females	13-14	204 (173-241)	175 (134-229)	449 (335-587)	862 (728-955)	1090 (920-1410)	810
Females	15-16	194 (173-217)	155 (135-177)	415 (329-488)	738 (620-889)	1060 (860-1360)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Biomonitoring Summary: https://www.cdc.gov/biomonitoring/Xylenes_BiomonitoringSummary.html

Urinary N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine in Smokers (2015 - 2016)

CAS Number 116477-44-2

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	17.3 (14.7-20.4)	19.8 (16.6-24.2)	46.8 (37.3-59.1)	89.5 (70.1-105)	123 (101-153)	804
Age 20-49 years	15-16	14.8 (11.8-18.5)	18.1 (13.8-22.6)	44.8 (34.6-58.7)	91.5 (69.0-121)	127 (103-153)	428
Age 50+ years	15-16	22.4 (18.6-27.0)	23.0 (17.1-31.6)	49.8 (37.0-66.2)	75.2 (67.2-95.1)	104 (87.9-157)	376
Males	15-16	17.3 (13.0-22.8)	22.2 (13.9-29.7)	55.5 (36.4-66.7)	91.0 (67.2-107)	123 (91.5-144)	485
Females	15-16	17.4 (15.2-20.0)	18.5 (16.4-22.7)	39.9 (32.4-53.9)	84.8 (66.2-103)	133 (102-163)	340

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 2.60.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine in Non-smokers (2015 - 2016)

CAS Number 116477-44-2

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	<LOD	<LOD	6.66 (<LOD-25.3)	1401
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	7.63 (<LOD-35.6)	684
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	4.77 (<LOD-15.3)	717
Males	15-16	*	<LOD	<LOD	<LOD	10.5 (2.64-25.6)	660
Females	15-16	*	<LOD	<LOD	<LOD	4.77 (<LOD-14.8)	802

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 2.60.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine in Smokers (creatinine corrected, 2015 - 2016)

CAS Number 116477-44-2

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	17.5 (14.8-20.7)	21.8 (18.2-25.5)	43.0 (38.0-47.9)	66.0 (59.0-72.1)	92.2 (72.1-107)	804
Age 20-49 years	15-16	14 (11.0-17.8)	16.3 (12.7-23.4)	37.0 (33.7-46.9)	66.5 (55.8-72.1)	83.3 (67.4-102)	428
Age 50+ years	15-16	25.1 (21.0-30.1)	29.1 (21.3-36.2)	47.9 (39.9-56.1)	66.0 (57.3-92.9)	100 (68.8-119)	376
Males	15-16	15 (11.9-19.0)	19.3 (13.7-23.7)	35.7 (29.1-44.8)	56.1 (47.9-64.9)	72.1 (58.4-92.9)	485
Females	15-16	21 (17.8-24.9)	24.9 (19.2-31.8)	50.8 (41.7-60.2)	74.4 (66.0-96.2)	102 (76.4-113)	340

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine in Non-smokers (creatinine corrected, 2015 - 2016)

CAS Number 116477-44-2

Metabolite of Acrylonitrile

Geometric mean and selected percentiles of urine concentrations (in µg/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	*	<LOD	<LOD	<LOD	11.2 (<LOD-15.3)	1399
Age 20-49 years	15-16	*	<LOD	<LOD	<LOD	14.2 (<LOD-26.4)	682
Age 50+ years	15-16	*	<LOD	<LOD	<LOD	10.4 (<LOD-15.3)	717
Males	15-16	*	<LOD	<LOD	<LOD	10.8 (8.76-22.3)	660
Females	15-16	*	<LOD	<LOD	<LOD	11.5 (<LOD-14.2)	800

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine in Smokers (2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	8.29 (7.67-8.97)	8.94 (8.03-9.52)	15.1 (14.4-16.7)	23.9 (19.7-29.8)	31.4 (25.4-39.8)	804
Age 20-49 years	15-16	7.47 (6.50-8.59)	7.80 (6.69-9.46)	14.4 (12.8-16.5)	23.9 (19.1-30.4)	32.6 (23.9-40.0)	428
Age 50+ years	15-16	9.73 (8.50-11.1)	9.52 (8.36-12.4)	16.5 (14.6-18.3)	25.5 (19.3-30.3)	30.7 (22.8-53.4)	376
Males	15-16	8.96 (7.68-10.4)	9.54 (8.06-11.3)	17.1 (14.8-19.7)	26.0 (19.9-33.6)	35.3 (26.0-44.1)	485
Females	15-16	7.56 (7.09-8.07)	7.84 (7.15-9.07)	13.1 (11.7-14.6)	20.1 (18.1-23.9)	27.5 (20.6-33.3)	340

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.43.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine in Non-smokers (2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	3.08 (2.90-3.28)	3.28 (2.98-3.59)	5.54 (5.25-5.94)	7.91 (7.28-8.85)	10.1 (8.75-12.9)	1401
Age 20-49 years	15-16	3.19 (2.92-3.48)	3.59 (3.19-3.94)	5.94 (5.34-6.46)	8.07 (7.20-8.91)	10.9 (8.74-13.9)	684
Age 50+ years	15-16	2.95 (2.72-3.21)	2.97 (2.61-3.44)	5.25 (4.67-5.58)	7.79 (6.80-8.91)	9.61 (7.91-11.7)	717
Males	15-16	3.71 (3.41-4.03)	4.10 (3.77-4.59)	6.52 (6.14-6.87)	8.89 (7.79-9.61)	11.2 (9.18-13.0)	660
Females	15-16	2.65 (2.48-2.83)	2.69 (2.31-2.97)	4.72 (4.08-5.10)	7.02 (6.19-7.96)	9.41 (7.91-11.9)	802

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.43.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine in Smokers (creatinine corrected, 2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	8.37 (7.72-9.09)	8.62 (7.73-9.57)	13.0 (11.9-14.4)	20.3 (17.5-23.8)	28.4 (23.3-35.6)	804
Age 20-49 years	15-16	7.08 (6.14-8.16)	6.74 (5.71-8.13)	11.3 (9.67-13.1)	17.7 (13.1-23.7)	23.8 (17.7-35.1)	428
Age 50+ years	15-16	10.9 (9.98-11.9)	10.9 (9.80-12.2)	15.4 (13.4-18.3)	23.9 (19.2-30.7)	33.4 (23.8-41.1)	376
Males	15-16	7.79 (7.11-8.54)	7.82 (7.05-8.81)	12.1 (10.8-13.1)	17.9 (14.6-21.7)	23.7 (16.6-32.6)	485
Females	15-16	9.12 (8.22-10.1)	9.15 (7.86-10.9)	15.3 (12.9-16.8)	23.8 (19.2-31.6)	34.7 (23.5-40.9)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine in Non-smokers (creatinine corrected, 2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	3.49 (3.36-3.61)	3.37 (3.26-3.51)	4.57 (4.25-4.72)	6.14 (5.89-6.47)	7.77 (6.73-8.41)	1399
Age 20-49 years	15-16	3.38 (3.16-3.61)	3.26 (2.98-3.48)	4.39 (4.00-4.70)	6.04 (5.39-6.47)	7.49 (6.22-8.42)	682
Age 50+ years	15-16	3.63 (3.49-3.79)	3.50 (3.33-3.73)	4.68 (4.28-5.05)	6.42 (5.90-7.00)	7.97 (6.73-8.48)	717
Males	15-16	3.41 (3.23-3.61)	3.35 (3.16-3.59)	4.48 (4.13-4.70)	5.94 (5.61-6.42)	7.26 (6.42-7.99)	660
Females	15-16	3.55 (3.42-3.68)	3.37 (3.26-3.52)	4.58 (4.25-4.89)	6.21 (5.90-6.85)	7.77 (6.47-8.88)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(4-hydroxy-2-methyl-2 buten-1-yl)-L-cysteine in Smokers (2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	26.6 (22.2-31.8)	34.1 (29.4-37.5)	76.4 (66.9-85.6)	124 (107-146)	166 (128-227)	804
Age 20-49 years	15-16	20.7 (15.4-27.8)	27.5 (20.9-35.3)	62.7 (51.9-81.6)	124 (91.8-160)	166 (118-247)	428
Age 50+ years	15-16	39.4 (33.5-46.4)	42.0 (31.4-59.4)	87.0 (70.1-101)	126 (111-143)	153 (128-207)	376
Males	15-16	25.9 (19.4-34.6)	35.3 (26.5-44.5)	80.5 (66.9-92.8)	126 (103-171)	171 (124-227)	485
Females	15-16	27.4 (23.5-32.0)	32.4 (27.5-37.7)	63.2 (53.7-85.6)	118 (101-130)	146 (128-207)	340

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.20.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(4-hydroxy-2-methyl-2 buten-1-yl)-L-cysteine in Non-smokers (2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in µg/L) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	2.94 (2.76-3.14)	2.75 (2.56-3.02)	5.15 (4.72-5.70)	9.65 (8.85-11.0)	15.5 (12.5-17.6)	1401
Age 20-49 years	15-16	2.88 (2.66-3.12)	2.75 (2.45-3.14)	5.03 (4.62-5.65)	9.35 (8.16-10.1)	14.0 (11.2-18.5)	684
Age 50+ years	15-16	2.96 (2.69-3.25)	2.75 (2.36-3.01)	5.20 (4.68-6.04)	10.3 (7.77-13.5)	16.5 (12.1-22.6)	717
Males	15-16	3.17 (2.91-3.46)	2.89 (2.62-3.38)	5.16 (4.67-5.80)	10.0 (8.07-13.5)	16.5 (13.4-20.7)	660
Females	15-16	2.77 (2.56-3.00)	2.65 (2.36-2.97)	5.15 (4.67-5.78)	9.60 (8.52-11.2)	15.5 (11.0-20.1)	802

Limit of detection (LOD, see Data Analysis section) for Survey year 15-16 is 1.20.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary N-Acetyl-S-(4-hydroxy-2-methyl-2 buten-1-yl)-L-cysteine in Smokers (creatinine corrected, 2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	26.9 (22.3-32.3)	37.6 (32.3-43.2)	67.7 (61.1-73.0)	110 (89.7-125)	148 (116-201)	804
Age 20-49 years	15-16	19.6 (14.3-27.0)	26.2 (19.0-35.4)	58.3 (42.1-72.8)	95.3 (73.0-125)	125 (89.2-201)	428
Age 50+ years	15-16	44.2 (39.6-49.3)	50.7 (44.9-59.1)	78.2 (64.8-89.1)	119 (101-153)	160 (138-251)	376
Males	15-16	22.5 (17.8-28.5)	33.3 (26.4-38.3)	57.9 (50.1-67.7)	92.1 (72.2-111)	116 (89.7-150)	485
Females	15-16	33.1 (27.1-40.3)	41.9 (35.5-49.8)	74.0 (66.2-85.6)	127 (110-160)	204 (142-248)	340

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary N-Acetyl-S-(4-hydroxy-2-methyl-2 buten-1-yl)-L-cysteine in Non-smokers (creatinine corrected, 2015 - 2016)

Metabolite of Isoprene

Geometric mean and selected percentiles of urine concentrations (in $\mu\text{g/g}$ of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	15-16	3.33 (3.18-3.48)	3.15 (2.94-3.31)	4.99 (4.55-5.31)	8.47 (7.36-9.17)	11.6 (9.92-13.5)	1399
Age 20-49 years	15-16	3.05 (2.89-3.21)	2.76 (2.58-3.05)	4.51 (4.25-5.06)	8.31 (7.10-9.39)	10.9 (9.62-12.7)	682
Age 50+ years	15-16	3.64 (3.36-3.93)	3.41 (3.10-3.80)	5.31 (4.87-5.82)	8.63 (7.08-10.7)	11.9 (10.4-14.6)	717
Males	15-16	2.92 (2.74-3.11)	2.74 (2.50-2.94)	4.19 (3.87-4.51)	7.29 (6.03-8.76)	10.8 (8.18-15.6)	660
Females	15-16	3.7 (3.52-3.90)	3.51 (3.20-3.80)	5.54 (5.07-5.79)	8.83 (7.70-10.0)	12.1 (9.75-14.8)	800

[^] Cigarette nonsmokers who used other tobacco products were excluded

Aldehydes

Serum Benzaldehyde in Smokers (2013 - 2014)

CAS Number 100-52-7

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.01 (.856-1.20)	1.07 (.897-1.21)	1.62 (1.38-1.81)	2.19 (1.78-3.03)	2.99 (2.06-4.44)	630
Age 18-49 years	13-14	1.04 (.877-1.23)	1.10 (.961-1.31)	1.63 (1.42-1.78)	2.14 (1.78-3.06)	2.99 (1.93-4.44)	377
Age 50+ years	13-14	.967 (.789-1.19)	.964 (.768-1.16)	1.60 (1.20-1.98)	2.28 (1.60-3.12)	2.76 (2.14-3.89)	253
Males	13-14	1.01 (.806-1.26)	1.09 (.774-1.37)	1.61 (1.39-1.88)	2.17 (1.72-3.57)	3.33 (2.03-4.44)	314
Females	13-14	1.02 (.874-1.18)	1.02 (.914-1.20)	1.62 (1.34-1.82)	2.28 (1.72-2.99)	2.76 (2.04-3.54)	316

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.461.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Benzaldehyde in Non-smokers (2013 - 2014)

CAS Number 100-52-7

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.42 (1.26-1.59)	1.44 (1.27-1.63)	2.11 (1.79-2.40)	2.94 (2.58-3.51)	3.81 (3.26-4.87)	976
Age 18-49 years	13-14	1.41 (1.25-1.59)	1.44 (1.25-1.65)	2.09 (1.76-2.51)	2.94 (2.56-3.52)	3.66 (2.95-4.90)	509
Age 50+ years	13-14	1.43 (1.23-1.65)	1.47 (1.23-1.66)	2.15 (1.76-2.44)	3.01 (2.48-3.80)	4.29 (3.01-5.49)	467
Males	13-14	1.30 (1.18-1.44)	1.32 (1.15-1.47)	1.97 (1.66-2.18)	2.80 (2.37-3.05)	3.67 (2.94-4.29)	436
Females	13-14	1.52 (1.33-1.74)	1.57 (1.35-1.74)	2.26 (1.88-2.55)	3.05 (2.69-3.62)	3.81 (3.37-5.00)	540

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.461.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Butyraldehyde in Smokers (2013 - 2014)

CAS Number 123-72-8

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.551 (.500-.608)	.584 (.532-.639)	.747 (.694-.804)	.956 (.867-.995)	1.08 (.988-1.17)	737
Age 18-49 years	13-14	.548 (.494-.607)	.580 (.525-.637)	.729 (.673-.810)	.950 (.828-1.04)	1.07 (.988-1.17)	441
Age 50+ years	13-14	.558 (.503-.619)	.586 (.536-.690)	.772 (.719-.824)	.965 (.879-.995)	1.14 (.973-1.43)	296
Males	13-14	.563 (.500-.635)	.585 (.539-.667)	.756 (.692-.805)	.937 (.856-1.02)	1.08 (.991-1.22)	386
Females	13-14	.540 (.491-.593)	.562 (.511-.640)	.742 (.670-.837)	.960 (.845-.996)	1.10 (.978-1.45)	351

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.313.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Butyraldehyde in Non-smokers (2013 - 2014)

CAS Number 123-72-8

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.468 (.425-.515)	.486 (.448-.530)	.656 (.612-.709)	.822 (.772-.865)	.993 (.924-1.08)	1158
Age 18-49 years	13-14	.469 (.424-.518)	.484 (.447-.527)	.664 (.608-.713)	.826 (.760-.931)	1.02 (.923-1.19)	599
Age 50+ years	13-14	.466 (.422-.515)	.488 (.441-.534)	.643 (.614-.697)	.813 (.772-.840)	.944 (.851-1.07)	559
Males	13-14	.486 (.435-.543)	.509 (.450-.555)	.673 (.622-.731)	.861 (.760-1.06)	1.08 (.915-1.35)	519
Females	13-14	.453 (.410-.501)	.476 (.439-.519)	.638 (.589-.690)	.788 (.738-.856)	.931 (.796-1.08)	639

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.313.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Crotonaldehyde in Smokers (2013 - 2014)

CAS Number 123-73-9

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.200 (.165-.228)	.298 (.227-.402)	.402 (.300-.481)	744
Age 18-49 years	13-14	*	<LOD	.195 (.159-.228)	.301 (.218-.402)	.402 (.269-.446)	441
Age 50+ years	13-14	*	<LOD	.212 (.160-.247)	.284 (.225-.341)	.335 (.276-.481)	303
Males	13-14	*	<LOD	.201 (.161-.247)	.309 (.234-.420)	.412 (.253-.492)	384
Females	13-14	*	<LOD	.193 (.158-.224)	.269 (.208-.366)	.345 (.244-.426)	360

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.147.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Crotonaldehyde in Non-smokers (2013 - 2014)

CAS Number 123-73-9

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.156 (<LOD-.176)	.222 (.196-.288)	.337 (.249-.431)	1143
Age 18-49 years	13-14	*	<LOD	.158 (<LOD-.178)	.257 (.196-.337)	.368 (.284-.531)	601
Age 50+ years	13-14	*	<LOD	.155 (<LOD-.178)	.207 (.187-.255)	.287 (.213-.379)	542
Males	13-14	*	<LOD	.157 (<LOD-.176)	.245 (.192-.318)	.363 (.246-.548)	515
Females	13-14	*	<LOD	.156 (<LOD-.176)	.215 (.195-.290)	.334 (.240-.381)	628

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.147.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Decanaldehyde in Smokers (2013 - 2014)

CAS Number 112-31-2

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	620
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	370
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	250
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	318
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	302

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 3.90.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Decanaldehyde in Non-smokers (2013 - 2014)

CAS Number 112-31-2

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	932
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	474
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	458
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	427
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	505

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 3.90.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Heptanaldehyde in Smokers (2013 - 2014)

CAS Number 111-71-7

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.500 (.473-.529)	.518 (.483-.555)	.605 (.567-.654)	.714 (.663-.770)	.789 (.750-.812)	664
Age 18-49 years	13-14	.502 (.473-.534)	.518 (.483-.555)	.605 (.558-.648)	.706 (.638-.786)	.786 (.706-.871)	399
Age 50+ years	13-14	.496 (.468-.526)	.515 (.471-.559)	.604 (.568-.663)	.747 (.669-.782)	.789 (.742-.812)	265
Males	13-14	.510 (.485-.536)	.529 (.491-.561)	.617 (.581-.662)	.747 (.681-.766)	.793 (.747-.859)	335
Females	13-14	.492 (.455-.532)	.511 (.468-.543)	.597 (.538-.666)	.693 (.634-.786)	.786 (.683-.856)	329

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.312.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Heptanaldehyde in Non-smokers (2013 - 2014)

CAS Number 111-71-7

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.477 (.450-.506)	.502 (.467-.532)	.593 (.570-.617)	.703 (.644-.756)	.771 (.727-.828)	1007
Age 18-49 years	13-14	.486 (.456-.517)	.511 (.468-.541)	.601 (.571-.625)	.720 (.643-.764)	.782 (.735-.882)	526
Age 50+ years	13-14	.468 (.437-.500)	.494 (.464-.522)	.584 (.552-.619)	.670 (.630-.731)	.760 (.697-.784)	481
Males	13-14	.481 (.445-.519)	.513 (.476-.546)	.613 (.584-.634)	.700 (.647-.745)	.760 (.700-.882)	447
Females	13-14	.474 (.448-.501)	.492 (.461-.523)	.577 (.559-.597)	.704 (.625-.771)	.774 (.704-.837)	560

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.312.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Hexanaldehyde in Smokers (2013 - 2014)

CAS Number 66-25-1

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2.01 (1.91-2.11)	2.05 (1.95-2.12)	2.51 (2.32-2.69)	2.97 (2.86-3.16)	3.50 (3.16-4.10)	657
Age 18-49 years	13-14	2.01 (1.88-2.13)	2.05 (1.92-2.13)	2.47 (2.26-2.75)	2.99 (2.81-3.29)	3.50 (3.09-4.10)	399
Age 50+ years	13-14	2.02 (1.92-2.12)	2.05 (1.95-2.21)	2.53 (2.32-2.69)	2.93 (2.77-3.21)	3.59 (2.96-4.81)	258
Males	13-14	1.92 (1.79-2.06)	1.98 (1.85-2.09)	2.38 (2.21-2.58)	2.90 (2.72-3.09)	3.31 (2.95-4.10)	335
Females	13-14	2.10 (2.00-2.20)	2.10 (1.98-2.20)	2.65 (2.31-2.83)	3.04 (2.82-3.50)	3.57 (3.16-4.75)	322

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.693.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Hexanaldehyde in Non-smokers (2013 - 2014)

CAS Number 66-25-1

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2.10 (2.03-2.18)	2.12 (2.05-2.20)	2.62 (2.49-2.72)	3.15 (3.01-3.36)	3.73 (3.31-4.73)	1041
Age 18-49 years	13-14	2.14 (2.02-2.28)	2.19 (2.08-2.31)	2.66 (2.50-2.79)	3.15 (3.01-3.47)	3.75 (3.28-4.74)	539
Age 50+ years	13-14	2.06 (1.94-2.19)	2.06 (1.97-2.18)	2.53 (2.40-2.71)	3.15 (2.85-3.40)	3.63 (3.16-4.84)	502
Males	13-14	2.10 (2.01-2.19)	2.10 (2.01-2.21)	2.64 (2.47-2.75)	3.13 (2.92-3.47)	4.07 (3.15-7.12)	471
Females	13-14	2.11 (2.00-2.23)	2.15 (2.05-2.24)	2.60 (2.44-2.77)	3.15 (2.94-3.39)	3.64 (3.29-4.11)	570

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.693.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Nonanaldehyde in Smokers (2013 - 2014)

CAS Number 124-19-6

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	3.32 (2.86-3.88)	4.89 (3.85-6.19)	6.19 (5.13-7.12)	675
Age 18-49 years	13-14	*	<LOD	3.24 (2.83-3.64)	4.75 (3.74-6.15)	6.16 (5.20-7.07)	404
Age 50+ years	13-14	*	<LOD	3.40 (2.81-4.38)	4.93 (3.81-6.48)	6.38 (4.45-7.18)	271
Males	13-14	*	<LOD	3.32 (2.76-4.23)	5.09 (3.71-6.19)	6.19 (5.20-7.12)	348
Females	13-14	*	<LOD	3.29 (2.75-4.13)	4.75 (3.64-6.48)	6.19 (4.38-7.49)	327

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 2.63.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Nonanaldehyde in Non-smokers (2013 - 2014)

CAS Number 124-19-6

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	3.19 (2.89-3.44)	4.22 (3.84-4.72)	5.09 (4.55-5.77)	1004
Age 18-49 years	13-14	*	<LOD	3.09 (2.79-3.39)	4.22 (3.69-5.08)	5.40 (4.39-6.78)	519
Age 50+ years	13-14	*	<LOD	3.27 (2.96-3.71)	4.22 (3.77-4.76)	4.90 (4.34-5.50)	485
Males	13-14	*	<LOD	3.20 (2.81-3.42)	4.03 (3.48-4.72)	5.08 (4.34-5.84)	454
Females	13-14	*	<LOD	3.17 (2.89-3.47)	4.26 (3.81-4.89)	5.20 (4.54-5.92)	550

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 2.63.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Octanaldehyde in Smokers (2013 - 2014)

CAS Number 124-13-0

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	.793 (.689-.889)	.970 (.810-1.13)	631
Age 18-49 years	13-14	*	<LOD	<LOD	.771 (<LOD-.954)	.915 (.771-1.13)	375
Age 50+ years	13-14	*	<LOD	<LOD	.844 (<LOD-1.06)	1.06 (.826-1.33)	256
Males	13-14	*	<LOD	<LOD	.795 (.744-1.01)	1.05 (.795-1.33)	318
Females	13-14	*	<LOD	<LOD	.763 (<LOD-.856)	.951 (.763-1.13)	313

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.660.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Octanaldehyde in Non-smokers (2013 - 2014)

CAS Number 124-13-0

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	.794 (<LOD-.981)	1.03 (.764-1.40)	965
Age 18-49 years	13-14	*	<LOD	<LOD	.755 (<LOD-.933)	1.03 (.737-1.37)	511
Age 50+ years	13-14	*	<LOD	<LOD	.808 (<LOD-1.11)	1.05 (.758-1.40)	454
Males	13-14	*	<LOD	<LOD	.794 (<LOD-1.02)	1.04 (.755-1.36)	434
Females	13-14	*	<LOD	<LOD	.787 (<LOD-1.03)	1.03 (.757-1.54)	531

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.660.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Pentanaldehyde in Smokers (2013 - 2014)

CAS Number 110-62-3

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.395 (.336-.441)	.510 (.462-.575)	.610 (.520-.715)	742
Age 18-49 years	13-14	*	<LOD	.402 (.345-.441)	.502 (.457-.575)	.600 (.505-.676)	444
Age 50+ years	13-14	*	<LOD	.378 (<LOD-.449)	.528 (.450-.610)	.615 (.524-.736)	298
Males	13-14	*	<LOD	.401 (.339-.457)	.518 (.464-.600)	.610 (.509-.675)	386
Females	13-14	*	<LOD	.374 (<LOD-.441)	.499 (.443-.567)	.615 (.499-.740)	356

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.316.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Pentanaldehyde in Non-smokers (2013 - 2014)

CAS Number 110-62-3

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	.370 (<LOD-.427)	.492 (.440-.550)	.566 (.510-.645)	1168
Age 18-49 years	13-14	*	<LOD	.388 (.323-.434)	.488 (.454-.537)	.570 (.510-.637)	604
Age 50+ years	13-14	*	<LOD	.360 (<LOD-.412)	.492 (.404-.565)	.564 (.479-.698)	564
Males	13-14	*	<LOD	.360 (<LOD-.417)	.480 (.424-.564)	.578 (.482-.698)	528
Females	13-14	*	<LOD	.388 (.322-.430)	.503 (.443-.560)	.565 (.510-.620)	640

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.316.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Propanaldehyde in Smokers (2013 - 2014)

CAS Number 123-38-6

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2.44 (2.29-2.59)	2.47 (2.34-2.66)	3.11 (2.97-3.36)	3.82 (3.57-4.26)	4.40 (4.09-4.74)	724
Age 18-49 years	13-14	2.39 (2.21-2.58)	2.44 (2.32-2.61)	3.05 (2.82-3.24)	3.79 (3.45-4.37)	4.70 (3.94-5.04)	433
Age 50+ years	13-14	2.54 (2.37-2.72)	2.62 (2.34-2.94)	3.36 (3.08-3.50)	3.90 (3.62-4.24)	4.33 (3.87-4.43)	291
Males	13-14	2.48 (2.26-2.72)	2.53 (2.29-2.83)	3.17 (2.94-3.55)	3.90 (3.51-4.40)	4.40 (3.89-5.95)	380
Females	13-14	2.39 (2.26-2.53)	2.44 (2.33-2.60)	3.03 (2.86-3.24)	3.76 (3.45-4.32)	4.45 (4.09-4.70)	344

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.16.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Propanaldehyde in Non-smokers (2013 - 2014)

CAS Number 123-38-6

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.73 (1.62-1.85)	1.82 (1.67-1.97)	2.27 (2.15-2.40)	2.67 (2.55-2.81)	3.10 (2.81-3.30)	1135
Age 18-49 years	13-14	1.72 (1.59-1.87)	1.84 (1.66-1.99)	2.27 (2.09-2.44)	2.69 (2.53-3.02)	3.10 (2.74-3.42)	587
Age 50+ years	13-14	1.74 (1.64-1.85)	1.81 (1.68-1.96)	2.28 (2.18-2.40)	2.63 (2.54-2.78)	3.17 (2.78-3.42)	548
Males	13-14	1.77 (1.64-1.91)	1.90 (1.70-2.01)	2.29 (2.18-2.44)	2.78 (2.57-3.02)	3.23 (2.81-3.42)	513
Females	13-14	1.69 (1.58-1.82)	1.77 (1.57-1.96)	2.25 (2.08-2.40)	2.64 (2.53-2.78)	3.02 (2.65-3.34)	622

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.16.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum Isopentanaldehyde in Smokers (2013 - 2014)

CAS Number 590-86-3

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	1.06 (.985-1.15)	1.15 (1.03-1.24)	1.59 (1.49-1.68)	2.02 (1.87-2.22)	2.37 (2.23-2.56)	766
Age 18-49 years	13-14	1.01 (.921-1.11)	1.11 (.973-1.20)	1.56 (1.46-1.68)	1.99 (1.81-2.21)	2.39 (2.16-2.64)	459
Age 50+ years	13-14	1.18 (1.10-1.27)	1.24 (1.11-1.34)	1.66 (1.49-1.79)	2.08 (1.88-2.35)	2.37 (2.22-2.48)	307
Males	13-14	1.08 (.973-1.20)	1.20 (1.03-1.34)	1.63 (1.55-1.74)	2.03 (1.91-2.22)	2.37 (2.13-2.63)	396
Females	13-14	1.05 (.964-1.14)	1.12 (1.03-1.20)	1.50 (1.38-1.72)	2.02 (1.70-2.46)	2.39 (2.16-2.75)	370

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.119.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum Isopentanaldehyde in Non-smokers (2013 - 2014)

CAS Number 590-86-3

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	.388 (.366-.411)	.380 (.356-.402)	.496 (.463-.539)	.652 (.600-.701)	.768 (.700-.892)	1185
Age 18-49 years	13-14	.370 (.342-.399)	.365 (.332-.396)	.472 (.432-.538)	.619 (.568-.760)	.768 (.672-.880)	616
Age 50+ years	13-14	.409 (.388-.432)	.397 (.375-.432)	.516 (.479-.560)	.687 (.617-.726)	.777 (.696-.961)	569
Males	13-14	.406 (.381-.433)	.393 (.367-.431)	.521 (.484-.558)	.686 (.636-.740)	.832 (.701-1.12)	539
Females	13-14	.373 (.347-.401)	.365 (.344-.393)	.472 (.441-.525)	.635 (.530-.726)	.742 (.672-.851)	646

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.119.

[^] Cigarette non-smokers who used other tobacco products were excluded

Serum o-Tolualdehyde in Smokers (2013 - 2014)

CAS Number 529-20-4

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	688
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	<LOD	412
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	276
Males	13-14	*	<LOD	<LOD	<LOD	<LOD	358
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	330

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.142.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Serum o-Tolualdehyde in Non-smokers (2013 - 2014)

CAS Number 529-20-4

Geometric mean and selected percentiles of serum concentrations (in ng/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	<LOD	<LOD	<LOD	<LOD	1026
Age 18-49 years	13-14	*	<LOD	<LOD	<LOD	.149 (<LOD-.186)	525
Age 50+ years	13-14	*	<LOD	<LOD	<LOD	<LOD	501
Males	13-14	*	<LOD	<LOD	<LOD	.149 (<LOD-.196)	463
Females	13-14	*	<LOD	<LOD	<LOD	<LOD	563

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 0.142.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Aromatic Amines

Urinary 4-Aminobiphenyl in Smokers (2013 - 2014)

CAS Number 92-67-1

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	23.0 (20.5-25.8)	25.2 (21.7-29.7)	44.6 (39.7-50.1)	66.9 (58.2-72.2)	85.4 (75.0-100)	878
Age 20-49 years	13-14	23.2 (19.4-27.8)	26.6 (19.9-32.5)	45.8 (39.5-55.0)	68.5 (59.4-81.2)	86.7 (73.6-101)	531
Age 50+ years	13-14	23.5 (21.2-26.1)	24.4 (21.7-28.6)	42.6 (36.5-45.8)	57.1 (50.4-70.2)	78.3 (57.1-98.8)	347
Males	13-14	21.7 (18.9-25.0)	24.2 (21.0-29.3)	44.6 (36.8-51.5)	64.3 (57.1-76.9)	88.3 (69.8-101)	488
Females	13-14	24.4 (21.4-27.8)	26.5 (21.4-30.5)	44.0 (39.7-48.2)	66.9 (55.3-79.1)	82.0 (71.4-101)	419

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.75.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 4-Aminobiphenyl in Non-smokers (2013 - 2014)

CAS Number 92-67-1

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	4.24 (3.90-4.61)	4.70 (4.14-5.28)	8.06 (7.61-8.69)	12.1 (10.9-13.8)	18.0 (15.9-20.0)	1307
Age 20-49 years	13-14	4.51 (4.03-5.04)	5.01 (4.24-5.96)	8.23 (7.60-8.99)	13.2 (11.8-16.2)	19.9 (16.7-28.4)	640
Age 50+ years	13-14	3.92 (3.52-4.36)	4.38 (3.81-5.00)	7.84 (6.75-8.88)	11.0 (10.0-13.5)	15.5 (11.6-20.3)	667
Males	13-14	4.46 (3.99-4.99)	5.27 (4.38-5.97)	8.57 (7.91-9.25)	12.3 (10.4-15.9)	16.8 (13.6-24.3)	631
Females	13-14	4.07 (3.64-4.54)	4.30 (3.72-4.96)	7.77 (6.92-8.58)	12.8 (10.9-15.6)	20.3 (16.1-28.5)	768

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.75.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 4-Aminobiphenyl in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 92-67-1

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	24.3 (20.9-28.2)	26.4 (21.7-32.0)	45.0 (38.3-53.0)	72.8 (61.4-91.6)	99.7 (85.0-123)	877
Age 20-49 years	13-14	22.2 (18.8-26.1)	23.0 (17.8-30.0)	40.2 (34.1-46.7)	69.0 (60.6-79.8)	89.7 (76.2-100)	530
Age 50+ years	13-14	30.7 (26.4-35.6)	34.9 (31.6-36.9)	51.7 (46.3-58.7)	91.9 (58.4-136)	132 (71.7-203)	347
Males	13-14	19.8 (17.6-22.4)	21.7 (17.9-25.5)	37.9 (32.8-44.3)	60.9 (49.6-74.0)	84.2 (67.1-97.6)	487
Females	13-14	29.9 (24.6-36.4)	31.1 (26.5-36.9)	49.5 (42.3-61.6)	83.5 (63.7-122)	122 (85.6-153)	419

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 4-Aminobiphenyl in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 92-67-1

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	5.1 (4.74-5.50)	5.11 (4.71-5.63)	9.26 (8.60-9.81)	15.7 (14.1-17.7)	22.2 (19.5-26.4)	1307
Age 20-49 years	13-14	5.05 (4.63-5.51)	4.90 (4.57-5.43)	8.94 (7.94-9.65)	15.3 (12.8-16.8)	22.7 (18.2-28.4)	640
Age 50+ years	13-14	5.18 (4.55-5.89)	5.45 (4.74-6.22)	9.66 (8.78-10.3)	16.0 (13.9-19.7)	22.2 (18.2-33.7)	667
Males	13-14	4.31 (3.87-4.81)	4.37 (3.90-4.92)	7.97 (6.62-9.18)	12.6 (10.9-15.1)	18.8 (15.1-23.1)	631
Females	13-14	5.87 (5.28-6.54)	5.91 (5.43-6.42)	10.4 (9.51-11.2)	18.2 (15.1-20.6)	28.4 (19.7-34.8)	768

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 1-Aminonaphthalene in Smokers (2013 - 2014)

CAS Number 134-32-7

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	34.9 (29.1-41.9)	47.5 (40.1-56.2)	84.8 (74.1-95.4)	139 (122-162)	183 (157-195)	837
Age 20-49 years	13-14	33.7 (26.0-43.6)	46.4 (37.2-55.3)	82.1 (68.9-103)	145 (122-179)	187 (177-195)	510
Age 50+ years	13-14	39.8 (34.2-46.3)	50.1 (44.4-58.7)	87.6 (80.6-95.5)	126 (109-152)	168 (131-200)	327
Males	13-14	32.9 (25.3-42.7)	47.5 (36.4-58.1)	88.4 (74.1-106)	139 (123-169)	185 (169-195)	471
Females	13-14	37.1 (30.1-45.8)	46.3 (39.9-54.4)	78.9 (67.8-95.5)	140 (107-162)	181 (140-208)	396

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.29.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Aminonaphthalene in Non-smokers (2013 - 2014)

CAS Number 134-32-7

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2.05 (1.92-2.18)	1.61 (1.47-1.74)	2.99 (2.75-3.22)	6.79 (5.47-7.87)	15.7 (12.2-24.0)	1285
Age 20-49 years	13-14	2.14 (1.94-2.35)	1.72 (1.52-1.90)	3.17 (2.81-3.46)	7.50 (6.26-8.94)	19.0 (12.1-32.6)	647
Age 50+ years	13-14	1.91 (1.72-2.12)	1.49 (1.39-1.66)	2.75 (2.34-3.22)	5.43 (4.25-7.29)	13.9 (6.10-36.2)	638
Males	13-14	2.21 (1.97-2.48)	1.69 (1.52-1.94)	3.29 (2.91-3.84)	7.73 (5.89-12.4)	23.6 (12.4-38.0)	623
Females	13-14	*	1.49 (1.38-1.72)	2.77 (2.44-3.15)	6.26 (4.61-7.54)	14.0 (8.53-22.4)	758

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 1.29.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 1-Aminonaphthalene in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 134-32-7

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	36.6 (29.6-45.4)	45.2 (35.2-56.4)	108 (90.4-125)	197 (158-247)	286 (222-352)	836
Age 20-49 years	13-14	32.1 (25.3-40.8)	37.2 (28.3-47.2)	94.9 (74.4-116)	172 (147-197)	241 (198-310)	509
Age 50+ years	13-14	51.8 (41.3-65.0)	65.0 (53.9-75.7)	140 (104-187)	247 (160-403)	413 (212-544)	327
Males	13-14	29.2 (22.7-37.5)	34.3 (28.3-44.2)	84.9 (66.9-106)	172 (133-200)	223 (189-264)	470
Females	13-14	46.4 (35.1-61.4)	56.9 (40.0-80.3)	126 (90.1-170)	234 (145-352)	345 (197-544)	396

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 1-Aminonaphthalene in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 134-32-7

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	2.47 (2.29-2.66)	2.12 (1.88-2.33)	4.12 (3.64-4.62)	8.54 (7.58-9.93)	18.3 (14.0-21.2)	1285
Age 20-49 years	13-14	2.39 (2.19-2.60)	2.02 (1.79-2.28)	4.12 (3.62-5.02)	8.27 (6.89-11.0)	18.8 (11.2-26.5)	647
Age 50+ years	13-14	2.56 (2.27-2.90)	2.21 (1.94-2.52)	4.14 (3.64-4.57)	8.74 (6.50-12.6)	17.8 (11.8-24.4)	638
Males	13-14	2.17 (1.96-2.39)	1.76 (1.57-1.96)	3.64 (2.94-4.41)	8.08 (6.48-11.7)	18.8 (12.6-26.5)	623
Females	13-14	*	2.40 (2.12-2.76)	4.44 (4.01-5.11)	9.12 (7.72-11.5)	18.3 (12.7-24.4)	758

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2-Aminonaphthalene in Smokers (2013 - 2014)

CAS Number 91-59-8

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	16.4 (14.7-18.3)	16.7 (14.4-18.8)	32.4 (30.0-35.6)	57.2 (46.2-76.7)	83.2 (60.4-114)	857
Age 20-49 years	13-14	16.8 (14.0-20.2)	17.2 (13.4-21.7)	34.0 (30.0-42.6)	60.1 (45.6-82.4)	84.1 (60.4-116)	519
Age 50+ years	13-14	16.0 (14.0-18.3)	16.2 (14.3-18.3)	28.2 (22.8-35.0)	49.2 (35.0-73.9)	74.3 (49.2-114)	338
Males	13-14	16.5 (14.1-19.4)	17.6 (14.6-20.6)	32.4 (30.2-36.2)	60.1 (47.3-76.7)	86.6 (76.4-113)	483
Females	13-14	16.3 (14.2-18.8)	15.5 (13.4-18.3)	31.2 (26.7-42.0)	54.1 (40.5-78.9)	78.9 (53.6-116)	404

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 2.79.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminonaphthalene in Non-smokers (2013 - 2014)

CAS Number 91-59-8

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	4.27 (4.00-4.55)	3.92 (3.51-4.38)	6.76 (6.34-7.61)	10.9 (9.89-12.3)	15.3 (13.2-19.0)	1293
Age 20-49 years	13-14	4.25 (3.90-4.63)	3.82 (3.26-4.46)	6.89 (6.11-7.99)	11.4 (10.4-13.9)	16.2 (14.0-20.8)	654
Age 50+ years	13-14	4.29 (3.94-4.66)	4.03 (3.58-4.45)	6.75 (6.25-7.48)	10.3 (9.29-12.1)	13.6 (11.8-19.0)	639
Males	13-14	4.73 (4.36-5.12)	4.47 (3.95-5.18)	7.97 (6.89-8.45)	13.1 (10.4-15.3)	17.6 (14.0-26.0)	626
Females	13-14	3.92 (3.63-4.23)	3.50 (2.99-4.06)	6.34 (5.62-6.95)	9.89 (8.69-11.1)	14.5 (11.4-17.0)	764

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 2.79.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2-Aminonaphthalene in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 91-59-8

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	17.1 (15.2-19.3)	18.9 (15.9-21.9)	30.7 (26.6-34.9)	48.0 (41.2-57.1)	64.2 (54.3-84.8)	856
Age 20-49 years	13-14	15.9 (13.5-18.6)	16.7 (13.5-21.2)	28.1 (24.2-32.5)	45.8 (40.4-53.0)	60.7 (49.9-77.6)	518
Age 50+ years	13-14	20.8 (18.9-22.8)	22.7 (20.4-26.2)	33.9 (31.0-37.1)	56.8 (37.8-79.4)	79.4 (41.5-116)	338
Males	13-14	14.7 (12.9-16.9)	15.9 (14.0-17.7)	26.5 (22.5-30.5)	47.0 (37.5-54.6)	61.3 (48.7-84.8)	482
Females	13-14	20 (17.7-22.5)	22.6 (18.9-25.1)	32.5 (28.6-38.1)	49.5 (39.3-77.6)	77.6 (46.5-106)	404

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2-Aminonaphthalene in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 91-59-8

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	5.2 (4.96-5.46)	5.15 (4.86-5.44)	7.79 (7.07-8.27)	11.6 (10.9-13.2)	16.5 (14.5-19.4)	1293
Age 20-49 years	13-14	4.78 (4.45-5.14)	4.81 (4.28-5.18)	7.04 (6.36-7.95)	10.6 (9.51-11.5)	14.2 (11.5-16.6)	654
Age 50+ years	13-14	5.83 (5.43-6.27)	5.52 (5.23-5.93)	8.20 (7.65-9.42)	14.1 (11.6-16.4)	19.5 (15.2-23.9)	639
Males	13-14	4.66 (4.34-4.99)	4.47 (4.12-4.93)	6.76 (6.16-7.63)	10.2 (8.27-12.0)	14.7 (10.6-20.4)	626
Females	13-14	5.71 (5.34-6.09)	5.63 (5.18-6.09)	8.96 (7.65-9.64)	12.6 (11.6-15.2)	17.9 (15.5-21.6)	764

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary o-Anisidine in Smokers (2013 - 2014)

CAS Number 90-04-0

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	60.5 (52.0-70.4)	62.0 (54.8-70.1)	114 (88.6-148)	186 (167-223)	257 (228-337)	793
Age 20-49 years	13-14	60.7 (51.5-71.4)	58.0 (50.6-65.5)	112 (89.3-147)	178 (161-225)	233 (188-355)	473
Age 50+ years	13-14	63.5 (53.1-76.1)	68.1 (55.4-75.8)	125 (80.7-152)	201 (155-248)	276 (219-337)	320
Males	13-14	66.6 (54.4-81.5)	64.8 (55.4-74.8)	115 (90.8-159)	191 (171-233)	299 (191-459)	449
Females	13-14	54.5 (46.7-63.6)	55.5 (49.8-66.4)	107 (81.8-139)	162 (139-219)	235 (172-284)	372

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 7.02.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary o-Anisidine in Non-smokers (2013 - 2014)

CAS Number 90-04-0

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	47.2 (44.5-50.0)	46.2 (42.0-49.9)	88.5 (83.2-94.8)	153 (142-174)	213 (187-240)	1209
Age 20-49 years	13-14	42.0 (37.6-46.9)	39.1 (35.3-45.7)	78.7 (68.6-87.1)	141 (123-153)	213 (155-267)	606
Age 50+ years	13-14	53.7 (48.8-59.1)	51.7 (47.9-56.3)	101 (92.0-111)	179 (144-196)	228 (187-358)	603
Males	13-14	54.6 (50.3-59.2)	51.3 (48.0-55.7)	100 (92.3-114)	171 (151-187)	231 (187-309)	583
Females	13-14	41.8 (38.4-45.4)	40.8 (36.9-45.1)	79.9 (68.6-88.4)	137 (122-155)	203 (174-235)	714

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 7.02.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary o-Anisidine in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 90-04-0

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	67.9 (60.8-75.9)	64.9 (54.2-73.6)	122 (96.7-156)	238 (194-317)	360 (292-492)	792
Age 20-49 years	13-14	62.1 (54.4-70.9)	57.5 (47.2-67.1)	107 (80.8-152)	194 (169-225)	317 (215-479)	472
Age 50+ years	13-14	86.6 (73.3-102)	77.6 (65.0-96.7)	160 (120-216)	338 (216-414)	431 (338-608)	320
Males	13-14	62 (52.2-73.6)	55.9 (45.5-68.3)	111 (83.2-152)	197 (160-292)	350 (197-608)	448
Females	13-14	75.2 (66.4-85.1)	69.4 (59.7-81.3)	126 (96.7-169)	285 (215-330)	360 (322-447)	372

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary o-Anisidine in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 90-04-0

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	58 (54.4-61.8)	50.8 (46.8-55.8)	102 (90.2-113)	215 (187-245)	372 (262-454)	1209
Age 20-49 years	13-14	47.7 (41.6-54.6)	40.5 (35.6-46.6)	78.4 (67.5-94.8)	165 (112-222)	290 (179-408)	606
Age 50+ years	13-14	73.7 (67.4-80.5)	64.9 (56.1-73.5)	129 (104-165)	269 (221-342)	448 (271-621)	603
Males	13-14	54.5 (51.3-58.0)	46.9 (41.6-52.0)	94.4 (77.6-103)	179 (149-244)	372 (236-475)	583
Females	13-14	61.1 (54.4-68.6)	51.5 (47.5-60.0)	107 (90.0-131)	226 (201-265)	368 (240-454)	714

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary 2,6-Dimethylaniline in Smokers (2013 - 2014)

CAS Number 87-62-7

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	50.3 (41.8-60.5)	40.0 (34.0-45.3)	81.7 (68.1-99.9)	268 (180-431)	859 (268-5580)	806
Age 20-49 years	13-14	45.8 (38.5-54.6)	37.1 (32.1-44.8)	71.6 (58.1-99.9)	201 (113-340)	431 (254-911)	485
Age 50+ years	13-14	63.8 (44.9-90.5)	43.1 (29.2-67.1)	116 (75.5-184)	453 (138-3250)	1870 (365-20100)	321
Males	13-14	51.2 (41.2-63.8)	40.7 (30.9-50.0)	79.2 (63.7-124)	250 (148-574)	672 (260-7450)	444
Females	13-14	49.4 (41.3-59.0)	38.6 (33.8-42.3)	77.6 (67.1-95.1)	276 (182-396)	859 (185-7920)	392

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 15.7.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2,6-Dimethylaniline in Non-smokers (2013 - 2014)

CAS Number 87-62-7

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	20.8 (17.4-23.4)	44.7 (39.8-50.9)	113 (87.2-165)	369 (217-484)	1239
Age 20-49 years	13-14	*	20.2 (<LOD-23.9)	41.7 (34.0-50.9)	88.2 (70.4-126)	246 (129-332)	619
Age 50+ years	13-14	*	21.3 (18.0-25.2)	50.6 (41.9-57.7)	155 (96.8-369)	590 (245-1700)	620
Males	13-14	30.9 (26.8-35.7)	23.6 (20.5-27.8)	50.6 (42.8-58.9)	114 (78.0-215)	369 (142-742)	595
Females	13-14	*	18.1 (<LOD-21.5)	41.5 (35.6-48.0)	119 (78.8-186)	448 (185-872)	736

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 15.7.

<LOD means less than the limit of detection, which may vary for some chemicals by year and by individual sample.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary 2,6-Dimethylaniline in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 87-62-7

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	53.6 (44.9-64.1)	39.6 (32.8-47.8)	78.3 (63.5-95.8)	253 (144-612)	1170 (321-2700)	805
Age 20-49 years	13-14	44.4 (37.8-52.2)	32.9 (29.2-39.0)	63.4 (54.7-77.3)	147 (107-212)	381 (188-1170)	484
Age 50+ years	13-14	83.5 (60.9-115)	50.9 (47.0-61.6)	113 (83.9-216)	900 (190-1440)	2520 (450-19100)	321
Males	13-14	46.9 (37.0-59.5)	33.0 (28.3-40.6)	64.7 (50.6-105)	212 (116-667)	1170 (190-12300)	443
Females	13-14	60.9 (49.4-75.1)	44.3 (34.6-55.2)	82.0 (65.9-101)	259 (125-900)	1140 (163-4150)	392

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary 2,6-Dimethylaniline in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 87-62-7

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	*	27.0 (24.5-29.2)	50.4 (44.8-57.3)	139 (107-189)	488 (375-670)	1239
Age 20-49 years	13-14	*	24.1 (<LOD-26.6)	39.8 (36.2-44.3)	88.6 (66.4-133)	302 (127-551)	619
Age 50+ years	13-14	*	30.5 (26.4-34.9)	65.2 (57.3-76.0)	250 (136-459)	745 (459-1630)	620
Males	13-14	30.5 (26.9-34.6)	22.8 (20.9-24.6)	41.0 (33.5-57.1)	107 (76.0-286)	439 (125-745)	595
Females	13-14	*	31.7 (<LOD-33.6)	53.2 (49.3-61.6)	180 (121-280)	566 (375-930)	736

<LOD means less than the limit of detection for the urine levels not corrected for creatinine.

* Not calculated: proportion of results below limit of detection was too high to provide a valid result.

[^] Cigarette nonsmokers who used other tobacco products were excluded

Urinary o-Toluidine in Smokers (2013 - 2014)

CAS Number 95-53-4

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the cigarette smoking^ U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	450 (405-501)	432 (391-495)	791 (690-926)	1420 (1160-1700)	2150 (1680-2690)	817
Age 20-49 years	13-14	466 (404-536)	474 (395-527)	830 (719-938)	1460 (1140-1730)	1960 (1420-2690)	487
Age 50+ years	13-14	427 (384-475)	391 (354-429)	714 (584-848)	1280 (1070-1910)	2670 (1680-3520)	330
Males	13-14	476 (414-547)	445 (396-508)	849 (726-954)	1570 (1160-2310)	2450 (1910-3230)	452
Females	13-14	427 (370-493)	395 (335-507)	729 (614-841)	1190 (1070-1510)	1840 (1240-2530)	393

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 111.

^ Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary o-Toluidine in Non-smokers (2013 - 2014)

CAS Number 95-53-4

Geometric mean and selected percentiles of urine concentrations (in pg/mL) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	295 (276-315)	283 (255-313)	556 (507-591)	1010 (933-1090)	1550 (1260-1870)	1261
Age 20-49 years	13-14	294 (266-325)	296 (247-358)	563 (504-641)	1010 (865-1130)	1430 (1090-1670)	628
Age 50+ years	13-14	286 (255-321)	272 (237-308)	540 (473-590)	1010 (753-1310)	1920 (1170-2770)	633
Males	13-14	330 (300-364)	327 (294-362)	604 (551-683)	1130 (895-1540)	1870 (1250-2650)	606
Females	13-14	268 (241-297)	253 (217-297)	519 (449-583)	959 (855-1030)	1360 (1130-1680)	748

Limit of detection (LOD, see Data Analysis section) for Survey year 13-14 is 111.

[^] Cigarette non-smokers who used other tobacco products were excluded

Urinary o-Toluidine in Smokers (creatinine corrected, 2013 - 2014)

CAS Number 95-53-4

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the cigarette smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	480 (436-528)	476 (429-532)	701 (646-788)	1070 (938-1210)	1430 (1220-1820)	816
Age 20-49 years	13-14	445 (394-503)	436 (383-519)	671 (598-775)	966 (830-1080)	1170 (979-1910)	486
Age 50+ years	13-14	573 (520-630)	533 (486-590)	778 (694-909)	1360 (1130-1630)	1840 (1570-3360)	330
Males	13-14	428 (376-486)	396 (365-445)	647 (567-745)	988 (831-1220)	1670 (1160-2530)	451
Females	13-14	537 (498-578)	539 (478-572)	735 (678-807)	1090 (938-1330)	1360 (1140-1580)	393

[^] Cigarette smokers were defined by an affirmative response to the Smoking-Cigarette Use question, 'Have you smoked at least 100 cigarettes in your life?' (SMQ020=1) and confirmation that they smoke either every day (SMQ040=1) or some days (SMQ040=2).

Urinary o-Toluidine in Non-smokers (creatinine corrected, 2013 - 2014)

CAS Number 95-53-4

Geometric mean and selected percentiles of urine concentrations (in ng/g of creatinine) for the non-smoking[^] U.S. population from the National Health and Nutrition Examination Survey.

Demographic Categories	Survey (years)	Geometric mean (95% CI)	50th Percentile (95% CI)	75th Percentile (95% CI)	90th Percentile (95% CI)	95th Percentile (95% CI)	Sample size
Total population	13-14	358 (341-377)	333 (314-357)	526 (493-559)	874 (755-960)	1230 (1050-1500)	1261
Age 20-49 years	13-14	334 (311-359)	314 (290-340)	490 (436-552)	804 (715-916)	1200 (909-1400)	628
Age 50+ years	13-14	384 (349-421)	357 (331-390)	562 (484-646)	897 (730-1190)	1470 (1050-2510)	633
Males	13-14	324 (301-349)	300 (269-331)	505 (432-534)	765 (632-903)	1160 (846-2010)	606
Females	13-14	390 (367-415)	359 (338-390)	557 (509-600)	955 (874-1050)	1340 (1190-1590)	748

[^] Cigarette nonsmokers who used other tobacco products were excluded

Appendices

Appendix A. Procedure to Estimate Percentiles

Includes procedures for percentiles whose estimate falls on a value that is repeated multiple times in the dataset

A common practice to calculate confidence intervals from survey data is to use large-sample normal approximations. Ninety-five percent confidence intervals on point estimates of percentiles are often computed by adding and subtracting from the point estimate a quantity equal to twice its standard error. This normal approximation method may not be adequate, however, when estimating the proportion of subjects above or below a selected value, especially when the proportion is near 0.0 or 1.0 or when the effective sample size is small. In addition, confidence intervals on proportions deviating from 0.5 are not theoretically expected to be symmetric around the point estimate. Further, adding and subtracting a multiple of the standard error to an estimate near 0.0 or 1.0 can lead to impossible confidence limits (i.e., proportion estimates below 0.0 or above 1.0). The approach used for the *Report* data tables (and for previous *Reports*) produces asymmetric confidence intervals consistent with skewed (non-normal) biologic data distributions.

The method we use to estimate percentiles and their confidence limits for the *Report* data tables and for previous reports is adapted from a method proposed by Woodruff (1952) for percentile estimation and a method described by Korn and Graubard (1998) for estimating confidence intervals for proportions. This method involves first obtaining an empirical point estimate of the desired percentile by creating a rank ordered listing of the sampled observations along with their sampling weights. From this listing and the sampling weights, it is possible to determine an empirical percentile estimate for the target population. After this point estimate of the percentile has been obtained, the fraction of results below the estimate is calculated. The fraction below the point estimate should be very close to the proportion corresponding to the desired percentile, but can deviate from this proportion depending on the frequency of non-unique sampled observations in the vicinity of the empirical percentile estimate and depending on the sampling weight associated with the sampled observation.

For example, when measuring some compounds as part of NHANES there may be multiple results below a common limit of detection (LOD) or multiple results with identical measured values due to the reporting limitations of the instrument. This phenomenon coupled with the sampling weight assigned to each measured result can lead to difficulties in accurately estimating some percentiles and their corresponding confidence limits because an exact percentile may fall within a large group of results with identical measured values. We circumvented this potential problem for the *Report* data tables by adding a unique, negligibly small number to each measured result. This small number was later subtracted from the percentile estimate without affecting the percentile estimate and without altering any of the original measured results.

By adding a unique, negligibly small number to each sampled observation, it was possible to associate a single sampled observation with the percentile estimate and thus to minimize the difference between the fraction below the point estimate and the proportion corresponding to the desired percentile. However, due to sample weighting, it is still possible to obtain a different point estimate (which will only differ by the difference between numerically adjacent analyte values) depending on how the data are sorted before adding the unique number to each result. We circumvented this potential problem by replacing actual sample weights with an average sample weight where the average is computed across subjects in the same

demographic domain who have identical measured results. We computed standard error estimates in a separate step using the original (unaltered) data. Clopper-Pearson 95% confidence intervals around the estimated proportion are obtained using the method described by Korn and Graubard (1998).

We describe below how SAS Proc Univariate and SUDAAN can be used to carry out this method of percentile and confidence interval estimation. SAS code for calculating these confidence intervals can be downloaded from <https://www.cdc.gov/exposurereport/>. In the narrative that follows, the term 'demographic domain' refers to a demographic group of interest, for example non-Hispanic blacks. The term 'set of subsample weights' refers to the sampling weights that correspond to the variable for which percentiles will be estimated, for example the set of subsample weights associated with total blood mercury measurements. The term 'analyte' refers to the biological or chemical compound measured in a group of subjects and for which percentiles are to be estimated.

Procedure to calculate percentile estimates and their confidence intervals

Step 1: Obtain a percentile estimate using the original (unaltered data):

Create a separate file with original data (ORIG_DATA). Use SAS (SAS Institute Inc. 1999) Proc Univariate (with default percentile definition equivalent to option PCTLDEF = 5 and with the Freq option variable equal to the original subsample sampling weight) to obtain a point estimate of the percentile (PTLE_ORIG) of an analyte's original results for the demographic domain of interest, for example, the 95th percentile of total blood mercury results for adults aged 20+ years.

Step 2: Obtain a percentile estimate using the altered data:

Create a separate file for use with altered data (ALTR_DATA). Sort the data by analyte measured value separately for each demographic domain and set of subsample weights. Use SAS Proc Means to compute the average sampling weight (WT_{AVE}) for each unique measured result. For each unique measured result, use a counter from 1 to the total number of subjects with identical values to create a unique integer to associate with each measured observation. Each of these numbers should then be divided by 1,000,000,000 and added to the corresponding measured observation. This will result in each measured observation having an additional fractional amount beyond the fourth decimal as long as there are less than 10,000 subjects with the same measured result. Use SAS Proc Univariate (again with default percentile definition equivalent to option PCTLDEF = 5 but now with the Freq option variable equal to WT_{AVE}) to obtain a point estimate of the percentile (PTLE_ALTR) of an analyte's altered results for the demographic domain of interest.

Step 3: Sort the data in the ORIG_DATA file by the stratum (sdmvstra) and primary sampling unit (sdmvpsu) variables. Use SUDAAN (SUDAAN User's Manual, 2001) Proc Descript with Taylor Linearization DESIGN = WR (i.e., sampling with replacement), with proper NEST statement, and with the original subsample sampling weight variable to estimate the proportion (P_ORIG) of subjects with results below the percentile estimate (PTLE_ORIG) obtained in Step 1 and discard P_ORIG but retain the standard error (SEMEAN_ORIG) associated with PTLE_ORIG.

Step 4: Sort the data in the ALTR_DATA file by the stratum (sdmvstra) and primary sampling unit (sdmvpsu) variables. Use SUDAAN (SUDAAN User's Manual, 2001) Proc Descript with Taylor Linearization DESIGN = WR (i.e., sampling with replacement), with proper NEST statement, and with the average sampling weight variable (WT_{AVE}) to estimate the proportion (P_ALTR) of

subjects with results below the percentile estimate (PTLE_ALTR) obtained in Step 2 and keep P_ALTR but discard the standard error (SEMEAN_ALTR) associated with PTLE_ALTR. Compute the degrees-of-freedom adjusted effective sample size:

$$(1) \quad n_{df} = ((t_{num}/t_{denom})^2)P_ALTR(1 - P_ALTR)/(SEMEAN_ORIG^2)$$

where t_{num} and t_{denom} are 0.975 critical values of the Student's t distribution with degrees of freedom equal to the actual sample size minus 1 and the number of primary sampling units (PSUs) minus the number of strata, respectively. Note: the degrees of freedom for t_{denom} can vary with the demographic domain of interest (e.g., males).

Step 5: After obtaining an estimate of P_ALTR (i.e., the proportion obtained in Step 4), compute the Clopper-Pearson 95% confidence interval ($P_L(x, n_{df})$, $P_U(x, n_{df})$) as follows:

$$(2) \quad P_L(x, n_{df}) = v_1 F_{v_1, v_2} (0.025) / (v_2 + v_1 F_{v_1, v_2} (0.025))$$

&

$$P_U(x, n_{df}) = v_3 F_{v_3, v_4} (0.975) / (v_4 + v_3 F_{v_3, v_4} (0.975))$$

where x is equal to P_ALTR times n_{df} , $v_1 = 2x$, $v_2 = 2(n_{df} - x + 1)$, $v_3 = 2(x + 1)$, $v_4 = 2(n_{df} - x)$, and $F_{d_1, d_2}(\beta)$ is the β quantile of an F distribution with d_1 and d_2 degrees of freedom. (Note: If n_{df} is greater than the actual sample size or if P_ALTR is equal to zero, then the actual sample size should be used in place of n_{df} .) This step will produce a lower and an upper limit for the estimated proportion obtained in Step 4.

Step 6: Use SAS Proc Univariate (again with default percentile definition equivalent to option PCTLDEF = 5 and with the Freq option variable equal to WT_{AVE}) to determine the analyte values that correspond to the desired percentile (proportion) and to the lower and upper proportion limits obtained in Step 5. Round these results to 2 or 3 decimals depending on the significant figures associated with the original measured values.

Example:

To estimate the 95th percentile of total blood mercury in adults 20+ years of age in the 2013-2014 survey, create two separate files: name one ORIG_DATA and the other ALTR_DATA. For the ORIG_DATA file use SAS Proc Univariate with the Freq option and the subsample sampling weight (or in this case the full sample sampling weight because total blood mercury is the analyte of interest) to get a weighted point estimate of the analyte value that corresponds to the 95th percentile (PTLE_ORIG). For this example, the value is 4.88 $\mu\text{g/L}$.

Sort the results in the ALTR_DATA file by analyte measured value. Use SAS Proc Means to compute the average sampling weight (WT_{AVE}) for each unique analyte measured value. For each unique measured result, use a counter from 1 to the total number of subjects with identical values to create a unique integer to associate with each measured observation. Divide each counter value by 1,000,000,000 and add this amount to the corresponding measured observation. For this altered data file (ALTR_DATA) use SAS Proc Univariate with the Freq option and WT_{AVE} to get a weighted point estimate of the analyte value that corresponds to the 95th percentile (PTLE_ALTR). For this example, the value is also 4.88 $\mu\text{g/L}$.

For the ORIG_DATA file use SUDAAN to estimate the weighted proportion (P_ORIG) of subjects with results below the value of PTLE_ORIG (which can differ from 0.95 depending on the number of results with identical values; for this example the proportion is 0.9491) and the

standard error (SEMEAN_ORIG) associated with P_ORIG (for this example SEMEAN_ORIG = 0.0044).

For the ALTR_DATA file use SUDAAN to estimate the weighted proportion of subjects (P_ALTR) with results below the value of PTLE_ALTR (which should also be very close to 0.95 regardless of the number of original results with identical values; for this example the proportion is also 0.9491). Then obtain a confidence interval on P_ALTR by computing the weighted Clopper-Pearson 95% confidence limits (equation 2 above) using the degrees-of-freedom adjusted effective sample size as described in equation 1 above. For this example, the effective sample size is 2113.64 resulting in lower and upper confidence limits of 0.93885 and 0.95808, respectively. Then use SAS Proc Univariate (with the Freq option variable equal to WT_{AVE}) to determine the analyte values corresponding to the weighted 93.9th and 95.8th percentiles. These point estimates are the lower and upper confidence limits on the 95th percentile estimate. Round the 95th percentile estimate and its confidence limits to 2 or 3 decimals depending on the significant figures associated with the original measured values. For this example, the rounded point estimate is 4.88 µg/L with lower and upper confidence limits of 4.36 and 5.21 µg/L, respectively.

Appendix C. Limit of Detection Table

Volume Four: Analysis of Chemicals Found in Cigarette Smoke in a Special Sample of U.S. Adults, NHANES 2011-2016

The analytical limit of detection (LOD) for each of the different chemical measurements is presented in the table below. The LOD is the concentration at which the measurement has a 95% probability of being greater than zero (Taylor, 1987). As analytical methods improve, LODs will often change. For this reason, LOD values are reported by survey periods (e.g., 1999-2000, 2001-2002, etc.).

Adducts of Hemoglobin

Chemical, in packed red blood cells, pmol/g hemoglobin	2011-2012	2013-2014	2015-2016
Acrylamide	--	0.110	0.110
Formaldehyde	--	0.670	--
Glycidamide	--	0.660	0.660

Tobacco Alkaloids and Metabolites

Chemical, in urine, ng/mL	2011-2012	2013-2014	2015-2016
Anabasine, Total	--	0.510	0.510
Anatabine, Total	--	0.390	0.390
Cotinine, Total	--	0.030	0.030
Cotinine-N-Oxide, Total	--	2.02	2.02
trans-3'-Hydroxycotinine, Total	--	0.030	0.030
1-(3-Pyridyl)-1-butanol-4-carboxylic acid	--	--	1.38
Nicotine, Total	--	10.5	10.5
Nicotine-N'-Oxide, Total	--	2.50	2.50
Nornicotine, Total	--	2.50	2.50

Volatile N-Nitrosamines (VNAs)

Chemical, in urine, ng/L	2011-2012	2013-2014	2015-2016
N-Nitrosodiethylamine (NDEA)	--	5.02	--
N-Nitrosoethylmethylamine (NMEA)	--	3.64	--
N-Nitrosomorpholine (NMOR)	--	7.84	--
N-Nitrosopiperidine (NPPI)	--	5.08	--
N-Nitrosopyrrolidine (NPYR)	--	8.15	--

Metals and Metalloids

Chemical, in urine, units	2011-2012	2013-2014	2015-2016
Antimony, µg/L	0.041	0.022	0.022
Arsenic, Total, µg/L	1.25	0.260	0.260
Arsenic (V) Acid, µg As/L	0.870	0.790	0.790
Arsenobetaine, µg As/L	1.19	1.16	1.16
Arsenocholine, µg As/L	0.280	0.110	0.110
Arsenous (III) Acid, µg As/L	0.480	0.120	0.120

Chemical, in urine, units	2011-2012	2013-2014	2015-2016
Dimethylarsinic Acid, µg As/L	1.80	1.91	1.91
Monomethylarsonic Acid, µg As/L	0.890	0.200	0.200
Trimethylarsine oxide, µg As/L	0.250	--	--
Barium, µg/L	0.100	0.060	0.060
Cadmium, µg/L	0.056	0.036	0.036
Cesium, µg/L	0.120	0.086	0.086
Cobalt, µg/L	0.048	0.023	0.023
Lead, µg/L	0.080	0.030	0.030
Manganese, µg/L	0.080	0.130	0.130
Molybdenum, µg/L	0.990	0.800	0.800
Strontium, µg/L	2.50	2.34	2.34
Thallium, µg/L	0.020	0.018	0.018
Tin, µg/L	0.220	0.090	0.090
Tungsten, µg/L	0.026	0.018	0.018
Uranium, µg/L	0.003	0.002	0.002

Perchlorate and Other Anions

Chemical, in urine, units	2011-2012	2013-2014	2015-2016
Nitrate, mg/L	0.700	0.700	0.700
Perchlorate, µg/L	0.050	0.050	0.050
Thiocyanate, mg/L	0.020	0.020	0.020

Polycyclic Aromatic Hydrocarbon Metabolites

Chemical, in urine, units	2011-2012	2013-2014	2015-2016
2-Hydroxyfluorene, ng/L	10.0	--	--
3-Hydroxyfluorene, ng/L	10.0	--	--
9-Hydroxyfluorene, ng/L	10.0	--	--
1-Hydroxyphenanthrene, ng/L	10.0	--	--
2-Hydroxyphenanthrene, ng/L	10.0	--	--
3-Hydroxyphenanthrene, ng/L	10.0	--	--
4-Hydroxyphenanthrene, ng/L	10.0	--	--
1-Hydroxypyrene, ng/L	10.0	--	--
1-Hydroxynaphthalene (1-Naphthol), µg/L	0.044	--	--
2-Hydroxynaphthalene (2-Naphthol), µg/L	0.042	--	--

Heterocyclic Amines

Chemical, in urine, ng/L	2011-2012	2013-2014	2015-2016
3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole (Trp-P-1)	--	0.790	--
2-Amino-3-methyl-9H-pyrido[2,3-b]indole (MeA-α-C)	--	0.330	--
2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (Ph1P)	--	0.340	--
2-Amino-9H-pyrido[2,3-b]indole (A-α-C)	--	0.620	--
2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)	--	0.370	--
2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P1)	--	0.310	--
2-Aminodipyrido[1,2-a:3',2'-d]imidazole (GLU-P2)	--	0.830	--
1-Methyl-9H-pyrido[3,4-b]indole (Harman)	--	4.590	--
1-Methyl-3-amino-5H-pyrido[4,3-b]indole (Trp-P-2)	--	0.630	--

Chemical, in urine, ng/L	2011-2012	2013-2014	2015-2016
9H-pyrido[3,4-b]indole (Norharman)	--	12.600	--

Volatile Organic Compounds (VOCs)

Chemical, in whole blood, ng/mL except as noted	2011-2012	2013-2014	2015-2016
1,1,1-Trichloroethane (Methyl chloroform)	--	0.010	0.010
1,1,1,2-Tetrachloroethane	--	0.040	0.040
1,2,3-Trichloropropane	--	0.040	0.040
1,2-Dibromoethane	--	0.015	0.015
1,2-Dichlorobenzene (o-Dichlorobenzene)	--	0.025	0.025
1,2-Dichloroethane (Ethylene dichloride)	--	0.010	0.010
1,3-Dichlorobenzene (m-Dichlorobenzene)	--	0.025	0.025
1,4-Dichlorobenzene (Paradichlorobenzene)	--	0.040	0.040
1,4-Dioxane	--	0.500	0.500
2,5-Dimethylfuran	--	0.011	0.011
Benzene	--	0.024	0.024
Benzonitrile	--	--	0.150
Bromodichloromethane	--	6.00	6.00
Chlorobenzene (Monochlorobenzene)	--	0.011	0.011
Chloroethane	--	0.045	0.045
Cyclohexane	--	0.020	0.020
Dibromochloromethane	--	5.00	5.00
Dichloromethane (Methylene chloride)	--	0.250	0.250
Diethyl ether	--	0.040	0.040
Ethyl acetate	--	0.158	0.158
Ethylbenzene	--	0.024	0.024
Furan	--	0.025	0.025
Heptane	--	0.100	0.100
Hexane	--	0.122	0.122
Isobutyronitrile	--	--	0.040
Isopropylbenzene (Cumene)	--	0.040	0.040
Methyl-tert-butyl ether (MTBE), pg/mL	--	10.0	10.0
Methylcyclopentane	--	0.020	0.020
Nitrobenzene	--	0.320	0.320
Octane	--	0.100	0.100
Tetrachloroethene (Perchloroethylene)	--	0.048	0.048
Tetrachloromethane (Carbon tetrachloride)	--	0.005	0.005
Tetrahydrofuran	--	0.125	0.125
Toluene	--	0.025	0.025
Tribromomethane (Bromoform)	--	8.00	8.00
Trichloroethene (Trichloroethylene)	--	0.012	0.012
Trichloromethane (Chloroform)	--	8.00	8.00
ααα-Trifluorotoluene	--	0.040	0.040
Vinyl Bromide	--	0.045	0.045
m-/p-Xylene	--	0.034	0.034
o-Xylene	--	0.024	0.024

Volatile Organic Compound (VOC) Metabolites

Chemical, in urine, µg/L	2011-2012	2013-2014	2015-2016
N-Acetyl-S-(2-carboxyethyl)-L-cysteine	6.96	6.96	6.96
N-Acetyl-S-(3-hydroxypropyl)-L-cysteine	13.0	13.0	13.0
N-Acetyl-S-(2-carbamoylethyl)-L-cysteine	2.20	2.20	2.20
N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine	9.40	9.40	9.40
N-Acetyl-S-(2-cyanoethyl)-L-cysteine	0.500	0.500	0.500
N-Acetyl-S-(2-hydroxyethyl)-L-cysteine	0.791	0.791	0.791
N-Acetyl-S-(phenyl)-L-cysteine	0.600	0.600	0.600
N-Acetyl-S-(n-propyl)-L-cysteine	1.20	1.20	1.20
N-Acetyl-S-(3,4-dihydroxybutyl)-L-cysteine	5.25	5.25	5.25
N-Acetyl-S-(1-hydroxymethyl-2-propenyl)-L-cysteine	0.700	0.700	0.700
N-Acetyl-S-(2-hydroxy-3-butenyl)-L-cysteine	0.700	0.700	0.700
N-Acetyl-S-(4-hydroxy-2-butenyl)-L-cysteine	0.600	0.600	0.600
2-Thioxothiazolidine-4 carboxylic acid	11.2	11.2	--
N-Acetyl-S-(3-hydroxypropyl-1-methyl)-L-cysteine	2.00	3.00	3.00
2-Aminothiazoline-4-carboxylic acid	15.0	15.0	15.0
N-Acetyl-S-(N-methylcarbamoyl)-L-cysteine	6.26	6.26	6.26
Phenylglyoxylic acid	12.0	12.0	12.0
N-Acetyl-S-(2-hydroxypropyl)-L-cysteine	5.30	5.30	5.30
N-Acetyl-S-(phenyl-2-hydroxyethyl)-L-cysteine	0.700	0.700	0.700
Mandelic acid	12.0	12.0	12.0
N-Acetyl-S-(trichlorovinyl)-L-cysteine	3.00	3.00	3.00
N-Acetyl-S-(benzyl)-L-cysteine	0.500	0.500	0.500
N-Acetyl-S-(1,2-dichlorovinyl)-L-cysteine	12.6	12.6	12.6
N-Acetyl-S-(2,2-dichlorovinyl)-L-cysteine	6.50	4.70	13.9
N-Acetyl-S-(dimethylphenyl)-L-cysteine	0.500	0.500	0.500
2-Methylhippuric acid	5.00	5.00	5.00
3- & 4-Methylhippuric acid	8.00	8.00	8.00
N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine	--	--	2.60
N-Acetyl-S-(2-hydroxy-3-methyl-3-buten-1-yl)-L-cysteine + N-Acetyl-S-[1-(hydroxymethyl)-2-methyl-2-propen-1-yl]-L-cysteine	--	--	1.43
N-Acetyl-S-(4-hydroxy-2-methyl-2-buten-1-yl)-L-cysteine	--	--	1.20

Aldehydes

Chemical, in urine, µg/L	2011-2012	2013-2014	2015-2016
Benzaldehyde	--	0.461	--
Butyraldehyde	--	0.313	--
Crotonaldehyde	--	0.147	--
Decanaldehyde	--	3.90	--
Heptanaldehyde	--	0.312	--
Hexanaldehyde	--	0.693	--
Nonanaldehyde	--	2.63	--
Octanaldehyde	--	0.660	--
Pentanaldehyde	--	0.316	--
Propanaldehyde	--	1.16	--
Isopentanaldehyde	--	0.119	--
o-Tolualdehyde	--	0.142	--

Aromatic Amines

Chemical, in urine, pg/mL	2011-2012	2013-2014	2015-2016
4-Aminobiphenyl	--	1.75	--
1-Aminonaphthalene	--	1.29	--
2-Aminonaphthalene	--	2.79	--
o-Anisidine	--	7.02	--
2,6-Dimethylaniline	--	15.7	--
o-Toluidine	--	111	--

Appendix D. References for Biomonitoring Analytical Methods

Adducts of Hemoglobin

Zhang Y, Wang Q, Zhang G, Jia W, Ren Y, Wu Y. Biomarker analysis of hemoglobin adducts of acrylamide and glycidamide enantiomers for mid-term internal exposure assessment by isotope dilution ultra-high-performance liquid chromatography tandem mass spectrometry. *Talanta*. 2018;178:825-33.

Duke TJ, Ruestow PS, Marsh GM. The influence of demographic, physical, behavioral, and dietary factors on hemoglobin adduct levels of acrylamide and glycidamide in the general U.S. population. *Crit Rev Food Sci Nutr*. 2018;58:700-10. doi: 10.1080/10408398.2016.1215289. Epub 2017 Sep 28.

Guo J, Yu D, Lv N, Bai R, Xu C, Chen G, et al. Relationships between acrylamide and glycidamide hemoglobin adduct levels and allergy-related outcomes in general US population, NHANES 2005-2006. *Environ Pollut*. 2017;225:506-13. doi: 10.1016/j.envpol.2017.03.016. Epub 2017 Mar 18.

Hielscher J, Monien BH, Abraham K, Jessel S, Seidel A, Lampen A. An isotope-dilution UPLC-MS/MS technique for the human biomonitoring of the internal exposure to glycidol via a valine adduct at the N-terminus of hemoglobin. *J Chromatogr B Analyt Technol Biomed Life Sci*. 2017;1059:7-13.

Yang M, Frame T, Tse C, Vesper HW. High-throughput, simultaneous quantitation of hemoglobin adducts of acrylamide, glycidamide, and ethylene oxide using UHPLC-MS/MS. *J Chromatogr B Analyt Technol Biomed Life Sci*. 2018 Jun 1;1086:197-205. doi: 10.1016/j.jchromb.2018.03.048. Epub 2018 Apr 3.

Guo J, Yu D, Lv N, Bai R, Xu C, Chen G, et al. Relationships between acrylamide and glycidamide hemoglobin adduct levels and allergy-related outcomes in general US population, NHANES 2005-2006. *Environ Pollut*. 2017 Jun;225:506-513. doi: 10.1016/j.envpol.2017.03.016. Epub 2017 Mar 18.

Chu PL, Lin LY, Chen PC, Su TC, Lin CY. Negative association between acrylamide exposure and body composition in adults: NHANES, 2003-2004. *Nutr Diabetes*. 2017 Mar 13;7(3):e246. doi: 10.1038/nutd.2016.48.

Obón-Santacana M, Lujan-Barroso L, Freisling H, Cadeau C, Fagherazzi G, Boutron-Ruault MC, et al. Dietary and lifestyle determinants of acrylamide and glycidamide hemoglobin adducts in non-smoking postmenopausal women from the EPIC cohort. *Eur J Nutr*. 2017 Apr;56(3):1157-1168. doi: 10.1007/s00394-016-1165-5. Epub 2016 Feb 5.

Obón-Santacana M, Freisling H, Peeters PH, Lujan-Barroso L, Ferrari P, Boutron-Ruault MC, et al. Acrylamide and glycidamide hemoglobin adduct levels and endometrial cancer risk: A nested case-control study in nonsmoking postmenopausal women from the EPIC cohort. *Int J Cancer*. 2016 Mar 1;138(5):1129-38. doi: 10.1002/ijc.29853. Epub 2015 Oct 1.

Obón-Santacana M, Lujan-Barroso L, Travis RC, Freisling H, Ferrari P, Severi G, et al. Acrylamide and Glycidamide Hemoglobin Adducts and Epithelial Ovarian Cancer: A Nested Case-Control Study in Nonsmoking Postmenopausal Women from the EPIC

Cohort. *Cancer Epidemiol Biomarkers Prev.* 2016 Jan;25(1):127-34. doi: 10.1158/1055-9965.EPI-15-0822. Epub 2015 Nov 23.

Xie J, Terry KL, Poole EM, Wilson KM, Rosner BA, Willett WC, et al. Acrylamide hemoglobin adduct levels and ovarian cancer risk: a nested case-control study. *Cancer Epidemiol Biomarkers Prev.* 2013 Apr;22(4):653-60. doi: 10.1158/1055-9965.EPI-12-1387. Epub 2013 Feb 15.

Vesper HW, Sternberg MR, Frame T, Pfeiffer CM. Among 10 sociodemographic and lifestyle variables, smoking is strongly associated with biomarkers of acrylamide exposure in a representative sample of the U.S. Population. *J Nutr.* 2013 Jun;143(6):995S-1000S. doi: 10.3945/jn.112.173013. Epub 2013 Apr 17.

Moorman WJ, Reutman SS, Shaw PB, Blade LM, Marlow D, Vesper H, et al. Occupational exposure to acrylamide in closed system production plants: air levels and biomonitoring. *J Toxicol Environ Health A.* 2012;75(2):100-11. doi: 10.1080/15287394.2011.615109.

Vesper HW, Caudill SP, Osterloh JD, Meyers T, Scott D, Myers GL. Exposure of the U.S. population to acrylamide in the National Health and Nutrition Examination Survey 2003-2004. *Environ Health Perspect.* 2010 Feb;118(2):278-83. doi: 10.1289/ehp.0901021.

Tran NL, Barraj LM, Murphy MM, Bi X. Dietary acrylamide exposure and hemoglobin adducts--National Health and Nutrition Examination Survey (2003-04). *Food and chemical toxicology: an international journal published for the British Industrial Biological Research Association.* 2010;48:3098-108. doi: 10.1016/j.fct.2010.08.003. Epub 2010 Aug 7.

von Stedingk H, Vikstrom AC, Rydberg P, Pedersen M, Nielsen JK, Segerback D, et al. Analysis of hemoglobin adducts from acrylamide, glycidamide, and ethylene oxide in paired mother/cord blood samples from Denmark. *Chem Res Toxicol.* 2011;24:1957-65.

von Stedingk H, Rydberg P, Tornqvist M. A new modified Edman procedure for analysis of N-terminal valine adducts in hemoglobin by LC-MS/MS. *J Chromatogr B Analyt Technol Biomed Life Sci.* 2010;878:2483-90.

Schettgen T, Muller J, Fromme H, Angerer J. Simultaneous quantification of haemoglobin adducts of ethylene oxide, propylene oxide, acrylonitrile, acrylamide and glycidamide in human blood by isotope-dilution GC/NCI-MS/MS. *J Chromatogr B Analyt Technol Biomed Life Sci.* 2010;878:2467-73.

Wilson KM, Vesper HW, Tocco P, Sampson L, Rosén J, Hellenäs KE, et al. Validation of a food frequency questionnaire measurement of dietary acrylamide intake using hemoglobin adducts of acrylamide and glycidamide. *Cancer Causes Control.* 2009 Apr;20(3):269-78. doi: 10.1007/s10552-008-9241-7. Epub 2008 Oct 15.

Vesper HW, Slimani N, Hallmans G, Tjønneland A, Agudo A, Benetou V, et al. Cross-sectional study on acrylamide hemoglobin adducts in subpopulations from the European Prospective Investigation into Cancer and Nutrition (EPIC) Study. *J Agric Food Chem.* 2008 Aug 13;56(15):6046-53. doi: 10.1021/jf703750t. Epub 2008 Jul 15.

Vesper HW, Slimani N, Hallmans G, Tjønneland A, Agudo A, Benetou V, et al. Cross-sectional study on acrylamide hemoglobin adducts in subpopulations from the European Prospective Investigation into Cancer and Nutrition (EPIC) study. *J Agric Food Chem* 2008; 56 (15):6046–53.

Vesper HW, Bernert JT, Ospina M, Meyers T, Ingham L, Smith A, et al. Assessment of the relation between biomarkers for smoking and biomarkers for acrylamide exposure in humans. *Cancer Epidemiol Biomarkers Prev* 2007;16(11):2471-8.

Vesper HW, Bernert JT, Ospina M, Meyers T, Ingham L, Smith A, et al. *Cancer Epidemiol Biomarkers Prev*. 2007 Nov;16(11):2471-8. Assessment of the relation between biomarkers for smoking and biomarkers for acrylamide exposure in humans.

Vesper HW, Ospina M, Meyers T, Ingham L, Smith A, Gray JG, et al. Automated method for measuring globin adducts of acrylamide and glycidamide at optimized Edman reaction conditions. *Rapid Commun Mass Spectrom*. 2006;20(6):959-64.

Ahn HS, Shin HS. Determination of ethylene oxide-hemoglobin adduct by silylation and gas chromatography-electron impact-mass spectrometry. *J Chromatogr B Analyt Technol Biomed Life Sci*. 2006;843:202-8.

Ospina M, Vesper HW, Licea-Perez H, Meyers T, Mi L, Myers G. LC/MS/MS method for the analysis of acrylamide and glycidamide hemoglobin adducts. *Adv Exp Med Biol*. 2005;561:97-107.

Vesper HW, Licea-Perez H, Meyers T, Ospina M, Myers GL. Pilot study on the impact of potato chips consumption on biomarkers of acrylamide exposure. *Adv Exp Med Biol*. 2005;561:89-96.

Ball L, Jones A, Boogaard P, Will W, Aston P. Development of a competitive immunoassay for the determination of N-(2-hydroxyethyl)valine adducts in human haemoglobin and its application in biological monitoring. *Biomarkers*. 2004;9:407-17.

Schettgen T, Broding HC, Angerer J, Drexler H. Hemoglobin adducts of ethylene oxide, propylene oxide, acrylonitrile and acrylamide-biomarkers in occupational and environmental medicine. *Toxicol Lett*. 2002;134:65-70.

Boogaard PJ. Use of haemoglobin adducts in exposure monitoring and risk assessment. *J Chromatogr B Analyt Technol Biomed Life Sci*. 2002;778:309-22.

Thier R, Lewalter J, Kempkes M, Selinski S, Bruning T, Bolt HM. Haemoglobin adducts of acrylonitrile and ethylene oxide in acrylonitrile workers, dependent on polymorphisms of the glutathione transferases GSTT1 and GSTM1. *Arch Toxicol*. 1999;73:197-202.

Boogaard PJ, Rocchi PS, van Sittert NJ. Biomonitoring of exposure to ethylene oxide and propylene oxide by determination of hemoglobin adducts: correlations between airborne exposure and adduct levels. *Int Arch Occup Environ Health*. 1999;72:142-50.

Bono R, Vincenti M, Meineri V, Pignata C, Saglia U, Giachino O, et al. Formation of N-(2-hydroxyethyl)valine due to exposure to ethylene oxide via tobacco smoke: A risk factor for onset of cancer. *Environ Res*. 1999;81:62-71.

Bergmark E. Hemoglobin adducts of acrylamide and acrylonitrile in laboratory workers, smokers and nonsmokers. *Chem Res Toxicol*. 1997;10:78-84.

Tavares R, Borba H, Monteiro M, Proenca MJ, Lynce N, Rueff J, et al. Monitoring of exposure to acrylonitrile by determination of N-(2-cyanoethyl)valine at the N-terminal position of haemoglobin. *Carcinogenesis*. 1996;17:2655-60.

Lawrence RM, Sweetman GM, Tavares R, Farmer PB. Synthesis and characterization of peptide adducts for use in monitoring human exposure to acrylonitrile and ethylene oxide. *Teratog Carcinog Mutagen*. 1996;16:139-48.

Tobacco Smoke

Cotinine

Bernert JT, McGuffey JE, Morrison MA, Pirkle JL. Comparison of serum and salivary cotinine measurements by a sensitive high-performance liquid chromatography/tandem mass spectrometry method as an indicator of exposure to tobacco smoke among smokers and nonsmokers. *J Anal Toxicol* 2000;24:333-9.

Bernert JT, Turner WE, Pirkle JL, Sosnoff CS, Akins JR, Waldrep MK, et al. Development and validation of sensitive method for determination of serum cotinine in smokers and nonsmokers by liquid chromatography/atmospheric pressure ionization tandem mass spectrometry. *Clin Chem* 1997;43:2281-91.

NNAL

Xia B, Xia Y, Wong J, et al. Quantitative analysis of five tobacco-specific N-nitrosamines in urine by liquid chromatography-atmospheric pressure ionization tandem mass spectrometry. *Biomed Chromatogr*. 2014;28(3):375-384.

Xia Y, Bernert JT. Stability of the tobacco-specific nitrosamine 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL) in urine samples stored at various temperatures. *J Anal Toxicol* 2010;34:411-5.

Xia Y, McGuffey JE, Bhattacharyya S, Sellergren B, Yilmaz E, Wang L, et al. Analysis of the tobacco-specific nitrosamine 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol in urine by extraction on a molecularly imprinted polymer column and liquid chromatography/atmospheric pressure ionization tandem mass spectrometry. *Anal Chem*. 2005;77(23):7639-45.

Personal Care and Consumer Product Chemicals and Metabolites

Zhou X, Kramer JP, Calafat AM, Ye X. Automated on-line column-switching high-performance liquid chromatography isotope dilution tandem mass spectrometry method for the quantification of bisphenol A, bisphenol F, bisphenol S, and 11 other phenols in urine. *J Chromatogr B Analyt Technol Biomed Life Sci*. 2014 Jan 1;944:152-6.

Dwivedi P, Zhou X, Powell TG, Calafat AM, Ye X. Impact of enzymatic hydrolysis on the quantification of total urinary concentrations of chemical biomarkers. *Chemosphere*. 2018 May;199:256-262.

Ye X, Kuklennyik Z, Bishop AM, Needham LL, Calafat AM. Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography isotope dilution tandem mass spectrometry. *J Chromatogr B* 2006;844:53-9.

Ye X, Kuklennyik Z, Needham LL, Calafat AM. Automated on-line column switching HPLCMS/MS method with peak focusing for the determination of nine environmental phenols in urine. *Anal Chem* 2005;77:5407-13.

Urinary Flame Retardants

Jayatilaka NK, Restrepo P, Williams L, Ospina M, Valentin-Blasini L, Calafat AM. Quantification of three chlorinated dialkyl phosphates, diphenyl phosphate, 2,3,4,5-tetrabromobenzoic acid, and four other organophosphates in human urine by solid phase extraction-high performance liquid chromatography-tandem mass spectrometry. *Anal Bioanal Chem.* (2017) 409:1323–1332. (For NHANES 2013-14)

Jayatilaka NK, Restrepo P, Davis Z, Vidal M, Calafat AM, Ospina M. “Quantification of 16 urinary biomarkers of exposure to flame retardants, plasticizers, and organophosphate insecticides for biomonitoring studies” *Chemosphere.* 2019 Jun 26;235:481-491. doi: 10.1016/j.chemosphere.2019.06.181. [Epub ahead of print] (NHANES 2011-12, 15-16)

Fungicides and Metabolites

Montesano MA, Olsson AO, Kuklenyik P, Needham LL, Bradman AS, Barr DB. Method for determination of acephate, methamidophos, omethoate, dimethoate, ethylenethiourea and propylenethiourea in human urine using high-performance liquid chromatography-atmospheric pressure chemical ionization tandem mass spectrometry. *J Expo Sci Environ Epidemiol.* 2007;17(4):321-30.

Bravo R, Caltabiano LM, Fernandez C, Smith KD, Gallegos M, Whitehead RD, et al. Quantification of phenolic metabolites of environmental chemicals in human urine using gas chromatography-tandem mass spectrometry and isotope dilution quantification. *J Chromatog B* 2005;820(2):229-236.

Ye X, Kuklenyik Z, Needham LL, Calafat AM. Automated on-line column switching HPLCMS/MS method with peak focusing for the determination of nine environmental phenols in urine. *Anal Chem* 2005;77:5407-13.

Herbicides and Metabolites

Atrazine

Kuklenyik Z, Panuwet P, Jayatilaka NK, Pirkle JL, Calafat AM. Two-dimensional high-performance liquid chromatography separation and tandem mass spectrometry detection of atrazine and its metabolic and hydrolysis products in urine. *J Chromatogr B Analyt Technol Biomed Life Sci.* 2012 Jul 15;901:1-8.

2,4-D and 2,4,5-T

Davis MD, Wade EL, Restrepo PR, Roman-Esteva W, Bravo R, Kuklenyik P, et al. Semiautomated solid phase extraction method for the mass spectrometric quantification of 12 specific metabolites of organophosphorus pesticides, synthetic pyrethroids, and select herbicides in human urine. *J Chromatogr B* 2013;929:18-26. (NHANES 2007-2008 and later)

Olsson AO, Baker SE, Nguyen JV, Romanoff LC, Udunka SO, Walker RD, et al. A liquid chromatography-tandem mass spectrometry multiresidue method for quantification of specific metabolites of organophosphorus pesticides, synthetic pyrethroids, selected herbicides, and DEET in human urine. *Anal Chem* 2004;76(9):2453-61. (NHANES 1999-2004)

Sulfonylurea Herbicides

Nguyen JV, Olsson AO, Bravo R, Needham LL, Barr DB. Quantification of atrazine, phenylurea, and sulfonylurea herbicide metabolites in urine by high-performance liquid chromatography-tandem mass spectrometry. *J Anal Toxicol.* 2007;31(4):181-6.

Baker SE, Olsson AO, Needham LL, Barr DB. High-performance liquid chromatography-tandem mass spectrometry method for quantifying sulfonylurea herbicides in human urine: reconsidering the validation process. *Anal Bioanal Chem* 2005; 383:963-76.

Insect Repellent and Metabolites (DEET)

Kuklenyik P, Baker SE, Bishop AM, Morales-A P, Calafat AM. On-line solid phase extraction-high performance liquid chromatography-isotope dilution-tandem mass spectrometry approach to quantify N,N-diethyl-m-toluamide and oxidative metabolites in urine. *Anal Chim Acta.* 2013 Jul 17;787:267-73. (For NHANES 2007-2008 through 2013-2014)

Baker SE, Bishop-Serafim A, Morales-Agudelo P, Vidal M, Ospina M, and Calafat AM. "Quantification of DEET and Neonicotinoid Pesticide Biomarkers in Human Urine by Online Solid Phase Extraction-High Performance Liquid Chromatography-Tandem Mass Spectrometry" *Anal. Bioanal Chem.* (2019) 411:669–678 <https://doi.org/10.1007/s00216-018-1481-0> (For NHANES 2015-16)

Carbamate Insecticides

Bravo R, Caltabiano LM, Fernandez C, Smith KD, Gallegos M, Whitehead RD, et al. Quantification of phenolic metabolites of environmental chemicals in human urine using gas chromatography-tandem mass spectrometry and isotope dilution quantification. *J Chromatog B* 2005;820(2):229-236.

Hill RH Jr, Shealy DB, Head SL, Williams CC, Bailey SL, Gregg M, et al. Determination of pesticide metabolites in human urine using isotope dilution technique and tandem mass spectrometry. *J Anal Toxicol* 1995;19(5):323-329.

Organochlorine Pesticide Metabolites

Ye X, Kuklenyik Z, Bishop AM, Needham LL, Calafat AM. Quantification of the urinary concentrations of parabens in humans by on-line solid phase extraction-high performance liquid chromatography isotope dilution tandem mass spectrometry. *J Chromatogr B* 2006;844:53-9.

Ye X, Kuklenyik Z, Needham LL, Calafat AM. Automated on-line column switching HPLCMS/MS method with peak focusing for the determination of nine environmental phenols in urine. *Anal Chem* 2005;77:5407-13.

Organophosphate Insecticides: Specific Metabolites

Davis MD, Wade EL, Restrepo PR, Roman-Esteva W, Bravo R, Kuklenyik P, et al. Semiautomated solid phase extraction method for the mass spectrometric quantification of 12 specific metabolites of organophosphorus pesticides, synthetic

pyrethroids, and select herbicides in human urine. *J Chromatogr B* 2013;929:18-26. (NHANES 2007-2008 and later)

Montesano MA, Olsson AO, Kuklennyik P, Needham LL, Bradman AS, Barr DB. Method for determination of acephate, methamidophos, omethoate, dimethoate, ethylenethiourea and propylenethiourea in human urine using high-performance liquid chromatography-atmospheric pressure chemical ionization tandem mass spectrometry. *J Expo Sci Environ Epidemiol*. 2007;17(4):321-30.

Olsson AO, Baker SE, Nguyen JV, Romanoff LC, Udunka SO, Walker RD, et al. A liquid chromatography-tandem mass spectrometry multiresidue method for quantification of specific metabolites of organophosphorus pesticides, synthetic pyrethroids, selected herbicides, and DEET in human urine. *Anal Chem* 2004;76(9):2453-61. (NHANES 1999-2004)

Organophosphate Insecticides: Dialkyl Phosphate Metabolites

Bravo R, Caltabiano LM, Weerasekera G, Whitehead RD, Fernandez C, Needham LL, et al. Measurement of dialkyl phosphate metabolites of organophosphorus pesticides in human urine using lyophilization with gas chromatography-tandem mass spectrometry and isotope dilution quantification. *J Expo Anal Environ Epidemiol* 2004;14:249-259.

Bravo R, Driskell WJ, Whitehead RD Jr, Needham LL, Barr DB. Quantitation of dialkyl phosphate metabolites of organophosphate pesticides in human urine using GC-MS-MS with isotopic internal standards. *J Anal Toxicol* 2002;26:245-252.

Jayatilaka NK, Restrepo P, Davis Z, Vidal M, Calafat AM, Ospina M. "Quantification of 16 urinary biomarkers of exposure to flame retardants, plasticizers, and organophosphate insecticides for biomonitoring studies" *Chemosphere*. 2019 Jun 26;235:481-491. doi: 10.1016/j.chemosphere.2019.06.181. [Epub ahead of print] (For NHANES 2011-2012 and 2015-2016).

Pyrethroids

Davis MD, Wade EL, Restrepo PR, Roman-Esteva W, Bravo R, Kuklennyik P, Calafat AM. Semiautomated solid phase extraction method for the mass spectrometric quantification of 12 specific metabolites of organophosphorus pesticides, synthetic pyrethroids, and select herbicides in human urine. *J Chromatogr B* 2013;929:18-26. (NHANES 2007-2008 and later)

Olsson AO, Baker SE, Nguyen JV, Romanoff LC, Udunka SO, Walker RD, et al. A liquid chromatography-tandem mass spectrometry multiresidue method for quantification of specific metabolites of organophosphorus pesticides, synthetic pyrethroids, selected herbicides, and DEET in human urine. *Anal Chem* 2004;76(9):2453-2461.

Metals and Metalloids

Georgi, J., et al. (2017). "Biomonitoring method for the analysis of chromium and cobalt in human whole blood using inductively coupled plasma-kinetic energy discrimination-mass spectrometry (ICP-KED-MS)." *Analytical methods* 9(23): 3464-3476. [NHANES 2015-2020]

Jones DR, Jarrett JM, Tevis DS, Franklin M, Mullinix NJ, Wallon KL, et al. Analysis of whole human blood for Pb, Cd, Hg, Se, and Mn by ICP-DRC-MS for biomonitoring and acute exposures. *Talanta* 2017;162: 114-22. [NHANES 2003-2018]

Quarles CD Jr, Jones DR, Jarrett JM, Shakirova G, Pan Y, Caldwell KL, et al. Analytical method for total chromium and nickel in urine using an inductively coupled plasma-universal cell technology-mass spectrometer (ICP-UCT-MS) in kinetic energy discrimination (KED) mode. *J Anal At Spectrom* 2014;29(2): 297-303. [NHANES 2017-current]

Sommer YL, Verdon CP, Fresquez MR, Ward CD, Wood EB, Pan Y, et al. Measurement of mercury species in human blood using triple spike isotope dilution with SPME-GC-ICP-DRCMS. *Anal Bioanal Chem* 2014;406(20):5039-47. [NHANES 2011-current]

Ruha, A. M., et al., (2009). "Urine mercury excretion following meso-dimercaptosuccinic acid challenge in fish eaters." *Archives of Pathology and Laboratory Medicine* 133(1): 87-92. [NHANES 2003-2020]

Jarrett JM, Xiao G, Caldwell K, Henahan D, Shakirova G, Jones RL. Eliminating molybdenum oxide interference in urine cadmium biomonitoring using ICP-DRC-MS. *J Anal At Spectrom* 2008;23(7): 962-967. [NHANES 1999–current]

Verdon CP, Caldwell KL, Fresques MR, Jones RL. Determination of seven arsenic compounds in urine by HPLC-ICP-DRC-MS: a CDC population biomonitoring method. *Anal Bioanal Chem* 2008;393(3):939-947. [NHANES 2003-current]

Jarrett JM, Jones RL, Caldwell KL, Verdon CP. Total urine arsenic measurements using inductively coupled plasma mass spectrometry with a dynamic reaction cell. *At Spectrosc* 2007;28(4):113-22. [NHANES 2003-2016]

Albalak R, Jones RL, Caldwell KL, Miller G. Inorganic mercury determination in whole blood using on-line microwave digestion with flow injection mercury system (FIMS). *At Spectrosc* 2005;26(6): 234-40. [NHANES 1999 — 2010]

Caldwell KL, Hartel J, Jarrett J, Jones RL. Inductively coupled plasma mass spectrometry to measure multiple toxic elements in urine in NHANES 1999-2000. *At Spectrosc* 2005;26(1):1-7. [NHANES 1999-current]

Caldwell, K. L., et al., (2003). "Use of Inductively Coupled Plasma Mass Spectrometry to Measure Urinary Iodine in NHANES 2000: Comparison with Previous Method." *Clinical Chemistry* 49(6): 1019-1021. [NHANES 1999-2020]

Chen HP, Paschal DC, Miller DT, Morrow JC. Determination of total and inorganic mercury in whole blood by on-line digestion with flow injection. *Atomic Spectroscopy* 1998;19:176-179.

Guo, T. and J. Baasner (1993). "On-line microwave sample pretreatment for the determination of mercury in blood by flow injection cold vapor atomic absorption spectrometry." *Talanta (Oxford)* 40(12): 1927-36. [NHANES 1999 – 2002]

Parsons, P, Slavin W. A rapid Zeeman graphite furnace atomic absorption spectrometric method for the determination of lead in blood. *Spectrochimica acta. Part B, At Spectrosc* 1993;48(6-7): 925-39.[NHANES 1999 – 2002]

Miller DT, Paschal DC, Gunter EW, Stroud PE, D'Angelo J. Determination of blood lead with electrothermal atomic absorption using a L'vov platform and matrix modifier. *Analyst* 1987;112:1701-4. [NHANES III – 2002]

Paschal DC, Kimberly MM. Automated direct determination of selenium in serum by electrothermal atomic absorption spectroscopy. *At Spectrosc* 1986;7:75-8. [NHANES III]

Lewis, S. A., Hardison, N. W., & Veillon, C. Comparison of isotope dilution mass spectrometry and graphite furnace atomic absorption spectrometry with Zeeman background correction for the determination of plasma selenium. *Anal Chem* 1986;58(6): 1272-3. [NHANES III]

Pruszkowska E, Carnrick GR, Slavin W. Direct determination of cadmium in urine with use of a stabilized temperature platform furnace and Zeeman background correction. *Clin Chem* 1983;29:477-80. [NHANES III]

Stoeppler M, Brandt K. Determination of cadmium in whole blood and urine by electrothermal atomic-absorption spectrophotometry. *Fresenius A Anal Chem* 1980;300:372-380.[NHANES 1999 – 2002]

Barthel, W. F., et al., (1973). "Modified Delves cup atomic absorption determination of lead in blood." *Journal - Association of Official Analytical Chemists* 56(5): 1252-1256. [NHANES II]

Perfluoroalkyl and Polyfluoroalkyl Substances: Surfactants

Kato K, Kalathil AA, Patel AM, Ye X, Calafat AM. Per- and polyfluoroalkyl substances and fluorinated alternatives in urine and serum by on-line solid phase extraction-liquid chromatography-tandem mass spectrometry. *Chemosphere*. 2018 Oct;209:338-345. (For NHANES 2013-14 in urine; from NHANES 2015+ in serum)

Kato K, Basden BJ, Needham LL, Calafat AM. Improved selectivity for the analysis of maternal serum and cord serum for polyfluoroalkyl chemicals. *J Chromatogr A* 2011;1218(15):2133-2137.

Kuklennyik Z, Needham LL, Calafat AM. Measurement of 18 perfluorinated organic acids and amides in human serum using on-line solid-phase extraction. *Anal Chem* 2005;77:6085-6091.

Kuklennyik Z, Reich JA, Tully JS, Needham LL, Calafat AM. Automated solid-phase extraction and measurement of perfluorinated organic acids and amides in human serum and milk. *Environ Sci Technol*. 2004 Jul 1;38(13):3698-704.

Phthalate and Phthalate Alternative Metabolites

Silva MJ, Wong LY, Samandar E, Preau JL, Calafat AM, Ye X. Exposure to di-2-ethylhexyl terephthalate in a convenience sample of U.S. adults from 2000 to 2016. *Arch Toxicol*. 2017 Oct;91(10):3287-3291. Erratum to: Exposure to di-2-ethylhexyl terephthalate in a convenience sample of U.S. adults from 2000 to 2016. Silva MJ, Wong LY, Samandar E, Preau JL, Calafat AM, Ye X. *Arch Toxicol*. 2017 Oct;91(10):3293. (from NHANES 2015+)

Silva MJ, Jia T, Samandar E, Preau JL, Calafat AM. Environmental exposure to plasticizer 1,2- cyclohexane dicarboxylic acid, diisononyl ester (DINCH) in US adults (2000-2012). *Environ Res* 2013; 126: 159-163. (NHANES 2011-2014)

Silva MJ, Samandar E, Preau JL, Reidy JA, Needham LL, Calafat AM. Quantification of 22 phthalate metabolites in human urine. *J Chromatogr B* 2007;860:106-12. (NHANES 2005-2012)

Kato K, Silva MJ, Needham LL, Calafat AM. Determination of 16 phthalate metabolites in urine using automated sample preparation and on-line preconcentration/high-performance liquid chromatography/tandem mass spectrometry. *Anal Chem* 2005;77(9):2985-91. (NHANES 2003- 2004)

Silva MJ, Slakman AR, Reidy JA, Preau JL, Herbert AR, Samandar E, et al. Analysis of human urine for 15 phthalate metabolites using automated solid-phase extraction. *J Chromatogr B* 2004;805:161-7. (NHANES 2001-2002)

Silva MJ, Malek NA, Hodge CC, Reidy JA, Kato K, Barr DB, et al. Improved quantitative detection of 11 urinary phthalate metabolites in humans using liquid chromatographyatmospheric pressure chemical ionization tandem mass spectrometry. *J Chromatogr B* 2003;789:393-404. (NHANES 1999-2000)

Blount BC, Milgram KE, Silva M, Malek N, Reidy J, Needham LL, et al. Quantitative detection of eight phthalate metabolites in human urine using HPLC-APCI-MS/MS. *Anal Chem* 2000;72:4127-4134.

Phytoestrogens and Metabolites

Parker DL, Rybak ME, Pfeiffer CM. Phytoestrogen biomonitoring: an extractionless LC-MS/MS method for measuring urinary isoflavones and lignans by use of atmospheric pressure photoionization (APPI). *Anal Bioanal Chem* 2012;402:1123-1136. (NHANES 2005-2006 and later)

Rybak ME, Parker DL, Pfeiffer CM. Determination of urinary phytoestrogens by HPLC-MS/MS: A comparison of atmospheric pressure chemical ionization (APCI) and electrospray ionization (ESI). *J Chromatogr R* 2008;861:145-150. (NHANES 2003-2004)

Kuklenyik Z, Ye X, Reich JA, Needham LL, Calafat AM. Automated on-line and off-line solid phase extraction methods for measuring isoflavones and lignans in urine. *J Chromatogr Sci* 2004; 42:495-500.

Valentin-Blasini L, Blount BC, Rogers HS, Needham LL. HPLC-MS/MS method for the measurement of seven phytoestrogens in human serum and urine. *J Expo Anal Environ Epidemiol* 2000;10:799-807.

Polycyclic Aromatic Hydrocarbon Metabolites

Wang Y, Meng L, Pittman EN, Etheredge A, Hubbard K, Trinidad DA, et al. Quantification of urinary mono-hydroxylated metabolites of polycyclic aromatic hydrocarbons by on-line solid phase extraction-high performance liquid chromatography-tandem mass spectrometry. *Anal Bioanal Chem*. 2017 Feb;409(4):931-937. (NHANES 2013-2014)

Li Z, Romanoff LC, Trinidad DA, Hussain N, Jones RS, Porter EN, et al. Measurement of urinary Monohydroxy polycyclic aromatic hydrocarbons using automated liquid-liquid extraction and gas chromatography/isotope dilution high-resolution mass spectrometry. *Anal Chem* 2006;78:5744-51.

Romanoff LC, Li Z, Young KJ, Blakely NC III, Patterson DG, Sandau CD. Automated solid-phase extraction method for measuring urinary polycyclic aromatic hydrocarbon

metabolites in human biomonitoring using isotope-dilution gas chromatography high-resolution mass spectrometry. *J Chromatog B* 2006;835:47-54.

Smith CJ, Huang WL, Walcott CJ, Turner WE, Grainger J, Patterson DG Jr. Quantification of monohydroxy-PAH metabolites in urine by solid-phase extraction with isotope dilution GC-HRMS. *Anal Bioanal Chem* 2002;372:216-220.

Heterocyclic Amines

Zhang L, Xia Y, Xia B, Nicodemus KJ, McGuffey J, McGahee E, et al. High-throughput and sensitive analysis of urinary heterocyclic aromatic amines using isotope-dilution liquid chromatography-tandem mass spectrometry and robotic sample preparation system. *Anal Bioanal Chem*. 2016 Nov;408(28):8149-8161. Epub 2016 Sep 29.

Volatile Organic Compounds (VOCs), including Disinfection By-Products

Chambers DM, Ocariz JM, McGuirk MF, Bount BC. Impact of cigarette smoking on volatile organic compound (VOC) blood levels in the U.S. Population: NHANES 2003–2004. *Environ. Int.* 2011;37:1321-8.

Alwis KU, Blount BC, Silva LK, Smith MM, Loose KH. Method for quantifying nitromethane in blood as a potential biomarker of halonitromethane exposure. *Environ Sci Technol* 2008;42 (7): 2522-7.

Chambers DM, Blount BC, McElprang DO, Waterhouse MG, Morrow J. Picogram measurement of volatile n-alkanes (n-hexane through n-dodecane) in blood using solid-phase microextraction to assess nonoccupational petroleum-based fuel exposure. *Anal Chem* 2008;80(12): 4666-74.

Chambers DM, McElprang DO, Waterhouse MG, Blount BC. An improved approach for accurate quantitation of benzene, toluene, ethylbenzene, xylene, and styrene in blood. *Anal Chem* 2006;78 (15): 5375-83.

Blount BC, Kobelski RJ, McElprang DO, Ashley DL, Morrow JC, Chambers DM, et al. Quantification of 31 volatile organic compounds in whole blood using solid-phase microextraction and gas chromatography-mass spectrometry. *J Chromatogr B Analyt Technol Biomed Life Sci* 2006;832: 292-301.

Bonin MA, Silva LK, Smith MM, Ashley DL, Blount BC. Measurement of trihalomethanes and methyl tert-butyl ether in whole blood using gas chromatography with high-resolution mass spectrometry. *J Anal Toxicol* 2005;29(2):81-9.

Chambers DM, McElprang DO, Mauldin JP, Hughes TM, Blount BC. Identification and elimination of polysiloxane curing agent interference encountered in the quantification of low picogram per milliliter methyl tert-butyl ether in blood by solid-phase microextraction headspace analysis. *Anal Chem* 2005;77 (9): 2912-9.

Volatile Organic Compound (VOC) Metabolites

Bhandari, D., McCarthy, D., Biren, C., Movassaghi, C., Blount, B. C., & De Jesús, V. R. (2019). Development of a UPLC-ESI-MS/MS method to measure urinary metabolites of selected VOCs: Benzene, cyanide, furfural, furfuryl alcohol, 5-hydroxymethylfurfural, and N-methyl-2-pyrrolidone. *Journal of Chromatography B*, 1126, 121746.

Alwis KU, Bailey TL, Patel D, Wang L, Blount BC. Measuring urinary N-acetyl-S-(4-hydroxy-2-methyl-2-buten-1-yl)-L-cysteine (IPMA3) as a potential biomarker of isoprene exposure. *Anal Chim Acta* 2016;941:61-66.

Alwis KU, Blount BC, Britt AS, Patel D, Ashley DL. Simultaneous analysis of 28 urinary VOC metabolites using ultra high-performance liquid chromatography coupled with electrospray ionization tandem mass spectrometry (UPLC-ESI/MSMS). *Anal Chim Acta* 2012;750:152-60.

Polybrominated Diphenyl Ethers and PBB 153 (Pooled and Individual Samples)

Jones R, Edenfield E, Anderson S, Zhang Y, Sjodin A. Semi-automated extraction and cleanup method for measuring persistent organic pollutants in human serum. *Organohalogen Compounds* 2012;74: 97-8.

Sjodin A, Jones RS, Lapeza CR, Focant JF, McGahee EE III, Patterson DG. Semiautomated high-throughput extraction and cleanup method for the measurement of polybrominated diphenyl ethers, polybrominated biphenyls, and polychlorinated biphenyls in human serum. *Anal Chem* 2004;76:1921-7.

Organochlorine Pesticides and Metabolites, and Non-dioxin-like and mono-ortho-substituted Polychlorinated Biphenyls (Pooled and Individual Samples)

Patterson, DG Jr., Wong L-Y, Turner WE, Caudill SP, DiPietro ES, McClure PC, et al. Levels in the U.S. population of those persistent organic pollutants (2003-2004) included in the Stockholm Convention or in other Long-Range Transboundary Air Pollution Agreements. *Environ Sci Technol* 2009;43(4):1211-8.

Jones R, Edenfield E, Anderson S, Zhang Y and Sjodin A. Semi-automated extraction and cleanup method for measuring persistent organic pollutants in human serum. *Organohalogen Compounds* 2012;74:97-8.

Sjodin A, Jones RS, Lapeza CR, Focant JF, McGahee EE III, Patterson DG. Semiautomated high-throughput extraction and cleanup method for the measurement of polybrominated diphenyl ethers, polybrominated biphenyls, and polychlorinated biphenyls in human serum. *Anal Chem* 2004;76:1921-7.

Patterson DG Jr., Alexander LR, Turner WE, Isaacs SG, Needham LL. The development and application of a high-resolution mass spectrometry method for measuring polychlorinated dibenzo-p-dioxins and dibenzofurans in serum. In: Clement RE, Sui KM, Hill HH Jr., eds. *Instrumentation for trace organic monitoring*. Chelsea, MI: Lewis Publishers; 1990. pp. 119-53.

Patterson DG Jr., Hampton L, Lapeza CR Jr., Belser WT, Green V, Alexander L, et al. High-resolution gas chromatographic/high resolution mass spectrometric analysis of human serum on a whole weight and lipid basis for 2,3,7,8 TCDD. *Anal Chem* 1987;59:2000-5.

Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (Pooled and Individual Samples), and Coplanar Polychlorinated Biphenyls (Pooled and Individual Samples)

Turner WE, Whitfield WE, Cash TP, DiPietro ES, Anderson CJ, McClure PC, et al. Same sample cleanup for PCDDs/PCDFs/cPCBs, PCNs and PBDDs/PBDFs in human serum and quantification by GC/ID-HRMS. *Organohalogen Compounds* 2011; 73: 661-4.

Patterson, DG Jr., Wong L-Y, Turner WE, Caudill SP, DiPietro ES, McClure PC, et al. Levels in the U.S. population of those persistent organic pollutants (2003-2004) included in the Stockholm Convention or in other Long-Range Transboundary Air Pollution Agreements. *Environ Sci Technol* 2009;43(4):1211-8.

Patterson DG Jr., Alexander LR, Turner WE, Isaacs SG, Needham LL. The development and application of a high-resolution mass spectrometry method for measuring polychlorinated dibenzo-p-dioxins and dibenzofurans in serum. In: Clement RE, Sui KM, Hill HH Jr., eds. *Instrumentation for Trace Organic Monitoring*. Chelsea, MI: Lewis Publishers; 1990. pp. 119-53.

Turner WE, DiPietro E, Cash TP, McClure PC, Patterson DG Jr., Shirkhan H. An improved SPE extraction and automated sample cleanup method for serum PCDDs, PCDFs, and coplanar PCBs. *Organohalogen Compounds* 1994; 19: 31-5.

Patterson DG Jr., Hampton L, Lapeza CR Jr., Belser WT, Green V, Alexander L, et al. High-resolution gas chromatographic/high resolution mass spectrometric analysis of human serum on a whole weight and lipid basis for 2,3,7,8 TCDD. *Anal Chem* 1987;59: 2000-5.



Centers for Disease Control and Prevention
National Center for Environmental Health
Division of Laboratory Sciences
Mail Stop F-20
4770 Buford Highway, NE
Atlanta, GA 30341-3724

Telephone: (toll free) 1-800-CDC-INFO (1-800-232-4636)
Email: CDCINFO@cdc.gov
Website: <https://www.cdc.gov/exposurereport>