Blood Mercury

Mercury is a naturally occurring metal. However, through many industrial processes (e.g., chemical manufacturing operations, coal combustion), mercury is widespread and persistent in the environment. Mercury exists in three basic forms: elemental mercury, inorganic mercury compounds, and organic mercury compounds. Organic methylmercury—the form of mercury that is of primary public health significance—can accumulate in the food chain in aquatic systems and lead to high concentrations in predatory fish. The major source of human exposure to methylmercury in the U.S. is consumption of contaminated fish (mostly predatory and larger species) and shellfish (Caldwell et al, 2009; CDC, 2017; NRC, 2000).

The human health effects of mercury are diverse and depend on the forms of mercury encountered and the dose and length of exposure (CDC, 2017). Fetuses and children may be more susceptible to adverse effects from mercury exposure than adults, with a primary concern being the occurrence of developmental and neurological health effects. Prenatal exposures interfere with the growth and migration of neurons and have the potential to cause irreversible damage to the developing central nervous system. In adults, mercury exposure has been associated with neurological effects such as sensory and motor impairment, particularly at high doses (NRC, 2000). The strength of possible associations between mercury exposure and cardiovascular effects continue to be researched (e.g., Genchi et al., 2017; Houston, 2014).

Because of specific concerns about exposure to women of child-bearing age and young children, this indicator reports the blood total mercury levels (includes organic and inorganic) among U.S. women age 16 to 49 and children age 1 to 5, using data from the 1999-2018 continuous National Health and Nutrition Examination Survey (NHANES). NHANES began reporting blood mercury data for all eligible participants age 1 and older in 2003, and this indicator also reports data for this population group from 2003 to 2018. NHANES is a series of surveys conducted by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics that is designed to collect data on the health and nutritional status of the civilian, non-institutionalized U.S. population using a complex, stratified, multistage, probability-cluster design. CDC's National Center for Environmental Health conducted the laboratory analyses for the biomonitoring samples. Beginning in 1999, NHANES became a continuous and annual national survey. The data presented here cover 10 different survey periods: 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012, 2013-2014, 2015-2016, and 2017-2018.

What the Data Show

Exhibit 1 presents the geometric mean and four percentiles (50^{th}, 75^{th}, 90^{th}, and 95^{th}) of blood mercury concentrations for women age 16 to 49, by race and ethnicity, sampled during each of the continuous NHANES survey periods. Geometric mean blood mercury levels fluctuated throughout the survey period, ranging from 0.623 micrograms per liter (µg/L) (2017-2018) to 1.02 µg/L (1999-2000). Decreases from 1999-2000 to 2017-2018 occurred for all four percentiles but were most pronounced at the 90^{th} (56.9 percent) percentile.

Among the five racial/ethnic groups reported in Exhibit 1, non-Hispanic black women age 16 to 49 consistently had the highest geometric mean blood mercury levels from 1999 to 2010. Asian women age 16 to 49 were added to the NHANES survey beginning in 2011-2012, and consistently had the highest geometric mean blood mercury levels from 2011 to 2018.

Exhibits 2 and 3 display geometric mean and four percentiles of blood total mercury concentrations for children age 1 to 5, by sex and by race and ethnicity, respectively. The geometric mean remained largely the same during the first three survey periods: 0.343 µg/L in 1999-2000, 0.318 µg/L in 2001-2002, and 0.326 µg/L in 2003-2004. The geometric mean for females was consistently higher than for males during the first three survey periods, with a range of 0.329-0.377 µg/L for females compared to 0.302-0.317 µg/L for males (Exhibit 2). For each of the first three survey periods, non-Hispanic blacks had a higher geometric mean than Mexican Americans and non-Hispanic whites (Exhibit 3). The geometric means for total, males and females, and two race/ethnicity groups (Mexican Americans and non-Hispanic whites) from 2005-2010, for non-Hispanic blacks from 2005-2008, and for all groups from 2013-2018 (except Asians from 2013-2016), were not reported because the proportion of results below the limit of detection was too high to provide a valid result. Geometric means were reported for all groups for the 2011-2012 survey period; in all cases, the geometric means were lower than those reported from 1999-2004.

Exhibits 4, 5, and 6 present the geometric mean and four percentiles of blood total mercury concentrations for the U.S. population age 1 year and older by sex, race and ethnicity, and age, respectively. The geometric mean among the total population ranged from a high of 0.863 µg/L during the 2005-2006 and 2009-2010 periods to a low of 0.643 µg/L during 2017-2018 (Exhibits 4, 5, and 6).

When comparing blood total mercury concentrations by sex (Exhibit 4), the geometric mean was consistently lower for females than for males, with the exception of the 2005-2006 survey period when the geometric mean was the same for both sexes (0.864 µg/L). Overall, geometric means for females ranged from 0.631-0.864 µg/L and for men ranged from 0.655-0.883 µg/L.

Comparing mercury concentrations by race and ethnicity reveals that geometric means were lowest for Mexican Americans,

ranging from 0.483-0.613 µg/L. From 2003-2010, the highest geometric means varied between non-Hispanic blacks (2003-2004, 2007-2008, and 2009-2010) and non-Hispanic whites (2005-2006). Asians were added to the NHANES survey beginning in 2011-2012, and had the highest geometric means from 2011-2018. For each group presented in Exhibit 4 and for non-Hispanic whites, non-Hispanic blacks, and Asians in Exhibit 5, the geometric mean blood mercury concentrations were lowest during the most recent 2017-2018 survey period. However, the mean blood mercury concentrations were lowest for Mexican Americans in 2011-2012 and all Hispanics in 2013-2014 (Exhibit 5).

Based on the survey periods when data were available for all age groups—2003-2004 and 2011-2012—geometric mean concentrations appear to increase with age. For example, in the 2003-2004 survey period, the geometric means were 0.326 µg/L for 1-5 years, 0.419 µg/L for 6-11 years, 0.490 µg/L for 12-19 years, and 0.979 µg/L for 20 years and older. The lowest measured concentrations for 1-5 and 6-11 year age groups occurred during 2011-2012, with geometric means of 0.262 µg/L and 0.330 µg/L, respectively. The lowest measured geometric mean concentrations for those 12-19 years (0.395 µg/L) occurred in 2015-2016, and the lowest geometric means for those 20 years and older (0.764 µg/L) occurred from 2017-2018 (Exhibit 6).

Limitations

- The relatively small number of samples collected in a 2-year cycle (e.g., 1999-2000 or 2001-2002) may, in some cases, result in measures of central tendency that are unstable from one survey period to the next.
- Health-based benchmarks for blood levels of mercury have not been established.

Data Sources

Data used for Exhibits 1 through 3 of this indicator were generated with Stata statistical software utilizing the NHANES laboratory files available online in SAS® transport file format (CDC, 2022a). Data used for Exhibits 4 through 6 were obtained directly from CDC's National Report on Human Exposure to Environmental Chemicals: Analysis of whole blood, serum, and urine samples, NHANES 1999-2018, which was updated in March 2022, and presents the results of the ongoing NHANES (CDC, 2022b).

References

Caldwell K.L., M.E. Mortensen, R.L. Jones, S.P. Caudill, and J.D. Osterloh. 2009. Total blood mercury concentrations in the U.S. population: 1999-2006. Int. J. Hyg. Environ. Health 212:588-598.

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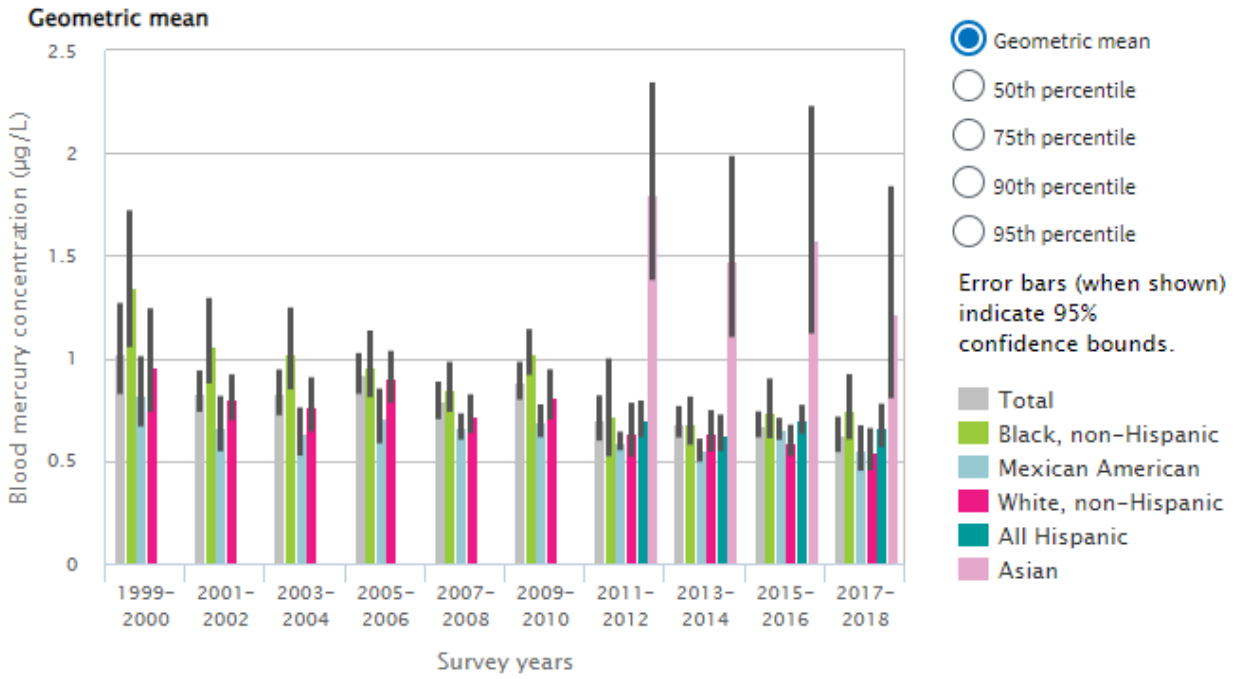
CDC. 2017. National Biomonitoring Program, biomonitoring summary for mercury. Last reviewed April 7, 2017. Accessed August 3, 2022. https://www.cdc.gov/biomonitoring/Mercury_BiomonitoringSummary.html.

Genchi, G., M.S. Sinicropi, A. Carocci, G. Lauria, and A. Catalano. 2017. Review: Mercury exposure and heart diseases. International Journal of Environmental Research and Public Health 14(74):1-13. Accessed June 29, 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5295325/.

Houston, M.C. 2014. The role of mercury in cardiovascular disease. Review article. J Cardiovasc Dis Diagn 2:170. Accessed June 29, 2018. https://www.hilarispublisher.com/open-access/the-role-of-mercury-in-cardiovascular-disease-2329-9517.1000170.pdf (PDF) (8 pp, 503K).

NRC (National Research Council). 2000. Toxicological effects of methylmercury. Washington, DC: National Academies Press.

Exhibit 1. Blood mercury concentrations for U.S. women age 16–49 years by race and ethnicity, 1999–2018



Other racial and ethnic groups are included in the "total" only.

NHANES data for All Hispanics and Asians were available starting with the 2011–2012 survey period.

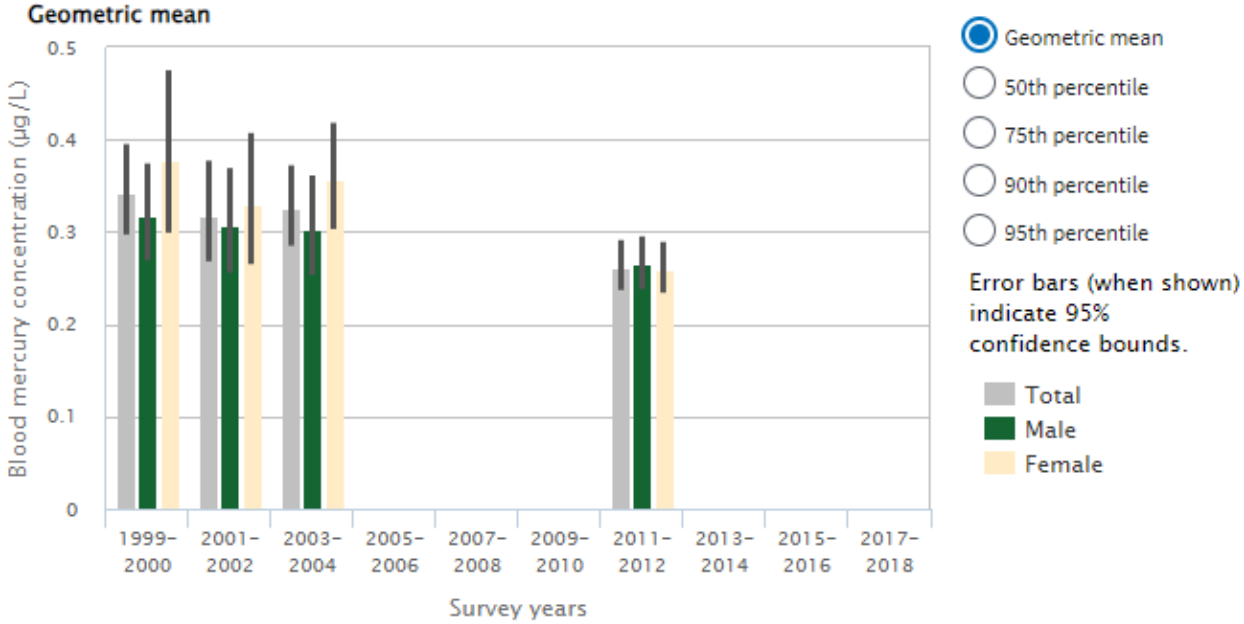
Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022a

Visit https://www.epa.gov/roe to see the full exhibit.

Exhibit 2. Blood mercury concentrations for U.S. children age 1–5 years by sex, 1999–2018

Geometric mean



Geometric means are not calculated or displayed in the exhibit in cases where the proportion of results below the limit of detection was too high to provide a valid result. The limit of detection for mercury was 0.14 µg/L in 1999–2002; 0.20 µg/L in 2003–2004; 0.33 µg/L in 2005–2010; 0.16 µg/L in 2011–2012; and 0.28 µg/L in 2013–2018.

Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022a

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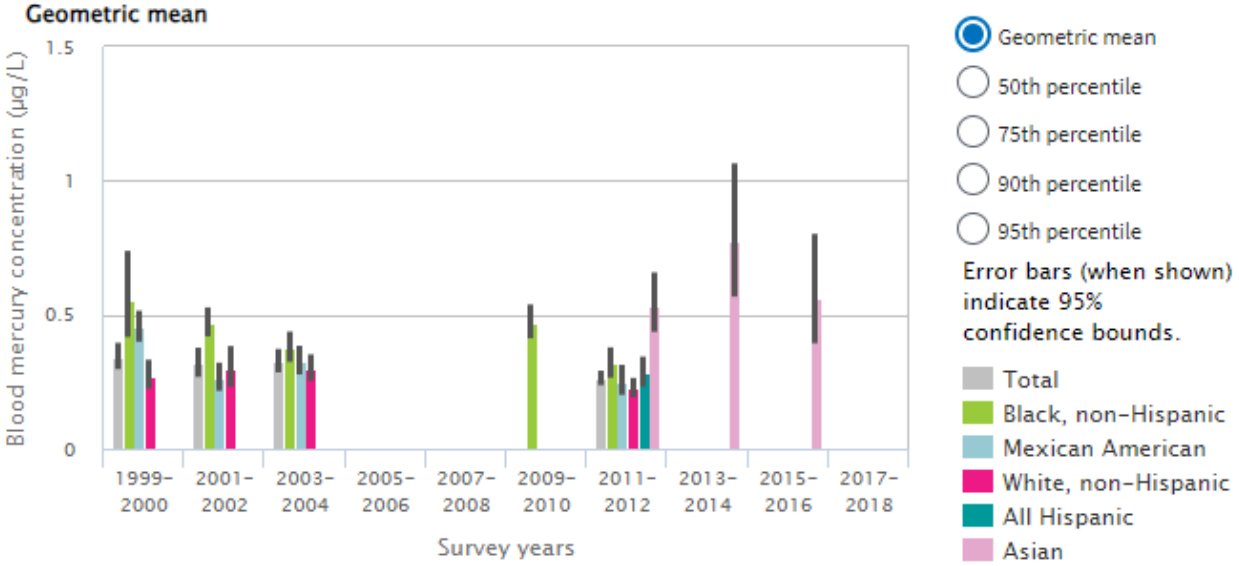
Exhibit 3. Blood mercury concentrations for U.S. children age 1–5 years by race and ethnicity, 1999–2018

Geometric mean



Geometric means are not calculated or displayed in the exhibit in cases where the proportion of results below the limit of detection was too high to provide a valid result. The limit of detection for mercury was 0.14 µg/L in 1999–2002; 0.20 µg/L in 2003–2004; 0.33 µg/L in 2005–2010; 0.16 µg/L in 2011–2012; and 0.28 µg/L in 2013–2018.

Other racial and ethnic groups are included in the "total" only.

NHANES data for All Hispanics and Asians were available starting with the 2011–2012 survey period.

Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022a

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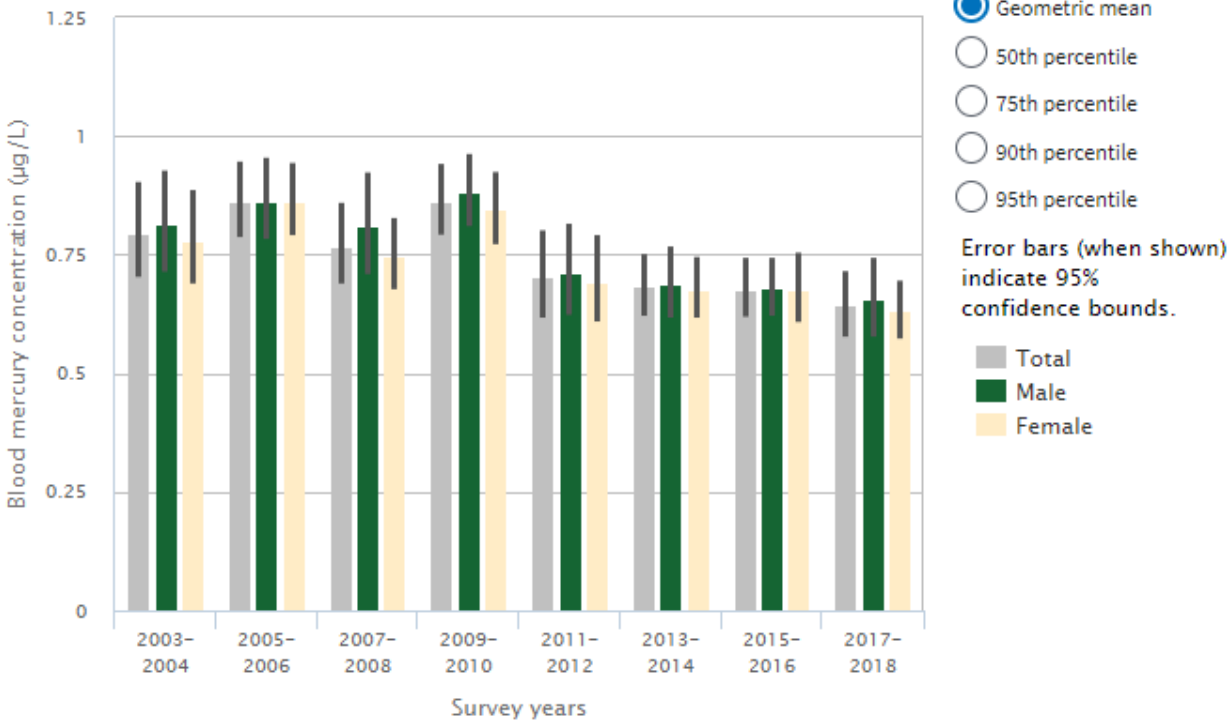
Exhibit 4. Blood mercury concentrations for the U.S. population age 1 year and older by sex, 2003–2018

Geometric mean

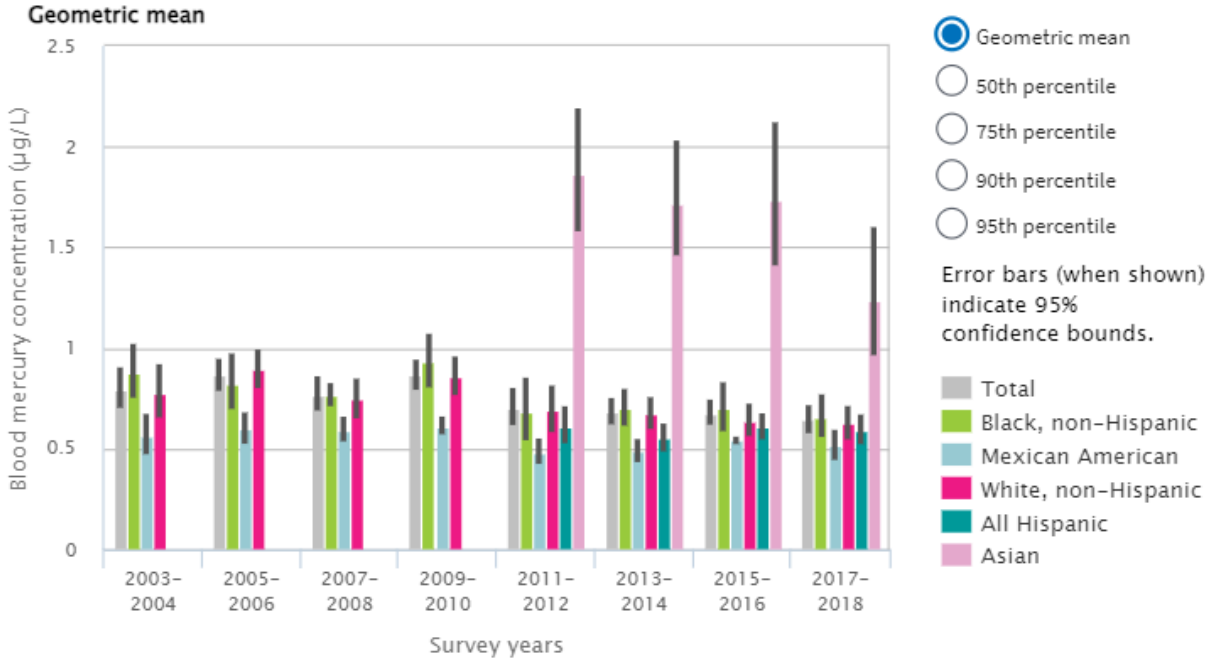


Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022b

Visit https://www.epa.gov/roe to see the full exhibit.

Exhibit 5. Blood mercury concentrations for the U.S. population age 1 year and older by race and ethnicity, 2003–2018



Other racial and ethnic groups are included in the "total" only.

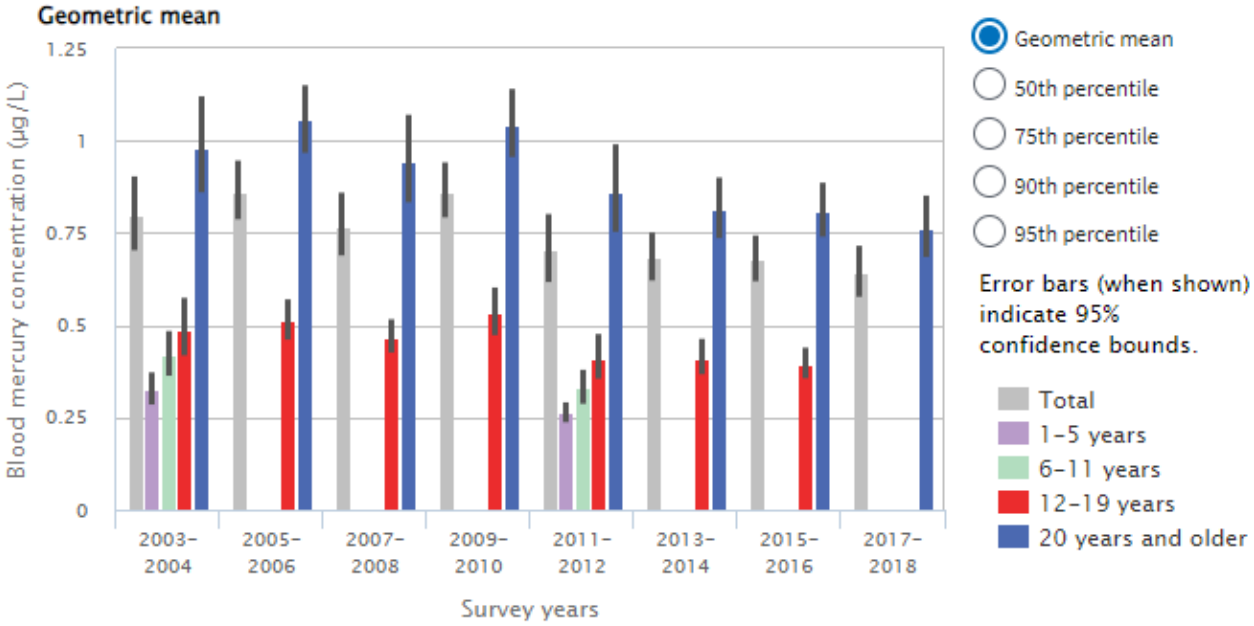
NHANES data for All Hispanics and Asians were available starting with the 2011–2012 survey period.

Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022b

Visit https://www.epa.gov/roe to see the full exhibit.

Exhibit 6. Blood mercury concentrations for the U.S. population age 1 year and older by age, 2003–2018



Geometric means are not calculated or displayed in the exhibit in cases where the proportion of results below the limit of detection was too high to provide a valid result. The limit of detection for mercury was 0.20 µg/L in 2003–2004; 0.33 µg/L in 2005–2010; 0.16 µg/L in 2011–2012; and 0.28 µg/L in 2013–2018.

Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022b

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