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, 2009; 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, 2009). 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 1999-2016 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 2016. 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 nine different survey periods: 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012, 2013-2014, and 2015-2016.

What the Data Show

Exhibit 1 presents the geometric mean and four percentiles (50th, 75th, 90th, and 95th) of blood mercury concentrations for women age 16 to 49, by race and ethnicity, sampled during each of the continuous NHANES survey periods. Among women age 16 to 49, geometric mean blood mercury levels fluctuated throughout the survey period, ranging from 0.675 micrograms per liter (µg/L) (2015-2016) to 1.02 µg/L (1999-2000). Decreases from 1999-2000 to 2015-2016 occurred for all four percentiles but were most pronounced at the 90th (46.5 percent) percentile.

Among the three racial/ethnic groups reported in Exhibit 1, non-Hispanic black women age 16 to 49 consistently had the highest geometric mean blood mercury levels over time, followed by non-Hispanic whites and then Mexican Americans except in 2015-2016, when Mexican Americans
had a higher geometric mean blood mercury level than non-Hispanic whites.

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 2013-2016, 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 0.678 µg/L during 2015-2016 (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 0.677-0.864 µg/L and for men ranged from 0.679-0.883 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. The highest geometric means varied between non-Hispanic blacks and non-Hispanic whites, with geometric means lower among non-Hispanic whites during 2003-2004, 2007-2010, and 2013-2016, with a range of 0.638-0.856 µg/L during those years. Geometric means were lower for non-Hispanic blacks during 2005-2006 (0.823 µg/L) and 2011-2012 (0.679 µg/L). For each group presented in Exhibit 4 and for non-Hispanic whites in Exhibit 5, the geometric mean blood mercury concentrations were lowest during the most recent 2015-2016 survey period. However, the mean blood mercury concentrations for non-Hispanic blacks and Mexican Americans increased after 2011-2012 (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) and 20 years and older (0.810 µg/L) occurred from 2015-2016 (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, 2018b). Data used for Exhibits 4 through 6 were obtained directly from CDC’s Fourth National Report on Human Exposure to Environmental Chemicals, Updated Tables, March 2018, Volume 1 (CDC, 2018a).

References


Geometric mean

Error bars (when shown) indicate 95% confidence bounds.

- Total
- Black, non-Hispanic
- Mexican American
- White, non-Hispanic

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

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, 2018b

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

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 2013–2016.

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.

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

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, 2018b

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Exhibit 4. Blood mercury concentrations for the U.S. population age 1 year and older by sex, 2003–2016

Geometric mean

Error bars (when shown) indicate 95% confidence bounds.

Survey years

Blood mercury concentration (µg/L)

2003–2004
2005–2006
2007–2008
2009–2010
2011–2012
2013–2014
2015–2016

Total
Male
Female

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, 2018a

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, 2003–2016

Survey years

Blood mercury concentration (μg/L)

Error bars (when shown) indicate 95% confidence bounds.

Total
Black, non-Hispanic
Mexican American
White, non-Hispanic

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

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, 2018a

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 2013–2016.

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, 2018a

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