

Report on the Environment

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Blood Lead

Lead is a naturally occurring metal found in small amounts in rock and soil. Lead has been used industrially in the production of gasoline, ceramic products, paints, metal alloys, batteries, and solder. While lead arising from the combustion of leaded gasoline was a major source of exposure in past decades, today deteriorated lead-based paint and resulting dust and soil contamination are the primary sources of environmental lead exposure for children and occupational and recreational sources are the main exposures among adults (CDC, 2017).

Lead is a neurotoxic metal that affects areas of the brain that regulate behavior and nerve cell development (NRC, 1993). Its adverse effects range from subtle responses to overt toxicity, depending on how much lead is taken into the body and the age and health status of the person (CDC, 1991). Lead is one of the few pollutants for which biomonitoring and health effect data are sufficient to clearly evaluate environmental management efforts to reduce lead in the environment.

Children, infants, and fetuses are more vulnerable to the effects of lead because the blood-brain barrier is not fully developed in them (Nadakavukaren, 2000). Thus, a smaller amount of lead will have a greater effect on children than on adults. In addition, lead absorption can be up to five times greater in children compared to adults. Currently, no level of lead in blood has been identified as safe in children. Rather, the Centers for Disease Control and Prevention (CDC) has established a “reference level” of 3.5 micrograms per deciliter ($\mu\text{g}/\text{dL}$), which was decreased from 5 $\mu\text{g}/\text{dL}$ in October 2021, to be used to identify children with elevated blood lead levels. The reference level is based on the 97.5th percentile of the blood lead level distribution in U.S. children aged 1-5 years in the NHANES database (CDC, 2021).

This indicator is based on data collected by the National Health and Nutrition Examination Survey (NHANES). NHANES is a series of surveys conducted by 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 began monitoring blood lead in 1976 as part of NHANES II, which covered the period from 1976 through 1980. Blood lead was also monitored in NHANES III, which covered the period between 1988 and 1994. 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.

Blood lead levels have declined steadily since NHANES surveillance of blood lead levels across the U.S. began in 1976. NHANES II (1976-1980) reported that 88.2 percent of children age 1 to 5—the population at the highest risk for lead exposure and effects—had blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$ (i.e., CDC’s defined elevated blood lead level for children under 6 years of age until May 2012). The largest reduction in children’s blood lead levels was seen between NHANES II and the first phase of NHANES III (1988-1991), when the prevalence of blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$ decreased to 8.9 percent (CDC 1994; Meyer et al., 2003). Data collected from 1991 to 1994 as part of the second phase of NHANES III showed a continual decrease, with 4.4 percent of children age 1 to 5 having blood lead levels greater than or equal to 10 $\mu\text{g}/\text{dL}$ (CDC, 2017). The data presented here cover 10 different survey periods from the continuous survey: 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

The geometric mean blood lead levels among all participants age 1 year and older ranged from 0.753 µg/dL (2017-2018) to 1.66 µg/dL (1999-2000) (Exhibit 1). During the most recent survey (2017-2018), 5 percent of those age 1 year or older exhibited blood lead levels of 2.41 µg/dL or greater (Exhibit 1).

Blood lead levels were consistently higher in males than females. In the 2017-2018 survey, males and females had geometric mean blood lead levels of 0.860 µg/dL and 0.664 µg/dL, respectively (Exhibit 1). For non-Hispanic blacks, Mexican Americans, non-Hispanic whites, all Hispanics, and Asians in the 2017-2018 survey, the geometric mean blood lead levels were 0.766, 0.662, 0.772, 0.629, and 1.02 µg/dL, respectively. Non-Hispanic blacks, Mexican Americans, and non-Hispanic whites exhibited similar decreases in blood lead levels between 1999-2000 and 2017-2018 (Exhibit 2). Data collection for all Hispanics and Asians began with the NHANES 2011-2012 survey, with decreases seen each year for all Hispanics and fluctuating levels observed for Asians.

In the 2017-2018 survey, adults 20 years and older had the highest geometric mean blood lead level (0.855 µg/dL) of all the reported age groups. This was followed by the geometric mean blood lead level of children 1 to 5 years of age (0.670 µg/dL), which was the age group with the highest level for all survey periods from 1999-2000 to 2007-2008. Next was children 6 to 11 years of age (0.475 µg/dL) and children 12 to 19 years of age (0.411 µg/dL) (Exhibit 3). Blood lead levels generally declined in all age groups throughout the 1999-2018 survey period, with the largest decrease in geometric mean blood lead levels seen among children 1 to 5 years of age (2.23 µg/dL [1999-2000] to 0.670 µg/dL [2017-2018]) (Exhibit 3).

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.

Data Sources

Data used for this indicator 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, 2022).

References

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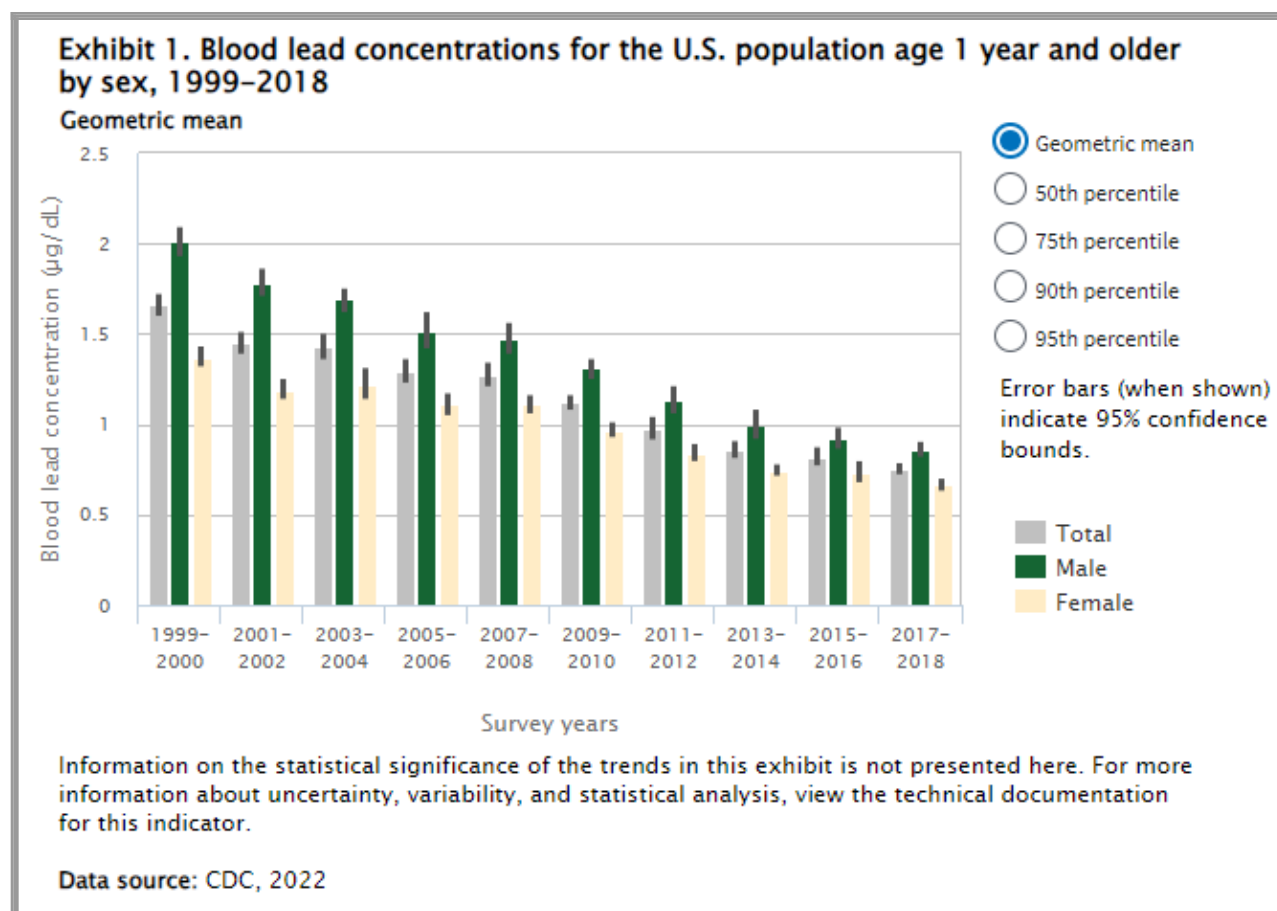
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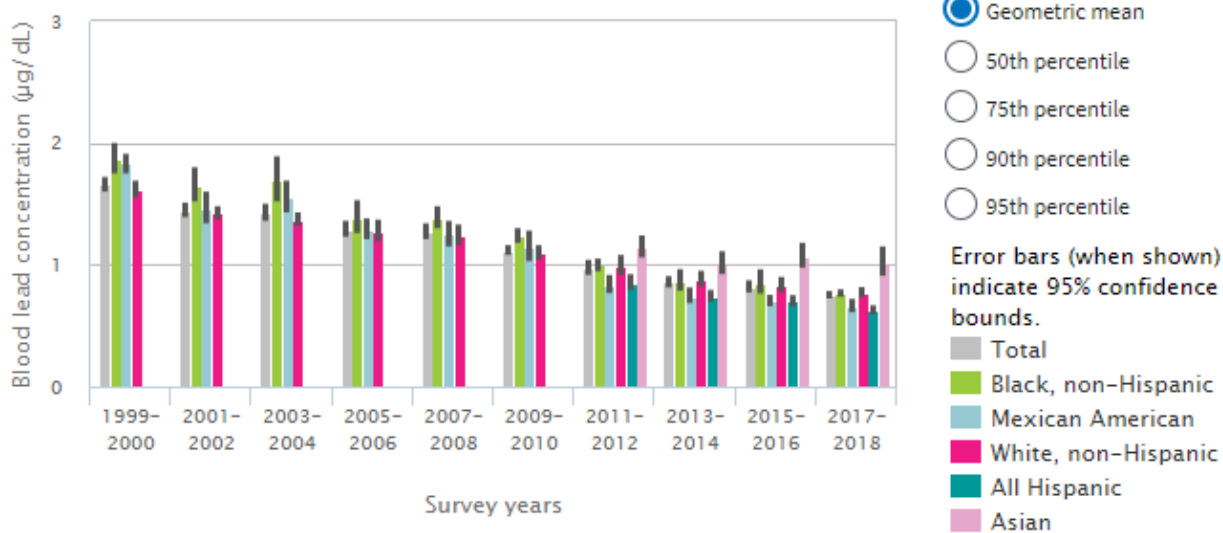
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Exhibit 2. Blood lead concentrations for the U.S. population age 1 year and older by race and ethnicity, 1999–2018

Geometric mean



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.

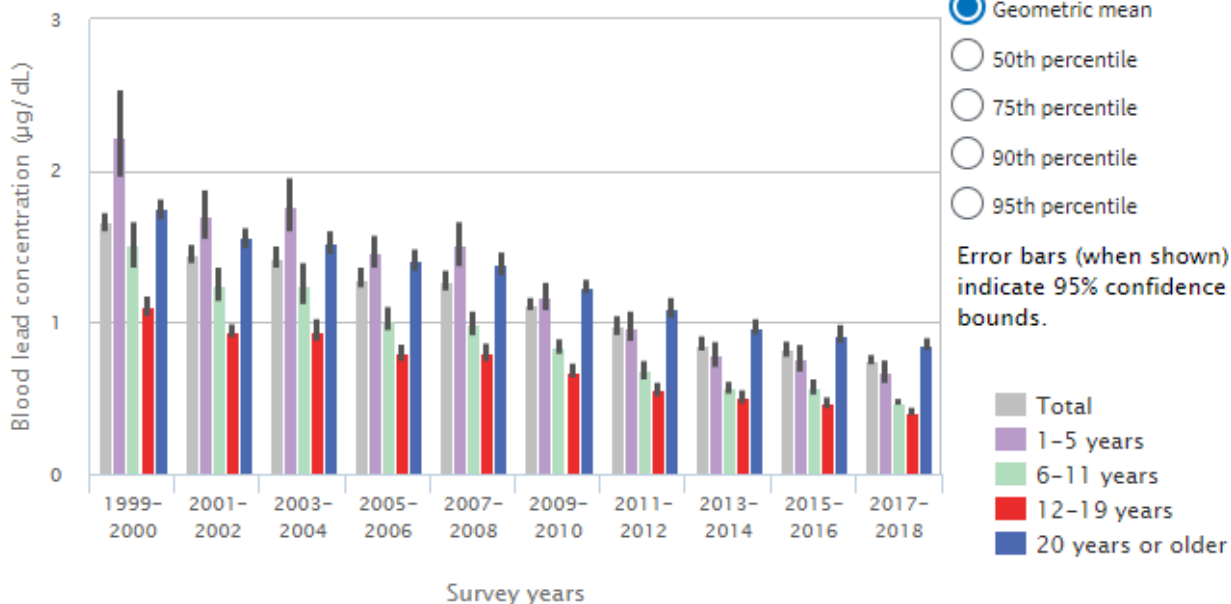
Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: CDC, 2022

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Exhibit 3. Blood lead concentrations for the U.S. population age 1 year and older by age group, 1999–2018

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, 2022

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