NHANES 1999–2000 Data Release

Revised January 2005

Laboratory 22 - Hair Mercury (LAB22)

Description

The objective of the NHANES Hair Mercury component is to document total mercury levels in human hair for a representative sample of U.S. children and women of reproductive age. Previous research has established that the mercury concentration in human scalp hair largely represents dietary methyl mercury exposure, methyl mercury being a known human neurotoxin.

Eligible Sample

The eligible sample was comprised of a full sample of boys and girls aged 1–5 years and women aged 16–49 years. Participants were excluded who lacked hair because of their hairstyle, alopecia totalis, or chemotherapy treatment; who had religious or cultural beliefs against cutting hair; and who wore wigs (unless the participant removed the wig).

Data Collection Methods

See Examination Protocol

Examination Protocol

The purpose of the hair sample collection is to obtain a suitable biological sample that can be used for the determination of total mercury levels in human hair. Prior to hair collection, subjects were asked whether their hair had been given a permanent, or if it had been treated with hair dye or hair relaxer within the last month. Responses to this question were recorded in the variable HRQ010. Hair samples were collected by a trained Mobile Examination Center Health Technologist in a dedicated room, with standardized protocols to avoid contamination. The samples collected represented approximately 100 strands of the 3-cm segment of hair closest to the occipital region (the back portion) of the scalp. Actual lab analysis of hair mercury utilized the 1-cm segment closest to the scalp. The collection procedure was designed to provide 100 mg of hair for analysis (or at least a minimum of 50 mg). This hair sample is used to characterize recent dietary exposure to methyl mercury over a relatively uniform time interval (approximately 2.5 months). Hair specimens were collected, processed, packaged, and stored under appropriate ambient temperature conditions to avoid contamination. Specimens were grouped together and then shipped to the laboratory for chemical analysis. Detailed specimen collection and processing instructions are discussed in the NHANES Specimen Collection Procedure Manual, which can be found at http://www.cdc.gov/nchs/data/nhanes/sc.pdf.

Analytic Methodology

Total hair mercury was analyzed according to the method described in Pellizzari et al. (1). This method involves the extraction of the analyte from hair samples using 30:70 sulfuric:nitric acid and subsequent analysis by cold vapor atomic fluorescence spectrometry. The analyte is identified by the presence of fluorescence signal from a mercury-specific detector. Hair mercury (HRXHG) was typically analyzed in batches of 20–40 samples, and quantification of the analyte was carried out by using batch-specific standard calibration curves. Quality control (QC) procedures included performance testing of a known human hair reference standard, QC standard checks initially and after every 10th sample, and replicate sampling (duplicate sample and duplicate extract repeats). Percent recovery of the mercury analyte was monitored by analyzing hair samples spiked with a known mercury reference standard prior to the extraction process. NHANES hair mercury laboratory values are reported as µg/Hg/g of hair, which is equivalent to parts per million (ppm).

Analytic Notes

Hair mercury detection limits varied by analytic batch in this survey, which was a result of the laboratory's batch-specific standardization methodology. This data release follows the conventions described in Pellizzari et al. (1). Whenever the values for HRXHG were below a batch detection limit, a fill value equal to the batch-specific detection limit divided by the square root of two was entered.

Historically in the toxicology literature, the selection of detection limits for reporting and analyzing data has been variable, and there is not a universally agreed upon convention among researchers. This data release provides total hair mercury data in two alternative formats. The variable HRXHG uses the method quantification limit (MQL) as the "detection limit," and individual samples that are below the MQL are flagged by the value of the companion variable HRDHGLC = 1. The HRXHG "fill value" for a sample that is below the batch-specific MQL is that MQL divided by the square root of 2. The variable HRDHG uses the method detection limit (MDL) as the detection limit, and individual samples below the MDL are flagged by the value of the corresponding companion variable HRDHGLC2 = 1. The HRDHG "fill value" for a sample that is below the batch-specific MDL is that MDL divided by the square root of 2.

The formal definitions of the MQL and MDL have been described previously (2). Briefly, the MQL is the lowest value that could be reliably quantified, given instrument precision for a specific batch. The MQL is operationally defined as 10 times the standard deviation of the reagent blanks in a specific batch run (3). The MDL is the lowest concentration level that, on a categorical level, can be determined to be statistically different from a reagent blank. The operational definition for the MDL is 3 times the standard deviation of the reagent blanks in a specific batch run. Overall, by these definitions, some 12% of the total hair mercury samples analyzed in this study were below the MQL, whereas 1% of the samples were below the MDL. The MDL-based version of the hair mercury variable was used analytically in the recent publication of prevalence results for 1999–2000 (4).

Additional NHANES 1999–2000 variables related to the Lab 22 Hair Mercury data are total and speciated blood mercury and urinary mercury data contained in the Lab06 (Nutritional Biochemistries) dataset.

Summary hair mercury data for 1999, the first year of this survey sample, was published previously in a Centers for Disease Control and Prevention's Morbidity & Mortality Weekly Report (5); an analysis of prevalence trends for the complete 1999-2000 Hair Mercury dataset was published subsequently (4). The NHANES 1999–2000 blood mercury data was analyzed by Schober et al. (6). U.S. reference range data for blood and urinary mercury are provided in the National Center for Environmental Health's Second National Report on Human Exposure to Environmental Chemicals (at http://www.cdc.gov/exposurereport/).

References

1. Pellizzari ED, Fernando R, Cramer GM, Meaburn GM, Bangerter K. Analysis of mercury in hair of EPA Region V population. J Expo Anal Environ Epidemiol. 1999;9:393–401.

2. American Chemical Society Committee on Environmental Improvement. Principles of environmental analysis. Anal Chem. 1983;55:2210–2218.

3. Environmental Protection Agency. Appendix B to Part 136- Definition and procedure for the determination of the method detection limit- Revision 1.11. 40 CFR. 1999;136:303–306.

4. McDowell MA, Dillon CF, Osterloh J, Bolger PM, Pellizzari E, Fernando R, De Oca RM, Schober SE, Sinks T, Jones RL, Mahaffey KR. Hair mercury levels in U.S. children and women of childbearing age: Reference range data from NHANES 1999–2000. Environ Health Perspect. 2004;112:1165–1171.

5. Blood and hair mercury levels in young children and women of childbearing age-United States, 1999. MMWR. 2001;50:140–143.

6. Schober SE, Sinks TH, Jones RL, Bolger PM, McDowell M, Osterloh J, Garrett ES, Canady RA, Dillon CF, Sun Y, Joseph CB, Mahaffey KR. Blood mercury levels in U.S. children and women of childbearing age, 1999–2000. JAMA. 2003;289:1667–1674.