

Mercury Exposure in an Urban Pediatric Population

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Objective.—To determine the prevalence of elevated urinary mercury (Hg), as a marker of exposure, in a population of children drawn from an inner-city community with documented access to elemental mercury.

Methods.—A prospective consecutive patient series was conducted from November 1998 to January 1999 at an inner-city clinic in New York. Anonymous urine specimens from subjects (aged 1–18 years) were collected in mercury-free containers, split, acidified with 1:100 hydrochloric acid, and frozen. Cold-vapor atomic absorption spectrofluorometric assays were conducted simultaneously at laboratories at the University of Washington and the New York City Department of Health.

Results.—We enrolled 100 children (mean age 9.4 years; 62% male; 55% Hispanic; and 43% African American). Assay results from both laboratories were strongly correlated ($r = 0.8$, $P < .0001$). Mean urinary Hg was 1.08 ± 1.82 $\mu\text{g/L}$. The 95th percentile for urinary Hg was 2.8 $\mu\text{g/L}$ (range 0.2 to 11.7 $\mu\text{g/L}$). Five subjects had Hg levels above 5 $\mu\text{g/L}$.

Conclusion.—We found that 5% of subjects had unsuspected elevated urinary Hg levels. This finding, in a group of inner-city minority children, strongly supports the need for further investigation of the sources of mercury exposure in this population.

KEY WORDS: mercury; toxin exposure; urban health

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Childhood exposure to mercury is a growing concern among health care providers and public health officials. Some published reports suggest that a substantial proportion of inner-city minority populations may be engaged in ritualistic uses of elemental mercury.^{1–6} These practices include sprinkling and burning elemental mercury in the home. The volatilization of elemental mercury may present a serious danger to home occupants, particularly children, because absorption of mercury vapor through the lung is nearly complete. Mercury, a potent neurotoxicant, has disproportionate effects on the developing organisms' central nervous system, and for the same dose of elemental mercury exposure, children are affected much more severely than adults.^{7–9}

In a previous report, we found that elemental mercury was readily available at folk pharmacies in a community located in an inner-city section of New York.¹ However, the full extent of elemental mercury exposure in children from this community has not been investigated. Thus, the

aim of this study was to determine the prevalence of elevated urinary mercury (Hg), as a marker of exposure, in a population of children drawn from an inner-city community with documented easy access to elemental mercury.

METHODS

Subjects and Setting

We conducted a prospective consecutive patient series from November 1998 to January 1999 at an ambulatory clinic in the South Bronx of New York City. The study site was located in the same community where we had earlier demonstrated widespread sales of elemental mercury.¹ Nearly all the children treated at this site reside in the same community. Of all children treated at this site, 69% are Hispanic, 30% are African American, and 99% are Medicaid eligible, below the federal poverty level, or working poor.

Inclusion criteria were as follows: 1) clinic visits for routine health maintenance or follow up, 2) routine urinalysis ordered by the physician, 3) no suspicion of urinary tract infection, and 4) age between 1 and 18 years. All children meeting the inclusion criteria were enrolled. All specimens were collected anonymously.

This study was approved by the Institutional Review Board at Montefiore Medical Center, Bronx, New York. Informed consent was waived because of the anonymous use of urine specimens originally collected for non-research purposes.

Laboratory Methods

Urine from each subject was placed in a polyethylene screw-cap container, acidified with 1:100 hydrochloric

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acid, split into pairs, and immediately refrigerated at 4° or lower. Samples from each pair were packed in a Coleman cooler with frozen cold packs and shipped by overnight express delivery service to Dr Woods' laboratory at the University of Washington in Seattle and to the New York City Department of Health Bureau of Laboratories for analyses.

Analysis of mercury in urine samples was performed using a state-of-the-art PSA Merlin Mercury Analysis System. This system employs continuous-flow, cold-vapor spectrofluorometry for mercury detection, has rapid and random-access automatic sampling capabilities (40 samples in less than 1 hour), and affords the highest possible resolution of Hg concentrations in biological media (20 ppt [ng/L] practical detection limit). Data were stored and analyzed using a computerized Touchstone software program. Each urine sample was analyzed in duplicate, and the mean of the 2 analyses was computed as the Hg concentration of that sample. A complete series of quality-control test samples derived from standard reference materials inorganic Hg solutions, including both water and spiked urine samples containing total Hg concentrations in the range of 0 to 100 µg/L, was run with each set of analyses.

To determine the prevalence of elevated urinary Hg, we considered urinary Hg levels above 5 µg/L to be elevated. Although there are no firmly established background levels for urinary Hg in children, published data indicate that the vast majority of unexposed children should have urinary Hg levels below 5 µg/L.⁹⁻¹¹

Data Analysis

The degree of correlation between urinary Hg measurements from both laboratories was examined by Pearson Correlation. Descriptive statistics were used to determine the distribution of mercury measurements.

RESULTS

A total of 100 children participated. There were no refusals. The mean age was 9.4 years. Sixty-two percent of subjects were boys, 55% were Hispanic, and 43% were African American.

Urinary Hg measurements from both laboratories were strongly correlated ($r = 0.8$, $P < .0001$). For all participants, the mean value of urinary Hg measurements was 1.08 µg/L (standard deviation ± 1.82). The 5th, 10th, 25th, 50th, 75th, and 95th percentiles for urinary Hg levels were 0.25, 0.25, 0.38, 0.64, 1.12, and 4.7 µg/L, respectively. The range was 0.2 to 11.7 µg/L.

Five subjects had urinary Hg levels greater than 5 µg/L, and 3 subjects had levels above 10 µg/L.

DISCUSSION

We found that 5% of children in this study had unsuspected elevated urinary Hg levels. These findings, in a group of inner-city minority children, have some ramifications. Published reports¹² indicate that dental personnel with urinary Hg measurements below 4 µg/L have subtle preclinical deficits in cognition, motor function,

and mood. A substantial number of children in our study had urinary Hg levels above 4 µg/L. This is potentially significant because neurodevelopmental deficits have been shown to be more prevalent among inner-city minority children.¹³ Thus, if present in the local environment, elemental mercury may be a contributing factor to the deficits observed in inner-city, low-income minority children.

We note several limitations of our study. As a result of the anonymous approach that was employed, we did not evaluate the children for recent dental work, number of dental amalgam surfaces, or dietary intake of fish. All of these factors have been associated with increased mercury burden.^{14,15} Therefore, we were unable to directly link the measured urinary Hg levels with ritualistic practices. In addition, we were unable to link the urinary Hg measurements to individual demographic data. However, regardless of the source of exposure, elevated urinary Hg is deserving of concern, especially in children. Also, we were unable to assess any relationship between urinary Hg levels and neurobehavioral function in these children, although other studies have documented preclinical toxicity in adults with low levels of exposure.¹²

The findings of this pilot study indicate that mercury exposure is ongoing in this population of children. Comparable populations are extant in cities throughout the United States. Prior work identified ritualistic use of elemental mercury as a possible source of environmental mercury exposure in this community. However, the full scope of sources and ramifications of mercury exposure among these children require more extensive study.

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