HAYDEN-WINKELMAN ARSENIC AND LEAD SURVEY
1999

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Objective

The objectives of this study in Hayden and Winkelman were: 1) to measure exposure to lead in young children through the analysis of blood samples, 2) to measure exposure to arsenic in older children and adults through the analysis of urine samples, and 3) to evaluate the potential for health effects from these exposures.

Background

Lead was commonly found in residential paints produced prior to 1978. Other sources have historically included copper smelters and combustion of leaded gasoline. Evaluating lead exposure is commonly done by analyzing a blood sample. The Centers for Disease Control and Prevention (CDC) have set the intervention level at 10 µg/dl (micrograms per deciliter).

Arsenic compounds are found naturally in the environment and many people are exposed to them at some level in the air, water, food and soil. Arsenic is also produced as a byproduct of copper smelting. Arsenic may be present in different forms, also called species. In general, arsenic species from foods like fish, shellfish, and mushrooms are much less toxic than other forms of arsenic, such as inorganic arsenic found in drinking water and dust. Total arsenic is a measure of all these forms of arsenic combined together. Speciated analysis is needed to separate out the inorganic arsenic, to better estimate the risk of adverse health effects that may result from exposure. Unfortunately, there is no amount of arsenic exposure established as "safe". The concentration of arsenic to which people are exposed from natural sources, called "background" levels, varies in different parts of the world. Europe is generally thought of as a low background area and urinary total arsenic levels are less than 10 µg/L (micrograms per liter), while those in Japan are about 50 µg/L.

Based on an Arizona Department of Health Services review, arsenic concentrations in drinking water since 1989 were <5-10 µg/L in Hayden and within a range of 4-35 µg/L in Winkelman. The EPA (Environmental Protection Agency) presently allows up to 50 µg/L of arsenic in drinking water. Persons drinking water with this concentration of arsenic would be expected to have a urinary arsenic level of approximately 30 µg/L. The EPA is currently considering a revision of this standard, and the allowable concentration may well be reduced. Occupationally exposed persons can have much higher urinary arsenic concentrations, although the American Conference of Governmental Industrial Hygienists has recommended a maximum urinary inorganic arsenic level of 35 µg/L for occupationally exposed workers. Based on this information we have chosen to use 30 µg/L as an action level that requires additional evaluation of the exposed person.

III. Study Design

All children aged 6-36 months in Hayden and Winkelman were eligible for blood lead testing, and all individuals able to collect urine in a cup were eligible for urinary arsenic testing. This study was approved by the Human Subjects Committee at the University of Arizona. Participation was voluntary and written informed consent was obtained from participants or their guardians.

All housing units in Hayden and Winkelman were approached by door-to-door survey, with each unit revisited up to 5 times before a household was considered unreachable. For study participants, a brief questionnaire was used to collect demographic and potential metal exposure information. Blood was collected from children by finger stick. Urine samples for arsenic were obtained from participating individuals, generally as a first morning urine collection.

All field teams included at least one person with Spanish language fluency. Questions were asked in English or Spanish as chosen by the participant. Study consent forms were available in both English and Spanish.

IV. Laboratory Analysis

Blood samples were analyzed for lead by TMCHE (Tucson, Arizona) using graphite furnace atomic absorption spectrophotometry. The minimum detection limit was 1 μg/dl. Urine samples were analyzed for arsenic by Cebrian Laboratories (Mexico City, Mexico) using hydride generation atomic absorption spectroscopy. For total arsenic, the minimum detection limit was 2.5 μg/L. For speciated arsenic, the minimum detection limit was 2.0 μg/L.

V. Summary of Results

LEAD

Between July 11 and October 17, 1999, seven children from 6-36 months of age were tested according to the protocol and study design. At the request of their parents, an additional seven children younger than six months or older than 3 years of age were tested (Table 1). Of eligible children, 41% participated from Hayden and 67% from Winkelman. Blood lead concentrations ranged from below detectable limits to 9 μg/dl, with an average of 3.6 μg/dl. Children with blood lead levels ≤ 9 μg/dl are not considered lead poisoned, based on CDC guidelines. Although no information was available from children in families choosing not to participate in this voluntary study, no cases of lead poisoning in children from Hayden or Winkelman were found.

Table 1. Blood lead testing in Hayden and Winkelman

	Participants (%)	Average blood lead (μg/dl)
Location		
Hayden	6 (43%)	2.8
Winkelman	8(57%)	4.3
Gender		
Male	6 (43%)	3.8
Female	8 (57%)	3.5
Age (months)		
< 6	2 (14%)	3.0
6-36	7 (50%)	3.7
> 36	5 (36%)	3.8

ARSENIC

Between June 25 and October 17, 1999, 224 people in Hayden and Winkelman were tested. Participation rates in eligible households were 52% in Hayden and 46% in Winkelman. For all urine samples, the average total arsenic concentration was 13.7 μg/L, ranging from below detectable limits to 114 μg/L (Table 2). For the 18 samples with total arsenic concentrations exceeding 30 μg/L, speciated analysis was used to measure inorganic arsenic. Five samples from three households were found to contain more than 30 μg/L of inorganic arsenic, with concentrations ranging from 30 to 47 μg/L. Some level of renovation, including painting, had occurred recently in all three households.

Table 2. Urinary arsenic testing in Hayden and Winkelman

	Participants (%)	Average urinary arsenic (µg/L)
Location		
Hayden	150 (67%)	14.3
Winkelman	74 (33%)	12.4
Gender		
Male	108 (48%)	14.8
Female	116 (52%)	12.7
Age		
≤ 16	47 (21%)	14.2
17-65	141 (63%)	14.4
≥ 66	36 (16%)	10.4
Working at smelter or mine		
Yes	33 (15%)	14.2
No	191 (85%)	13.6
Age of housing		
Since 1980	43 (19%)	14.1
1960-1979	58 (26%)	11.2
Before 1960	117 (52%)	13.9
Unsure	6 (3%)	29.8
Length of time lived in house (years)		
≤ 5	70 (31%)	15.8
6-10	53 (24%)	14.9
11-20	26 (12%)	9.3
> 20	75 (33%)	12.4
Household renovation (within 6 months of survey, includes painting)		
Yes	111 (50%)	14.1
No	113 (50%)	13.3
Seafood or mushrooms within 7 days		
Yes	100 (45%)	14.3
No	124 (55%)	13.2

VI. Conclusions

All 14 children tested in Hayden and Winkelman had blood lead concentrations below the CDC intervention level of 10 µg/dl, with an average blood lead concentration of 3.6 µg/dl. No evidence of excessive environmental lead exposure was found in the study participants.

The average urinary total arsenic concentration in Hayden and Winkelman was 13.7 µg/l, which is substantially less than our action level of 30 µg/L.

Five (2%) of 224 individuals tested in Hayden and Winkelman had inorganic urinary arsenic concentrations exceeding 30 μg/L. The maximum concentration measured was 47 μg/L. The possible adverse effects of such levels are not known. We have recommended that these five individuals have their urine retested. If the levels are still high, then interventions should be considered to reduce their arsenic exposure. Given the recent renovation activities in these three households, exposure to house dust may have been a contributing factor.

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