Health Consultation

EXPOSURE INVESTIGATION

SPRING VALLEY CHEMICAL MUNITIONS
(a/k/a AMERICAN UNIVERSITY CHILD DEVELOPMENT CENTER)

WASHINGTON, DISTRICT OF COLUMBIA, DC

MARCH 8, 2001

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333
Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

Exposure Investigation and Consultation Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
Summary

The U.S. Army reported that elevated concentrations of arsenic were detected in surface soil samples collected from some locations in the playground at the Child Development Center (CDC) at the American University in Washington, D.C. Parents of the children who attended the CDC expressed concern that their children may have been exposed to this contamination. In response to this concern, ATSDR collected hair samples from children who were attending the CDC and adult staff at the CDC and tested the samples for arsenic. Hair arsenic concentrations were not elevated in the 28 children and 4 adults who participated in this exposure investigation.

Background

During World War I, the U.S. Army conducted chemical warfare research in the area where American University is now located. Chemical weapons were detonated during research and testing operations, and chemical agents and weapons were also buried in some areas. The testing areas have since been developed and are now occupied by university property and residential homes.

The U.S. Army recently identified a contaminated area at the Child Developmental Center (CDC) at the American University. Surface soil samples collected from the playground are contaminated with arsenic at an average concentration of 57 ppm and a maximum concentration of 498 ppm. The chemical form of the arsenic in the soil has not been identified.

The playground area is covered with about 2 inches of mulch, or grass in some areas. There is also a small garden in the playground. Children and CDC staff reportedly ate vegetables grown in the garden last summer. Upon discovery of this contamination, the CDC was relocated to another area of the campus.

About 30 children are currently enrolled at the CDC. The children range in age from 2½ to 5½ years old. About half of the children have been at CDC for 7 months or less; the rest have been there for 1 year or longer.

The parents of the children have expressed concern over possible exposures to arsenic that their children may have received while playing in the playground. In order to test for these exposures, ATSDR, in conjunction with the District of Columbia Department of Health, collected hair samples from children and CDC staff and tested the samples for arsenic.

This Exposure Investigation (EI) was done to determine the extent of a community health problem and to develop plans for its control. The results obtained are applicable only to the participants of this investigation and are not generalizable to other individuals or populations.
Rationale

Arsenic that is ingested is excreted from the body into the urine within a few days after exposure [1]. Therefore, testing urine for arsenic as an indicator of arsenic exposure is not useful unless testing is conducted soon after the exposure has occurred.

The concentration of arsenic in the root of the hair is in equilibrium with the concentration of arsenic in the blood [2]. Therefore, arsenic is deposited in the hair as it grows out. Hair contains a high content of the protein, keratin, which is rich in the amino acid, cysteine. The arsenic covalently binds to the sulfhydryl group in cysteine, thereby becoming irreversibly bound to the hair. By measuring the concentration of arsenic in a length of hair, one can obtain an integrated measure of arsenic exposure over the period of time the hair grew. Scalp hair grows at a rate of about 1 centimeter (cm)/month, so a 5 cm (about 2 inches) segment of hair represents about 5 months of growth.

External contamination can cause elevated levels of arsenic in hair [2]. Arsenic contamination in air, water, soil, or dust particles can deposit on the hair and bind to the hair shaft. This arsenic may be resistant to being washed off, thereby giving a spuriously elevated hair arsenic level. The potential for external contamination of hair may be increased in long hairs that have been exposed to external contamination for many months or years. Arsenic that is externally bound to the hair has no biological activity and has no health significance.

Target Population

All children who were enrolled at the CDC at the time of the EI were eligible to participate. Testing was also offered to adult teachers and staff at the CDC.

Consent/Assent Form

Prior to testing, a parent or legal guardian of each minor participant was required to sign an informed consent form. Staff from the District of Columbia Department of Health and CDC distributed the consent forms to the parents or guardians of the children and obtained their written consent prior to the EI.

Test Procedures

On January 31 to February 1, 2001, an ATSDR physician collected a hair sample of approximately 0.5 grams from each EI participant. The following protocol, which was provided by the contract laboratory (National Medical Services; Willow Grove, PA), was used in collecting the hair samples. The hair was cut from the back of the head at the nape of the neck.
Hair Collection Procedure

(1) Find an appropriate spot for hair collection, then twist a bundle of hair making sure the tightly twisted hair is more than 1/4 inch in diameter.

(2) While holding the tightly twisted hair in one hand, spread open the hair collection tube with the other hand, then enclose the twisted hair in the collection tube as close to the donor’s scalp as possible.

(3) Place the twist tie around the hair below the plastic collection tube. This keeps the hair intact during shipping and also indicates the root end.

(4) Cut the hair bundle as close to the scalp as possible. Do not remove the collection tube from the cut hair.

(5) Return the collection tube holding the hair to its original position in the hair collection tube holder. Do not remove the twist tie.

For hair that was longer than 2 inches, the 2 inch segment closest to the scalp was used for testing. The hair on some of the children was shorter than 2 inches. For these children, loose hair was cut from the back of the head as close to the scalp as possible.

ATSDR staff sent the hair samples by overnight express to the National Medical Services for analysis. Prior to testing, the hair was twice washed with a non-ionic detergent and twice rinsed with de-ionized water. The hair samples were then analyzed for arsenic using graphite furnace atomic absorption spectroscopy.

Survey forms

A parent or guardian of each child completed a questionnaire for their child that solicited information on possible sources of arsenic exposure in the home. These domestic sources included possible contact with wood preservatives, pesticides, and other arsenic-containing chemicals; use of arsenic-containing herbal medicines; secondary exposures to occupational or recreation sources of arsenic; and consumption of fish and seafood.

Results

Hair samples were collected from 28 children and 4 adults. Detectable levels of arsenic were measured in hair samples from eight of the 32 EI participants at concentrations ranging from 0.10 to 0.14 milligrams per kilogram or parts per million (ppm). In the other 24 hair samples, arsenic was not detected above the analytical detection level. For most of the hair samples, the detection level was 0.1 ppm or less. For some of the boys, the detection level was higher (0.41, 0.27, 0.19 ppm) because of the relatively small mass of hair that was available for analysis. The average hair arsenic concentration in the EI participants was 0.08 ppm, and the median concentration was 0.05 ppm (for these calculations, the arsenic concentration of a non-detectable sample was assumed to be one-half the detection limit of the sample).
Background hair arsenic levels in the general population have not been well characterized. In medical toxicology textbooks, it is often reported that hair arsenic levels in unexposed populations are less than 1 ppm [1,3,4]. In a recent monograph on arsenic, the National Research Council reported that results from several studies indicated that hair arsenic levels in unexposed populations generally range from 0.02 to 0.2 ppm [2]. In a study conducted by the National Center for Environmental Health, it was reported that the average arsenic level in hair samples from 50 people was 0.15 ppm, with a 95th percentile of 0.28 ppm [5].

All of the hair arsenic levels detected in the EI participants were within the ranges reported for unexposed populations. ATSDR concludes that none of the EI participants had hair arsenic levels that indicated unusual exposure to arsenic.

**Reporting Results**

ATSDR staff met with the parents or guardians and gave them the test results for their child and an explanation of their significance.

**Conclusions**

(1) Hair arsenic concentrations were not elevated in the 28 children and 4 adults who participated in this exposure investigation.

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References

(1) Agency for Toxic Substances and Disease Registry; Toxicological Profile for Arsenic (Update); September 2000.


(4) MJ Ellenhor and DG Baceloux; Arsenic; in: Medical Toxicology: Diagnosis and Treatment of Human Poisoning; Elsevier, New York; 1988; pages 1012-1016.