

WASHINGTON OCCUPATIONAL HEALTH ASSOCIATES, INC.

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HEALTH CONSULTATION

**ARSENIC EXPOSURE INVESTIGATION AT AMERICAN
UNIVERSITY**

WASHINGTON, D.C.

March 26, 2001

Prepared by:

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Executive Summary

The U.S. Army Corps of Engineers discovered elevated levels of arsenic in the soil in selected areas of American University (AU) including the Child Development Center (CDC). In response, the University offered testing to select groups of individuals who could potentially have been in contact with soil containing elevated levels of arsenic. The testing examined several groups of participants from the CDC, including staff and students who attended the CDC in the past 12 months, maintenance and grounds crew members, and athletes who play on the intramural fields. A total of 41 adults and 27 children provided hair and/or urine samples for arsenic testing.

Hair samples were provided by 66 individuals (39 adults and 27 children). 63 individuals had non-detectable levels of arsenic and 3 individuals had detectable levels (0.12 mg/kg (ppm), 0.09 mg/kg, and 0.12 mg/kg), but were well within the normal range (0.08 mg/kg to 0.69 mg/kg). Urine samples were provided by 4 adults. All had arsenic levels within normal reporting range (< 0.05 mg/L).

The results of the testing program at American University determined that there are no elevated levels of arsenic in the population tested.

Background

The U.S. Army Corps of Engineers has been conducting an on-site search for chemical and ordinance contaminants left behind at AU and surrounding areas during and immediately after World War I¹. Through this search, several chemicals were discovered on campus grounds and the levels are currently being quantified. One of the chemicals of concern and in elevated concentrations was arsenic. Arsenic was initially found in composite samples at the Child Development Center (CDC) play area at 31 mg/kg. Further analysis of discrete samples revealed that the average concentration of arsenic in this soil was approximately 60 mg/kg with a range up to 498 mg/kg. Additional testing by AU has confirmed the distribution and levels of arsenic in soil adjacent to the CDC.

Inorganic arsenic is found throughout the environment. The Environmental Protection Agency (EPA) has determined that the background level of arsenic in the Spring Valley Area is 13 ppm (95th percentile). Elevated levels of inorganic arsenic may be present in soil, either from natural mineral deposits or contamination from human activities, which may lead to ingestion exposure². Exposure depends on the intensity, frequency, and duration of contact with the soil as well as the bioavailability of arsenic. Biological monitoring may be used to determine if potential exposure may be translated into actual exposure. Measurement of inorganic arsenic exposure in urine is the best way to determine recent exposure (within the last 1 to 2 days), while measuring inorganic arsenic in hair or fingernails may be used to detect chronic exposures within the past six months to one year^{2,3}.

Reported background and elevated levels of arsenic in human urine and hair are highly variable and depend on many factors including individual diets. The Agency for

Toxic Substances and Disease Registry (ATSDR) has noted that normal levels of arsenic in hair or nails are less than 1 mg/kg², National Medical Services Laboratories, who performed the analysis for arsenic in hair reports a normal background level of 0.08 mg/kg to 0.69 mg/kg. Other levels have been reported as follows in the literature: urine arsenic concentrations of unexposed persons may range from 0.01-0.30 mg/L; people who ate a seafood meal developed maximal urine arsenic concentrations of 0.2-1.7 mg/L within 4 hours⁴. Concentrations in hair of normal persons are less than 1 mg/kg, whereas concentrations in subjects with chronic poisoning are often in the range of 1-5 mg/kg and may range as high as 47 mg/kg⁴.

Target Population

AU conducted a comparative exposure analysis and identified three groups that had the highest possibility for potential exposure. These included children who attended CDC, grounds/maintenance crew members who work with potentially contaminated soil, and student rugby players who could come into contact with soil on the intramural fields. AU notified approximately 175 individuals belonging to these groups and offered them the opportunity to be tested.

Sixty-eight individuals had their hair and/or urine tested for arsenic exposure at AU. The sample size was comprised of 20 AU grounds crew/staff members, 27 children that currently attend the CDC or have attended the CDC in the last 12 months, and 21 AU students who play on the rugby team. Testing was offered on two separate days. One subject is currently living abroad and was tested at a local clinic in Chile.

Methodology

Washington Occupational Health Associates, Inc. (WOHA) collected hair and urine samples at American University on February 10 and 15, 2001. Sixty-six people provided hair samples. Each participant (or parent of a child participant) was provided a consent form and questionnaire to complete (*See Exhibit*). The samples were collected from a standardized protocol recommended by the ATSDR. Care was taken to ensure that participants remained comfortable during the testing.

Each technician practiced the recommended hair collection procedure:

1. Find an appropriate spot for hair collection at the nape of the neck and as close to the scalp as possible or from other sites on the head when the nape does not yield the desired length and amount of hair for testing. Tightly twist a bundle of hair, making sure that the bundle is approximately ¼ of an inch in diameter and up to 2 inches in length.
2. While holding the tightly twisted hair in one hand, cut the twisted hair bundle as close to the scalp as possible.
3. Place the hair in the hair collection container provided and send to the lab for analysis.

Random urine samples were collected from 2 individuals that did not have enough hair to sample and from 2 individuals that volunteered for urine testing as well as hair testing.

An American Medical Laboratories (AML) courier picked up all hair and urine samples on the days of testing and these samples were delivered to AML for analysis. AML tested all urine samples for arsenic and forwarded all hair samples to National Medical Services Laboratory for analysis. AML reported all results directly to WOHA.

Analysis

Urine: urine arsenic was determined using ICP-MS (inductively coupled plasma-mass spectrometry) testing with a detection limit of 0.010 mg/L.

Hair: prior to testing, the hair was washed twice 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. The detection limit range was 0.03 – 3.0 mg/kg of hair.

Results

Hair samples were collected from 39 adults and 27 children. Detectable levels of arsenic were reported in 3 children (0.09 mg/kg, 0.12 mg/kg, and 0.12 mg/kg) of the total 66 hair samples collected. Detectable limits in these individuals ranged from 0.03 – 3.0 mg/kg of hair. For the remaining 63 individuals, no arsenic was detected above the reporting limit range of 0.08 to 0.69 mg/kg of hair. The reporting limit range varied due to the varying volume of hair sample received from each individual.

The mean (average) hair arsenic concentration was 0.053 mg/kg and the median concentration was 0.05 mg/kg. For these calculations, the arsenic concentration of a non-detectable sample was assumed to be one-half the detection limit of the sample. This is consistent with the method used by ATSDR in their exposure investigation.

Urine samples were collected from 4 adults. Detectable levels of arsenic were reported in all four specimens (0.017 mg/L, 0.022 mg/L, 0.030 mg/L, and 0.050 mg/L). All reported detectable values fell at or below the range limit of less than 0.050 mg/L of urine.

See Exhibit of Results.

Reporting

WOHA staff tabulated the results of the 68 samples for qualitative analysis and provided each individual with a notification letter regarding their result. In order to protect the privacy of the participants in the testing, individual results were not and will not be released to American University. A WOHA staff member distributed the letters

directly to the individuals on March 1, 2001. Dr. Kenneth Chase, Anish Ranpuria, and Christy Schroeder were available to meet with individuals regarding their results in meetings held on March 5th, 2001.

Conclusion

Based on the sampling performed by WOHA, hair and urine arsenic concentrations were not elevated in the 41 adults and 27 children who participated in this testing program. The results were within the ranges reported for unexposed populations. WOHA's testing is consistent with the results obtained by the Agency for Toxic Substances and Disease Registry (ATSDR) testing program. ATSDR concluded that hair arsenic concentrations were not elevated in the 28 children and 4 adults who participated in their investigation⁵.

If you have any questions, regarding this report, please do not hesitate to contact us.

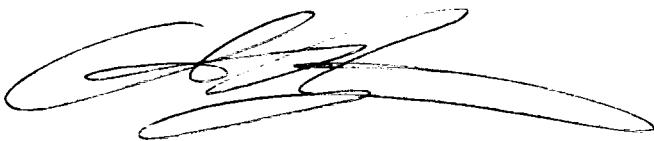
Sincerely,



Kenneth H. Chase, MD, FACOEM
President



Christy Schroeder, RN, BSN
Research Associate



Anish K. Ranpuria, MPH

REFERENCES

1. U.S. Army Corps of Engineers. "American University Experiment Station." Office of History Headquarters. May 1994.
2. Agency for Toxic Substances and Disease Registry; Toxicological Profile for Arsenic (Update). September 2000.
3. V. Valkovic. Human Hair, Volume II: Trace-Element Levels. CRC Press, Inc. Boca Raton, FL. 1988.
4. RC Baselt. Biological Monitoring Methods for Industrial Chemicals. 2nd Edition.
5. Agency for Toxic Substances and Disease Registry (ATSDR) 2001. Health Consultation: Exposure Investigation, Spring Valley Chemical Munitions (a/k/a American University Child Development Center). Washington D.C. March 8, 2001.

ATTACHMENTS/EXHIBITS

7. If you are a student athlete, please list the sport(s) in which you participate and dates of participation:

8. If you are engaged in teaching or research involving chemicals, please briefly describe the nature of the work:

9. If you work in the physical plant department, please describe your job:

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**Consent for Biological Monitoring
American University**

American University has decided to make testing for potential arsenic exposure available to students, faculty, and staff for the University who has had the potential for exposure to soil containing arsenic. The testing involves sampling and chemical analysis of a sample of hair or urine from each participant. This testing will be performed at no cost to you. The University has retained the services of an independent consulting firm, Washington Occupational Health Associates (WOHA) who will collect the actual samples. Your signature on the attached consent form will authorize American University to conduct the test and release the results to you.

If your hair will be tested, a technician will cut a hair sample of about 0.5 grams from the back of your head (nape of the neck) using a pair of scissors. This mass of hair is equal to a bundle of hair about ¼ inch in diameter and 2 inches long. There is no physical pain or discomfort associated with this procedure. This hair sample will be tested only for arsenic.

If your urine will be tested, you will be given a container from the technician and asked to provide a sample. This urine sample will be tested only for arsenic.

Regardless of which test method is used, you will also be asked to fill out a short questionnaire to describe factors relating to potential arsenic exposure.

Participation in this testing is totally voluntary and you may choose to stop at any time, even after signing this consent form.

WOHA will provide you with your test results and an explanation of their significance. The test results will be mailed to you. The results of this test are an indicator of possible exposure to arsenic. These test results are not an indicator of disease and cannot be used to predict the future occurrence of disease.

If you are not a University employee, your individual test results will be maintained under absolute confidentiality. Summary statistics of the tests that do not reveal individual results will be made available to American University, the federal Agency for Toxic Substances and Disease Registry (ATSDR), and the Washington DC Department of Health to determine if any further public health or industrial hygiene intervention steps are necessary.

For University employees, individual test results will not be made available to the University unless your permission is granted for their release. Individual test results will be maintained under absolute confidentiality. Summary statistics of the tests that do not reveal individual results will be made available to American University, the federal Agency for Toxic Substances and Disease Registry (ATSDR), and the Washington DC Department of Health to determine if any further public health or industrial hygiene intervention steps are necessary. If you agree to release the results to the University, these results will be maintained in a confidential supplemental file in the Human Resources Department. These test results will not be included in your personnel file.

For further information, please call the American University information line at (202) 885-2020.

Participant Consent: I am 18 years of age or older and legally competent to understand American University's arsenic exposure testing program. I have read the description of this testing program. All of my questions have been satisfactorily answered. I voluntarily request I be included in this testing program.

Name (print) _____

Age _____ Sex _____

Nature of relationship with AU (student/staff/faculty, etc.) _____

Dates of attendance/employment at AU _____

Mailing Address _____

Telephone number _____

Signature _____

Witness _____ Date _____

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**Consent for Hair Testing
American University Child Development Center**

American University has decided to make testing for potential arsenic exposure available to children who have attended the Child Development Center (CDC) within the past twelve months. The testing involves sampling and chemical analysis of a sample of hair from each child. This testing will be performed at no cost to you. The University has retained the services of an independent consulting firm, Washington Occupational Health Associates (WOHA), who will collect the actual samples. The signature of a parent or legal guardian on the attached consent form will authorize WOHA to conduct the test and release the results to you.

A technician will cut a hair sample of about 0.5 grams from the back of the head (nape of the neck) of each child using a pair of scissors. This mass of hair is equal to a bundle of hair about ¼ inch in diameter and 2 inches long. There is no physical pain or discomfort associated with this procedure. This hair sample will be tested only for arsenic.

Participation in this testing is totally voluntary and you may choose to stop at any time, even after signing this consent form.

WOHA will provide you with your child's test results and an explanation of their significance. The results will be mailed to you. The results of this test are an indicator of possible exposure to arsenic. These test results are not an indicator of disease and cannot be used to predict the future occurrence of disease.

Individual test results will not be made available to American University or to the public and will be maintained under absolute confidentiality unless parental permission is granted for their release. Summary statistics of the tests that do not reveal individual results will be made available to American University, the Agency for Toxic Substances and Disease Registry (ATSDR), and the DC Department of Health to determine if any further public health intervention steps are necessary. We want to stress that these statistics are summaries only, and that your confidentiality will be maintained.

For further information, please call the American University information line at (202) 885-2020.

Participant Consent: I am the parent or legal guardian of the child indicated below. I have read the description of this testing program. All of my questions have been satisfactorily answered. I voluntarily request that my child be included in this testing program.

Child's name (print) _____

Age _____

Sex _____

Dates of attendance at CDC _____

Parent/Guardian's name (print) _____

Mailing Address _____

Telephone number _____

Signature _____

Witness _____ Date _____

DATE OF COLLECTION	SPECIMEN TYPE	PERSONNEL TYPE	RESULTS
2/10/01	Hair	Child (CDC)	0.12 mcg/g
2/10/01	Hair	Child (CDC)	None Detected
2/10/01	Hair	Grounds Crew	None Detected
2/10/01	Hair	Child (CDC)	None Detected
2/10/01	Hair	Child (CDC)	None Detected
2/10/01	Hair	Child (CDC)	None Detected
2/10/01	Hair	Student/Rugby Player	None Detected
2/10/01	Hair	Child (CDC)	None Detected
2/10/01	Hair	Child (CDC)	0.09 mcg/g
2/10/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Staff (CDC)	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Urine	Grounds Crew	22 ug/L Creatinine: 163 mg/dL Arsenic Creatinine Ratio: 13.5

DATE OF COLLECTION	SPECIMEN TYPE	PERSONNEL TYPE	RESULTS
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Urine	Grounds Crew	30 ug/L Creatinine: 98 mg/dL Arsenic/Creatinine Ratio: 30.6
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Child (CDC)	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Student/Rugby Player	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Grounds Crew	None Detected
2/15/01	Hair	Student	None Detected