National Health and Nutrition Examination Survey

2015-2016 Data Documentation, Codebook, and Frequencies

Arsenic - Total - Urine - Special Sample (Subsample) (UTASS_I)

Data File: UTASS_I.xpt

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Last Revised: NA

Component Description

Arsenic is widely distributed in the earth's crust and is found most often in ground water rather than surface water. People encounter arsenic in many chemical forms that vary greatly in toxicity. The most toxic of the naturally occurring arsenic compounds are inorganic forms of arsenic and their methylated metabolites. Less toxic are the organic arsenic compounds. Although this method does not reveal the chemical form of arsenic to which a person is exposed, it is sensitive enough to screen urine specimens rapidly from people thought to be exposed to arsenic or to evaluate total environmental or other total non-occupational exposure to arsenic.

Eligible Sample

Participants aged 18 years and older, who met the regular one-third subsample selection criteria, were included in this special subsample. Additionally, to oversample adult smokers, those participants aged 18 years and older, not in the regular one-third subsample, who smoked at least 100 cigarettes in their entire lifetime (SMQ022=1) and now smoke cigarettes every day (SMQ040=1), were also included in this special subsample.

Description of Laboratory Methodology

The method described in this manual assesses arsenic exposure by analyzing urine through the use of inductively coupled-plasma dynamic reaction cell-mass spectrometry (ICP-DRC-MS). Urine is analyzed because urinary excretion is the major pathway for eliminating arsenic from the mammalian body (Vahter ME, 1988). This method achieves rapid and accurate quantification of total urinary arsenic.

Total urine arsenic concentrations are determined by using ICP-DRC-MS. This multi-element analytical technique is based on quadrupole ICP-MS technology (Date AR et al., 1989) and includes DRC™ technology (Tanner SD et al., 1999), which minimizes or eliminates much argon-based polyatomic interference. Coupling radio frequency power into a flowing argon stream seeded with electrons creates the plasma, the heat source, which is ionized gas suspended in a magnetic field. Predominant species in the plasma are positive argon ions and electrons. Diluted urine samples are converted into an aerosol by using a nebulizer inserted within a spray chamber. A portion of the aerosol is transported through the spray chamber and then through the central channel of the plasma, where it is exposed to temperatures of 6000-8000 ºK. This thermal energy atomizes and ionizes the sample. The ions and the argon enter the mass spectrometer through an interface that separates the ICP, which is operating at atmospheric pressure (approximately 760 torr), from the mass spectrometer, which is operating at approximately 10^{-5} torr. The mass spectrometer permits detection of ions at each mass-to-charge ratio in rapid sequence, which allows the determination of individual isotopes of an element. Once inside the mass spectrometer, the ions pass through the ion optics, then through DRC™, and finally through the mass-analyzing quadrupole before being detected as

they strike the surface of the detector. The ion optics uses an electrical field to focus the ion beam into the DRC™. The DRC™ component is pressurized with an appropriate reaction gas and contains a quadrupole. In the DRC™, elimination or reduction of argon-based polyatomic interferences takes place through the interaction of the reaction gas with the interfering polyatomic species in the incoming ion beam. The quadrupole in the DRC™ allows elimination of unwanted reaction by-products that would otherwise react to form new interferences. Electrical signals, resulting from the detection of the ions, are processed into digital information that is used to indicate the intensity of the ions, and subsequently the concentration of the element. In this method, arsenic (isotope mass 75) and gallium (isotope mass 71) is measured in urine by ICP-DRC-MS, using argon/hydrogen (90%/10%, respectively) as a reaction gas (Neubauer K. et al., 1999). Urine samples are diluted 1:9 with 2% (v/v) double-distilled nitric acid containing gallium or tellurium for internal standardization.

Refer to the Laboratory Method Files section for a detailed description of the laboratory methods used.

There were no changes to laboratory methods, lab equipment, or lab site for this component for 2015-2016 cycle.

Laboratory Method Files

Urinary Metals and Total Arsenic Laboratory Procedure Manual (June 2018)

Laboratory Quality Assurance and Monitoring

Urine samples are processed, stored, and shipped to the Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, GA for analysis.

Detailed instructions on specimen collection and processing are discussed in the NHANES Laboratory Procedures Manual (LPM). Vials are stored under appropriate frozen (–30°C) conditions until they are shipped to National Center for Environmental Health for testing.

The NHANES quality assurance and quality control (QA/QC) protocols meet the 1988 Clinical Laboratory Improvement Act mandates. Detailed QA/QC instructions are discussed in the NHANES LPM

Mobile Examination Centers (MECs)

Laboratory team performance is monitored using several techniques. NCHS and contract consultants use a structured competency assessment evaluation during visits to evaluate both the quality of the laboratory work and the quality-control procedures. Each laboratory staff member is observed for equipment operation, specimen collection and preparation; testing procedures and constructive feedback are given to each staff member. Formal retraining sessions are conducted annually to ensure that required skill levels were maintained.

Analytical Laboratories

NHANES uses several methods to monitor the quality of the analyses performed by the contract laboratories. In the MEC, these methods include performing blind split samples collected on “dry run” sessions. In addition, contract laboratories randomly perform repeat testing on 2% of all specimens.

NCHS developed and distributed a quality control protocol for all CDC and contract laboratories, which outlined the use of Westgard rules (Westgard et al., 1981) when running NHANES specimens. Progress reports containing any problems encountered during shipping or receipt of specimens, summary statistics for each control pool, QC graphs, instrument calibration, reagents, and any special considerations are submitted to NCHS quarterly. The reports are reviewed for trends or shifts in the data. The laboratories are required to explain

any identified areas of concern.

All QC procedures recommended by the manufacturers were followed. Reported results for all assays meet the Division of Laboratory Sciences' quality control and quality assurance performance criteria for accuracy and precision, similar to the Westgard rules (Caudill et al., 2008).

Data Processing and Editing

The data were reviewed. Incomplete data or improbable values were sent to the performing laboratory for confirmation.

Analytic Notes

Refer to the 2015-2016 Laboratory Data Overview for general information on NHANES laboratory data.

Subsample Weights

Urinary total arsenic was measured in a one-third subsample of persons 18 years and older. Special sample weights are required to analyze these data properly. Specific sample weights for this subsample are included in this data file and should be used when analyzing these data.

Demographic and Other Related Variables

The analysis of NHANES laboratory data must be conducted using the appropriate survey design and demographic variables. The NHANES 2015-2016 Demographics File contains demographic data, health indicators, and other related information collected during household interviews as well as the sample design variables. The recommended procedure for variance estimation requires use of stratum and PSU variables (SDMVSTRA and SDMVPSU, respectively) in the demographic data file.

Starting in the 2015-2016 NHANES cycle, the variable URXUCR (urine creatinine) will not be reported in this file. URXUCR can be found in the data file titled Albumin & Creatinine – Urine.

This laboratory data file can be linked to the other NHANES data files using the unique survey participant identifier (i.e., SEQN).

Detection Limits

The detection limits were constant in the data set. Two variables are provided for each of these analytes. The variable name ending in "LC" (ex., URDUASLC) indicates whether the result was below the limit of detection: "0" means that the result was at or above the limit of detection, "1" indicates that the result was below the limit of detection. For analytes with analytic results below the lower limit of detection (ex., URDUASLC=1), an imputed fill value was placed in the analyte results field. This value is the lower limit of detection divided by square root of 2 (LLOD/sqrt [2]). The other variable prefixed URX (ex., URXUAS) provides the analytic result for that analyte.

The lower limit of detection (LLOD, in µg/L) for total arsenic is:

Variable Name	SAS Label	LLOD
URXUAS	Urinary Total Arsenic	0.26

Please refer to the NHANES Analytic Guidelines and the on-line NHANES Tutorial for further details on the use of sample weights and other analytic issues.

References

- Caudill S.P., Schleicher R.L., Pirkle J.L., Multi-rule quality control for the age-related eye disease study. Statist. Med. (2008) 27(30):4094-40106.
- Date AR, Gray AL. Applications of inductively coupled plasma-mass spectrometry. New York: Chapman and Hall; 1989.
- Neubauer K. Vollkopf U. The benefits of a DRC™ to remove carbon- and chloride-based spectral interferences by ICP-MS. Atomic Spectroscopy 1999; 20(2):64-8.
- Tanner SD, Baranov VI. Theory, design and operation of a DRC™ for ICP-MS. Atomic Spectroscopy 1999; 20(2):45-52.
- Vahter ME. Arsenic. In: Clarkson T W, Friberg L, Nordberg G F, Sager P R, editors. Biological monitoring of toxic metals. New York: Plenum Press, 1988. p.303-21.
- Westgard J.O., Barry P.L., Hunt M.R., Groth T. A multi-rule Shewhart chart for quality control in clinical chemistry. Clin Chem (1981) 27:493-501.

Codebook and Frequencies

SEQN - Respondent sequence number

Variable Name:	SEQN
SAS Label:	Respondent sequence number
English Text:	Respondent sequence number.
Target:	Both males and females 18 YEARS - 150 YEARS

WTFSM - Two year smoking weights

Variable Name: WTFSM

SAS Label: Two year smoking weights

English Text: Two year smoking weightsweights

Target: Both males and females 18 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
5682.8332946 to 708016.13026	Range of Values	2389	2389	
0	No Lab Result	73	2462	
.	Missing	0	2462	

URXUAS - Urinary arsenic, total (ug/L)

Variable Name: URXUAS

SAS Label: Urinary arsenic, total (ug/L)

English Text: Urinary arsenic, total (ug/L)

Target: Both males and females 18 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.18 to 677.14	Range of Values	2373	2373	
.	Missing	89	2462	