National Health and Nutrition Examination Survey

2017-March 2020 Data Documentation, Codebook, and Frequencies

Arsenics - Speciated - Urine (P_UAS)

Data File: P_UAS.xpt

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Last Revised: NA

Component Description

The NHANES program suspended field operations in March 2020 due to the coronavirus disease 2019 (COVID-19) pandemic. As a result, data collection for the NHANES 2019-2020 cycle was not completed and the collected data are not nationally representative. Therefore, data collected from 2019 to March 2020 were combined with data from the NHANES 2017-2018 cycle to form a nationally representative sample of NHANES 2017-March 2020 pre-pandemic data. These data are available to the public. Please refer to the Analytic Notes section for more details on the use of the data.

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 (ATSDR, 2007). Less toxic are the organic arsenic compounds (ATSDR, 2007). Exposure to inorganic arsenic can result in a variety of adverse health effects, such as skin disorders, nerve impairment, cancer of the liver, bladder, kidneys, prostate, and lungs, and even death from large doses (ATSDR, 2007). Organic arsenic compounds are generally less toxic and may be encountered by ingesting various types of fish, shellfish, or seaweed (Brown et al., 1990).

Eligible Sample

All examined participants aged 3 to 5 years and a one-third subsample of examined participants aged 6 years and older in the NHANES 2017-March 2020 pre-pandemic sample were eligible.

Description of Laboratory Methodology

Arsenobetaine, arsenocholine, monomethylarsonic acid, dimethylarsinic acid, arsenous (III) acid, arsenic (V) acid

The concentration of speciated arsenics is determined by using high performance liquid chromatography (HPLC) to separate the species coupled to an ICP-DRC-MS to detect the arsenic species. This analytical technique is based on separation by anion-exchange chromatography (IC), followed by detection using quadrupole ICP-MS technology, and includes DRC™ technology (Baranov VI et al., 1999), which minimizes or eliminates many argon-based polyatomic interferences (Tanner S et al., 2000), will require 0.5 mL of urine. Arsenic species column separation is largely achieved due to differences in charge-charge interactions of each negatively charged arsenic component in the mobile phase, with the positively charged quaternary ammonium groups bound at the column's solid-liquid interface. Upon exit from the column, the chromatographic eluent goes through a nebulizer, where it is converted into an aerosol upon entering the spray chamber.

Carried by a stream of argon gas, a portion of the aerosol is transported through the spray chamber and then through the central channel of the plasma, where it is heated to temperatures of 6000-8000° K. 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 the 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.

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

Laboratory Method Files

Arsenics - Speciated - Urine Laboratory Procedure Manual (August 2021)

Arsenics - Speciated - Urine Laboratory Procedure Manual (November 2021)

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 2017-2018 and 2019-2020 NHANES Laboratory Procedures Manuals (LPMs). 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 Amendment mandates. Detailed QA/QC instructions are discussed in the NHANES LPMs.

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 QC 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 QC 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’ QA/QC 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

The COVID-19 pandemic required suspension of NHANES 2019-2020 field operations in March 2020 after data were collected in 18 of the 30 survey locations in the 2019-2020 sample. Data collection was cancelled for the remaining 12 locations. Because the collected data from 18 locations were not nationally

representative, these data were combined with data from the previous cycle (2017-2018) to create a 2017-March 2020 pre-pandemic data file. A special weighting process was applied to the 2017-March 2020 pre-pandemic data file. The resulting sample weights in the demographic data file should be used to calculate estimates from the combined cycles. These sample weights are not appropriate for independent analyses of the 2019-2020 data and will not yield nationally representative results for either the 2017-2018 data alone or the 2019-March 2020 data alone. Please refer to the NHANES website for additional information for the NHANES 2017-March 2020 pre-pandemic data, and for the previous 2017-2018 public use data file with specific weights for that 2-year cycle.

Refer to the 2017-2018 and 2019-2020 Laboratory Data Overview documents for general information on NHANES laboratory data.

There are over 800 laboratory tests performed on NHANES participants. However, not all participants provided biospecimens or enough volume for all the tests to be performed. The specimen availability can also vary by age or other population characteristics. Analysts should evaluate the extent of missing data in the dataset related to the outcome of interest as well as any predictor variables used in the analyses to determine whether additional re-weighting for item non-response is necessary.

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.

Subsample Weights

The analytes included in this dataset were measured in all examined participants aged 3-5 years, and in a one-third subsample of participants 6 years and older. Special sample weights are required to analyze these data properly. Variable (WTSAPRP) encoding of the specific sample weights for this subsample is included in this data file and should be used when analyzing these data. These special sample weights were created to account for the subsample selection probability, as well as the additional nonresponse to these lab tests. Therefore, if participants were eligible for the subsample, but did not provide a urine specimen, they would have the sample weight value assigned as “0” in their records.

Demographic and Other Related Variables

The analysis of NHANES laboratory data must be conducted the appropriate survey design and demographic variables. The NHANES 2017- March 2020 Pre-Pandemic 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.

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

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.

Detection Limits

The detection limits were constant for all of the analytes in the data set. Two variables are provided for each of these analytes. The variable name ending in “LC” (ex., URDUABLC) indicates whether the result was below the limit of detection: the value “0” means that the result was at or above the limit of detection, “1” indicates that the result was below the limit of detection. The other variable prefixed URX (ex., URXUAB) provides the analytic result for that analyte. For analytes with analytic results below the lower limit of detection (ex., URDUABLC=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 lower limit of detection (LLOD, in µg/L) for the speciated arsenics are:

Variable Name	Analyte Description	LLOD
URXUAS3	Urinary Arsenous Acid	0.12
URXUAS5	Urinary Arsenic acid	0.79
URXUAB	Urinary Arsenobetaine	1.16
URXUAC	Urinary Arsenocholine	0.11
URXUDMA	Urinary Dimethylarsinic Acid	1.91
URXUMMA	Urinary Monomethylarsonic Acid	0.20

References

- Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service
- Baranov VI, Tanner SD. A dynamic reaction cell for inductively coupled plasma mass spectrometry (ICP-DRC-MS). Part 1. The rf-field energy contribution in thermodynamics of ion-molecule reactions. J. Anal. At. Spectrom. 1999;14:1133-1142.
- Brown RM, Newton D, Pickford CJ, Sherlock JC. Human metabolism of arsenobetaine ingested with fish. Hum Exp Toxicol 1990;9:41-6.
- Caudill S.P., Schleicher R.L., Pirkle J.L. Multi-rule quality control for the age-related eye disease study. Statist. Med. (2008) 27(20:4094-4106.
- Tanner S, Baranov VI, Vollkopf U. A dynamic reaction cell for inductively coupled plasma mass spectroscopy (ICP-DRC-MS). Part III. Optimization and analytical performance. J. Anal. At. Spectrom. 2000;15:1261-1269.
- 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 3 YEARS - 150 YEARS

WTSAPRP - Subsample A Weights Pre-Pandemic

Variable Name: WTSAPRP

SAS Label: Subsample A Weights Pre-Pandemic

English Text: Subsample A Weights Pre-Pandemic

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
2395.195359 to 955677.30961	Range of Values	4727	4727	
0	No Lab Specimen	163	4890	
.	Missing	0	4890	

URXUAS3 - Urinary Arsenous acid (ug/L)

Variable Name: URXUAS3

SAS Label: Urinary Arsenous acid (ug/L)

English Text: Urinary Arsenous acid (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.08 to 5.77	Range of Values	4625	4625	
.	Missing	265	4890	

URDUA3LC - Urinary Arsenous acid comment code

Variable Name: URDUA3LC

SAS Label: Urinary Arsenous acid comment code

English Text: Urinary Arsenous acid comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	1698	1698	
1	Below lower detection limit	2927	4625	
.	Missing	265	4890	

URXUAS5 - Urinary Arsenic acid (ug/L)

Variable Name: URXUAS5

SAS Label: Urinary Arsenic acid (ug/L)

English Text: Urinary Arsenic acid (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.56 to 7	Range of Values	4625	4625	
.	Missing	265	4890	

URDUA5LC - Urinary Arsenic acid comment code

Variable Name: URDUA5LC

SAS Label: Urinary Arsenic acid comment code

English Text: Urinary Arsenic acid comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	261	261	
1	Below lower detection limit	4364	4625	
.	Missing	265	4890	

URXUAB - Urinary Arsenobetaine (ug/L)

Variable Name: URXUAB

SAS Label: Urinary Arsenobetaine (ug/L)

English Text: Urinary Arsenobetaine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.82 to 2505.42	Range of Values	4625	4625	
.	Missing	265	4890	

URDUABLC - Urinary Arsenobetaine comment code

Variable Name: URDUABLC

SAS Label: Urinary Arsenobetaine comment code

English Text: Urinary Arsenobetaine comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	1848	1848	
1	Below lower detection limit	2777	4625	
.	Missing	265	4890	

URXUAC - Urinary Arsenocholine (ug/L)

Variable Name: URXUAC

SAS Label: Urinary Arsenocholine (ug/L)

English Text: Urinary Arsenocholine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.08 to 23.64	Range of Values	4625	4625	
.	Missing	265	4890	

URDUACLC - Urinary Arsenocholine comment code

Variable Name: URDUACLC

SAS Label: Urinary Arsenocholine comment code

English Text: Urinary Arsenocholine comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	428	428	
1	Below lower detection limit	4197	4625	
.	Missing	265	4890	

URXUDMA - Urinary Dimethylarsinic acid (ug/L)

Variable Name: URXUDMA

SAS Label: Urinary Dimethylarsinic acid (ug/L)

English Text: Urinary Dimethylarsinic acid (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
1.35 to 181.55	Range of Values	4625	4625	
.	Missing	265	4890	

URDUDALC - Urinary Dimethylarsinic acid comment

Variable Name: URDUDALC

SAS Label: Urinary Dimethylarsinic acid comment

English Text: Urinary Dimethylarsinic acid comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limlt	3289	3289	
1	Below lower detection limit	1336	4625	
.	Missing	265	4890	

URXUMMA - Urinary Monomethylarsonic acid (ug/L)

Variable Name: URXUMMA

SAS Label: Urinary Monomethylarsonic acid (ug/L)

English Text: Urinary Monomethylarsonic acid (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.14 to 6.43	Range of Values	4625	4625	
.	Missing	265	4890	

URDUMMAL - Urinary Monomethylarsonic acid comment

Variable Name: URDUMMAL

SAS Label: Urinary Monomethylarsonic acid comment

English Text: Urinary Monomethylarsonic acid comment code

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2108	2108	
1	below lower detection limit	2517	4625	
.	Missing	265	4890	