National Health and Nutrition Examination Survey

2017-March 2020 Data Documentation, Codebook, and Frequencies

Metals - Urine (P_UM)

Data File: P_UM.xpt

First Published: November 2021

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.

Metals

Trace metals have been associated with adverse health effects in occupational studies or laboratory studies but have not been monitored in general population groups. This method is used to achieve rapid and accurate quantifications of multiple elements of toxicological and nutritional interest. The method is sensitive and rapid enough to analyze urine specimens from subjects suspected of being exposed to a number of important toxic elements, or to evaluate environmental or other non-occupational exposure to these same elements (Caldwell, 2005).

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. Due to disclosure concern, urine lead data from participants aged 3 to 5 years, as well as urine strontium and uranium from participants 3 years and older may only be accessed through the NCHS Research Data Center. Urine lead data from participants aged 6 years and older, and urine barium, cadmium, cesium, cobalt, manganese, molybdenum, antimony, thallium, tin, and tungsten data from all examined participants 3 years and older are included in this dataset. See Analytic Notes for additional information on urine lead data from participants aged 3 to 5 years and urine strontium and uranium for participants 3 years and older.

Description of Laboratory Methodology

This method (Caldwell, 2005) directly measures the barium, cadmium, cesium, cobalt, manganese, molybdenum, lead, antimony, thallium, tin, tungsten, and other elemental content of urine specimens using inductively coupled plasma mass spectrometry (ICP-MS) after a simple dilution sample preparation step. Liquid samples are reduced to small droplets in an argon aerosol via a nebulizer, and then the droplets enter the ICP where the thermal energy atomizes the sample and then ionizes the atoms. The ions are pulled into the mass spectrometer where they are focused through the universal cell technology (UCT), the quadrupole mass filter, and finally are selectively counted in rapid sequence at the detector according to their mass-to-charge (m/z) ratio. When detecting cadmium, the UCT is filled with oxygen gas to eliminate polyatomic interferences. When detecting cobalt, the UCT is filled with helium gas and operated in a kinetic energy discrimination (KED) mode to eliminate polyatomic interferences. The UCT is vented to vacuum while detecting the other elements. Quantification is accomplished by comparing the blank-subtracted counting rate of the element of interest from a sample, ratioed to an internal standard, to the counting rate, ratioed to an internal standard, of blank-subtracted, matrix-matched, external calibrators, tested within the same analytical run.

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

was a change to the method between the 2017-2018 and the 2019-March 2020 cycles.

Laboratory Method Files

Metals - Urine (August 2021)

Metals - Urine (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 Amendments 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) used 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 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

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 using 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 change in methods between the 2017-2018 and 2019-March 2020 cycles resulted in different lower detection limits between the data obtained in the 2019-March 2020 and those in the 2017-2018 survey cycle. In order to make the merged dataset compatible the higher detection limit of the two methods for each analyte was used for both cycles. Two variables are provided for each of these analytes. The variable name ending in "LC" (ex., URDUBALC) 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., URXUBA) provides the analytic result for that analyte. For analytes with analytic results below the lower limit of detection (ex., URDUBALC=1), an imputed fill value was placed in the analyte results field. This value is the lower limit of detection divided by the square root of 2 (LLOD/sqrt[2]).

The lower limit of detection (LLOD, in µg/L) for the urinary metals in the present dataset are:

Variable Name	SAS Label	LLOD
URXUBA	Urinary Barium	0.084
URXUCD	Urinary Cadmium	0.055
URXUCS	Urinary Cesium	0.130
URXUCO	Urinary Cobalt	0.024
URXUMN	Urinary Manganese	0.130
URXUMO	Urinary Molybdenum	0.80
URXUPB	Urinary Lead	0.030
URXUSB	Urinary Antimony	0.022
URXUTL	Urinary Thallium	0.018
URXUSN	Urinary Tin	0.20
URXUTU	Urinary Tungsten	0.018

Data Access

Urine Lead data for youth aged 3 to 5 years and urine strontium and uranium for participants 3 years and older are included in file "Lead (Youth), Strontium, and Uranium - Urine (P_UM_R)", and are available through the NCHS Research Data Center.

References

- Caldwell K.L., et al., (2005) Inductively coupled plasma mass spectrometry to measure multiple toxic elements in urine in NHANES 1999-2000. Atomic Spectroscopy. 26(1):1-7. [NHANES 1999-2020].

- Caudill SP, Schleicher RL, Pirkle JL. Multi-rule quality control for the age-related eye disease study. Statist Med 2008; 27:4094-106.

- 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	

URXUBA - Barium, urine (ug/L)

Variable Name: URXUBA

SAS Label: Barium, urine (ug/L)

English Text: Barium, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.059 to 92.612	Range of Values	4595	4595	
.	Missing	295	4890	

URDUBALC - Urinary Barium Comment Code

Variable Name: URDUBALC

SAS Label: Urinary Barium Comment Code

English Text: Urinary Barium 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	4544	4544	
1	Below lower detection limit	51	4595	
.	Missing	295	4890	

URXUCD - Cadmium, urine (ug/L)

Variable Name:	URXUCD
SAS Label:	Cadmium, urine (ug/L)
English Text:	Cadmium, urine (ug/L)
Target:	Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.039 to 7.581	Range of Values	4595	4595	
.	Missing	295	4890	

URDUCDLC - Urinary Cadmium Comment Code

Variable Name: URDUCDLC

SAS Label: Urinary Cadmium Comment Code

English Text: Urinary Cadmium 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	3235	3235	
1	Below lower detection limit	1360	4595	
.	Missing	295	4890	

URXUCO - Cobalt, urine (ug/L)

Variable Name: URXUCO

SAS Label: Cobalt, urine (ug/L)

English Text: Cobalt, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.017 to 32.377	Range of Values	4594	4594	
.	Missing	296	4890	

URDUCOLC - Urinary Cobalt Comment Code

Variable Name: URDUCOLC

SAS Label: Urinary Cobalt Comment Code

English Text: Urinary Cobalt 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	4567	4567	
1	Below lower detection limit	27	4594	
.	Missing	296	4890	

URXUCS - Cesium, urine (ug/L)

Variable Name: URXUCS

SAS Label: Cesium, urine (ug/L)

English Text: Cesium, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.223 to 33.27	Range of Values	4595	4595	
.	Missing	295	4890	

URDUCSLC - Urinary Cesium Comment Code

Variable Name: URDUCSLC

SAS Label: Urinary Cesium Comment Code

English Text: Urinary Cesium 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	4595	4595	
1	Below lower detection limit	0	4595	
.	Missing	295	4890	

URXUMO - Molybdenum, urine (ug/L)

Variable Name: URXUMO

SAS Label: Molybdenum, urine (ug/L)

English Text: Molybdenum, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.93 to 665.23	Range of Values	4595	4595	
.	Missing	295	4890	

URDUMOLC - Urinary Molybdenum Comment Code

Variable Name: URDUMOLC

SAS Label: Urinary Molybdenum Comment Code

English Text: Urinary Molybdenum 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	4595	4595	
1	Below lower detection limit	0	4595	
.	Missing	295	4890	

URXUMN - Manganese, urine (ug/L)

Variable Name: URXUMN

SAS Label: Manganese, urine (ug/L)

English Text: Manganese, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.092 to 11.844	Range of Values	4595	4595	
.	Missing	295	4890	

URDUMNLC - Urinary Mn Comment Code

Variable Name: URDUMNLC

SAS Label: Urinary Mn Comment Code

English Text: Urinary Mn 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	1499	1499	
1	Below lower detection limit	3096	4595	
.	Missing	295	4890	

URXUPB - Lead, urine (ug/L)

Variable Name: URXUPB

SAS Label: Lead, urine (ug/L)

English Text: Lead, urine (ug/L)

Target: Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.021 to 19.34	Range of Values	3937	3937	
.	Missing	953	4890	

URDUPBLC - Urinary Lead Comment Code

Variable Name: URDUPBLC

SAS Label: Urinary Lead Comment Code

English Text: Urinary Lead Comment Code

Target: Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	3905	3905	
1	Below lower detection limit	32	3937	
.	Missing	953	4890	

URXUSB - Antimony, urine (ug/L)

Variable Name: URXUSB

SAS Label: Antimony, urine (ug/L)

English Text: Antimony, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.016 to 4.285	Range of Values	4595	4595	
.	Missing	295	4890	

URDUSBLC - Urinary Antimony Comment Code

Variable Name:	URDUSBLC
SAS Label:	Urinary Antimony Comment Code
English Text:	Urinary Antimony 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	3811	3811	
1	Below lower detection limit	784	4595	
.	Missing	295	4890	

URXUSN - Tin, urine (ug/L)

Variable Name: URXUSN

SAS Label: Tin, urine (ug/L)

English Text: Tin, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.14 to 132.29	Range of Values	4595	4595	
.	Missing	295	4890	

URDUSNLC - USN Comment Code

Variable Name: URDUSNLC

SAS Label: USN Comment Code

English Text: USN 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	3772	3772	
1	Below lower detection limit	823	4595	
.	Missing	295	4890	

URXUTL - Thallium, urine (ug/L)

Variable Name: URXUTL

SAS Label: Thallium, urine (ug/L)

English Text: Thallium, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.013 to 1.492	Range of Values	4595	4595	
.	Missing	295	4890	

URDUTLLC - Urinary Thallium Comment Code

Variable Name: URDUTLLC

SAS Label: Urinary Thallium Comment Code

English Text: Urinary Thallium 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	4582	4582	
1	Below lower detection limit	13	4595	
.	Missing	295	4890	

URXUTU - Tungsten, urine (ug/L)

Variable Name: URXUTU

SAS Label: Tungsten, urine (ug/L)

English Text: Tungsten, urine (ug/L)

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.013 to 29.4	Range of Values	4595	4595	
.	Missing	295	4890	

URDUTULC - Urinary Tungsten Comment Code

Variable Name: URDUTULC

SAS Label: Urinary Tungsten Comment Code

English Text: Urinary Tungsten 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	4166	4166	
1	Below lower detection limit	429	4595	
.	Missing	295	4890	