Documentation, Codebook, and Frequencies

Laboratory Component:
Heavy Metals

Survey Years:
2003 to 2004

SAS Export File:
L06HM_C.XPT

nhanes

First Published: July 2007
Last Revised:N/A

NHANES 2003–2004 Data Documentation

Laboratory Assessment: Lab 6HM - Heavy Metals

Years of Coverage: 2003–2004   **First Published:** July 2007   **Last Revised:** N/A

Component Description

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 screen urine specimens from subjects suspected to be exposed to a number of important toxic elements or to evaluate environmental or other nonoccupational exposure to these same elements.

Eligible Sample

Participants aged 6 years and older who met the subsample requirements.

Description of Laboratory Methodology

Inductively coupled plasma-mass spectrometry (ICP-MS) is a multi-element analytical technique (1). Liquid samples are introduced into the ICP through a nebulizer and spray chamber carried by a flowing argon stream. By coupling radio-frequency power into flowing argon, plasma is created in which the predominant species are positive argon ions and electrons. The sample passes through a region of the plasma that has a temperature of 6000–8000 K. The thermal energy atomizes the sample and then ionizes the atoms. The ions, along with the argon, enter the mass spectrometer through an interface that separates the ICP from the mass spectrometer, which is operating at an atmospheric pressure of 10^{-5} torr. The mass spectrometer permits ions at each mass to be detected in rapid sequence, allowing individual isotopes of an element to be determined. Electrical signals resulting from the detection of the ions are processed into digital information that is used to indicate first the intensity of the ions and then the concentration of the element. The ICP-MS method is used to measure the following 12 elements in urine: beryllium (Be), cobalt (Co), molybdenum (Mo), cadmium (Cd), antimony (Sb), cesium (Cs), barium (Ba), tungsten (W), platinum (Pt), thallium (Tl), lead (Pb), and uranium (U). This method is based on the method by Mulligan et al. (2) Urine samples are diluted

1+9 with 2% (v/v), double-distilled, concentrated nitric acid containing both iridium (Ir) and rhodium (Rh) for multi-internal standardization. This procedure can be used for all 12 elements or subsets of the 12 elements.

Laboratory Quality Control and Monitoring

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

Detailed specimen collection and processing instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Vials are stored under appropriate frozen (–20°C) conditions until they are shipped to National Center for Environmental Health for testing.

Mobile Examination Centers (MECs)

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

The NHANES QA/QC protocols meet the 1988 Clinical Laboratory Improvement Act mandates. Detailed QA/QC instructions are discussed in the NHANES LPM.

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 2.0% of all specimens.

NCHS developed and distributed a quality control protocol for all the contract laboratories which outlined the Westgard rules 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 and Westat 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 Science's quality control and quality assurance performance criteria for accuracy and precision (similar to specifications outlined by Westgard 1981).

Analytic Notes

Subsample weights
Measures of urinary heavy metals were measured in a one third subsample of persons 6 years and over. 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.

Variance estimation
The analysis of NHANES 2003-2004 laboratory data must be conducted with the key survey design and basic demographic variables. The NHANES 2003-2004 Demographic Data File contains demographic and 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.

Links to NHANES Data Files
This laboratory data file can be linked to the other NHANES 2003-2004 data files using the unique survey participant identifier SEQN.

Detection Limits
The detection limit was variable for many of the analytes in the data set. Two variables are provided for each of these analytes. The variable named LBD___LC indicates whether the result was below the limit of detection. There are two values: "0" and "1"". "0" means that the result was at or above the limit of detection.   "1" indicates that the result was below the limit of detection. Urinary beryllium, cadmium, lead, platinum, tungsten, and uranium have multiple lower limits of detection in this data file. The other variable named LBX___ provides the analytic result for that analyte. In cases, where the result was below the limit of detection, the value for that variable is the detection limit divided by the

square root of two.

URXUCD and URDUCD:

When comparing urine cadmium across two-year cycles please note that even though these two variables have different names the data is comparable. Variable URXUCD is used in 1999-2000 and 2003-2004 and variable URDUCD was used in 2001-2002. Variable URDUCD was derived to correct for molybdenum interference (Reference to 2001-2002 lab 6 heavy metal documentation). Beginning in 2003-2004 the urinary cadmium data is corrected at the testing laboratory for molybdenum interference.

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

References

1. Date AR, Gray AL. Applications of Inductively Coupled Plasma Mass Spectrometry. NY: Chapman and Hall; 1989.

2. Franke AA, Custer LJ. High-performance liquid chromatographic assay of isoflavonoids and coumestrol from human urine. J Chromatogr B Biomed Appl. 1994;662:47–60.

3. Gamache PH, Acworth IN. Analysis of phytoestrogens and polyphenols in plasma, tissue, and urine using HPLC with coulometric array detection. Proc Soc Exp Biol Med. 1998;217:274–280.

4. Joannou GE, Kelly GE, Reeder AY, Waring M, Nelson C. A urinary profile study of dietary phytoestrogens. J Steroid Biochem Mol Biol. 1995;54:167–184.

5. Messina M, Barnes S, Setchell KD. Phyto-oestrogens and breast cancer. Lancet. 1997;350:971–972.

6. Barnes S, Coward L, Kirk M, Sfakianos J. HPLC-mass spectrometry analysis of isoflavones. Proc Soc Exp Biol Med. 1998;217:254–262.

Locator Fields

Title: Lab 6HM - Heavy Metals

Contact Number: 1-866-441-NCHS

Years of Content: 2003–2004

First Published: July 2007

Revised: N/A

Access Constraints: None

Use Constraints: None

Geographic Coverage: National

Subject: Heavy Metals

Record Source: NHANES 2003–2004

Survey Methodology: NHANES 2003–2004 is a stratified multistage probability sample of the civilian non-institutionalized population of the U.S.

Medium: NHANES Web site; SAS transport files

National Health and Nutrition Examination Survey
Codebook for Data Production (2003-2004)

Heavy Metals (L06HM_C)
Person Level Data

First Published: July 2007
Last Revised: N/A

SEQN	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Respondent sequence number

English Text: Respondent sequence number.

English Instructions:

WTSA2YR	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Two-year MEC weights of subsample A

English Text: Heavy Metals Subsample 2 year Mec Weight.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0 to 455771.88304	Range of Values	2673	2673	
.	Missing	0	2673	

URXUCR	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Creatinine, urine (mg/dL)

English Text: Creatinine, urine (mg/dL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
6 to 768	Range of Values	2586	2586	
.	Missing	87	2673	

URXUBA	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Barium, urine (ng/mL)			

English Text: Barium, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.15 to 108.1	Range of Values	2374	2374	
0.22	Fill Value of Limit of Detection	184	2558	
.	Missing	115	2673	

URDUBALC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary barium comment code			

English Text: Urinary barium comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2374	2374	
1	Below lower detection limit	184	2558	
.	Missing	115	2673	

URXUBE	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Beryllium, urine (ng/mL)			
English Text: Beryllium, urine (ng/mL).				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0.11 to 0.13	Range of Values	24	24	
0.05	First Fill Value of Limit of Detection	30	54	
0.08	Second Fill Value of Limit of Detection	2504	2558	
.	Missing	115	2673	

URDUBELC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary beryllium comment code			
English Text: Urinary beryllium comment code.				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	24	24	
1	Below lower detection limit	2534	2558	
.	Missing	115	2673	

URXUCD	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Cadmium, urine (ng/mL)

English Text: Cadmium, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.04 to 14.94	Range of Values	2317	2317	
0.03	First Fill Value of Limit of Detection	178	2495	
0.04	Second Fill Value of Limit of Detection	48	2543	
.	Missing	130	2673	

URDUCDLC	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Urinary cadmium comment code

English Text: Urinary cadmium comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2317	2317	
1	Below lower detection limit	226	2543	
.	Missing	130	2673	

URXUCO	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Cobalt, urine (ng/mL)			
English Text: Cobalt, urine (ng/mL).				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0.08 to 127.87	Range of Values	2463	2463	
0.06	Fill Value of Limit of Detection	95	2558	
.	Missing	115	2673	

URDUCOLC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary cobalt comment code			
English Text: Urinary cobalt comment code.				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2463	2463	
1	Below lower detection limit	95	2558	
.	Missing	115	2673	

URXUCS	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Cesium, urine (ng/mL)			
English Text: Cesium, urine (ng/mL).				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0.34 to 552.12	Range of Values	2558	2558	
.	Missing	115	2673	

URDUCSLC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary cesium comment code			
English Text: Urinary cesium comment code.				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2558	2558	
1	Below lower detection limit	0	2558	
.	Missing	115	2673	

URXUMO	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Molybdenum, urine (ng/mL)

English Text: Molybdenum, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
1.7 to 1215.9	Range of Values	2555	2555	
1.06	Fill Value of Limit of Detection	3	2558	
.	Missing	115	2673	

URDUMOLC	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Urinary molybdenum comment code

English Text: Urinary molybdenum comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2555	2555	
1	Below lower detection limit	3	2558	
.	Missing	115	2673	

URXUPB	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Lead, urine (ng/mL)

English Text: Lead, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.17 to 12.9	Range of Values	2170	2170	
0.07	First Fill Value of Limit of Detection	3	2173	
0.23	Second Fill Value of Limit of Detection	385	2558	
.	Missing	115	2673	

URDUPBLC	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Urinary lead comment code

English Text: Urinary lead comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2170	2170	
1	Below lower detection limit	388	2558	
.	Missing	115	2673	

URXUPT	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Platinum, urine (ng/mL)

English Text: Platinum, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.01 to 1.7	Range of Values	10	10	
0.01	First Fill Value of Limit of Detection	25	35	
0.05	Second Fill Value of Limit of Detection	2523	2558	
.	Missing	115	2673	

URDUPTLC	Target
	B(6 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Urinary platinum comment code

English Text: Urinary platinum comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	10	10	
1	Below lower detection limit	2548	2558	
.	Missing	115	2673	

URXUSB	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Antimony, urine (ng/mL)			

English Text: Antimony, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.04 to 3.73	Range of Values	1601	1601	
0.02	First Fill Value of Limit of Detection	2	1603	
0.05	Second Fill Value of Limit of Detection	955	2558	
.	Missing	115	2673	

URDUSBLC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary antimony comment code			

English Text: Urinary antimony comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	1601	1601	
1	Below lower detection limit	957	2558	
.	Missing	115	2673	

URXUTL	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Thallium, urine (ng/mL)			
English Text: Thallium, urine (ng/mL).				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0.02 to 1.41	Range of Values	2539	2539	
0.011	Fill Value of Limit of Detection	19	2558	
.	Missing	115	2673	

URDUTLLC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary thallium comment code			
English Text: Urinary thallium comment code.				
English Instructions:				

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2539	2539	
1	Below lower detection limit	19	2558	
.	Missing	115	2673	

URXUTU	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Tungsten, urine (ng/mL)			

English Text: Tungsten, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.02 to 3.93	Range of Values	2115	2115	
0.01	First Fill Value of Limit of Detection	7	2122	
0.02	Second Fill Value of Limit of Detection	421	2543	
0.03	Third Fill Value of Limit of Detection	15	2558	
.	Missing	115	2673	

URDUTULC	Target			
	B(6 Yrs. to 150 Yrs.)			
Hard Edits	**SAS Label**			
	Urinary tungsten comment code			

English Text: Urinary tungsten comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	2115	2115	
1	Below lower detection limit	443	2558	
.	Missing	115	2673	

URXUUR	Target
	B(6 Yrs. to 150 Yrs.)

Hard Edits	SAS Label
	Uranium, urine (ng/mL)

English Text: Uranium, urine (ng/mL).

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0.001 to 0.979	Range of Values	1795	1795	
0.001	First Fill Value of Limit of Detection	6	1801	
0.004	Second Fill Value of Limit of Detection	756	2557	
.	Missing	116	2673	

URDUURLC	Target
	B(6 Yrs. to 150 Yrs.)

Hard Edits	SAS Label
	Urinary uranium comment code

English Text: Urinary uranium comment code.

English Instructions:

Code or Value	Description	Count	Cumulative	Skip to Item
0	At or above the detection limit	1795	1795	
1	Below lower detection limit	762	2557	
.	Missing	116	2673	