National Health and Nutrition Examination Survey

2015-2016 Data Documentation, Codebook, and Frequencies

Aromatic Diamines - Urine (UADM_I)

Data File: UADM_I.xpt

First Published: October 2018

Last Revised: NA

Component Description

Urinary aromatic diamines can be formed from the metabolism of diisocyanates, which are widely used in the polymer industry, particularly in the production of polyurethane-based consumer products (e.g., foam cushions, mattresses, pillows, and car seats), elastomers, coating, and adhesives (Lockey, J. E., et. al, 2015).

Diisocyanates may be released into the environment through industrial waste, and volatilization and degradation of consumer products. Exposure to diisocyanates can occur through dermal contact, ingestion, and inhalation. All diisocyanates are classified as skin and respiratory sensitizers (Lockey, J. E., et. al, 2015; Timchalk, C., et. al, 1994). Exposure to these chemicals can be lethal when inhaled at high concentrations by sensitized subjects, can elicit hypersensitivity pneumonitis and accelerated lung function loss, and is considered one of the most frequently reported causes of occupational asthma (Lockey, J. E., et. al, 2015; Dykewicz, M. S., 2009; Merget, R., et. al, 2002). In addition, the in vivo hydrolyzed product of diisocyanates (i.e., diamines such as 4,4'-Diaminodiphenylmethane (4MDA), 2,4-Diaminotoluene (4TDA), 2,6-Diaminotoluene (6TDA), 1,5-Diaminonaphthalene (5NDA), and p-phenylenediamine (PPDA)) have been reported as hepatotoxic and carcinogenic in human and animal models (Timchalk, C., et. al, 1994; Report on Carcinogens, 13th ed.; IARC, 1999; McGill, D.B., et. al, 1974).

Eligible Sample

All examined participants aged 3 to 5 years were eligible and participants aged 6 years and older from a one-third subsample were eligible.

Description of Laboratory Methodology

This method is a quantitative procedure for the measurement of urinary aromatic diamines using ultra performance liquid chromatography coupled with atmospheric pressure chemical ionization tandem mass spectrometry (UPLC-APCI-MS/MS). Prior to chromatographic separation, urine samples are hydrolyzed in 0.6 M hydrochloric acid at 80 °C for 4 hours. Hydrolyzed samples are passed through solid phase extraction (SPE) sorbents. Chromatographic separation is achieved using a reversed phase column with 5 mM ammonium acetate buffer at pH 9.2 (mobile phase A) and 5/95% 100 mM ammonium acetate buffer/acetonitrile (mobile phase B). The eluent from the column is ionized using an APCI interface to generate and transmit positive ions into the mass spectrometer.

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

This is a new component in the 2015-2016 survey cycle.

Laboratory Method Files

Aromatic Diamines Laboratory Procedure Manual (October 2018)

Laboratory Quality Assurance and Monitoring

Urine specimens 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 (–20°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 Services’ 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

Aromatic diamines in urine were measured in a full sample of participants ages 3-5 and a one-third subsample of participants aged 6 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.

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 for the analytes in the data set. Two variables are provided for each of these analytes. The variable named ending in “LC” (ex., URDAAMLC) 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. For analytes with analytic results below the lower limit of detection (ex., URDAAMLC=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 other variable prefixed URX (ex., URXAAM) provides the analytic result for the analyte.

The lower limit of detection (LLOD, in ng/mL) for urinary aromatic diamines:

Variable Name	SAS Label	LLOD
URX4TDA	2,4-Diaminotoluene (4TDA) (ng/mL)	0.640
URX6TDA	2,6-Diaminotoluene (6TDA) (ng/mL)	0.640
URX4MDA	4,4'-Diaminodiphenylmethane (4MDA) (ng/mL)	0.048
URX5NDA	1,5-Diaminonaphthalene (5NDA) (ng/mL)	1.00
URXPPDA	p-Phenylenediamine (PPDA) (ng/mL)	2.00

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

- Dykewicz, M. S. Occupational asthma: Current concepts in pathogenesis, diagnosis, and management. Journal of Allergy and Clinical Immunology 2009, 123, 519-528.
- Lockey, J. E.; Redlich, C. A.; Streicher, R.; Pfahles-Hutchens, A.; Hakkinen, P. J.; Ellison, G. L.; Harber, P.; Utell, M.; Holland, J.; Comai, A.; White, M. Isocyanates and human health: Multistakeholder information needs and research priorities. Journal of Occupational and Environmental Medicine 2015, 57, 44-51.
- McGill, D. B.; Motto, J. D. An industrial outbreak of toxic hepatitis due to methylenedianiline. New England Journal of Medicine 1974, 291, 278-282.
- Merget, R.; Marczynski, B.; Chen, Z.; Remberger, K.; Raulf-Heimsoth, M.; Willroth, P. O.; Baur, X. Haemorrhagic hypersensitivity pneumonitis due to naphthylene-1,5-diisocyanate. European Respiratory Journal 2002, 19, 377-380.
- Report on Carcinogens, 13th edition, http://ntp.niehs.nih.gov/ntp/roc/content/profiles/toluenediisocyanates.pdf.
- Timchalk, C.; Smith, F. A.; Bartels, M. J. Route-dependent comparative metabolism of [14C]toluene 2,4-diisocyanate and [14C]toluene 2,4-diamine in Fischer 344 rats. Toxicology and Applied Pharmacology 1994, 124, 181-190.
- 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

WTSA2YR - Subsample A Weights

Variable Name: WTSA2YR

SAS Label: Subsample A Weights

English Text: Subsample A Weights

Target: Both males and females 3 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
6552.119284 to 708844.24678	Range of Values	3231	3231	
0	Participants 6+ years with no lab specimen	48	3279	
.	Missing	0	3279	

URX4TDA - 2,4-Diaminotoluene (4TDA) (ng/mL)

Variable Name: URX4TDA

SAS Label: 2,4-Diaminotoluene (4TDA) (ng/mL)

English Text: 2,4-Diaminotoluene (4TDA) (ng/mL)

Target: Both males and females 3 YEARS - 150 YEARS

Hard Edits: 0.0000 to 999.99

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.453 to 48.8	Range of Values	2595	2595	
.	Missing	684	3279	

URD4DALC - 2,4-Diaminotoluene (4TDA) Comment Code

Variable Name: URD4DALC

SAS Label: 2,4-Diaminotoluene (4TDA) Comment Code

English Text: 2,4-Diaminotoluene (4TDA) 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 detection limit	176	176	
1	Below lower detection limit	2419	2595	
.	Missing	684	3279	

URX6TDA - 2,6-Diaminotoluene (6TDA) (ng/mL)

Variable Name: URX6TDA

SAS Label: 2,6-Diaminotoluene (6TDA) (ng/mL)

English Text: 2,6-Diaminotoluene (6TDA) (ng/mL)

Target: Both males and females 3 YEARS - 150 YEARS

Hard Edits: 0.0000 to 999.99

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.453 to 16.6	Range of Values	2430	2430	
.	Missing	849	3279	

URD6DALC - 2,6-Diaminotoluene (6TDA) Comment Code

Variable Name: URD6DALC

SAS Label: 2,6-Diaminotoluene (6TDA) Comment Code

English Text: 2,6-Diaminotoluene (6TDA) 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 detection limit	46	46	
1	Below lower detection limit	2384	2430	
.	Missing	849	3279	

URX4MDA - 4MDA (ng/mL)

Variable Name: URX4MDA

SAS Label: 4MDA (ng/mL)

English Text: 4,4'-Diaminodiphenylmethane (4MDA) (ng/mL)

Target: Both males and females 3 YEARS - 150 YEARS

Hard Edits: 0.0000 to 999.99

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.034 to 18.8	Range of Values	2831	2831	
.	Missing	448	3279	

URD4MALC - 4MDA Comment Code

Variable Name: URD4MALC

SAS Label: 4MDA Comment Code

English Text: 4,4'-Diaminodiphenylmethane (4MDA) 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 detection limit	1584	1584	
1	Below lower detection limit	1247	2831	
.	Missing	448	3279	

URX5NDA - 1,5-Diaminonaphthalene (5NDA) (ng/mL)

Variable Name: URX5NDA

SAS Label: 1,5-Diaminonaphthalene (5NDA) (ng/mL)

English Text: 1,5-Diaminonaphthalene (5NDA) (ng/mL)

Target: Both males and females 3 YEARS - 150 YEARS

Hard Edits: 0.0000 to 999.99

Code or Value	Value Description	Count	Cumulative	Skip to Item
0.71 to 3.68	Range of Values	2758	2758	
.	Missing	521	3279	

URD5NALC - 5NDA Comment Code

Variable Name: URD5NALC

SAS Label: 5NDA Comment Code

English Text: 1,5-Diaminonaphthalene (5NDA) 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 detection limit	3	3	
1	Below lower detection limit	2755	2758	
.	Missing	521	3279	

URXPPDA - p-Phenylenediamine (PPDA) (ng/mL)

Variable Name: URXPPDA

SAS Label: p-Phenylenediamine (PPDA) (ng/mL)

English Text: p-Phenylenediamine (PPDA) (ng/mL)

Target: Both males and females 3 YEARS - 150 YEARS

Hard Edits: 0.0000 to 999.99

Code or Value	Value Description	Count	Cumulative	Skip to Item
1.41 to 282	Range of Values	2608	2608	
.	Missing	671	3279	

URDPDALC - p-Phenylenediamine (PPDA) Comment Code

Variable Name: URDPDALC

SAS Label: p-Phenylenediamine (PPDA) Comment Code

English Text: p-Phenylenediamine (PPDA) 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 detection limit	310	310	
1	Below lower detection limit	2298	2608	
.	Missing	671	3279	