NHANES 1999–2000 Data Documentation

April 2005

Lab 21 – Volatile Organic Compounds (VOC)

Description

Nearly 200 toxic air contaminants have been associated with adverse health effects in occupational studies or laboratory studies, but have not been monitored in general population groups. Information on levels of exposure to these compounds is essential to determine the need for regulatory mechanisms to reduce the levels of hazardous air pollutants to which the general population is exposed.

In this component, personal exposure to air toxics (specifically, volatile organic compounds, or VOCs) were assessed through the use of passive exposure monitors (or badges) worn by participants for a period of 48–72 hours. The following 10 VOCs were measured in the personal exposure badges: benzene, chloroform, ethylbenzene, tetrachloroethene, toluene, trichloroethene, o-xylene, m-,p-xylene, 1,4-dichlorobenzene, and methyl tert-butyl ether (MTBE).

Participants began wearing the exposure monitors when they left the mobile examination center (MEC) after completing an examination and returned the badges 48–72 hours later, either at the MEC or the field office. During the return visit, a short questionnaire was administered to participants to assess personal activities and exposures related to VOC measures. The questionnaire data are included in this file.

Eligible Sample and Component-Specific Exclusions:

For the survey years, the eligible sample was as follows: in 1999, there was a one-fourth subsample of persons 20–59 years; in 2000, there was a one-third subsample of persons 20–59 years. There were no component-specific exclusions.

Laboratory Protocol

Two different laboratories assessed VOCs in exposure monitors.

Lab 1

A selected group of VOCs in vapor form are measured by a modification of Method 7 of the Occupational Safety and Health Administration (OSHA) of the U. S. Dept. of Labor (1). The method has been modified to use 3M 3520 Organic Vapor Monitors (OVM) (manufactured without glued-on labels) as the sampling media and gas chromatography/mass spectrometry (GC/MS) as the detection device (2). Sampling times have been extended for additional sensitivity. The vapors are quantified by desorption from the collection media with a solution of carbon disulfide and acetone, and identified and measured against a standard curve on the GC/MS. The GC/MS is operated in the selected-ion-monitoring mode (SIM) for additional sensitivity.

Lab 2

Analysis is performed using an HP 5890 Series II Plus GC (Gas Chromatograph) with an HP 5972 MSD (Mass Selective Detector Quadrupole Mass Spectrometer) and EnviroQuant software. We initially used a Restek RTX-1, 60 m, 0.25 mm ID column and a 1-µm film thickness (catalog #10156; Restek Corp., Bellefonte, PA) with good separation for all target analytes. More recently, we have been using a Restek RTX B624, 60 m, 0.25 mm ID with 1.4-µm thickness column (catalog # 10969), which provides even better resolution for separation of the solvent peaks and methylene chloride. With the last column, the gas chromatography-mass spectrometry (GC/MS) conditions are:

- scan mode from 35 to 260 amu.
- injection splitless for 0.5 min and splitting 50:1 for the rest of the run.
- helium carrier; initial pressure 3 psi for 0.5 min, ramp 90 psi/min to 22.5 psi; linear velocity 31.1 cm/sec.
- injection port temperature 180°C.
- detector temperature 250°C.
- temperature program: start at 40°C, hold for 12 min, ramp at 8°C/min to 200°C.

Survey Staff

The NHANES 1999–2000 laboratory staff consists of medical technologists and phlebotomists. The medical technologists hold baccalaureates in medical technology. The American Society for Clinical Pathologists or a similar organization certifies the medical technologists and the phlebotomists. All laboratory staff complete comprehensive training in standardized laboratory procedures before they begin working in the MEC.

Data Collection Forms

Detailed specimen collection and processing instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Each chapter in the LPM specifies the procedure to be used for preparation of the participant, specimen collection, labeling, processing, and preservation, and conditions for specimen transport that are appropriate for that method.

Quality Control Procedures

MECs

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

The NHANES quality control and quality assurance protocols meet the 1988 Clinical Laboratory Improvement Act mandates. Detailed quality control and quality assurance 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 second examinations on previously examined participants and 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 outlining the Westgaard 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 periodically reviewed for trends or shifts in the data, and the laboratories are required to explain any identified areas of concern. NCHS/Westat are currently reviewing these reports.

The comparability of the measures between the two laboratories was evaluated through review by an expert panel.

Data Processing and Preparation

Automated data collection procedures for the survey were introduced in NHANES 1999–2000. In the mobile examination centers (MECs) and analytical laboratories, data for the laboratory component is recorded directly onto a computerized data collection form. The system is centrally integrated and it allows for ongoing monitoring of much of the data. While the complete blood count and pregnancy analyses are performed in the MEC laboratory, most analyses are conducted elsewhere by 21 laboratories across the United States.

Guidelines have been developed that provide standards for naming variables, filling missing values, and handling missing records. NCHS staff, assisted by contract staff, have developed data-editing specifications that check data sets for valid codes, ranges, and skip pattern consistencies and examine the consistency of values between interrelated variables. Comments have been reviewed and recoded. NCHS staff verifies extremely high and low values whenever possible, and numerous consistency checks are performed. Nonetheless, users should examine the range and frequency of values before analyzing data.

Data Editing

The data editing specifications are as follows:

- Age and gender checks;
- Total number of observations complete for each field;
- No field overlap, truncated values, or weird results;
- Direct data entry (DDE) errors;

- Abnormal results confirmed by lab;
- Test algorithm performed;
- Checked comment codes to resolve missing results and missing records;
- All missing results and missing MEC-examined records are accounted;
- Duplicate records were verified and deleted; and
- Below detection limit formula was applied.

Analytic Notes

The values for the analytes are expressed as the weight of the analyte per cubic meter. The number of cubic meters is derived from the period of time the exposure monitor was used. The variable LBAVOCSD indicates the number of hours the monitor was used.

Detection limits varied by time period for these analytes. A derived variable for each analyte, LBD_LC, was created to indicate those results that were below the limit of detection. Detection limits were standardized for 48-hour sample duration. If the result was below the limit of detection, the value provided for the analyte is the detection limit adjusted for the actual duration the badge was exposed (LBAVOCSD) divided by the square root of 2.

Special Notes about this Dataset

Measures for this component were assessed in a randomly selected subsample of participants aged 12–59 years. Specific sample weights for this subsample are included in this data file and should be used when analyzing these data.

The dataset includes 2-year subsample weights. The recommended procedure for variance estimation requires use of stratum and PSU variables (SDMVSTRA and SDMVPSU, respectively), which are included in the demographic data file for each data release. For further information, see the NHANES Analytic Guidelines, June 2004 version at: http://www.cdc.gov/nchs/data/nhanes/nhanes_general_guidelines_june_04.pdf .

References

1. Organic Vapors, Method 07, OSHA Sampling and Analytical Methods Manual.
2. Morandi MT, Stock TH. Personal Exposures to Toxic Air Pollutants. Vol. 2. Houston: University of Texas; 1998.