NHANES 2001–2002 Data Documentation
February, 2006
MEC Examination

Audiometry-Tympanometry Curve Raw Data Files (AUXTYM_B)

Survey Years Included in this File: 2001–2002

Component Description:

The main NHANES 2001-2002 Audiometry Examination data files (AUX_B) are separately released. This file included quantitative data for tympanometric measurements, as well as tympanogram quality ratings. The purpose of the present data release is to provide the underlying raw data curves for this set of tympanograms, which will allow analysts to display actual tympanograms, make qualitative judgments regarding test adequacy and interpretation, and to perform quantitative analyses.

Eligible Sample and Section-Specific Exclusions:

Tympanometry screening was performed on the same subjects as the Audiometry Examination Component. This consisted of a ½ sample of U.S. adults ages 20 to 69 years. Subjects using hearing aids who were not able to remove them for testing and subjects who had sufficient ear pain at the time of the exam that they could not tolerate headphones or the tympanometer probe were excluded from the Audiometry Component. There were no other precluding conditions for any part of the audiologic exam.

Examination Protocol:

This is described in detail in the NHANES 2001-2002 Audiometry Examination Component Documentation and in the NHANES 2001 Audiometry/Tympanometry Procedures Manual located at the main NHANES website. NHANES employed a Micro Audiometrics Earscan™ Acoustic Impedance Tympanometer (http://www.earscan.com/pdf/manuals/earscan_estram_man.pdf).

Tympanic membrane compliance testing was performed by a trained examiner in a soundproof room in the NHANES mobile examination center (MEC). A screening questionnaire was administered before testing to assess factors that might have affected tympanometry test results. Analysts should refer to the Audiometry section of the NHANES 2001-2002 examination data file for information on the MEC screening questionnaire. In addition, questions on hearing status, including noise exposure history and the use of hearing aids, can be found in the Household Interview questionnaire data files for Audiometry (AUQ_B) and Occupation (OCQ_B). The tympanometer produced an electronic output, and the single best curve for each ear obtained during testing was uploaded for data capture and processing.

Quality Control During Data Collection:

The physical volume calibration of the tympanometer was checked at the start and end of each stand and daily throughout testing. Air pressure was calibrated automatically by the unit each time it was turned on. The tympanometer also received an exhaustive NIST-traceable calibration check annually. For details of equipment maintenance procedures, analysts should consult the NHANES Audiometry/Tympanometry Procedures Manual.

Data Processing and Editing:

The automated tympanometer utilizes an electromagnetic impedance unit incorporating a pressure transducer to indicate changes in compliance of the tympanic membrane while simultaneously varying the air pressure in the sealed canal of the same ear. This is accomplished by measuring the sound pressure level of a probe tone introduced into the ear canal (226 Hz at 85 dB SPL), while the air pressure in the ear canal is changing from +200 to -312 daPa. The equivalent volume is also measured and can range from 0.2 to 7.0 ml. During this procedure, an 84-point tympanogram is recorded, as well as numeric values for middle ear pressure, physical volume, compliance, and gradient (tympanometric width). The variables containing the numeric data for these latter measurements (AUXTMEPR, AUXTMEPL, AUXTPVR, AUXTPVL, AUXTCOMR, AUXTCOML, AUXTWIDR, and AUXTWIDL) are located in the separately released NHANES 2001-2002 Audiometric Examination data file (AUX_B). Again, please note that the measurements reported in the tympanometry raw data file represent the raw data for single best of two curves obtained during testing. Subjective quality ratings for these tympanograms are the variables AUAREQC and AUALEQC in the Audiometry Examination Data file. These ratings provide an initial basis for screening the quality of tympanograms, however analysts may need to make their own quality assessments based on criteria for their own particular study. Note that the rating process scored tympanograms on the basis of quality alone, not normality. Abnormal tympanograms were classified as “good” if they were consistent with a subject’s audiometric data, including otoscopy, numeric tympanometry readings, and audiogram. Also, analysts should consider there may be some “noisy” tracings with possible artifactual numeric readings calculated from peak artifact.

Component-Specific Analytic Notes and File Variables:

The tympanometry portion of the data file includes 168 variables, representing equivalent volume (compliance) data for pressure values beginning at -300 dekaPascals (daPa), ranging down to +198 daPa. One daPa is equivalent to the pressure of 1.02 mm H20. Please note that while the tympanogram is obtained during testing by varying the pressure from positive to negative, graphically it is traditionally plotted from negative pressure to positive. Accordingly, the last pressure measurement recorded during the test is the first variable listed in the data file. Note also that although the actual test procedure included pressure output from +200 through -312 daPa, data points in the tympanometry curve file include only measurements from +198 through -300 daPa in 6 daPa increments. The responses for a particular ear are contained in a series of 84 equally-spaced sequential measurement variables. The tympanometry variable set for the right ear is AUDTYR01-AUDTYR84; for the left ear it is AUDTYL01-AUDTYL84. Each successive variable represents a 6 daPa increase in applied pressure. For example, for the right

ear, AUDTYR01 represents -300 daPa; AUDTYR02 represents -294 daPa; AUDTYR03 represents -288 daPa, etc., through AUDTYR84, which represents +198 daPa. These data can be used to create tympanometric graphs of compliance as a function of pressure for each ear. To do this it is necessary to create a variable to record the associated pressure values. An example of SAS™ programming code to calculate is provided separately.

Finally, please note that demographic data (for example, age and gender) are not found on the tympanometry and acoustic reflex raw data files, but are provided separately in the NHANES 2001-2002 demographic data files (DEMO_B). To make representative estimates for the U.S. population, the analyst must use the appropriate set of sample weights which are the Audiometry Subsample Examination weights.

NCHS Research Data Center:

N.A.

References:

N.A.

Appendix A. Sample SAS™ Program for Tympanometric Graphs

The following SAS™ code, or a similar process in another programming language, may be used to obtain tympanometric plots of compliance (y) versus pressure (x) for left and right ear data for individual examinees (identified by SEQN) using the tympanometry raw data file (AUXTYM_B). Note that the use of name-range variable lists in the array statements assumes that the variables are ordered as shown in the public release version of the data file and code book. Variations in ordering for the specified variables will result in errors.

```
DATA TYMPGRAPH (KEEP=SEQN RIGHT_COMPLIANCE LEFT_COMPLIANCE PRESSURE);
SET AUXTYM_B;
/*Keep statement minimizes dataset size for efficient processing*/
ARRAY LCOMPL (84) AUDTYL01--AUDTYL84;
ARRAY RCOMPL (84) AUDTYR01--AUDTYR84;
J=-300; *Start pressure values at -300 daPa;
DO I=1 TO 84;
LEFT_COMPLIANCE=LCOMPL(I);
RIGHT_COMPLIANCE=RCOMPL(I);
PRESSURE=J; *Associate a pressure value with compliance;
OUTPUT;
J=J + 6; *Increase pressure by 6 daPa for next point;
DROP I;
END;
FORMAT LEFT_COMPLIANCE 5.3 RIGHT_COMPLIANCE 5.3;
LABEL PRESSURE='Pressure in DaPa (1 DaPa= 1.02 cm H2O)';
LABEL LEFT_COMPLIANCE='Compliance in ml';
```

```
RUN;

/*Proc GPlot requires sorted input data*/
PROC SORT DATA=TYMPGRAPH; BY SEQN; RUN;
SYMBOL1 COLOR=RED
INTERPOL=JOIN
VALUE=DOT
HEIGHT=0.5;
SYMBOL2 FONT=MARKER VALUE=C
COLOR=BLUE
INTERPOL=JOIN
HEIGHT=0.3;
AXIS1 ORDER=(-300 TO 200 BY 100)
LABEL=(JUSTIFY=CENTER FONT=CENTB
"Pressure in DaPa (1 DaPa= 1.02 cm H2O)")
MAJOR=(HEIGHT=2) MINOR=(HEIGHT=1)
WIDTH=3;
AXIS2 ORDER=(0 TO 2.5 BY 1)
LABEL=(ANGLE=90 JUSTIFY=CENTER FONT=CENTB "COMPLIANCE IN ML" )
MAJOR=(HEIGHT=2) MINOR=(HEIGHT=1)
WIDTH=3;
LEGEND1 LABEL=NONE
POSITION=(TOP CENTER INSIDE)
MODE=SHARE;

PROC GPLOT DATA=TYMPGRAPH;
BY SEQN;
PLOT LEFT_COMPLIANCE*PRESSURE RIGHT_COMPLIANCE*PRESSURE / OVERLAY
LEGEND=LEGEND1
HAXIS=AXIS1 HMINOR=4
VAXIS=AXIS2 VMINOR=1;
TITLE 'NHANES 1999+ TYMPANOGRAM';
RUN;
QUIT;
```