National Health and Nutrition Examination Survey

August 2021-August 2023 Data Documentation, Codebook, and Frequencies

Cholesterol - Total (TCHOL_L)

Data File: TCHOL_L.xpt

First Published: September 2024

Last Revised: NA

Component Description

Heart disease is the leading cause of death in the United States (Murphy, et. al., 2018). Blood lipid levels are fundamental measures included in NHANES that can be used for cardiovascular risk assessment. The goals the NHANES blood lipids measurements include: 1) monitoring the prevalence and trends in major cardiovascular conditions and overall risk factors in the U.S.; 2) evaluating prevention and treatment programs targeting cardiovascular disease in the U.S.; and 3) monitoring the status of hyperlipidemia.

In 2018, new Blood Cholesterol Guidelines were released, by the American College of Cardiology and American Heart Association Task Force on Clinical Practice Guidelines, which aim to reduce the risk of atherosclerotic cardiovascular disease through cholesterol management (Grundy, et. al., 2018). The blood lipids measurements in NHANES include total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides. The present file provides data on total cholesterol. Data on LDL-C and triglycerides are provided in the Cholesterol – Low – Density Lipoprotein and Triglycerides (TRIGLY_L) files, and HDL-C data are provided in Cholesterol - High - Density Lipoprotein (HDL_L).

Eligible Sample

Examined participants aged 6 years and older were eligible.

Description of Laboratory Methodology

Total Cholesterol

The laboratory method used to measure total cholesterol is an enzymatic assay. In this enzymatic assay, esterified cholesterol is converted to cholesterol by cholesterol esterase. The resulting cholesterol is then acted upon by cholesterol oxidase to produce cholest-4-en-3-one and hydrogen peroxide. The hydrogen peroxide then reacts with 4-aminophenazone in the presence of peroxidase to produce a colored product that is measured at 505 nm (secondary wavelength = 700 nm). The final step is known as the Trinder reaction. This method is a single reagent, endpoint reaction that is specific for cholesterol.

Cholesterol, a steroid molecule with a hydroxyl group in the C3 position, is synthesized in many types of tissue, but mainly in the liver and intestinal wall. About 75 percent of cholesterol is newly synthesized, with the remainder originating from dietary intake. Cholesterol measurement is performed to screen for atherosclerotic risk and in the diagnosis

and treatment of disorders involving elevated cholesterol as well as lipid and lipoprotein metabolic disorders.

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

Serum total cholesterol levels were directly measured. Please see below the Data Processing and Editing section for more details. For laboratory methods used for LDL-C and triglycerides, and HDL-C, please refer to the accompanying documentation for the respective dataset.

There were no changes to the lab method or lab site for this component in the NHANES August 2021-2023 cycle. However, the lab equipment used changed from the Cobas 6000 Analyzer to the Cobas 8000 during the cycle.

Laboratory Method Files

Total Cholesterol (Frozen) Laboratory Procedure Manual (September 2024)

Laboratory Quality Assurance and Monitoring

Serum specimens were processed, stored, and shipped to the University of Minnesota, Minneapolis, MN for analysis.

Detailed instructions on specimen collection and processing are discussed in the NHANES Laboratory Procedures Manuals (LPM). Vials are stored under appropriate frozen (−30°C) conditions until they are shipped to University of Minnesota 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 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 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 specimens 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) when testing 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.

Data Processing and Editing

The data were reviewed. Incomplete data or improbable values were sent to the performing laboratory for confirmation.

One derived variable was created in this data file. The variable was created using the following formula:

LBDTCSI

The total cholesterol in mg/dL (LBXTC) was converted to mmol/L (LBDTCSI) by multiplying by 0.02586.

Analytic Notes

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.

Phlebotomy Weights

For the August 2021-August 2023 cycle, analysis of nonresponse patterns for the phlebotomy component in the MEC examination revealed differences by age group and race/ethnicity, among other characteristics. For example, approximately 67% of children aged 1-17 years who were examined in the MEC provided a blood specimen through phlebotomy, while 95% of examined adults aged 18 and older provided a blood specimen. Therefore, an additional phlebotomy weight, WTPH2YR, has been included in this data release to address possible nonresponse bias. Participants who are eligible but did not provide a blood specimen have their phlebotomy weight assigned a value of "0" in their records. The phlebotomy weight should be used for analyses that use variables derived from blood analytes, and is included in all relevant data files

Demographic and Other Related Variables

The analysis of NHANES laboratory data must be conducted using the appropriate survey design and demographic variables. The NHANES August 2021-August 2023 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.

The Fasting Questionnaire File includes auxiliary information, such as fasting status, length of fast, and the time of venipuncture.

The laboratory data file can be linked to other NHANES data file using the unique survey participant identifier (i.e., SEQN).

Detection Limits

The detection limits were constant for this analyte in the data set.

The lower limit of detection (LLOD, in mg/dL) for total cholesterol:

Variable Name	Analyte Description	LLOD
LBXTC	Serum Total cholesterol (Frozen)	4

No Correction Need for Total Cholesterol Results for NHANES August 2021 - August 2023

A method validation (bridging) study was performed to compare results from an instrument change in the August 2021-August 2023 cycle. The Cobas 6000 Chemistry Analyzer was upgraded to the Cobas 8000 Chemistry Analyzer during the cycle. Randomly selected serum samples (n=178) from previous NHANES were measured using both instruments and the results were used to conduct the analysis. On average, serum total cholesterol values measured from the Cobas 6000 were 0.56% higher than values from the Cobas 8000 (p = 0.0001). Data from the bridging study indicated the correlation coefficient (r) between the measurements was 0.998. Regression analyses were performed using Analyse-it, v4.30.4. The weighted Deming regression equation did not show a significant slope or intercept (95% confidence interval [CI] for slope included 1 and for intercept included 0 [mg/L]):

Cobas 8000 = -0.985 + 1 * (Cobas 6000); 95% CI of slope (0.9909 to 1.009) and intercept (-2.536 to 0.5662).

Therefore, the NHANES August 2021-August 2023 total cholesterol values did not have to be adjusted.

References

- Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, Braun LT, de Ferranti S, Faiella-Tommasino J, Forman DE, Goldberg R, Heidenreich PA, Hlatky MA, Jones DW, Lloyd-Jones D, Lopez-Pajares N, Ndumele CE, Orringer CE, Peralta CA, Saseen JJ, Smith SC Jr, Sperling L, Virani SS, Yeboah J. (2018). AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA guideline on the management of blood cholesterol: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. Circulation. 2019;139:e1082–e1143.
- Murphy SL, Xu JQ, Kochanek KD, Arias, E. Mortality in the United States, 2017. NCHS Data Brief, no 328. Hyattsville, MD: National Center for Health Statistics. 2018. https://www.cdc.gov/nchs/data/databriefs/db328-h.pdf
- 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 6 YEARS - 150 YEARS

WTPH2YR - Phlebotomy 2 Year Weight

Variable Name:	WTPH2YR
SAS Label:	Phlebotomy 2 Year Weight
English Text:	Phlebotomy 2 Year Weight
Target:	Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
4391.8220579 to 241728.85724	Range of Values	7316	7316	
0	No blood sample provided	752	8068	
.	Missing	0	8068	

LBXTC - Total Cholesterol (mg/dL)

Variable Name:	LBXTC
SAS Label:	Total Cholesterol (mg/dL)
English Text:	Total Cholesterol (mg/dL)
Target:	Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
62 to 438	Range of Values	6890	6890	
.	Missing	1178	8068	

LBDTCSI - Total Cholesterol (mmol/L)

Variable Name:	LBDTCSI
SAS Label:	Total Cholesterol (mmol/L)
English Text:	Total Cholesterol (mmol/L)
Target:	Both males and females 6 YEARS - 150 YEARS

Code or Value	Value Description	Count	Cumulative	Skip to Item
1.6 to 11.33	Range of Values	6890	6890	
.	Missing	1178	8068	