National Health and Nutrition Examination Survey 2003-2004

Documentation, Codebook, and Frequencies

MEC Laboratory Component: Total Cholesterol and HDL-Cholesterol

Survey Years:
2003 to 2004

SAS Export File:
L13_C.XPT

First Publish: June 2006
Last Revised: April 2008

NHANES 2003–2004 Data Documentation

Laboratory Assessment: Lab 13 – Total Cholesterol and HDL-Cholesterol

Years of Coverage: 2003–2004 **First Published:** June 2006 **Last Revised:** April 2008

Added note in the Analytical Notes Section; **see**: "Change in Assay Methods Most Likely Responsible for Increased HDL Cholesterol values in NHANES 2003-2006 when compared to NHANES 1999-2002".

Component Description

The data will be used to monitor the status of hyperlipidemia and the success of the National Cholesterol Education Program.

The main element of the cardiovascular disease laboratory component in NHANES is blood lipid levels. Cardiovascular disease is the leading cause of death in the United States. The data will be used to monitor the status of hyperlipidemia and the success of the National Cholesterol Education Program.

Eligible Sample

Participants aged 3 years and older were tested.

Description of Laboratory Methodology

Total cholesterol is measured enzymatically in serum in a series of coupled reactions that hydrolyze cholesteryl esters and oxidize the 3-OH group of cholesterol. One of the reaction byproducts, H_2O_2 is measured quantitatively in a peroxidase-catalyzed reaction that produces a color. Absorbance is measured at 500 nm. The color intensity is proportional to cholesterol concentration. The reaction sequence is as follows:

$$\text{cholesteryl ester} + H_2O \xrightarrow{\text{cholesteryl ester hydrolase}} \text{cholesterol} + \text{fatty acid}$$

$$\text{cholesterol} + O_2 \xrightarrow{\text{cholesterol oxidase}} \text{cholest-4-en-3-one} + H_2O_2$$

$$2H_2O_2 + \text{4-aminophenazone} + \text{phenol} \xrightarrow{\text{peroxidase}} \text{4-(}p\text{-benzoquinone-monoimino)-phenazone} + 4\ H_2O$$

HDL-Cholesterol is measured directly in serum. The apolipoprotein B

containing lipoproteins in the specimen are reacted with a blocking reagent that renders them non-reactive with the enzymatic cholesterol reagent under conditions of the assay.

The procedures use the Roche/Boehringer-Mannheim Diagnostics direct HDL method. The method uses sulfated alpha-cyclodextrin in the presence of Mg^{+2}, which forms complexes with apoB containing lipoproteins, and polyethylene glycol-coupled cholesteryl esterase and cholesterol oxidase for the HDL-cholesterol measurement. The reactions are as follows:

ApoB containing lipoproteins + α-cyclodextrin + Mg^{+2} + dextran SO_4 ---> soluble non-reactive complexes with apoB-containing lipoproteins

HDL-cholesteryl esters $\xrightarrow{\text{PEG-cholesteryl esterase}}$ HDL-unesterified cholesterol + fatty acid

Unesterified cholesterol + O_2 $\xrightarrow{\text{PEG-cholesterol oxidase}}$ cholestenone + H_2O_2

H_2O_2 + 5-aminophenazone + N-ethyl-N-(3-methylphenyl)-N'_succinyl ethylene diamine + H_2O + H^+ peroxidase ---> qunoneimine dye + H_2O

Absorbance is measured at 600 nm.

There were no changes to the equipment, lab method, or lab site from the previous 2 years.

A detailed description of the laboratory method used can be found on the NHANES website.

Laboratory Quality Control and Monitoring

The NHANES quality assurance and quality control (QA/QC) protocols meet the 1988 Clinical Laboratory Improvement Act mandates. Detailed quality control and quality assurance instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Read the LABDOC file for detailed QA/QC protocols. A detailed description of the QA/QC procedures can be found on the NHANES web site.

Data Processing and Editing

Blood specimens were processed, stored, and shipped to Johns Hopkins Hospital, Baltimore, MD for analysis. Detailed specimen collection and processing instructions are discussed in the NHANES Laboratory/Medical Technologists Procedures Manual (LPM). Read the LABDOC file for detailed data processing and editing protocols. The

analytical methods are described in the **Description of the Laboratory Methodology** section.

There was no top coding on this file.

Two derived variables were created in this data file. The formula for their derivation is as follows:

LBDTCSI:

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

LBDHDDSI:

The HDL-cholesterol in mg/dL (LBXHDD) was converted to mmol/L (LBDHDDSI) by multiplying by 0.02586.

The HDL-cholesterol data was not corrected for 2003-2004 data. This was unlike the previous 1999-2000 and 2001-2002 data where HDL was corrected. The direct immunoassay method for 2003-2004 showed acceptable bias (CV < 4%) and precision (CV < 5%) when compared to HDL-cholesterol quality controls (Solomon Park Research Laboratories, Kirkland, WA) with assigned values established by the Centers for Disease Control and Prevention. Refer to the documentation for 1999-2000 and 2001-2002 for more details on how the data was corrected. (NHANES 1999-2000 Data Files and NHANES 2001-2002 Data Files web site)

Detailed instructions on specimen collection and processing can be found on the NHANES web site.

Analytic Notes

Change in Assay Methods Most Likely Responsible for Increased HDL Cholesterol values in NHANES 2003-2006 when compared to NHANES 1999-2002

Researchers are cautioned to interpret trends in HDL cholesterol for NHANES 1999-2006 in view of probable HDL cholesterol method effects. The HDL cholesterol values showed an average increase of 3.0 mg/dL in NHANES 2003-2006 compared to NHANES 1999-2002. The HDL cholesterol was analyzed in 1999-2002 using two methods - heparin manganese precipitation and a direct HDL immunoassay depending on the participant age and amount of specimen. Most

participants in 1999-2002 were measured by the precipitation method. Starting in 2003, all HDL cholesterol samples were analyzed using the direct HDL cholesterol immunoassay method. The heparin-manganese precipitation method and direct immunoassay method for 1999-2000, 2001-2002 and 2005-2006 showed an undesirable bias (>4%) when compared to the laboratory's HDL-cholesterol quality controls (Solomon Park Research Laboratories, Kirkland, WA) that were assigned values established by the Centers for Disease Control and Prevention. The CDC HDL cholesterol reference method uses heparin-manganese to precipitate HDL-cholesterol and the Abell-Kendall method to measure cholesterol. The HDL cholesterol for 1999-2000, 2001-2002 and 2005-2006 were adjusted using: Corrected HDL = [(Solomon Park assigned HDL value) x (Participant HDL)] /(Quality Control HDL value associated with participant sample). The bias for the HDL cholesterol method for 2003-2004 was acceptable (<4%) and the participant results were not corrected. In addition, there was a change in instrumentation in 2005-2006 and there were several modifications of the direct HDL cholesterol method. To control for these differences in methods and instrumentation, the HDL cholesterol was corrected using the Solomon Lab quality controls as described above.

Despite this correction procedure, all age, gender, and race-ethnicity groups showed an increase in mean HDL cholesterol after 2003. It is most likely that the change from the precipitation method to the direct method in 2003 was responsible for the increase in HDL cholesterol values. Other covariates (body mass index, medications, physical exercise, smoking and alcohol consumption) may explain some of the HDL cholesterol increased values, but it is unlikely to account for the majority of the mean increase in HDL cholesterol. Further investigations will be done to attempt to explain the increased HDL cholesterol values and provide further guidance on the interpretation of HDL cholesterols for NHANES 1999-2006.

The analysis of NHANES 2003–2004 laboratory data must be conducted with the key survey design and basic demographic variables. The NHANES 2003–2004 Household Questionnaire Data Files contain demographic data, health indicators, and other related information collected during household interviews. They also contain all survey design variables and sample weights for these age groups. The phlebotomy file includes auxiliary information such as the conditions precluding venipuncture. The household questionnaire and phlebotomy files may be linked to the laboratory data file using the unique survey participant identifier SEQN.

LBXTC:

The Lab 13 Total Cholesterol data file contains laboratory test results for total cholesterol (LBXTC), which uses the reference analytic method. However, the NHANES Laboratory 40 biochemistry profiles also include measurements of total cholesterol. The Laboratory 40 variable name is LBXSCH. The appropriate variable to use is LBXTC from Laboratory 13.

References

N/A

Locator Fields

Title: Total Cholesterol and HDL-Cholesterol

Contact Number: 1-866-441-NCHS

Years of Content: 2003–2004

First Published: June 2006

Revised: April 2008

Access Constraints: None

Use Constraints: None

Geographic Coverage: National

Subject: Cholesterol and HDL-Cholesterol

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)

Total Cholesterol and HDL-Cholesterol (L13_C)

Person Level Data

June 2006

SEQN	Target
	B(3 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Respondent sequence number
English Text: Respondent sequence number.	
English Instructions:	

LBXTC	Target
	B(3 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Total Cholesterol (mg/dL)
English Text: Total Cholesterol (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
68 to 704	Range of Values	7774	7774	
.	Missing	782	8556	

LBXHDD	Target
	B(3 Yrs. to 150 Yrs.)
Hard Edits	**SAS Label**
	Direct HDL-Cholesterol (mg/dL)
English Text: Direct HDL-Cholesterol (mg/dL)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
19 to 154	Range of Values	7773	7773	
.	Missing	783	8556	

LBDTCSI	Target
	B(3 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Total Cholesterol (mmol/L)
English Text: Total Cholesterol (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
1.76 to 18.21	Range of Values	7774	7774	
.	Missing	782	8556	

LBDHDDSI	Target
	B(3 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Direct HDL-Cholesterol (mmol/L)
English Text: Direct HDL-Cholesterol (mmol/L)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.49 to 3.98	Range of Values	7773	7773	
.	Missing	783	8556	