National Health and Nutrition Examination Survey 2001–2002

# Documentation, Codebook, and Frequencies

## Laboratory Component:
Vitamins A, E and Carotenoids

**Survey Years:**
**2001 to 2002**

**SAS Export File:**
**L06VIT_B.XPT**


**First Published: October 2007**
**Last revised: N/A**

# NHANES 2001–2002 Data Documentation

**Laboratory Assessment: Lab 06- Vitamin A** (retinol, retinyl palmitate, retinyl stearate)**, Vitamin E** (α-tocopherol and γ-tocopherol)**, Carotenoids** (α-carotene, trans-β-carotene, cis β-carotene, β-cryptoxanthin, combined lutein/zeaxanthin, and trans-lycopene)

**First Published:** October 2007 **Last Revised:** N/A

## Component Description

The objectives of this component are: 1) to provide data for monitoring secular trends in measures of nutritional status in the U.S. population; 2) to evaluate the effect of people's habits and behaviors such as physical activity and the use of alcohol, tobacco, and dietary supplements on people's nutritional status; and 3) to evaluate the effect of changes in nutrition and public health policies including welfare reform legislation, food fortification policy, and child nutrition programs on the nutritional status of the U.S. population. These data will be used to estimate deficiencies and toxicities of specific nutrients in the population and subgroups, to provide population reference data, and to estimate the contribution of diet, supplements, and other factors to serum levels of nutrients. Data will be used for research to further define nutrient requirements as well as optimal levels for disease prevention and health promotion.

## Eligible Sample

Participants aged 3 years and older who do not meet any of the exclusion criteria are eligible.

## Description of Laboratory Methodology

Serum concentrations of vitamins A (retinol) and E (α and γ-tocopherol), two retinyl esters, and six carotenoids (α-carotene, trans-β-carotene, cis β-carotene, β-cryptoxanthin, combined lutein/zeaxanthin, and trans-lycopene) are measured using high performance liquid chromatography with photodiode array detection. A small volume (100 μL) of serum is mixed with an ethanol solution containing two internal standards- retinyl butyrate and nonapreno-β-carotene (C45). The micronutrients are extracted from the aqueous phase into hexane and dried under vacuum. The extract is redissolved in ethanol and acetonitrile and is filtered to remove any insoluble material. An aliquot of the filtrate is injected onto a C18 reversed phase column and isocratically eluted with a mobile phase consisting of equal parts of ethanol and acetonitrile. Absorbance of these substances in solution is

linearly proportional to concentration, thus spectrophotometric methods are used for quantitative analysis. Three wavelengths, approximately corresponding to absorption maxima, namely, 300, 325, and 450 nm, are simultaneously monitored and chromatograms are recorded. Quantitation is accomplished by comparing the peak height of the analyte in the unknown with the peak height of a known amount of the same analyte in a calibrator solution. Calculations are corrected based on the peak height of the internal standard in the unknown compared with the peak height of the internal standard in the calibrator solution. Retinol and the retinyl esters are compared with retinyl butyrate at 325 nm, α-and γ-tocopherol are compared with retinyl butyrate at 300 nm, and the carotenoids are compared with C45 at 450 nm.

## Laboratory Quality Control and Monitoring

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 Laboratory/Medical Technologists Procedures Manual (LPM). Read the LABDOC file for detailed QA/QC protocols.

There weren't any changes to the laboratory, method, or site from 1999-2000.

A detailed description of the quality assurance and quality control procedures can be found on the NHANES website.

## Data Processing and Editing

Serum specimens were processed, stored, and shipped to the Division of Laboratory Sciences, National Center for Environmental Health, and Centers for Disease Control and Prevention for analysis. Detailed specimen collection and processing instructions are discussed in the NHANES LPM. Vials were stored under appropriate frozen (–20°C) conditions until they were shipped to National Center for Environmental Health for testing.

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

The vitamin A (retinol) results in ug/dL were converted into umol/L by multiplying by 0.03491.

The retinyl palmitate results in ug/dL were converted into umol/L by multiplying by 0.03491.

The retinyl stearate results in ug/dL were converted into umol/L by multiplying by 0.03491.

The vitamin E (α-tocopherol) results in ug/dL were converted into umol/L by multiplying by 0.02322.

The γ-tocopherol results in ug/dL were converted into umol/L by multiplying by 0.02402.

The α-carotene results in ug/dL were converted into umol/L by multiplying by 0.01863.

The trans-β-carotene results in ug/dL were converted into umol/L by multiplying by 0.01863.

The cis-β-carotene results in ug/dL were converted into umol/L by multiplying by 0.01863.

The β-cryptoxanthin results in ug/dL were converted into umol/L by multiplying by 0.01810.

The combined lutein/zeaxanthin results in ug/dL were converted into umol/L by multiplying by 0.01758.

The trans-lycopene results in ug/dL were converted into umol/L by multiplying by 0.01863.

## Analytic Notes

The analysis of NHANES 2001–2002 laboratory data must be conducted with the key survey design and basic demographic variables. The NHANES 2001–2002 Household Questionnaire Data Files contain demographic data, health indicators, and other related information collected during household interviews. The Household Questionnaire Data Files also contain all survey design variables and sample weights required to analyze these data. The Phlebotomy Examination file

includes auxiliary information on duration of fasting, the time of day of the venipuncture, and the conditions precluding venipuncture. The Household Questionnaire and Phlebotomy Exam files may be linked to the laboratory data file using the unique survey participant identifier SEQN.

### Regression Analysis for 2001-2002 and 2003-2004 for Vitamins A, E, and Carotenoids:

In 2001-2002, Vitamins A, E and Carotenoids were analyzed using a HPLC method performed at CDC/NCEH. In 2003-2004, Vitamins A, E and Carotenoids were analyzed using a comparable HPLC method at Craft Technologies, Inc. (CTI) [See Lab 45 in NHANES 2003-2004 for method details]. Crossover studies between CDC/NCEH and CTI were done in early 2003 and late 2004 and differences existed between the methods for some analytes. The following Deming regression analyses were performed to compare data from 2001-2002 to 2003-2004:

**Early 2003 Deming Regression Analysis for A/E/Carotenoids Y(CDC)=X(CTI) in ug/dL:**

| Test | n | Y(CDC) = X (CTI) | $r^2$ |
|---|---|---|---|
| Alpha-Carotene | 100 | y = 0.9734x + 0.1847 | 0.9944 |
| Trans-Beta-Carotene | 100 | y = 1.0764x - 0.0248 | 0.9971 |
| Cis-Beta-Carotene | 100 | y = 0.8017x - 0.0372 | 0.9685 |
| Beta-Cryptoxanthin | 100 | y = 1.1359x - 0.2116 | 0.9945 |
| Gamma-Tocopherol | 100 | y = 1.0346x - 8.5749 | 0.9818 |
| Lutein/Zeaxanthin | 99 | y = 0.9321x + 0.1231 | 0.9455 |
| Trans-Lycopene | 100 | y = 1.0719x - 0.1817 | 0.9947 |
| Retinyl Palmitate | 100 | y = 1.0245x + 0.5039 | 0.1988 |
| Retinyl Stearate | 97 | y = 0.803x - 0.0048 | 0.9807 |
| Vitamin A | 100 | y = 0.9406x - 0.1199 | 0.9887 |
| Vitamin E | 100 | y = 0.9541x - 22.231 | 0.9941 |

| **Late 2004 Deming Regression Analysis for A/E/Carotenoids Y(CDC)=X(CTI) in ug/dL:** | | | |
|---|---|---|---|
| | | | |
| Test | n | Y(CDC) = X (CTI) | $r^2$ |
| Alpha-Carotene | 99 | y = 0.9989x + 0.2204 | 0.9768 |
| Trans-Beta-Carotene | 98 | y = 1.0275x + 1.2976 | 0.9960 |
| Cis-Beta-Carotene | 99 | y = 0.7154x + 0.1344 | 0.9826 |
| Beta-Cryptoxanthin | 98 | y = 1.0824x - 0.056 | 0.9696 |
| Gamma-Tocopherol | 98 | y = 1.0306x - 5.523 | 0.9922 |
| Lutein/Zeaxanthin | 99 | y = 1.1082x - 1.602 | 0.9141 |
| Trans-Lycopene | 98 | y = 1.0971x + 0.0645 | 0.9737 |
| Retinyl Palmitate | 98 | y = 0.7989x + 1.2106 | 0.8845 |
| Retinyl Stearate | 98 | y = 0.7681x + 0.1483 | 0.9621 |
| Vitamin A | 99 | y = 0.9806x + 0.2901 | 0.9934 |
| Vitamin E | 98 | y = 0.93x + 22.614 | 0.9905 |

| **Combined Deming Regression Analysis for A/E/Carotenoids Y(CDC)=X(CTI) in ug/dL:** | | | |
|---|---|---|---|
| | | | |
| Test | n | Y(CDC) = X (CTI) | $r^2$ |
| Alpha-Carotene | 199 | y = 0.9837x + 0.2137 | 0.9877 |
| Trans-Beta-Carotene | 198 | y = 1.0339x + 0.8812 | 0.9960 |
| Cis-Beta-Carotene | 199 | y = 0.7232x + 0.0879 | 0.9815 |
| Beta-Cryptoxanthin | 198 | y = 1.0958x - 0.0542 | 0.9793 |
| Gamma-Tocopherol | 198 | y = 1.029x - 6.287 | 0.9893 |
| Lutein/Zeaxanthin | 198 | y = 1.0641x - 1.2402 | 0.9225 |
| Trans-Lycopene | 198 | y = 1.0852x - 0.0681 | 0.9849 |
| Retinyl Palmitate | 198 | y = 0.8227x + 0.99 | 0.7603 |
| Retinyl Stearate | 195 | y = 0.7881x + 0.0711 | 0.9675 |
| Vitamin A | 199 | y = 0.9805x - 1.0069 | 0.9871 |
| Vitamin E | 198 | y = 0.9397x + 1.649 | 0.9914 |

The combined regression was performed using crossover data from early 2003 and late 2004. The data user may wish to apply regression formulas to compare results from 2001-2002 and 2003-2004.

## References

1. N/A

## NCHS Locator Fields

**Title:** Serum concentrations of Vitamin A, E and Carotenoids

**Contact Number:** 1-866-441-NCHS

**Years of Content:** 2001–2002

**First Published:** October 2007

**Revised:** N/A

**Access Constraints:** None

**Use Constraints:** None

**Geographic Coverage:** National

**Subject:** fat-soluble micronutrients

**Record Source:** NHANES 2001–2002

**Survey Methodology:** NHANES 2001–2002 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 (2001-2002)

## Vitamins A, E, and Carotenoids (L06VIT_B)
## Person Level Data

First Published: October 2007
Last Revised: N/A

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

| LBXALC | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | a-carotene(ug/dL) |
| **English Text:** a-carotene(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.7 to 190.6 | Range of Values | 7614 | 7614 | |
| 0.49 | Fill Value of Limit of Detection | 745 | 8359 | |
| . | Missing | 903 | 9262 | |

| LBDALCSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | a-carotene(umol/L) |
| **English Text:** a-carotene(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.013 to 3.551 | Range of Values | 7614 | 7614 | |
| 0.009 | Fill Value of Limit of Detection | 745 | 8359 | |
| . | Missing | 903 | 9262 | |

| LBXBEC | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | trans-b-carotene(ug/dL) |
| **English Text:** trans-b-carotene(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.8 to 242.3 | Range of Values | 8351 | 8351 | |
| 0.57 | Fill Value of Limit of Detection | 7 | 8358 | |
| . | Missing | 904 | 9262 | |

| LBDBECSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | trans-b-carotene(umol/L) |
| **English Text:** trans-b-carotene(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.015 to 4.514 | Range of Values | 8351 | 8351 | |
| 0.011 | Fill Value of Limit of Detection | 7 | 8358 | |
| . | Missing | 904 | 9262 | |

| LBXCBC | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | cis-b-carotene(ug/dL) |
| **English Text:** cis-b-carotene(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.7 to 13.6 | Range of Values | 4025 | 4025 | |
| 0.49 | Fill Value of Limit of Detection | 4334 | 8359 | |
| . | Missing | 903 | 9262 | |

| LBDCBCSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | cis-b-carotene(umol/L) |
| **English Text:** cis-b-carotene(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.013 to 0.253 | Range of Values | 4025 | 4025 | |
| 0.009 | Fill Value of Limit of Detection | 4334 | 8359 | |
| . | Missing | 903 | 9262 | |

| LBXCRY | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | b-cryptoxanthin(ug/dL) |
| **English Text:** b-cryptoxanthin(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.9 to 208.6 | Range of Values | 8305 | 8305 | |
| 0.64 | Fill Value of Limit of Detection | 12 | 8317 | |
| . | Missing | 945 | 9262 | |

| LBDCRYSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | b-cryptoxanthin(umol/L) |
| **English Text:** b-cryptoxanthin(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.016 to 3.776 | Range of Values | 8305 | 8305 | |
| 0.012 | Fill Value of Limit of Detection | 12 | 8317 | |
| . | Missing | 945 | 9262 | |

| LBXGTC | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | g-tocopherol(ug/dL) |
| **English Text:** g-tocopherol(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 18 to 1977 | Range of Values | 8307 | 8307 | |
| 8 | Fill Value of Limit of Detection | 1 | 8308 | |
| . | Missing | 954 | 9262 | |

| LBDGTCSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | g-tocopherol(umol/L) |
| **English Text:** g-tocopherol(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.432 to 47.488 | Range of Values | 8307 | 8307 | |
| 0.192 | Fill Value of Limit of Detection | 1 | 8308 | |
| . | Missing | 954 | 9262 | |

| LBXLUZ | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Combined Lutein/zeaxanthin(ug/dL) |
| **English Text:** Combined Lutein/zeaxanthin(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 2.5 to 85 | Range of Values | 8342 | 8342 | |
| 1.7 | Fill Value of Limit of Detection | 11 | 8353 | |
| . | Missing | 909 | 9262 | |

| LBDLUZSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Combined Lutein/zeaxanthin(umol/L) |
| **English Text:** Combined Lutein/zeaxanthin(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.044 to 1.494 | Range of Values | 8342 | 8342 | |
| 0.03 | Fill Value of Limit of Detection | 11 | 8353 | |
| . | Missing | 909 | 9262 | |

| LBXLYC | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | trans-lycopene(ug/dL) |
| **English Text:** trans-lycopene(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.8 to 79.8 | Range of Values | 8336 | 8336 | |
| 0.57 | Fill Value of Limit of Detection | 12 | 8348 | |
| . | Missing | 914 | 9262 | |

| LBDLYCSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | trans-lycopene(umol/L) |
| **English Text:** trans-lycopene(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.015 to 1.487 | Range of Values | 8336 | 8336 | |
| 0.011 | Fill Value of Limit of Detection | 12 | 8348 | |
| . | Missing | 914 | 9262 | |

| LBXRPL | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinyl palmitate(ug/dL) |
| **English Text:** Retinyl palmitate(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.2 to 72.7 | Range of Values | 7885 | 7885 | |
| 0.14 | Fill Value of Limit of Detection | 168 | 8053 | |
| . | Missing | 1209 | 9262 | |

| LBDRPLSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinyl palmitate(umol/L) |
| **English Text:** Retinyl palmitate(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.007 to 2.538 | Range of Values | 7885 | 7885 | |
| 0.005 | Fill Value of Limit of Detection | 168 | 8053 | |
| . | Missing | 1209 | 9262 | |

| LBXRST | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinyl stearate(ug/dL) |
| **English Text:** Retinyl stearate(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.5 to 29.8 | Range of Values | 1073 | 1073 | |
| 0.35 | Fill Value of Limit of Detection | 7033 | 8106 | |
| . | Missing | 1156 | 9262 | |

| LBDRSTSI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinyl stearate(umol/L) |
| **English Text:** Retinyl stearate(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.017 to 1.04 | Range of Values | 1073 | 1073 | |
| 0.012 | Fill Value of Limit of Detection | 7033 | 8106 | |
| . | Missing | 1156 | 9262 | |

| LBXVIA | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinol(ug/dL) |
| **English Text:** Retinol(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 1.4 to 182.1 | Range of Values | 8365 | 8365 | |
| . | Missing | 897 | 9262 | |

| LBDVIASI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | Retinol(umol/L) |
| **English Text:** Retinol(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 0.049 to 6.357 | Range of Values | 8365 | 8365 | |
| . | Missing | 897 | 9262 | |

| LBXVIE | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | a-tocopherol(ug/dL) |
| **English Text:** a-tocopherol(ug/dL) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 75.3 to 13083.9 | Range of Values | 8365 | 8365 | |
| . | Missing | 897 | 9262 | |

| LBDVIESI | Target |
|---|---|
| | B(3 Yrs. to 150 Yrs.) |
| **Hard Edits** | **SAS Label** |
| | a-tocopherol(umol/L) |
| **English Text:** a-tocopherol(umol/L) | |
| **English Instructions:** | |

| Code or Value | Description | Count | Cumulative | Skip to Item |
|---|---|---|---|---|
| 1.748 to 303.808 | Range of Values | 8365 | 8365 | |
| . | Missing | 897 | 9262 | |