Appendix A:
NHANES Reports Related to Nutritional Status

**National Center for Health Statistics (NCHS) Series 11 Reports**


**National Center for Health Statistics (NCHS) Series 2 Reports**

http://www.cdc.gov/nchs/products/pubs/pubd/series/ser.htm#sr2


**National Center for Health Statistics (NCHS) Advance Data Reports**

http://www.cdc.gov/nchs/about/major/nhanes/advancedatas.htm


Life Sciences Research Office (LSRO) Reports


Appendix B:
References for Analytical Methods for Biochemical Indicators

Detailed Laboratory Procedure Manuals for Analytical Methods

- NHANES 2001–2002: [http://www.cdc.gov/nchs/about/major/nhanes/lab_methods01_02.htm](http://www.cdc.gov/nchs/about/major/nhanes/lab_methods01_02.htm)

Additional Useful Analytical Method References

**Water-Soluble Vitamins & Related Biochemical Compounds**


**Fat-Soluble Vitamins & Micronutrients**

**Trace Elements**

Paschal DC, Kimberly MM. Automated direct determination of selenium in serum by electrothermal atomic absorption spectroscopy. At Spectrosc. 1986;7:75-8.


**Iron-Status Indicators**


**Isoflavones & Lignans**


Appendix C:
Confidence Interval Estimation for Percentiles

A common practice to calculate confidence intervals from survey data is to use large-sample normal approximations. Ninety-five percent confidence intervals on point estimates of percentiles are often computed by adding and subtracting from the point estimate a quantity equal to twice its standard error. This normal approximation method may not be adequate, however, when estimating the proportion of subjects above or below a selected value (especially when the proportion is near 0.0 or 1.0 or when the effective sample size is small).

In addition, confidence intervals on proportions deviating from 0.5 are not theoretically expected to be symmetric around the point estimate. Further, adding and subtracting a multiple of the standard error to an estimate near 0.0 or 1.0 can lead to impossible confidence limits (i.e., proportion estimates below 0.0 or above 1.0).

We used the method of Korn and Graubard (1998) to compute Clopper-Pearson 95 percent confidence intervals about percentile estimates. We describe the method below, using SAS Proc Univariate and SUDAAN. SAS code for calculating these confidence intervals can be downloaded from http://www.cdc.gov/exposurereport.

Procedure to calculate confidence intervals about percentiles

Step 1: Use SAS (SAS Institute Inc., 1999) Proc Univariate to obtain a point estimate of the percentile of a chemical’s results for the demographic group of interest (e.g., the 90th percentile of blood lead results for children aged 1–5 years). Use the Freq option to assign the correct sample weight for each chemical result.

Step 2: Use SUDAAN (SUDAAN Users Manual, 2001) Proc Descript with Taylor Linearization DESIGN = WR (i.e., sampling with replacement) and the proper sampling weight to estimate the proportion (p) of subjects with results below the percentile estimate obtained in Step 1 and to obtain the standard error (sep) associated with this proportion estimate. Compute the degrees-of-freedom adjusted effective sample size

\[ n_{df} = \left( \frac{t_{num}}{t_{denom}} \right)^2 \frac{p(1-p)}{se_p^2} \]  

(1)

where \( t_{num} \) and \( t_{denom} \) are 0.975 critical values of the Student’s t distribution with degrees of freedom equal to the sample size minus 1 and the number of PSUs minus the number of strata, respectively. Note: the degrees of freedom for \( t_{denom} \) can vary with the demographic subgroup of interest (e.g., males).
**Step 3:** After obtaining an estimate of \( p \) (i.e., the proportion obtained in Step 2), compute the Clopper-Pearson 95 percent confidence interval \((P_L(x,n_{df}), P_U(x,n_{df}))\) as follows:

\[
P_L(x,n_{df}) = \frac{v_1 F_{v_1,v_2}(0.025)}{(v_2 + v_1 F_{v_1,v_2}(0.025))} \quad \& \quad P_U(x,n_{df}) = \frac{v_3 F_{v_3,v_4}(0.975)}{(v_4 + v_3 F_{v_3,v_4}(0.975))}
\]

where \( x \) is equal to \( p \) times \( n_{df} \), \( v_1 = 2x \), \( v_2 = 2(n_{df} - x + 1) \), \( v_3 = 2(x + 1) \), \( v_4 = 2(n_{df} - x) \), and \( F_{d1,d2}(\beta) \) is the \( \beta \) quantile of an F distribution with \( d_1 \) and \( d_2 \) degrees of freedom. (Note: If \( n_{df} \) is greater than the actual sample size, or if \( p \) is equal to zero, then the actual sample size should be used.) This step will produce a lower and an upper limit for the estimated proportion obtained in Step 2.

**Step 4:** Use SAS Proc Univariate (again using the Freq option to assign weights) to determine the chemical values that correspond to the proportion obtained in Step 2 and the lower and upper limits on this proportion obtained in Step 3.

**Example:**

To estimate the 75th percentile, use SAS Proc Univariate with the Freq option to get a weighted point estimate of the chemical value that corresponds to the 75th percentile. Then use SUDAAN to estimate the weighted proportion of subjects with results below the 75th percentile (which should be very near 0.75). Next, obtain a confidence interval on this proportion by computing the weighted Clopper-Pearson 95 percent confidence limits using the degrees-of-freedom adjusted effective sample size. Suppose these confidence limits are 0.67 and 0.81, then use SAS Proc Univariate with the Freq option to determine the chemical values corresponding to the weighted 67th and 81st percentiles. These point estimates are the lower and upper confidence limits on the 75th percentile.

**References**

Korn EL, Graubard BI. Confidence intervals for proportions with small expected number of positive counts estimated from survey data. Survey Methodology. 1998;24:193-201.
Appendix D:
Limit of Detection Table

The table below presents the analytical limit of detection (LOD) for each of the different indicators. The LOD is the level at which the measurement has a 95 percent probability of being greater than zero (Taylor 1987). For the same indicator, LOD values may change over time as a result of changes to analytical methods. This was the case for urinary phytoestrogens. We used the higher of the two LOD values for the analysis of the combined four-year data.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Water-Soluble Vitamins &amp; Related Biochemical Compounds</strong></td>
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<tr>
<td>Serum folate</td>
<td>ng/mL</td>
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<td>0.1</td>
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<td>Red blood cell (RBC) folate</td>
<td>ng/mL RBC</td>
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<td>20</td>
</tr>
<tr>
<td>Serum vitamin B12</td>
<td>pg/mL</td>
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<td>20</td>
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<td>Plasma homocysteine</td>
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<td>0.35</td>
</tr>
<tr>
<td>Plasma methylmalonic acid</td>
<td>µmol/L</td>
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<td>0.05</td>
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<tr>
<td><strong>Fat-Soluble Vitamins &amp; Micronutrients</strong></td>
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<tr>
<td>Serum vitamin A</td>
<td>µg/dL</td>
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<td>Serum gamma-tocopherol</td>
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<td>Serum alpha-carotene</td>
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<td>Serum trans-beta-carotene</td>
<td>µg/dL</td>
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<td>Serum beta-cryptoxanthin</td>
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<tr>
<td>Serum trans-lycopene</td>
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<tr>
<td>Serum vitamin D, 25-hydroxy</td>
<td>ng/mL</td>
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<td><strong>Iron-Status Indicators</strong></td>
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<tr>
<td>Serum ferritin</td>
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<td>1.1</td>
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<tr>
<td>Serum iron</td>
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<td>Serum total iron-binding capacity</td>
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<tr>
<td>Serum transferrin saturation</td>
<td>%</td>
<td>n/a</td>
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<tr>
<td>Erythrocyte protoporphyrin</td>
<td>µg/dL RBC</td>
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<td><strong>Trace Elements</strong></td>
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<tr>
<td>Urinary iodine</td>
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<td>Serum selenium</td>
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<td><strong>Isoflavones &amp; Lignans</strong></td>
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<tr>
<td>Urinary genistein</td>
<td>µg/L</td>
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<td>Urinary daidzein</td>
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<tr>
<td>Urinary enterolactone</td>
<td>µg/L</td>
<td>0.6</td>
<td>1.9</td>
</tr>
</tbody>
</table>
References

Appendix E:
Selected References of Descriptive NHANES Papers on Biochemical Indicators of Diet and Nutrition

Water-Soluble Vitamins & Related Biochemical Compounds


Fat-Soluble Vitamins & Micronutrients


Iron-Status Indicators


**Trace Elements**


**Isoflavones & Lignans**

