Within-individual Variance Estimates for Nutrients from What We Eat in America, NHANES 2002

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Introduction

These estimates of within-individual variances were produced to permit the estimation of distributions of the usual intake of nutrients and other dietary components from intake datasets that contain only one day of nutrient intake per person. They were used in preparing the report ***What We Eat in America, NHANES 2001-2002: Usual Nutrient Intakes from Food Compared to Dietary Reference Intakes*** (1). They may have additional applications in analysis of What We Eat in America (WWEIA), NHANES 2001-2002 data (2,3) or of other intake datasets comprised of only one day of intake per individual.

The variance estimates are provided for 21 gender/age groups corresponding to 14 gender/age groups for which the Food and Nutrition Board of the Institute of Medicine at the National Academies established Dietary Reference Intakes (4) and for 6 additional summary groups. Estimates are provided for 35 nutrients and dietary components. The gender/age groups and nutrients are listed below and identified in the files containing the variance estimates.

The within-individual variance component estimates are provided in two formats: a comma-delimited text file and a SAS® system file of the XPORT type (5). Both files have one record for each nutrient and gender/age group combination containing the following five fields: gender/age group represented numerically, a text description of the gender/age group, the nutrient represented numerically, a text description of the nutrient, and the within-individual variance component estimate. In the SAS file, these fields are named SUBPOP, SUBPOP_C, NUTRIENT, NUT_C, and VARMERR.

These estimates were produced with and are intended for use with C-SIDE software (6) which runs under the Unix operating system and which implements the method of estimating usual intake distributions developed at Iowa State University (7). They may be also of use in estimating usual intake distributions through SIDE (6), the pc/SAS version of C-SIDE, or through an alternative method such as the method of estimating usual intake distributions suggested by the National Research Council (8).

The usual intake estimation procedure requires multiple days of nutrient intake data for at least a representative subsample of the individuals in the sample in order to estimate within-individual variances and separate the total variation in intake into within- and between-individual components. In WWEIA, NHANES 2001-2002, dietary intakes were collected for one 24-hour period per individual in 2001 and for two 24-hour periods beginning in 2002. As a precaution to protect the confidentiality of survey participants, single-year data from NHANES are not released for public use. For that reason, only Day 1 interview data are included in the WWEIA, NHANES 2001-2002 release. However, the restricted 2002 Day 2 dietary data are available through the Research Data Center, National Center for Health Statistics, Hyattsville, MD (9), and were available to the author for producing variance estimates.

Usual Intake Estimation with C-SIDE

The usual intake estimation method as implemented by C-SIDE may be summarized as follows:

1. *Preliminary data adjustments*
   Preliminary data adjustments include shifting observed intake data by a small amount away from zero, incorporating survey weights, and correcting for the effect of the sample day (Day 1 versus Day 2) on the mean and the variance of the distribution of observed intakes. Adjustment may also be made for differences in diet due to non-person specific effects such as seasonality or weekend-versus-weekday eating patterns.

2. *Transformation to normality*
   Observed intake data (whether adjusted or not) generally have nonnormal distributions. For certain nutrients skewness is quite extreme. Most statistical procedures rely on an assumption of normality. At this step the adjusted dietary intake data are transformed into normality. This is done in a two step process. First, a power or log transformation is used to transform the data as close to normal as possible. Second, a nonparametric transformation, based on a grafted polynomial model, takes the power-transformed data into normality.

3. *Estimation of within- and between-individual variances in intakes*
   A measurement error model is used, under the assumption of normality, to obtain estimates for the components of within- and between-individual variances. The variance components are used to estimate the distribution of usual intakes in the normal scale, which is assumed to exhibit only between-individual variation.

4. *Back-transformation into the original scale*
   The final step is to transform the estimated usual intake distribution from the normal scale into the original scale. This inverse transformation ensures that the mean of the original intakes is retained in the usual intake distribution transformed back to the original scale.

The variance estimates provided in this report were computed during step 3 of this process. Because these estimates were derived from data transformed to normality with a (total) variance of 1, they fall in the range of 0 to 1 and, more specifically, could be labeled as the fraction of total variation attributable to within-individual effects.

Using the within-individual variance estimates with 1 day of intake data for all individuals

Normally, an input file for a C-SIDE program is comprised of 2 days of intake data for at least some of the individuals. Under the default settings, an input file with only one day of intake for all individuals will be rejected. Two changes to normal use of C-SIDE allow for the estimation of usual intakes from a sample of individuals for which there is only one day of intake but externally computed within-individual variance components are available. First, an input file should be constructed that contains the full set of one-day intake data for all of the individuals included in the analysis, as well as a second set of exactly the same intake data, but identified as having been collected on a second day. The fabricated second day intakes are necessary because normal use of C-SIDE requires input data files to contain intake data for more than one day for at least some of the individuals. Second, the within-individual variance components are supplied as external inputs to C-SIDE using adjustments to the default parameter settings as described below.

PEVCR	=	within-person individual variance component	
NPEVCR	=	999999	(forces C-SIDE to use the external estimate of within-individual variance)
FXHETVAR	=	N	(turns off the correction for heterogeneous within-individual variances - necessary because of the duplicate second day records in the input file)

The procedure for supplying external variance components to facilitate analysis of one-day data was provided by Dr. Kevin W. Dodd (10) at the National Cancer Institute, who was one of the developers of C-SIDE. The ability of C-SIDE to operate in this fashion is an undocumented feature of the software. Versions of C-SIDE later than the current version 1.02 may use different settings to obtain the same behavior, and may expand on this functionality.

The report ***What We Eat in America, NHANES 2001-2002: Usual Nutrient Intakes from Food Compared to Dietary Reference Intakes*** (1) contains further description of the use of C-SIDE to estimate the distribution of usual intakes and to make comparisons to Dietary Reference Intakes.

References

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8. National Research Council, Subcommittee on Criteria for Dietary Evaluation. *Nutrient Adequacy: Assessment Using Food Consumption Surveys*. Washington, D.C. National Academy Press. 1986.

9. NCHS Research Data Center website: available at http://www.cdc.gov/nchs/r&d/rdc.htm.

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Gender/age groups

1	Males and females 1-3
2	Males and females 4-8
3	Males 9-13
4	Males 14-18
5	Males 19-30
6	Males 31-50
7	Males 51-70
8	Males 71+
9	Females 9-13
10	Females 14-18
11	Females 19-30
12	Females 31-50
13	Females 51-70
14	Females 71+
15	Males 19-50
16	Males 51+
17	Males 19+
18	Females 19-50
19	Females 51+
20	Females 19+
21	Males and females 1+

Nutrients and Dietary Components

1	Vitamin A (RAE)
2	Vitamin E (mg alpha-tocopherol)
3	Thiamin (mg)
4	Riboflavin (mg)
5	Niacin (mg)
6	Vitamin B6 (mg)
7	Folate (DFE)
8	Vitamin B12 (mcg)
9	Vitamin C (mg)
10	Phosphorus (mg)
11	Magnesium (mg)
12	Iron (mg)
13	Zinc (mg)
14	Copper (mg)
15	Selenium (mcg)
16	Carbohydrate (g)
17	Protein (g / kg body weight)
18	Vitamin K (mcg)
19	Calcium (mg)
20	Potassium (mg)
21	Sodium (mg)
22	Fiber (g)
23	Linoleic Acid 18:2 (g)
24	Linolenic Acid 18:3 (g)
25	Food energy (kcal)
26	Protein (g)
27	Total sugars (g)
28	Total fat (g)
29	Saturated fat (g)
30	Monounsaturated fat (g)
31	Polyunsaturated fat (g)
32	Cholesterol (mg)
33	Retinol (mcg)
34	Food folate (natural) (mcg)
35	Folic acid (mcg)