Appendix C
Statistical and Reporting Guidelines

This report presents population means and proportions, standard errors of estimates, and percentiles of dietary intake distributions. Sample weights were used to account for sample design and nonresponse. Information about the NHANES-III survey design was used in estimating variances and testing for statistical significance.

Several software packages were used to produce the tabulations:

- ***C-SIDE: Software for Intake Distribution Estimation (Version 1.0)***—used to estimate means, percentiles, and standard errors for nutrient intake tables.

- ***SUDAAN (Version 7.5)***—used to calculate means, standard errors, and tests of statistical significance for non-nutrient tables, using the DESCRIPT procedure.

- ***SAS (Version 8.2)***—used to read the NHANES-III data files, call SUDAAN procedures, process SUDAAN output, and write SUDAAN results to ASCII files.

- ***TPL (Table Producing Language)***—this software produced all data tables in appendix D.

General Procedures

NHANES-III sample weights account for the fact that each sample person does not have an equal probability of selection into the sample. NHANES-III provides sample weights for three samples: the interviewed sample weight (WTPEQX6), the MEC-examined sample weight (WTPFEX6), and the MEC and home-examined sample weight (WTPFHX6). The sampling weight used for each table in this report was specific to the data item presented in the table, and is indicated by the source of data listed in the table footnote.

Variance is generally underestimated in a complex survey when information about the survey design is not used in variance estimation. For this report, two alternate methods were used to account for the sample design.

- Balance repeated replication (BRR)—this method was specified when using C-SIDE software to obtain estimates for nutrient tables. The BRR method used the 52 replicate weights provided in the NHANES-III data.

- Taylor series linearization—this method is used in SUDAAN procedures. The complex survey design is accounted for by specifying strata and PSU in the "nest" statement of SUDAAN procedures.

Coefficients of variation (CVs) and t-statistics were generated and examined, but are not provided in the tables. CVs were examined to determine the statistical reliability of estimates, as described below in the section on Reporting Guidelines. T-statistics were examined to determine the statistical significance of differences in means and proportions. When examining categorical data, t-statistics were used and the Bonferroni adjustment was applied to adjust for multiplicity of tests.

All tests for statistical significance are tests for differences between two independent samples defined by program participation and/or income-level. In volumes I and II, differences between

program participants and income-eligible nonparticipants are denoted by symbols on values for income-eligible nonparticipants; differences between program participants and higher-income nonparticipants are denoted by symbols on values for higher-income nonparticipants. In volumes III and IV, differences between the lowest-income group and the low-income group are denoted by symbols on values for the low-income group; differences between the lowest-income group and high-income group are denoted by symbols on values for the high-income group.

Differences in means and proportions were tested for statistical significance using α levels of 0.01, 0.05, and 0.001. For categorical data, differences involve multiple non-independent comparisons and were tested using α levels of 0.01, 0.05, and 0.001 adjusted using the Bonferroni method, by dividing α levels by the number of comparisons.

Age Standardization

Tables presented in appendix A include age-adjusted estimates for the total population (i.e., all age groups), calculated using the direct method (Klein, 2001). The age-adjusted estimates were obtained by weighting estimates for each age category by the year 2000 population distribution.

The population distribution used for age-adjustment is from *Monthly Estimates of the United States Population: April 2000*. Age-adjusted estimates were calculated by the SUDAAN software.

Nutrient Analyses

A primary goal for the analysis of dietary intake was to estimate the proportion of individuals whose intake is inadequate. Reference standards used to define adequate intake reflect expectations for usual intake. To apply these standards appropriately, it is necessary to have information about the distribution of intake in the population of interest. The variance of the distribution of observed intake is too large to produce reliable estimates of the prevalence of inadequate intake. This is because the variance of observed intake includes both within-person (day-to-day) and between-person variation. Methods have been established for adjusting observed intake distributions to estimate distributions of usual intake by removing within-person variation (NRC, 1986 and Nusser et al, 1996). These adjustments require two or more days of intake data for at least some subjects.

NHANES-III collected replicate 24-hour recalls on a convenience sample of approximately 5 percent of respondents. The nonrandom nature and small size of the replicate recall sample prohibited its use in estimating usual dietary intake. Instead, we used the Continuing Survey of Food Intake of Individuals (CSFII) 1994-96, to obtain estimates of within-person variation. CSFII is a nationally representative survey that includes two days of dietary intake data for all subjects.

CSFII data were used to estimate variance components for 96 demographic cells defined by age group (8), gender (male, female, both), and program participation or income (3 plus overall).[1] The variance components from CSFII were used to adjust observed intakes collected in the NHANES-III single-day dietary recalls. Estimation for all nutrients was done using *C-SIDE: Software for Intake Distribution Estimation* (Iowa State University, 1996). Because iron requirements for menstruating females are known to be asymmetrical, the adjustments performed by the C-SIDE software (using this "Iowa State Method") were not appropriate.

[1] Age groups correspond to the DRI age groups for volumes I, III, IV. CSFII used to estimate variance components for volume II (WIC participants and nonparticipants) were aggregated by year of age (4) and program participation or income (3 plus overall), but not by gender.

Therefore, distributions of iron intake were adjusted using the full probability approach as described in the IOM report *Dietary Reference Intakes: Applications in Dietary Assessment* (IOM, 2001). CSFII variance components are shown in table C1.

Reporting Guidelines

This report follows the recommendations in the NHANES-III Analytic Guidelines in the appendix titled "Joint Policy on Variance Estimation and Statistical Reporting Standards for NHANES-III and CSFII Reports: HNIS/NCHS Analytic Working Group Recommendations" (NCHS, 1996). The recommendations for presentation of statistical data call for estimates to be flagged if any of the following conditions are met:

1. **Inadequate sample size for normal approximation.** For means and for proportions based on commonly occurring events (where $0.25 < P < 0.75$), an estimate is flagged if it is based on a cell size of less than 30 times a "broadly calculated average design effect."

2. **Large coefficient of variation.** Estimates are flagged if the coefficient of variation (ratio of the standard error to the mean expressed as a percent) is greater than 30.

3. **Inadequate sample size for uncommon or very common events.** For proportions below 0.25 or above 0.75, the criteria for statistical reliability is that the cell size be sufficiently large that the minimum of nP and n(1-P) be greater than or equal to 8 times a broadly calculated average design effect, where n is the cell size and P is the estimated proportion. (I.e., an estimate is flagged when $n < 8 * (\text{avg design effect}) / \min(P,(1-P))$.) The coefficient of variation is not used in these cases.

For each data item, the design effect was calculated for each table cell as the ratio of the complex sampling design variance calculated by SUDAAN, to the simple random sample variance. The average design effect for a data item is the average of estimated design effects across age groups (pooled genders) within a demographic group, where demographic groups correspond to the columns of tables (groups defined by program participation and income).

Table C-1—CSFII variance components for 10 nutrients

Total energy

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.44606	175	0.55702	89	0.28737	563	0.45537
65-69 years	799	0.46388	196	0.49223	123	0.40943	475	0.50817
70-74 years	594	0.42600	138	0.48029	94	0.38348	352	0.47035
75-79 years	428	0.45120	138	0.55827	88	0.34527	201	0.52169
80 + years	494	0.41972	155	0.41166	97	0.32901	242	0.50153
Male								
60-64 years	440	0.51128	91	0.62633	43	0.25740	301	0.55287
65-69 years	405	0.54502	78	0.57626	60	0.58320	265	0.53722
70-74 years	323	0.45012	69	0.49642	41	0.49554	206	0.48307
75-79 years	212	0.51473	59	0.61123	44	0.39088	109	0.58433
80 + years	256	0.40840	72	0.31886	50	0.36863	134	0.51636
Female								
60-64 years	395	0.56061	84	0.54011	46	0.50835	262	0.58062
65-69 years	394	0.54411	118	0.57799	63	0.34491	210	0.64436
70-74 years	271	0.53540	69	0.64151	53	0.37674	146	0.64345
75-79 years	216	0.46463	79	0.52723	44	0.33307	92	0.51734
80 + years	238	0.52524	83	0.56999	47	0.42385	108	0.56404

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation*.

Table C-1—CSFII variance components for 10 nutrients — Continued

Vitamin C

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.54460	175	0.66681	89	0.54152	563	0.53184
65-69 years	799	0.46672	196	0.45079	123	0.48036	475	0.50458
70-74 years	594	0.44750	138	0.48873	94	0.54827	352	0.44549
75-79 years	428	0.42005	138	0.44572	88	0.42620	201	0.43561
80 + years	494	0.53946	155	0.65857	97	0.60761	242	0.45985
Male								
60-64 years	440	0.52381	91	0.60576	43	0.77160	301	0.49362
65-69 years	405	0.45011	78	0.33301	60	0.44045	265	0.52382
70-74 years	323	0.37616	69	0.50773	41	0.59439	206	0.36115
75-79 years	212	0.36472	59	0.35193	44	0.34030	109	0.41326
80 + years	256	0.49524	72	0.62089	50	0.69061	134	0.38813
Female								
60-64 years	395	0.57326	84	0.73123	46	0.43921	262	0.58553
65-69 years	394	0.49304	118	0.54422	63	0.56634	210	0.47790
70-74 years	271	0.54576	69	0.44329	53	0.52263	146	0.60980
75-79 years	216	0.48747	79	0.54720	44	0.46578	92	0.46428
80 + years	238	0.61463	83	0.75083	47	0.37819	108	0.58414

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Iron

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.50969	175	0.56144	89	0.42673	563	0.53694
65-69 years	799	0.51134	196	0.47927	123	0.50598	475	0.55146
70-74 years	594	0.43657	138	0.46546	94	0.35931	352	0.48451
75-79 years	428	0.47616	138	0.59026	88	0.46120	201	0.43358
80 + years	494	0.47894	155	0.50054	97	0.56902	242	0.45554
Male								
60-64 years	440	0.59144	91	0.59562	43	0.41893	301	0.66091
65-69 years	405	0.55207	78	0.52300	60	0.48077	265	0.57055
70-74 years	323	0.45991	69	0.48305	41	0.48002	206	0.50064
75-79 years	212	0.48051	59	0.64315	44	0.44748	109	0.43542
80 + years	256	0.46091	72	0.57491	50	0.52971	134	0.36516
Female								
60-64 years	395	0.52712	84	0.55270	46	0.52061	262	0.54376
65-69 years	394	0.56149	118	0.51019	63	0.56532	210	0.65292
70-74 years	271	0.48864	69	0.46634	53	0.29473	146	0.56917
75-79 years	216	0.52329	79	0.57879	44	0.49446	92	0.48243
80 + years	238	0.54444	83	0.44641	47	0.68349	108	0.58578

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Zinc

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.59146	175	0.70766	89	0.40620	563	0.62103
65-69 years	799	0.60928	196	0.64454	123	0.64826	475	0.60163
70-74 years	594	0.53359	138	0.58580	94	0.49909	352	0.55300
75-79 years	428	0.57990	138	0.61352	88	0.63496	201	0.57242
80 + years	494	0.61432	155	0.64891	97	0.55278	242	0.68034
Male								
60-64 years	440	0.68547	91	0.73392	43	0.56845	301	0.73801
65-69 years	405	0.65543	78	0.71565	60	0.78952	265	0.57786
70-74 years	323	0.55150	69	0.51598	41	0.56800	206	0.60229
75-79 years	212	0.58135	59	0.67577	44	0.61335	109	0.58195
80 + years	256	0.63483	72	0.63409	50	0.59789	134	0.67436
Female								
60-64 years	395	0.64510	84	0.75629	46	0.53830	262	0.65240
65-69 years	394	0.67056	118	0.61887	63	0.61621	210	0.75129
70-74 years	271	0.61778	69	0.76671	53	0.48168	146	0.61565
75-79 years	216	0.62056	79	0.57241	44	0.66023	92	0.65294
80 + years	238	0.67242	83	0.65767	47	0.51362	108	0.78863

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation*.

Table C-1—CSFII variance components for 10 nutrients — Continued

Calcium

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.50104	175	0.53477	89	0.44513	563	0.51802
65-69 years	799	0.48084	196	0.43787	123	0.52756	475	0.49442
70-74 years	594	0.44861	138	0.38430	94	0.47057	352	0.50015
75-79 years	428	0.40590	138	0.43133	88	0.50101	201	0.38503
80 + years	494	0.49835	155	0.53580	97	0.42944	242	0.54969
Male								
60-64 years	440	0.54666	91	0.59787	43	0.43948	301	0.58143
65-69 years	405	0.54709	78	0.50643	60	0.77226	265	0.51741
70-74 years	323	0.52851	69	0.42150	41	0.56027	206	0.58942
75-79 years	212	0.45384	59	0.48134	44	0.42643	109	0.48254
80 + years	256	0.44811	72	0.51748	50	0.37170	134	0.50796
Female								
60-64 years	395	0.50532	84	0.44114	46	0.52422	262	0.53265
65-69 years	394	0.46453	118	0.41528	63	0.40748	210	0.53249
70-74 years	271	0.42993	69	0.42887	53	0.40793	146	0.45918
75-79 years	216	0.37588	79	0.38913	44	0.60780	92	0.29778
80 + years	238	0.56801	83	0.62232	47	0.53625	108	0.59363

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Total fat

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.64991	175	0.59703	89	0.67066	563	0.67917
65-69 years	799	0.57998	196	0.61813	123	0.58774	475	0.57008
70-74 years	594	0.57542	138	0.55010	94	0.49135	352	0.61502
75-79 years	428	0.64202	138	0.57564	88	0.87099	201	0.62495
80 + years	494	0.54844	155	0.61476	97	0.41677	242	0.58013
Male								
60-64 years	440	0.58869	91	0.63526	43	0.61337	301	0.59903
65-69 years	405	0.60220	78	0.78820	60	0.46204	265	0.60105
70-74 years	323	0.52961	69	0.49947	41	0.38789	206	0.58488
75-79 years	212	0.66122	59	0.65339	44	0.80842	109	0.66222
80 + years	256	0.57801	72	0.66931	50	0.38201	134	0.63591
Female								
60-64 years	395	0.72642	84	0.56954	46	0.86188	262	0.77353
65-69 years	394	0.56362	118	0.53457	63	0.78080	210	0.53939
70-74 years	271	0.62061	69	0.62206	53	0.58605	146	0.64813
75-79 years	216	0.62058	79	0.54663	44	0.90435	92	0.56428
80 + years	238	0.51596	83	0.54470	47	0.45124	108	0.53464

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Saturated fat

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.62038	175	0.57543	89	0.47314	563	0.67107
65-69 years	799	0.53374	196	0.64239	123	0.52303	475	0.49996
70-74 years	594	0.55618	138	0.57763	94	0.48507	352	0.57746
75-79 years	428	0.54327	138	0.47271	88	0.72428	201	0.54282
80 + years	494	0.49233	155	0.57029	97	0.40978	242	0.48361
Male								
60-64 years	440	0.56448	91	0.53729	43	0.53961	301	0.61656
65-69 years	405	0.53975	78	0.72410	60	0.41330	265	0.51707
70-74 years	323	0.48880	69	0.55086	41	0.43387	206	0.49231
75-79 years	212	0.57062	59	0.55110	44	0.61345	109	0.56640
80 + years	256	0.52455	72	0.64984	50	0.39948	134	0.52121
Female								
60-64 years	395	0.69754	84	0.63979	46	0.55214	262	0.74277
65-69 years	394	0.53259	118	0.61018	63	0.57112	210	0.48741
70-74 years	271	0.62428	69	0.63471	53	0.51844	146	0.66701
75-79 years	216	0.50857	79	0.42241	44	0.75429	92	0.47949
80 + years	238	0.46456	83	0.50357	47	0.42907	108	0.45708

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Cholesterol

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.68897	175	0.71024	89	0.53722	563	0.72494
65-69 years	799	0.63687	196	0.55961	123	0.66329	475	0.67717
70-74 years	594	0.71985	138	0.68487	94	0.73476	352	0.74016
75-79 years	428	0.66519	138	0.51020	88	0.67793	201	0.79469
80 + years	494	0.59165	155	0.61684	97	0.52302	242	0.61501
Male								
60-64 years	440	0.73571	91	0.69667	43	0.61774	301	0.81298
65-69 years	405	0.67079	78	0.46015	60	0.66517	265	0.76988
70-74 years	323	0.72405	69	0.71430	41	0.86570	206	0.70936
75-79 years	212	0.68941	59	0.47658	44	0.81761	109	0.80461
80 + years	256	0.61145	72	0.68354	50	0.52823	134	0.61230
Female								
60-64 years	395	0.74747	84	0.79714	46	0.63287	262	0.78066
65-69 years	394	0.65041	118	0.66954	63	0.75533	210	0.61901
70-74 years	271	0.80441	69	0.78630	53	0.67817	146	0.87584
75-79 years	216	0.71407	79	0.60592	44	0.59877	92	0.88921
80 + years	238	0.62665	83	0.63368	47	0.54417	108	0.66641

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*

Table C-1—CSFII variance components for 10 nutrients — Continued

Sodium

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.55699	175	0.64372	89	0.49366	563	0.56325
65-69 years	799	0.58048	196	0.60982	123	0.47017	475	0.62582
70-74 years	594	0.50180	138	0.49964	94	0.44257	352	0.57218
75-79 years	428	0.52311	138	0.54361	88	0.45301	201	0.58304
80 + years	494	0.52808	155	0.49851	97	0.48624	242	0.58763
Male								
60-64 years	440	0.63846	91	0.68342	43	0.68074	301	0.67609
65-69 years	405	0.63143	78	0.59131	60	0.58365	265	0.66170
70-74 years	323	0.49478	69	0.50945	41	0.49589	206	0.52216
75-79 years	212	0.60645	59	0.61957	44	0.52853	109	0.66162
80 + years	256	0.48489	72	0.44184	50	0.40622	134	0.54178
Female								
60-64 years	395	0.60920	84	0.61771	46	0.52348	262	0.61542
65-69 years	394	0.67825	118	0.77592	63	0.43671	210	0.72954
70-74 years	271	0.61670	69	0.55053	53	0.41299	146	0.78496
75-79 years	216	0.50996	79	0.48336	44	0.44266	92	0.60160
80 + years	238	0.64208	83	0.62475	47	0.60363	108	0.70817

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation*.

Table C-1—CSFII variance components for 10 nutrients — Continued

Fiber

	Total persons		Lowest income: ≤ 130% poverty		Low-income: 131-185% poverty		Higher-income: > 185% poverty	
	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance	Sample size	Within-individual variance
Both sexes								
60-64 years	835	0.50978	175	0.61501	89	0.52581	563	0.51165
65-69 years	799	0.47692	196	0.53538	123	0.58682	475	0.47415
70-74 years	594	0.40939	138	0.36441	94	0.60232	352	0.43808
75-79 years	428	0.49442	138	0.60289	88	0.48149	201	0.48850
80 + years	494	0.54562	155	0.66487	97	0.56979	242	0.47920
Male								
60-64 years	440	0.51047	91	0.60183	43	0.47678	301	0.53856
65-69 years	405	0.48055	78	0.55032	60	0.60277	265	0.44202
70-74 years	323	0.38640	69	0.23856	41	0.90862	206	0.40553
75-79 years	212	0.54586	59	0.50626	44	0.65438	109	0.57835
80 + years	256	0.56119	72	0.74821	50	0.61817	134	0.46528
Female								
60-64 years	395	0.58205	84	0.73826	46	0.61943	262	0.56871
65-69 years	394	0.52547	118	0.54989	63	0.58202	210	0.55273
70-74 years	271	0.47885	69	0.56014	53	0.45095	146	0.51808
75-79 years	216	0.46198	79	0.70901	44	0.30457	92	0.38558
80 + years	238	0.54854	83	0.60924	47	0.48525	108	0.52948

Source: Variance components were estimated from two days of 24-hour recalls from the *Continuing Survey of Food Intakes by Individuals (CSFII)* using *C-SIDE: Software for Intake Distribution Estimation.*