Third National Health and Nutrition Examination Survey
(NHANES III), 1988-94

NHANES III SECOND EXAM FILE DOCUMENTATION

Series 11, No. 3A

July 1999

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Introduction

The National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) collects, analyzes, and disseminates data on the health status of U.S. residents. The results of surveys, analyses, and studies are made known through a number of data release mechanisms including publications, mainframe computer data files, CD-ROMs (Search and Retrieval Software, Statistical Export and Tabulation System (SETS)), and the Internet.

The National Health and Nutrition Examination Survey (NHANES) is a periodic survey conducted by NCHS. The third National Health and Nutrition Examination Survey (NHANES III), conducted from 1988 through 1994, was the seventh in a series of these surveys based on a complex, multi-stage sample design. It was designed to provide national estimates of the health and nutritional status of the United States' civilian, noninstitutionalized population aged two months and older.

The following table summarizes the NHANES III data which are currently available on CD-ROM, including this release.

Table 1. Available NHANES III CD-ROMs

CD-ROM Name	Release Date	Size in Megabytes	Data Files / Description
NHANES III, 1988-94, Series 11, No. 3A, ASCII Version (this release)	July 1999	33	Second exam sample files for dietary recall, examination, laboratory, additional laboratory analytes and documentation
NHANES III, 1988-94, Series 11, No. 2A, ASCII Version	April 1998	407	Dietary recall (replacement), electrocardiography, laboratory (additional analytes), and vitamins/medicines data files and documentation
NHANES III, 1988-94, Series 11, No. 1, Revised SETS Version 1.22a	October 1997	285	Adult and youth household questionnaire, examination, and laboratory data files and documentation, plan and operation, analytic and reporting guidelines, weighting and estimation methodology, field operations, non-response bias
NHANES III, 1988-94, Series 11, No. 1A, ASCII Version	July 1997	454	Adult and youth household questionnaire, dietary recall, examination, and laboratory data files and documentation
NHANES III, 1988-94, Series 11, No. 1, SETS Version 1.22a *	July 1997	285	Adult and youth household questionnaire, examination, and laboratory data files and documentation

NHANES III Reference Manuals and Reports October 1996	October 1996	152	Plan and operation, analytic and reporting guidelines, weighting and estimation methodology, field operations, non-response bias

* Do not use this CD-ROM It had technical problems and has been superseded by the revised SETS version 1.22a, Series 11, No. 1, released in October 1997.

This CD-ROM, Series 11 No. 3A, contains data obtained from a second exam of selected survey participants who had a primary exam. This release does not replace the previous NHANES III data releases series 11 Nos. 1A and 2A).

Table 2. Location of the interview and examination components in the NHANES III public use data files

Topic	Data File						
	HA	HY	EXAM	LAB	DIET	VMS	ECG
Sample weights	X	X	X	X	.	.	X
Age/race/sex	X	X	X	X	.	.	X
Ethnic background	X	X	.	.	.	.	.
Household composition	X	X	.	.	.	.	.
Individual characteristics	X	X	.	.	.	.	.
Health insurance	X	X	.	.	.	.	.
Family background	X	X	.	.	.	.	.
Occupation of family head	X	X	.	.	.	.	.
Housing characteristics	X	X	.	.	.	.	.
Family characteristics	X	X	.	.	.	.	.
Orientation	X	X	.	.	.	.	.
Health services	X	X	.	.	.	.	.
Selected health conditions	X	X	X	.	.	.	.
Diabetes questions	X	.	.	.	.	.	.
High blood pressure and cholesterol questions	X	.	.	.	.	.	.
Cardiovascular disease questions	X	.	.	.	.	.	.
Musculoskeletal conditions	X	.	.	.	.	.	.
Physical functioning questions	X	.	.	.	.	.	.
Gallbladder disease questions	X	.	.	.	.	.	.

Table 2. (continued) Location of the interview and examination components in the NHANES III public use data files

	Data File						
Topic	HA	HY	EXAM	LAB	DIET	VMS	ECG
Kidney conditions	X	.	.	.	.	.	.
Respiratory and allergy questions	X	X	.	.	.	.	.
Diet questions	X	.	.	.	.	.	.
Food frequency	X	.	X	.	.	.	.
Vision questions	X	X	.	.	.	.	.
Hearing questions	X	X	.	.	.	.	.
Dental care and status	X	X	.	.	.	.	.
Tobacco	X	.	X	.	.	.	.
Occupation	X	.	.	.	.	.	.
Language usage	X	X	.	.	.	.	.
Exercise	X	.	.	.	.	.	.
Social support/residence	X	.	.	.	.	.	.
Vitamin/mineral/medicine usage	X	X	X	.	.	.	.
Blood pressure measurement	X	.	X	.	.	.	.
Birth	.	X	X	.	.	.	.
Infant feeding practices/diet	.	X	.	.	.	.	.
Motor and social development	.	X	.	.	.	.	.
Functional impairment	X	X	.	.	.	.	.
School attendance	.	X	.	.	.	.	.
Cognitive function	.	X	X	.	.	.	.

Table 2. (continued) Location of the interview and examination components in the NHANES III public use data files

Topic	Data File						
	HA	HY	EXAM	LAB	DIET	VMS	ECG
Alcohol and drug use	.	.	X	.	.	.	.
Reproductive health	.	.	X	.	.	.	.
Diagnostic interview schedule	.	.	X	.	.	.	.
Activity	.	.	X	.	.	.	.
Physician's examination	.	.	X	.	.	.	.
Height and weight	.	.	X	.	.	.	.
Body measurements	.	.	X	.	.	.	.
Dental examination	.	.	X	.	.	.	.
Allergy skin test	.	.	X	.	.	.	.
Audiometry	.	.	X	.	.	.	.
Tympanometry	.	.	X	.	.	.	.
WISC and WRAT	.	.	X	.	.	.	.
Spirometry	.	.	X	.	.	.	.
Bone densitometry	.	.	X	.	.	.	.
Gallbladder ultrasonography	.	.	X	.	.	.	.
Central nervous system function evaluation	.	.	X	.	.	.	.
Fundus photography	.	.	X	.	.	.	.
Physical function evaluation	.	.	X	.	.	.	.
Fasting questions	.	.	.	X	.	.	.

Table 2. (continued) Location of the interview and examination components in the NHANES III public use data files

Topic	Data File						
	HA	HY	EXAM	LAB	DIET	VMS	ECG
Laboratory tests on blood and urine	.	.	.	X	.	.	.
Total nutrient intakes	.	.	X	.	.	.	.
Individual foods	.	.	.	.	X	.	.
Combination foods	.	.	.	.	X	.	.
Ingredients	.	.	.	.	X	.	.
Prescription Medicines	X	X	.	.	.	X	.
Vitamins and Minerals	X	X	.	.	.	X	.
Electrocardiography	.	.	.	.	.	.	X

Data File Definitions

HA - Household Adult Data File
HY - Household Youth Data File
EXAM - Examination Data File
LAB - Laboratory Data File and Second Laboratory Data File
DIET - Dietary Recall Data Files
VMS - Vitamin Mineral Supplement Data File
ECG - Electrocardiography Data File

This document includes the documentation for the NHANES III Second Exam Second Laboratory File and also contains a general overview of the survey and the use of
the data files. The general overview includes five sections. The first section, entitled "Guidelines for Data Users," contains important information about the use of the data files. The second section, "Survey Description," is a brief overview of the survey plan and operation. The third section, "Sample Design and Analysis Guidelines," describes some technical aspects of the sampling plan and discusses some analytic issues particularly related to the use of data from complex sample surveys. The "Data Preparation and Processing Procedures" section describes the editing conventions and the codes used to represent the data. The last and fifth section, "General References," includes a reference list for the survey overview sections of the document.

Public Use Data Files for the third National Health and Nutrition Examination Survey will also be available from the National Technical Information Service (NTIS). A list of NCHS public use data tapes available for purchase from NTIS may be obtained from the Data Dissemination Branch at NCHS. Information regarding a bibliography (on disk) of journal articles

citing data from all the NHANES and the availability of NHANES III data in CD-ROM/SETS software format can be obtained from the Data Dissemination Branch at:

Data Dissemination Branch
National Center for Health Statistics
Room 1018
6525 Belcrest Road
Hyattsville, Maryland 20782

Phone: (301)458-4636

URL:http://www.cdc.gov/nchswww

NTIS can be contacted at:

NTIS - Computer Products Office
5285 Port Royal Road
Springfield, Virginia 22161
(703) 487-4807

Copies of all NHANES III questionnaires and data collection forms are included in the Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-94 (NCHS, 1994; U.S. DHHS, 1996). This publication, along with detailed information on NHANES procedures, interviewing, data collection, quality control techniques, survey design, nonresponse, and sample weighting can be found on the NHANES III Reference Manuals and Reports CD-ROM (U.S. DHHS, 1996). Information on how to order this CD-ROM is also available from the Data Dissemination Branch at NCHS at the address and telephone number given above.

NHANES III Second Exam Sample

The NHANES III Second Exam Sample was a sub-study of NHANES III, conducted for research purposes. These research files are intended to provide additional data for use with special statistical methods to improve estimates from the main survey data and for methodologic investigations. Following this description of the Second Exam Sample is information on the overall survey which is also relevant for the Second Exam Sample, including: general guidelines for data users, a description of the survey, sample design, analysis guidelines and a description of the data preparation and processing procedures.

Sample design and survey description

No statistical sampling design was applied for the second exam. However, a nonrandom sample of about five percent was obtained by selecting approximately 20
participants from the roughly 400 sample persons examined at each survey location. The following general guidelines were used by the MEC staff to select participants for the second exam:

1) select mainly adults, 2)half between the ages of 20-39 years, and half over 40 years; 3) select about half men and half women. The sample obtained consists of 2,603 persons, with 1,205 males (46 percent)and 1,398 females (54 percent).

Age group	2nd # of Exams	Percentage of 2nd Exams
< 12	212	8
12-19	231	9
20-39	809	31
40-59	578	22
> 60	773	30

The second exams were scheduled after the first or primary exams, when possible at the same time of day as the first exam. The second exams were conducted over the same time period as the primary exams for a particular survey location by the
same MEC staff, although priority was given to scheduling and completing primary exams. The second exams were administered following the same protocols as for the primary exam, with the following exceptions: the food frequency questionnaire
was not administered to adolescents 12-16 years; the WISC/WRAT was not administered to youths 6-16 years, and hand/knee x-rays were not re-administered on adults aged 60 and over.

Analytic Issues

Due to the research nature of these data, special caution should be used in

analysis. All analyses should include thorough investigation of the potential selection bias of this small non-random sub-sample. Careful attention to identifying and evaluating differences in important characteristics (e.g., age and race-ethnicity) between the subsample and the main sample should be considered along with other issues.

The second exam data can be linked to the primary exam data and the household interview data using the unique identifier (SEQN). This is necessary to obtain the demographic data for the sample. NCHS recommends that the survey design variables (e.g., sample weights) not be linked with the second exam data, since the survey design variables were created for the full sample. There are no sample weights or other design variables specifically created for the second exam sample. There are weights labeled as "replicate...weight," but these are Fay's BRR Replicate Interview Weights. These weights are to be applied to the primary exam sample, with software which uses the balanced repeated replication (BRR) method. They should not be used with the Second Exam Sample.

Because the second exams were identical to the primary exams, with the exceptions noted above, the file structure for the second exams is the same as for the primary exam files. The variable nomenclature is the same with the following important distinction: the first or primary exam variable names have a 'p' in the third position while the second or "replicate" exam variable names have a 'r' in the third position (e.g., 'BMPWT' or 'BMRWT').

GUIDELINES FOR DATA USERS

Please refer to the following important information before analyzing data.

NHANES III Background Documents

- The Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-94, (NCHS, 1994; U.S. DHHS, 1996) provides an overview of the survey and includes copies of the survey forms.

- The sample design, nonresponse, and analytic guidelines documents on the NHANES III Reference Manuals and Reports CD-ROM (U.S. DHHS, 1996) discuss the reasons that sample weights and the complex survey design should be taken into account when conducting any analysis.

- Instruction manuals, laboratory procedures, and other NHANES III reference manuals on the NHANES III Reference Manuals and Reports CD-ROM(U.S. DHHS, 1996) are also available for further information on the details of the survey.

Analytic Data Set Preparation

- Most NHANES III survey design and demographic variables are found only on the Adult and Youth Household Data Files available on the first release. In preparing a data set for analysis, other data files must be merged with either or both of these files to obtain many important analytic variables.

- All of the NHANES III public use data files are linked with the common survey participant identification number (SEQN). Merging information from multiple NHANES III data files using this variable ensures that the appropriate information for each survey participant is linked correctly.

- NHANES III public use data files do not have the same number of records on each file. The Household Questionnaire Files (divided into two files, Adult and Youth) contain more records than the Examination Data File because not everyone who was interviewed completed the examination. The Laboratory Data File contains data only for persons aged one year and older. The Individual Foods Data File based on the dietary recall has multiple records for each person rather than the one record per sample person contained in the other data files.

- For each data file, SAS program code with standard variable names and labels is provided as separate text files on the CD-ROM that contains the data files. This SAS program code can be used to create a SAS data set from the data file.

- Modifications were made to items in the questionnaires, laboratory, and examination components over the course of the survey; as a result, data may not be available for certain variables for the full six years. In addition, variables may differ by phase since some changes were implemented between phases. Users are encouraged to read the Notes

sections of this document carefully for information about changes.

- Extremely high and low values have been verified whenever possible, and numerous consistency checks have been performed. Nonetheless, users should examine the range and frequency of values before analyzing data.

- Some data were not ready for release at the time of this publication due to continued processing of the data or analysis of laboratory specimens. A listing of those data are available in the general information section of each data file.

- Confidential and administrative data are not being released to the public. Additionally, some variables have been recoded to help protect the confidentiality of the survey participants. For example, all age-related variables were recoded to 90+ years for persons who were 90 years of age and older.

- Some variable names may differ from those used in the Phase 1 NHANES III Provisional Data Release and some variables included in the Phase 1 provisional release may not appear on these files.

- Although the data files have been edited carefully, errors may be detected. Please notify NCHS staff (301-458-4636) of any errors in the data file or the documentation.

Analytic Considerations

- NHANES III (1988-94) was designed so that the survey's first three years, 1988-91, its last three years, 1991-94, and the entire six years were national probability samples. Analysts are encouraged to use all six years of survey results.

- Sample weights are available for analyzing NHANES III data. One of the following three sample weights will be appropriate for nearly all analyses: interviewed sample final weight (WTPFQX6), examined sample final weight (WTPFEX6), and mobile examination center (MEC)- and home-examined sample final weight (WTPFHX6). Choosing which of these sample weights to use in any analysis depends on the variables being used. A good rule of thumb is to use "the least common denominator" approach. In this approach, the user checks the variables of interest. The variable that was collected on the smallest number of persons is the "least common denominator," and the sample weight that applies to that variable is the appropriate one to use for that analysis. For more detailed information, see the Analytic and Reporting Guidelines for NHANES III (U.S. DHHS, 1996).

Referencing or Citing NHANES III Data

- In publications, please acknowledge NCHS as the original data source. For instance, the reference for the NHANES III Laboratory Data File on this CD-ROM is:

  U.S. Department of Health and Human Services (DHHS). National Center for Health Statistics. Third National Health and Nutrition

Examination Survey, 1988-1994, NHANES III Second Laboratory Data File (CD-ROM, Series 11, No. 3A). Hyattsville, MD.: Centers for Disease Control and Prevention, 1999.

- Please place the acronym "NHANES III" in the titles or abstracts of journal articles and other publications in order to facilitate the retrieval of such materials in bibliographic searches.

SURVEY DESCRIPTION

The third National Health and Nutrition Examination Survey (NHANES III) was the seventh in a series of large health examination surveys conducted in the United States beginning in 1960. Three of these surveys, the National Health Examination Surveys (NHES), were conducted in the 1960's (NCHS, 1965; NCHS, 1967; NCHS, 1969). In 1970, an expanded nutrition component was added to provide data with which to assess nutritional status and dietary practices, and the name was changed to the National Health and Nutrition Examination Survey (Miller, 1973; Engel, 1978; McDowell, 1981). A special survey of Hispanic populations in the United States was conducted during 1982-1984 (NCHS, 1985).

The general structure of the NHANES III sample design was similar to that of the previous NHANES. All of the surveys used complex, multi-stage, stratified, clustered samples of civilian, noninstitutionalized populations. NHANES III was the first NHANES without an upper age limit; in fact, the age range for the survey was two months and older. A home examination option was employed for the first time in order to obtain examination data for very young children and for elderly persons who were unable to visit the mobile examination center (MEC). The home examination included only a subset of the components used in the full MEC examination since it would have been difficult to collect some types of data in a home setting. A detailed description of design specifications and copies of the data collection forms can be found in the Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-1994 (NCHS, 1994; U.S. DHHS, 1996).

NHANES III was conducted from October 1988 through October 1994 in two phases, each of which comprised a national probability sample. The first phase was conducted from October 18, 1988, through October 24, 1991, at 44 locations. The second phase was conducted from September 20, 1991, through October 15, 1994, at 45 different locations. In NHANES III, 39,695 persons were selected over the six years; of those, 33,994 (86%) were interviewed in their homes. All interviewed persons were invited to the MEC for a medical examination. Seventy-eight percent (30,818) of the selected persons were examined in the MEC, and an additional 493 persons were given a special, limited examination in their homes.

Data collection began with a household interview. Several questionnaires were administered in the household: Household Screener Questionnaire, Family Questionnaire, Household Adult Questionnaire, and Household Youth Questionnaire.

At the MEC, an examination was performed, and five automated questionnaires or interviews were administered: MEC Adult Questionnaire, MEC Youth Questionnaire, MEC Proxy Questionnaire, 24-Hour Dietary Recall, and Dietary Food Frequency (ages 12-16 years). The health examination component included a variety of tests and procedures. The examinee's age at the time of the interview and other factors determined which procedures were administered. Blood and urine specimens were obtained, and a number of tests and measurements were performed including body measurements, spirometry, fundus photography, x-rays, electrocardiography, allergy and glucose tolerance tests, and ultrasonography. Measurements were taken of bone density, hearing, and physical, cognitive, and central nervous system

functions. A physician performed a limited standardized medical examination and a dentist performed a standardized dental examination. While some of the blood and urine analyses were performed in the MEC laboratory, most analyses were conducted elsewhere by contract laboratories.

A home examination was conducted for those sample persons aged 2-11 months and aged 20 years or older who were unable to visit the mobile examination center. The home examination consisted of an abbreviated version of the tests and interviews performed in the MEC. Depending on age of the sample person, the components included body measurements, blood pressure, spirometry, venipuncture, physical function evaluation, and a questionnaire to inquire about infant feeding, selected health conditions, cognitive function, tobacco use, and reproductive history.

SAMPLE DESIGN AND ANALYSIS GUIDELINES

Sample Design

The general structure of the NHANES III sample design is the same as that of the previous NHANES. Each of these surveys used a stratified, multi-stage probability design. The major design parameters of the two previous NHANES and the special Hispanic HANES, as well as NHANES III, have been previously summarized (Miller, 1973; McDowell, 1981; NCHS, 1985; NCHS, 1994). The NHANES III sample was designed to be self-weighting within a primary sampling unit (PSU) for subdomains (age, sex, and race-ethnic groups). While the sample was fairly close to self-weighting nationally for each of these subdomain groups, it was not representative of the total population, which includes institutionalized, non-civilian persons that were outside the scope of the survey.

The NHANES III sample represented the total civilian, noninstitutionalized population, two months of age or over, in the 50 states and the District of Columbia of the United States. The first stage of the design consisted of selecting a sample of 81 PSU's that were mostly individual counties. In a few cases, adjacent counties were combined to keep PSU's above a minimum population size. The PSU's were stratified and selected with probability proportional to size (PPS). Thirteen large counties (strata) were chosen with certainty (probability of one). For operational reasons, these 13 certainty PSU's were divided into 21 survey locations. After the 13 certainty strata were designated, the remaining PSU's in the United States were grouped into 34 strata, and two PSU's were selected per stratum (68 survey locations). The selection was done with PPS and without replacement. The NHANES III sample therefore consists of 81 PSU's or 89 locations.

The 89 locations were randomly divided into two groups, one for each phase. The first group consisted of 44 and the other of 45 locations. One set of PSU's was allocated to the first three-year survey period (1988-91) and the other set to the second three-year period (1991-94). Therefore, unbiased estimates (from the point of view of sample selection) of health and nutrition characteristics can be independently produced for both Phase 1 and Phase 2 as well as for both phases combined.

For most of the sample, the second stage of the design consisted of area segments composed of city or suburban blocks, combinations of blocks, or other area segments in places where block statistics were not produced in the 1980 Census. In the first phase of NHANES III, the area segments were used only for a sample of persons who lived in housing units built before 1980. For units built in 1980 and later, the second stage consisted of sets of addresses selected from building permits issued in 1980 or later. These are referred to as "new construction segments." In the second phase, 1990 Census data and maps were used to define the area segments. Because the second phase followed within a few years of the 1990 Census, new construction did not account for a significant part of the sample, and the entire sample came from the area segments.

The third stage of sample selection consisted of households and certain types of group quarters, such as dormitories. All households and eligible

group quarters in the sample segments were listed, and a subsample was designated for screening to identify potential sample persons. The subsampling rates enabled production of a national, approximately equal-probability sample of households in most of the United States with higher rates for the geographic strata with high Mexican-American populations. Within each geographic stratum, there was a nearly equal-probability sample of households across all 89 stands.

Persons within the sample of households or group quarters were the fourth stage of sample selection. All eligible members within a household were listed, and a subsample of individuals was selected based on sex, age, and race or ethnicity. The definitions of the sex, age, race or ethnic classes, subsampling rates, and designation of potential sample persons within screened households were developed to provide approximately self-weighting samples for each subdomain within geographic strata and at the same time to maximize the average number of sample persons per sample household. Previous NHANES indicated that this increased the overall participation rate. Although the exact sample sizes were not known until data collection was completed, estimates were made. Below is a summary of the sample sizes for the full six-year NHANES III at each stage of selection:

Number of PSU's	81
Number of stands (survey locations)	89
Number of segments	2,144
Number of households screened	93,653
Number of households with sample persons	19,528
Number of designated sample persons	39,695
Number of interviewed sample persons	33,994
Number of MEC-examined sample persons	30,818
Number of home-examined sample persons	493

More detailed information on the sample design and weighting and estimation procedures for NHANES III can be found in the Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-94 (NCHS, 1994; U.S. DHHS, 1996) and in the Analytic and Reporting Guidelines: Third National Health and Nutrition Examination Survey (NHANES III), 1988-94 (U.S. DHHS, 1996).

Analysis Guidelines

Because of the complex survey design used in NHANES III, traditional methods of statistical analysis based on the assumption of a simple random sample are not applicable. Detailed descriptions of this issue and possible analytic methods for analyzing NHANES data have been described earlier (NCHS, 1985; Yetley, 1987; Landis, 1982; Delgado, 1990). Recent analytic and reporting guidelines that should be used for most NHANES III analyses and publications are contained in Analytic and Reporting Guidelines (U.S. DHHS, 1996). These recommendations differ slightly from those used by analysts for previous NHANES surveys. These suggested guidelines provide a framework to users for producing estimates that conform to the analytic design of the survey. All users are strongly urged to review these analytic and reporting guidelines before beginning any analyses of NHANES III data.

It is important to remember that this set of statistical guidelines is not absolute. When conducting analyses, the analyst needs to use his/her subject matter knowledge (including methodological issues) as well as

information about the survey design. The more one deviates from the original analytic categories defined in the sample design, the more important it is to evaluate the results carefully and to interpret the findings cautiously.

In NHANES III, 89 survey locations were randomly divided into two sets or phases, the first consisting of 44 and the other of 45 locations. One set of PSU's was allocated to the first three-year survey period (1988-91) and the other set to the second three-year period (1991-94). Therefore, unbiased national estimates of health and nutrition characteristics can be independently produced for each phase as well as for both phases combined. Computation of national estimates from both phases combined (i.e., total NHANES III) is the preferred option; individual phase estimates may be highly variable. In addition, individual phase estimates are not statistically independent. It is also difficult to evaluate whether differences in individual phase estimates are real or due to methodological differences. That is, differences may be due to changes in sampling methods or data collection methodology over time. At this time, there is no valid statistical test for examining differences between Phase 1 and Phase 2. Therefore, although point estimates can be produced separately for each phase, no test is available to test whether those estimates are significantly different from each other.

NHANES III is based on a complex, multi-stage probability sample design. Several aspects of the NHANES design must be taken into account in data analysis, including the sample weights and the complex survey design. Appropriate sample weights are needed to estimate prevalence, means, medians, and other statistics. Sample weights are used to produce correct population estimates because each sample person does not have the same probability of selection. The sample weights incorporate the differential probabilities of selection and include adjustments for noncoverage and nonresponse. A detailed discussion of nonresponse adjustments and issues related to survey coverage have been published (U.S. DHHS, 1996). With the large oversampling of young children, older persons, black persons, and Mexican-Americans in NHANES III, it is essential that the sample weights be used in all analyses. Otherwise, a misinterpretation of results is highly likely. Other aspects of the design that must be taken into account in data analyses are the strata and PSU pairings from the sample design. These pairings should be used to estimate variances and test for statistical significance. For weighted analyses, analysts can use special computer software packages that use an appropriate method for estimating variances for complex samples such as SUDAAN (Shah, 1995) and WesVarPC (Westat, 1996).

Although initial exploratory analyses may be performed on unweighted data using standard statistical packages and assuming simple random sampling, final analyses should be done on weighted data using appropriate sample weights. A summary of the weighting methodology and the type of sample weights developed for NHANES III is included in Weighting and Estimation Methodology (U.S. DHHS, 1996).

The purpose of weighting the sample data is to permit analysts to produce estimates of statistics that would have been obtained if the entire sampling frame (the United States) had been surveyed. Sample weights can be considered as measures of the number of persons the particular sample

observation represents. Weighting takes into account several features of the survey: the specific probabilities of selection for the individual domains that were oversampled as well as nonresponse and differences between

the sample and the total U.S. population. Differences between the sample and the population may arise due to sampling variability, differential undercoverage in the survey among demographic groups, and possibly other types of response errors, such as differential response rates or misclassification errors. Sample weighting in NHANES III was used to:

1. Compensate for differential probabilities of selection among subgroups (i.e., age-sex-race-ethnicity subdomains where persons living in different geographic strata were sampled at different rates);
2. Reduce biases arising from the fact that nonrespondents may be different from those who participate;
3. Bring sample data up to the dimensions of the target population totals;
4. Compensate, to the extent possible, for inadequacies in the sampling frame (resulting from omissions of some housing units in the listing of area segments, omissions of persons with no fixed address, etc.); and
5. To reduce variances in the estimation procedure by using auxiliary information that is known with a high degree of accuracy.

In NHANES III, the sample weighting was carried out in three stages. The first stage involved the computation of weights to compensate for unequal probabilities of selection (objective 1, above). The second stage adjusted for nonresponse (objective 2). The third stage used poststratification of the sample weights to Census Bureau estimates of the U.S. population to accomplish the third, fourth, and fifth objectives simultaneously. In NHANES III, several types of sample weights (see the sample weights table that follows) were computed for the interviewed and examined sample and are included in the NHANES III data file. Also, sample weights were computed separately for Phase 1 (1988-91), Phase 2 (1991-94), and total NHANES III (1988-94) to facilitate analysis of items collected only in Phase 1, only in Phase 2, and over six years of the survey. Three sets of pseudo strata and PSU pairings are provided to use with SUDAAN in variance estimation. Since NHANES III is based on a complex, multi-stage sample design, appropriate sample weights should be used in analyses to produce national estimates of prevalence and associated variances while accounting for unequal probability of selection of sample persons. For example, the final interview weight, WTPFQX6, should be used for analysis of the items or questions from the family or household questionnaires, and the final MEC examination weight, WTPFEX6, should be used for analysis of the questionnaires and measurements administered in the MEC. Furthermore, for a combined analysis of measurements from the MEC examinations and associated medical history questions from the household interview, the final MEC examination weight, WTPFEX6, should be used. We recommend using SUDAAN (Shah, 1995) to estimate statistics of interest and the associated variance. However, one can also use other published methods for variance estimation. Application of SUDAAN and alternative methods, such as the average design effect approach, balance repeated replication (BRR) methods, or jackknife methods for variance estimation, are discussed in Weighting and Estimation Methodology (U.S. DHHS, 1996).

Appropriate Uses of the NHANES III Sample Weights

Final interview weight, WTPFQX6

Use only in conjunction with the sample interviewed at home and with items collected during the household interview.

Final examination (MEC only) weight, WTPFEX6

Use only in conjunction with the MEC-examined sample and with interview and examination items collected at the MEC.

Final MEC+home examination weight, WTPFHX6

Use only in conjunction with the MEC+home-examined sample and with items collected at both the MEC and home.

Final allergy weight, WTPFALG6

Use only in conjunction with the allergy subsample and with items collected as part of the allergy component of the exam.

Final CNS weight, WTPFCNS6

Use only in conjunction with the CNS subsample and with items collected as part of the CNS component of the exam.

Final morning examination (MEC only) subsample weight, WTPFSD6

Use only in conjunction with the MEC-examined persons assigned to the morning subsample and only with items collected in the MEC exam.

Final afternoon/evening examination (MEC only) subsample weight, WTPFMD6

Use only in conjunction with the MEC-examined persons assigned to the afternoon/evening subsample and only with items collected in the MEC exam.

Final morning examination (MEC+home) subsample weight, WTPFHSD6

Use only in conjunction with the MEC- and home-examined persons assigned to the morning subsample and with items collected during the MEC and home examinations.

Final afternoon/evening examination (MEC+home) weight, WTPFHMD6

Use only in conjunction with the MEC- and home-examined persons assigned to the afternoon/evening subsample and with items collected during the MEC and home examinations.

DATA PREPARATION AND PROCESSING PROCEDURES

Automated data collection procedures for the survey were introduced in NHANES III. In the mobile examination centers, data for the interview and examination components were recorded directly onto a computerized data collection form. With the exception of a few independently automated systems, the system was centrally integrated. This operation allowed for ongoing monitoring of much of the data. Before the introduction of the computer-assisted personal interview (CAPI), the household questionnaire data were reviewed manually by field editors and interviewers. CAPI (1992-1994 only) questionnaires featured built-in edits to prevent entering inconsistencies and out-of-range responses. The multi-level data collection and quality control systems are discussed in detail in the Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988-1994 (NCHS, 1994; U.S. DHHS, 1996). All interview, laboratory, and examination data were sent to NCHS for final processing.

Guidelines were developed that provided standards for naming variables, filling missing values and coding conventional responses, handling missing records, and standardizing two-part quantity/unit questionnaire variables. NCHS staff, assisted by contract staff, developed data editing specifications that checked data sets for valid codes, ranges, and skip pattern consistencies and examined the consistency of values between interrelated variables. Comments, collected in both interviews and examination components, were reviewed and recoded when possible. Responses to "Other" and "Specify" were recoded either to existing code categories or to new categories. The documentation for each data set includes notes for those variables that have been recoded and standardized and for those variables that differ significantly from what appears in the original data collection instrument. While the data have undergone many quality control and editing procedures, there still may be values that appear extreme or illogical. Values that varied considerably from what was expected were examined by analysts who checked for comments or other responses that might help to clarify unusual values. Generally, values were retained unless they could not possibly be true, in which case they were changed to "Blank but applicable." Therefore, the user must review each data set for extreme or inconsistent values and determine the status of each value for analysis.

Several editing conventions were used in the creation of final analytic data sets:

1. Standardized variables were created to replace all two-part quantity/unit questions using standard conversion factors. Standardized variables have the same name as the variable of the two-part question with an "S" suffix. For instance, MAPF18S (Months received WIC benefits) in the MEC Adult Questionnaire was created from the two-part response option to question F18, "How long did you receive benefits from the WIC program?," using the conversion factor 12 months per year.

2. Recoded variables were created by combining responses from two or more like variables, or by collapsing responses to create a summary variable for the purpose of confidentiality. Recoded variables have the original variable name with an R suffix. For example, place of birth

variable (HFA6X) in the Family Questionnaire was collapsed to a three level response category (U.S., Mexico, Other) and renamed HFA6XR. Generally, only the recoded variable has been included in the data file.

3. Fill values, a series of one or more digits, were used to represent certain specific conditions or responses. Below is a list of the fill values that were employed. Some of the fill values pertain only to questionnaire data, although 8-fill and blank-fill values are found in all data sets. Other fill values, not included in this list, are used to represent component-specific conditions.

   6-fills = Varies/varied. (Questionnaires only)

   7-fills = Fewer than the smallest number that could be reported within the question structure (e.g., fewer than one cigarette per day). (Questionnaires only)

   8-fills = Blank but applicable/cannot be determined. This means that a respondent was eligible to receive the question, test, or component but did not because of refusal, lack of time, lack of staff, loss of data, broken vial, language barrier, unreliability, or other similar reasons.

   9-fills = Don't know. This fill was used only when a respondent did not know the response to a question and said, "I don't know." (Questionnaires only)

   Blank fills = Inapplicable. If a respondent was not eligible for a questionnaire, test, or component because of age, gender, or specific reason, the variable was blank-filled. In the questionnaire, if a respondent was not asked a question because of a skip-pattern, variables corresponding to the question were blank-filled. For examination or laboratory components, if a person was excluded by a defined protocol (e.g., screening exclusion questions) and these criteria are included in the data set, then the corresponding variables were blank-filled for that person. For home examinees, variables for examination components and blood tests not performed as part of the home examination protocol were blank-filled.

4. For variables describing discrete data, codes of zero (0) were used to mean "none," "never," or the equivalent. Value labels for which "0" is used include: "has not had," "never regularly," "still taking," or "never stopped using." Unless otherwise labeled, for variables containing continuous data, "zero" means "zero.

5. Where there are logical skip patterns in the flow of the questionnaire or examination component, the skip was indicated by placing the variable label of the skip destination in parentheses as part of the value label of the response generating the skip. For example, in the Physical Function Evaluation, the variable PFPWC (in wheelchair) has a value label, "2 No (PFPSCOOT)" that means that the next item for persons not in a wheelchair would be represented by the variable, PFPSCOOT.

Variable Nomenclature

A unique name was assigned to every NHANES III variable using a standard convention. By following this naming convention, the origin of each variable is clear, and there is no chance of overlaying similar variables across multiple components. Variables range in length from three to eight characters. The first two variable characters represent the topic (e.g., analyte, questionnaire instrument, examination component) and are listed below alphabetically by topic. For questionnaires administered in the household, the remainder of the variable name following the first two characters indicates the question section and number. For example, data for the response to the Household Adult Questionnaire question B1 are contained in the variable HAB1. For most laboratory and examination variables, as well as some other variables, a "P" in the third position refers to "primary" and the remainder of the variable name is a brief description of the item. For instance, in the Laboratory Data File, information on the length of time the person fasted before the first blood draw is contained in the variable PHPFAST. The variable PHPFAST was derived as follows: characters 1-2 (PH) refer to "phlebotomy," character 3 (P) refers to "primary," characters 4-8 (FAST) refer to an abbreviation for "fasting."

CODE	TOPIC
AT	Alanine aminotransferase (from biochemistry profile)
AM	Albumin (from biochemistry profile)
AP	Alkaline phosphatase (from biochemistry profile)
AL	Allergy skin test
AC	Alpha carotene
AN	Anisocytosis
TM	Antimicrosomal antibodies
TA	Antithyroglobulin antibodies
AA	Apolipoprotein (AI)
AB	Apolipoprotein (B)
AS	Aspartate aminotransferase (from biochemistry profile)
LA	Atypical lymphocyte
AU	Audiometry
BA	Band
BO	Basophil
BS	Basophilic stippling
BC	Beta carotene
BX	Beta cryptoxanthin
BL	Blast
BU	Blood urea nitrogen (BUN) (from biochemistry profile)
BM	Body measurements
BD	Bone densitometry
C1	C-peptide (first venipuncture)
C2	C-peptide (second venipuncture)
CR	C-reactive protein
UD	Cadmium
CN	Central nervous system function evaluation
CL	Chloride (from biochemistry profile)
CO	Cotinine
CE	Creatinine (serum)(from biochemistry profile)
UR	Creatinine (urine)

CODE	TOPIC
DM	Demographic
DE	Dental examination
MQ	Diagnostic interview schedule
DR	Dietary recall (total nutrient intakes)
EO	Eosinophil
EP	Erythrocyte protoporphyrin
FR	Ferritin
FB	Fibrinogen
RB	Folate (RBC)
FO	Folate (serum)
FH	Follicle stimulating hormone (FSH)
FP	Fundus photography
GG	Gamma glutamyl transferase (GGT) (from biochemistry profile)
GU	Gallbladder ultrasonography
GB	Globulin (from biochemistry profile)
G1	Glucose (first venipuncture)
G2	Glucose (second venipuncture)
SG	Glucose (from biochemistry profile)
GH	Glycated hemoglobin
GR	Granulocyte
C3	HCO3 (Bicarbonate)(from biochemistry profile)
HD	HDL cholesterol
HP	Helicobacter pylori antibody
HT	Hematocrit
HG	Hemoglobin
AH	Hepatitis A antibody (HAV)
HB	Hepatitis B core antibody (anti-HBc)
SS	Hepatitis B surface antibody (anti-HBs)
SA	Hepatitis B surface antigen (HBsAg)
HC	Hepatitis C antibody (HCV)
DH	Hepatitis D antibody (HDV)
H1	Herpes 1 antibody
H2	Herpes 2 antibody
HX	Home examination (general)
HO	Homocysteine
HF	Household family questionnaire
HA	Household adult questionnaire
HQ	Household questionnaire variables (composite)
HS	Household screener questionnaire
HY	Household youth questionnaire
HZ	Hypochromia
I1	Insulin (first venipuncture)
I2	Insulin (second venipuncture)
UI	Iodine (urine)
FE	Iron
SF	Iron (from biochemistry profile)
LD	Lactate dehydrogenase (from biochemistry profile)
L1	Latex antibody
LC	LDL cholesterol (calculated)
PB	Lead
LP	Lipoprotein (a)
LH	Luteinizing hormone

CODE	TOPIC
LU	Lutein/zeaxanthin
LY	Lycopene
LM	Lymphocyte
MR	Macrocyte
MC	Mean cell hemoglobin (MCH)
MH	Mean cell hemoglobin concentration (MCHC)
MV	Mean cell volume (MCV)
PV	Mean platelet volume
MA	MEC adult questionnaire
MX	MEC examination (general)
FF	Dietary food frequency (ages 12-16 years)
MP	MEC proxy questionnaire
MY	MEC youth questionnaire
ME	Metamyelocyte
MI	Microcyte
MO	Monocyte
MN	Mononuclear cell
ML	Myelocyte
IC	Normalized calcium (derived from ionized calcium)
OS	Osmolality (from biochemistry profile)
PH	Phlebotomy data collected in MEC (e.g., questions)
PS	Phosphorus (from biochemistry profile)
PF	Physical function evaluation
PE	Physician's examination
PL	Platelet
DW	Platelet distribution width
PK	Poikilocytosis
PO	Polychromatophilia
SK	Potassium (from biochemistry profile)
PR	Promyelocyte
RC	Red blood cell count (RBC)
RW	Red cell distribution width (RDW)
RE	Retinyl esters
RF	Rheumatoid factor antibody
RU	Rubella antibody
WT	Sample weights
SE	Selenium
SI	Sickle cell
NA	Sodium (from biochemistry profile)
SH	Spherocyte
SP	Spirometry
SD	Survey design
TT	Target cell
TE	Tetanus
TH	Thyroid Stimulating Hormone (TSH)
T4	Thyroxine
TB	Total bilirubin (from biochemistry profile)
CA	Total calcium
SC	Total calcium (from biochemistry profile)
TC	Total cholesterol
CH	Total cholesterol (from biochemistry profile)
TI	Total iron binding capacity (TIBC)
TP	Total protein (from biochemistry profile)
TX	Toxic granulation

CODE	TOPIC
TO	Toxoplasmosis antibody
PX	Transferrin saturation
TG	Triglycerides
TR	Triglycerides (from biochemistry profile)
TY	Tympanometry
UA	Uric acid (from biochemistry profile)
UB	Urinary albumin
VU	Vacuolated cells
VR	Varicella antibody
VA	Vitamin A
VB	Vitamin B12
VC	Vitamin C
VD	Vitamin D
VE	Vitamin E
WC	White blood cell count (WBC)
WW	WISC/WRAT cognitive test

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NHANES III SECOND LABORATORY DATA FILE

Introduction

This laboratory data file contains data in addition to that released on the first laboratory file. This documentation presents information that should be reviewed before proceeding with data analysis.

The documentation for this laboratory data file is divided into four main sections. The first section, "General Information," provides information about the contents of the data file. The second section, "Data File Index," includes a brief description of all the variables on the data set and shows the standard name of each variable and its position in the data set. The third section, "Item Descriptions, Codes, Counts, and Notes" provides a description for each component, the standard variable name and a brief description of the values that variable can take on, a count of the frequency of occurrence of each value, notes by variable and appendices as necessary. "References" are provided in the fourth section.

Blood specimens were collected on examinees aged one year and older at the mobile examination center (MEC). For those examinees aged one year and older who did not travel to the MEC, a home examination was conducted. Only a limited number of tests were performed on specimens collected during the Home Examination. Appendix 1 lists the laboratory tests by specimen type, age group, sex, and whether the specimen was collected in the Home Examination.

The analysis of NHANES III laboratory data must be conducted with the key survey design and basic demographic variables. Other released files may be linked to the Second Laboratory Data File using the unique survey participant (sample person) identifier SEQN.

Examinee Screening

Prior to the phlebotomy, a questionnaire was administered to determine an examinee's eligibility for all phlebotomy procedures (including venipuncture and the oral glucose tolerance test). It included questions to determine if it was safe to perform the venipuncture, to document and determine fasting compliance and to aid in analyzing the results of the laboratory tests performed. Examinees reporting hemophilia or recent cancer chemotherapy treatment were excluded from the venipuncture. For those examinees, the laboratory test results fields for all blood-based laboratory tests were left blank.

Although examinees aged 12 years and older were instructed to fast for 10-16 hours prior to the morning examination or for six hours before the afternoon or evening examination, the instructions were not followed uniformly. Laboratory test results and the duration of the fast have been included on the data file regardless of the examinee's fasting compliance. Analysts should consider whether fasting status is crucial before undertaking analyses. Examinees who reported insulin use during the household interview were not instructed to fast.

Specimen Collection and Processing Procedures

Detailed specimen collection and processing instructions are discussed in the Manual for Medical Technicians (U.S. DHHS, 1996). Vials were stored under appropriate refrigerated (4-8 degrees Centigrade) or frozen (-20 degrees Centigrade) conditions until they were shipped to analytical laboratories for testing. The analytical methods used by each of the participating laboratories are described in the Laboratory Procedures Used for NHANES III (U.S. DHHS, 1996). The manual contains quality control graphs and statistical summary information for each laboratory test at the end of the laboratory method description.

Examiner Training and Quality Control

The NHANES III laboratory staff consisted of medical technologists and phlebotomists. The medical technologists held baccalaureates in medical technology. Both they and the phlebotomists were certified by the American Society for Clinical Pathologists or by a similar organization.

All laboratory staff completed comprehensive training in standardized laboratory procedures before they began working in the MEC. The MEC phlebotomists completed comprehensive training in pediatric phlebotomy techniques, including instruction by a pediatric nurse practitioner. Laboratory team performance was monitored using several techniques. NCHS and contract consultants used a structured quality assurance evaluation during unscheduled visits to evaluate both the quality of the laboratory work and the quality-control procedures. Each laboratory staff person was observed for equipment operation, specimen collection and preparation, and testing procedures, and constructive feedback was given to each team. Formal retraining sessions were conducted annually to ensure that required skill levels were maintained.

Laboratory Protocol Changes from 1988 to 1994

Most laboratory tests were performed for the entire six years of NHANES III. For statistical analyses of these laboratory test results, the appropriate six-year sample weight should be used.

Data Preparation and Processing

Results from urine pregnancy tests are included in the NHANES III Examination Data File, rather than in the Laboratory Data File.

For laboratory tests with a lower detection limit, results below the lower detection limit were replaced with a value equal to the detection limit divided by the square root of two. This value was created to help the user distinguish a nondetectable laboratory test result from a measured laboratory test result. Appendix 2 documents the detection limit for each laboratory test.

The SI unit (le Systeme International d Unites) is an outgrowth of the metric system that has been used throughout most of the world. In addition to providing a uniform international system of units of measurement, a uniform style is prescribed. Laboratory test results not originally reported in SI units were converted to SI units if applicable. Conversion factors, the format of the NHANES and SI results, and NHANES and SI units of measure are in Appendix 3. In converting NHANES III data to SI units, the goal was to preserve the level of detail reported by the laboratories in the original laboratory test result. Therefore, the number of significant digits in the laboratory test results data may be different from that in published references.

NHANES III Second Laboratory Data File Index
Serum Data

Description	Variable Name	Positions
GENERAL INFORMATION		
Sample person identification number	SEQN	1-5
Session for MEC examination	MXRSESSR	6
Date of repl. MEC exam time in: month	MXRTIMO	7-8
Number of days between exams	MXPRDAYS	9-10
SECOND EXAM DATA		
SERUM MEASURES		
Serum cotinine (ng/mL) RP	COR	11-15
Serum homocysteine: SI (umol/L) RP	HORSI	16-19
Serum vitamin D (ng/mL) - RP	VDR	20-23
Serum vitamin D: SI (nmol/L) - RP	VDRSI	24-28
Serum TSH (uU/mL), replicate	THR	29-34
Serum TSH: SI (mU/L), replicate	THRSI	35-40
Serum antimicrosomal antibody (U/mL) RP	TMR	41-44
Serum ATA (U/mL), replicate	TAR	45-48

NHANES III Second Laboratory Data File
Serum Data

DATASET=LAB2SE
N=2596 DOCUMENTATION DATE=06/22/99

GENERAL INFORMATION

Positions SAS name	Counts	Item description and code	Notes
1-5		Sample person identification number	
SEQN	2596	00009-53616	
6		Examination session for MEC	
MXRSESSR		examinees - replicates	
	1417	1 Morning	
	686	2 Afternoon	
	493	3 Evening	
7-8		Month of second exam	
MXRTIMO	148	01	
	116	02	
	169	03	
	160	04	
	183	05	
	117	06	
	118	07	
	200	08	
	130	09	
	152	10	
	146	11	
	88	12	
	869	Blank	
9-10		Number of days between exams	
MXPRDAYS	1	00 None/never	
	1726	01-52	
	869	Blank	

NHANES III Second Laboratory Data File
Serum Data

SECOND EXAM DATA

SERUM MEASURES

Positions SAS name	Counts	Item description and code	Notes
11-15		Serum cotinine (ng/mL) RP	
COR	180	0.035 Below level of detection	
	1362	00.05-01590	
	75	88888 Blank but applicable	
	979	Blank	
16-19		Serum homocysteine: SI (umol/L) RP	See note
HORSI	976	03.1-0125	
	1620	Blank	
20-23		Serum vitamin D (ng/mL) - RP	See note
VDR	1	03.5 Below detection limit	
	1421	05.6-80.2	
	1174	Blank	
24-28		Serum vitamin D: SI (nmol/L) - RP	
VDRSI	1	008.7 Below detection limit	
	1421	00014-200.2	
	1174	Blank	
29-34		Serum thyroid stimulating hormone (TSH) (uU/mL), replicate	See note
THR	7	000.00 Below detection limit	
	1359	000.01-205.01	
	1230	Blank	
35-40		Serum thyroid stimulating hormone (TSH): SI (mU/L), replicate	See note
THRSI	7	000.00 Below detection limit	
	1359	000.01-205.01	
	1230	Blank	

NHANES III Second Laboratory Data File
Serum Data

SECOND EXAM DATA

SERUM MEASURES

Positions SAS name	Counts	Item description and code	Notes
41-44 TMR		Serum antimicrosomal antibody (U/mL), replicate	
	1211	00.3 Below detection limit	
	155	00.5-0960	
	1230	Blank	
45-48 TAR		Serum anti-thyroglobulin antibody (ATA) (U/mL), replicate	
	1220	00.7 Below detection limit	
	146	0001-3000	
	1230	Blank	

NOTES

Blank Result Field

Some laboratory tests were performed after the survey was completed. Examinees who did not have a specimen available for these tests, or were not in the age range eligible for the test have a blank in the result field.

Laboratory tests that were performed during the survey have a blank in the result field if the examinee was not eligible for the test (for example, not in the age range to be tested). If there was insufficient specimen for the test but the examinee was eligible, the result field is coded as blank but applicable.

NHANES III Reference Manuals

For analytical methods see U.S. Department of Health and Human Services (DHHS). National Center for Health Statistics. NHANES III reference manuals and reports (CD-ROM). Hyattsville, MD: Centers for Disease Control and Prevention, 1996. Available from National Technical Information Service (NTIS), Springfield, VA. Acrobat .PDF format; includes access software: Adobe Systems, Inc. Acrobat Reader 2.1.

Laboratory Tests

COR:

Cotinine results from 1988-1994 are included in this field. The first laboratory file contained results from 1988-1991. This test was performed on examinees aged 4 years and above.

NOTE: Users are advised to use this field for analysis rather than data from the first release because additional phase 1 data (1988-1991) data and the phase 2 data(1991-1994) have been added. For the analytical method, see the NHANES III reference manuals (see above).

HORSI:

Serum homocysteine testing was performed on examinees aged 12 years and older in phase II only (1991-1994).

For the analytical method see the NHANES III reference manuals (see above).

HPR:

Helicobacter pylori antibody was measured in 1993 on 6-19 year old examinees from phase 1 (1988-1991) of the survey using an enzyme-linked immunoassay (ELISA)(Pylori Staat, Whittaker Bioproducts, Walkersville, MD). Examinees 20 years and older from phase 1 were tested for H. Pylori antibody in 1996 using H. Pylori IgG ELISA (Wampole Laboratories, Cranbury, NJ). An additional immunoassay was also performed on examinees age 20 years and above. See HPRCAG for details on the second IgG assay.

HPRCAG:

For examinees 20 years and older, in addition to determining if H. Pylori IgG was present, anti-cagA IgG was also measured. This non-commercial method was developed and standardized by Vanderbuilt University. The method is described in Blaser MJ, Perez-Perez GI, Kleanthous H, Cover TL, Peek RM, Chyou PH, Stemmermann GN, and Nomura A. Infection with Helicobacter pylori strains possessing cagA is associated with an increased risk of developing adenocarcinoma of the stomach. Cancer Research 55:2111-2115, 1995.

T4R, T4RSI:

Thyroxine testing was performed on examinees aged 12 years and above. The T4 laboratory method in the NHANES III reference manuals (see above) is different from the method used for this result. These results were determined using an enzyme-based homogeneous immunoassay on the Hitachi 704.

THR, THRSI: Thyroid stimulating hormone (TSH)

Testing was performed on examinees aged 12 years and above. Results on specimens sent to the laboratory after March 1993 were reduced by 17% to reflect the change in standards supplied by the manufacturer.

The equation used for the correction was:

Uncorrected value x 0.83 = Corrected value.

Data from March 1993 through October 1994 was adjusted to correspond with the data tested from October 1988 through February 1993 to allow the entire data set to be used based on the same method.

For the analytical method see the NHANES III reference manuals (see above).

VDR:

Vitamin D testing was performed on sera from examinees aged 12 years and older.

For the analytical method see the NHANES III reference manuals (see above).

Appendix 1. Blood and Urine Assessments by Specimen Type and Age Group

Some of the blood and urine assessments have footnotes. These footnotes appear at the end of the appendix.

AGE GROUP		
1-3 years	4-5 years	6-11 years
	Whole blood	
CBC (1)(5)	CBC (1) (5)	CBC (1) (5)
Differential smear	Differential smear	Differential smear
Lead (5)	Lead (5)	Lead (5)
Protoporphyrin (5)	Protoporphyrin (5)	Protoporphyrin (5)
	RBC folate	RBC folate
	Glycated hemoglobin (5)	Glycated hemoglobin (5)
	Serum	
Iron (5)	Iron (5)	Iron (5)
TIBC (5)	TIBC (5)	TIBC (5)
Ferritin (5)	Ferritin (5)	Ferritin (5)
	Folate (5)	Folate (5)
	Apolipoprotein AI(4)(5)	Apolipoprotein AI(4)(5)
	Apolipoprotein B(4)(5)	Apolipoprotein B(4)(5)
	Cholesterol (5)	Cholesterol (5)
	HDL/LDL (5)	HDL/LDL (5)
	Triglycerides (5)	Triglycerides (5)
	Lp(a)(2)(5)	Lp(a)(2)(5)
	Cotinine (4)	Cotinine (4)
	C-reactive protein (5)	C-reactive protein (5)
	Vitamin A (5)	Vitamin A (5)
	Carotenes (5)	Carotenes (5)
	Retinyl esters (5)	Retinyl esters (5)
	Vitamin E (5)	Vitamin E (5)
	Vitamin B12 (2)	Vitamin B12 (2)
		Helicobacter pylori (4)
	Tetanus	Tetanus
		Vitamin C
		Hepatitis A

Appendix 1. Blood and Urine Assessments by Specimen Type and Age Group (continued)

AGE GROUP		
1-3 years	4-5 years	6-11 years
	Serum (continued)	
		Hepatitis B/delta
		Hepatitis C
		Hepatitis E
		Rubella (5)
		Varicella (5)
	Urine	
		Cadmium
		Creatinine
		Albumin
		Iodine

Appendix 1. Blood and Urine Assessments by Specimen Type and Age Group (continued)

AGE GROUP	
12-19 years	20 years and older
Whole blood	
CBC (1)(5)	CBC (1)(5)
Differential smear	Differential smear
Lead (5)	Lead (5)
Protoporphyrin (5)	Protoporphyrin (5)
	RBC folate
Glycated hemoglobin (5)	Glycated hemoglobin (5)
Serum	
Iron (5)	Iron (5)
TIBC (5)	TIBC (5)
Ferritin (5)	Ferritin (5)
Folate (5)	Folate (5)
Apolipoprotein AI(4)(5)	Apolipoprotein AI(4)(5)
Apolipoprotein B(4)(5)	Apolipoprotein B(4)(5)
Cholesterol (5)	Cholesterol (5)
HDL/LDL (5)	HDL/LDL (5)
Triglycerides (5)	Triglycerides (5)
Lp(a)(2)(5)	Lp(a)(2)(5)
Cotinine (4)	Cotinine (4)
C-reactive protein (5)	C-reactive protein (5)
	Rheumatoid factor (60+)
Vitamin A (5)	Vitamin A (5)
Carotenes (5)	Carotenes (5)
Retinyl esters (5)	Retinyl esters (5)
Vitamin E (5)	Vitamin E (5)
Vitamin B12 (2)	Vitamin B12 (2)
Helicobacter pylori (4)	
Tetanus	Tetanus
Vitamin C	Vitamin C
Hepatitis A	Hepatitis A
Hepatitis B/delta	Hepatitis B/delta
Hepatitis C	Hepatitis C
Hepatitis E	Hepatitis E
Rubella (5)	Rubella (5)
Varicella (5)	Varicella (5)

Appendix 1. Blood and Urine Assessments by Specimen Type and Age Group (continued)

AGE GROUP	
12-19 years	20 years and older
Serum	
Diphtheria	Diptheria
Herpes simplex I and II	Herpes simplex I and II
HIV I (ages 18+)(3)(5)	HIV I (ages 18+)(3)(5)
Toxoplasmosis (5)	Toxoplasmosis (5)
Vitamin D (OHD)	Vitamin D (OHD)
Total/normalized calcium	Total/normalized calcium
Selenium (5)	Selenium (5)
Thyroxine (T4)	Thyroxine (T4)
Thyroid-stimulating hormone	Thyroid-stimulating hormone
Antithyroglobulin antibodies	Antithyroglobulin antibodies
Antimicrosomal antibodies	Antimicrosomal antibodies
	FSH/LH (females aged 35-60 years)
	Insulin (6)
	C-peptide (6)
Biochemistry profile (5)	Biochemistry profile (5)
Bicarbonate	Bicarbonate
Blood urea nitrogen	Blood urea nitrogen
Total bilirubin	Total bilirubin
Alkaline phosphatase	Alkaline phosphatase
Cholesterol	Cholesterol
AST	AST
ALT	ALT
LDH	LDH
GGT	GGT
Total protein	Total protein
Albumin	Albumin
Creatinine	Creatinine
Glucose	Glucose
Calcium	Calcium
Chloride	Chloride
Uric acid	Uric acid
Phosphorus	Phosphorus
Sodium	Sodium
Potassium	Potassium
Triglycerides	Triglycerides
Globulin	Globulin
Iron	Iron
Osmolality	Osmolality

Appendix 1. Blood and Urine Assessments by Specimen Type and Age Group (continued)

AGE GROUP	
12-19 years	20 years and older
Plasma	
	Glucose (examinees aged 20-39 years and 75 years and older) OGTT (examinees aged 40-74 years) Fibrinogen (examinees aged 40 years and older)(5)
Urine	
Cadmium	Cadmium
Creatinine	Creatinine
Albumin	Albumin
Iodine	Iodine
Urine drug (ages 18 years and over)(2)(3)	Urine drug (examinees aged 18 years and over)(2)(3)
Cocaine	Cocaine
Opiates	Opiates
Phencyclidine	Phencyclidine
Amphetamines	Amphetamines
Marijuana	Marijuana
	Pregnancy test (females aged 20-59 years)
White Cells	
Storage/banking (5)	Storage/banking (5)

(1) Includes hematocrit, hemoglobin, red, white and platelet cell counts, mean cell volume, mean cell hemoglobin, mean cell hemoglobin concentration, red cell distribution width, platelet distribution width, mean platelet volume, and 3-cell differential
(2) Phase 2 only
(3) Anonymous
(4) Phase 1 only
(5) Home examination also
(6) In phase 2, also from second venipuncture for examinees aged 40-74 years

Appendix 2. Laboratory Test Detection Limits

Some of the laboratory test detection limits have footnotes. These footnotes appear at the end of the appendix.

Test	Detection limit
Albumin (urine)	0.5 ug/mL
Alpha carotene	0 ug/dL
Antimicrosomal antibody (AMA)	0.5 U/mL
Antithyroglobulin antibody (ATA)	1.0 U/mL
Beta carotene	0.67 ug/dL
Beta cryptoxanthin	0 ug/dL
C-peptide	0.03 pmol/mL
C-reactive protein	0.3 mg/dL
Cadmium (urine)	0.01 ng/mL
Cotinine	0.05 ng/mL
Creatinine (urine)	1 mg/dL
Erythrocyte protoporphyrin	2.5 ug/dL RBC
Ferritin	3 ng/mL
Folate (serum)	0.2 ng/mL
Follicle stimulating hormone (FSH)	0.15 IU/L
Glucose	2 mg/dL
Glycated hemoglobin	0 %
Helicobacter pylori	Qualitative tests
Hematology parameters	
Granulocyte	0 %
Granulocyte (1)	0 number
Hematocrit	0 %
Hemoglobin	0 g/dL
Lymphocyte	0 %
Lymphocyte (1)	0 number
Mean cell hemoglobin	0 pg
Mean cell hemoglobin concentration	0 g/dL
Monocyte	0 %
Monocyte (1)	0 number
Platelet count (1)	0
Platelet distribution width	0 %
Red blood cell count (RBC) (1)	0
Red blood cell distribution width	0 %
White blood cell count (WBC) (1)	0
Hepatitis profile	Qualitative tests
Herpes	Qualitative tests
High density lipoprotein (HDL)	10 mg/dL
Homocysteine	0 umol/L
Human immunodeficiency virus (HIV)	Qualitative tests
Insulin	2.5 uU/mL
Iodine (urine)	0.2 ug/dL
Iron	3.0 ug/dL
Lead	1 ug/dL
Lipoprotein(a)	0 mg/dL
Lutein/zeaxanthin	0.43 ug/dL

Appendix 2. Laboratory Test Detection Limits (continued)

Test	Detection limit
Luteinizing hormone (LH)	0.15 IU/L
Lycopene	0.63 ug/dL
Normalized calcium	0.5 mmol/L
RBC folate	4.4 ng/mL
Retinyl esters	0 ug/dL
Rheumatoid factor	Qualitative tests
Rubella	0 IU
Selenium	8 ng/mL
Tetanus	0 U/mL
Thyroid stimulating hormone (TSH)	0.01 mU/mL
Thyroxine (T4)	1.0 ug/dL
Total iron binding capacity (TIBC)	9 ug/dL
Total cholesterol	10 mg/dL
Total calcium	1.5 mmol/L
Toxoplasmosis	0 IU
Triglycerides	10 mg/dL
Varicella	0
Vitamin B12	20 pg/mL
Vitamin E	20 ug/dL
Vitamin C	0 mg/dL
Vitamin A	0.5 ug/dL
Vitamin D	5.0 ng/mL

(1) Units for white blood cell count, red blood cell count, platelet count, lymphocyte number, granulocyte number, and mononuclear number are referenced in the Manual for Medical Technicians p. 5-1 (U.S. DHHS, 1996).

Note: Lower detection limits for analytes included in the general "biochemistry profile" are found in the Laboratory Procedures Used for NHANES III (U.S. DHHS, 1996).

Appendix 3. NHANES III SI Table

Some of the laboratory test in the SI table footnotes. These footnotes appear at the end of the appendix.

Test (1)	NHANES Unit	NHANES Format	Conversion Factor	SI Unit	SI Format
Alanine aminotransferase(2)	N/A	N/A	N/A	U/L	XXX
Albumin (serum) (2)	g/dL	X.X	10	g/L	XX
Albumin (urine)	ug/mL	XXXXX.XX	N/A	N/A	N/A
Alkaline phosphatase (2)	N/A	N/A	N/A	U/L	XXX
Alpha carotene	ug/dL	XXX	0.01863	umol/L	X.XX
Antimicrosomal antibody	N/A	N/A	N/A	N/A	N/A
Antithyroglobulin antibody	N/A	N/A	N/A	N/A	N/A
Apolipoprotein AI	mg/dL	XXX	0.01	g/L	X.XX
Apolipoprotein B	mg/dL	XXX	0.01	g/L	X.XX
Aspartate amino-transferase (2)	N/A	N/A	N/A	U/L	XXX
Beta carotene	ug/dL	XXX	0.01863	umol/L	XX.XX
Beta cryptoxanthin	ug/dL	XXX	0.01809	umol/L	X.XX
Bicarbonate (2)	N/A	N/A	N/A	mmol/L	XX
Bilirubin (total)(2)	mg/dL	XX.X	17.1	umol/L	XXX.XX
Blood urea nitrogen (2)	mg/dL	XXX	0.357	mmol/L	XX.XX
C-peptide	pmol/mL	XX.XXX	1	nmol/L	XX.XXX
C-reactive protein	N/A	N/A	N/A	N/A	N/A
Cadmium (urine)	ng/mL	XX.XX	8.897	nmol/L	XXX.XX
Calcium (total)	N/A	N/A	N/A	mmol/L	X.XX
Calcium (normalized)	N/A	N/A	N/A	mmol/L	X.XX
Calcium (2)	mg/dL	XX.X	0.25	mmol/L	X.XXX
Chloride (2)	N/A	N/A	N/A	mmol/L	XXX.X
Cholesterol	mg/dL	XXX	0.02586	mmol/L	XX.XX
Cholesterol (HDL)	mg/dL	XXX	0.02586	mmol/L	X.XX
Cholesterol (LDL)	mg/dL	XXX	0.02586	mmol/L	X.XX
Cholesterol (2)	mg/dL	XXX	0.02586	mmol/L	XX.XXX
Cotinine	ng/mL	XXXX.XXX	N/A	N/A	N/A
Creatinine (2)	mg/dL	XX.X	88.4	umol/L	XXXX.X
Creatinine (urine)	mg/dL	XXX.X	0.0884	mmol/L	XX.X
Diphtheria	N/A	N/A	N/A	N/A	N/A
Ferritin	ng/mL	XXXX	1	ug/L	XXXX
Fibrinogen	mg/dL	XXX	0.01	g/L	X.XX
Folate	ng/mL	XXX.X	2.266	nmol/L	XXX.X
Folate (RBC)	ng/mL	XXXX	2.266	nmol/L	XXXX.X
Follicle-stimulating hormone	N/A	N/A	N/A	IU/L	XXX.X
GGT (2)	N/A	N/A	N/A	U/L	XXXX

Appendix 3. NHANES III SI Table

Test (1)	NHANES Unit	NHANES Format	Conversion Factor	SI Unit	SI Format
Globulin (2)	g/dL	X.X	10	g/L	XX
Glucose (2)	mg/dL	XXX	0.05551	mmol/L	XX.XX
Glucose (plasma)	mg/dL	XXX.X	0.05551	mmol/L	XX.XXX
Glycated hemoglobin	%	XX.X	N/A	N/A	N/A
Helicobacter pylori	N/A	N/A	N/A	N/A	N/A
Hematocrit	%	XX.XX	0.01	L/L=1	0.XXX
Hemoglobin	g/dL	XX.XX	10	g/L	XXX.X
Hepatitis A virus	N/A	N/A	N/A	N/A	N/A
Hepatitis B core antibody (anti-HBc)	N/A	N/A	N/A	N/A	N/A
Hepatitis B surface antigen (HbsAg)	N/A	N/A	N/A	N/A	N/A
Hepatitis C virus	N/A	N/A	N/A	N/A	N/A
Hepatitis D virus	N/A	N/A	N/A	N/A	N/A
Hepatitis B surface antibody (anti-HBs)	N/A	N/A	N/A	N/A	N/A
Herpes I & II	N/A	N/A	N/A	N/A	N/A
Homocysteine	N/A	N/A	N/A	umol/L	XX.X
Human immuno-deficiency virus	N/A	N/A	N/A	N/A	N/A
Insulin	uU/mL	XXX.XX	6.0	pmol/L	XXX.XX
Iodine (urine)	ug/dL	XXX.X	N/A	N/A	N/A
Iron	ug/dL	XXX	0.1791	umol/L	XX.XX
Iron (2)	ug/dL	XXX	0.1791	umol/L	XX.X
LDH (2)	N/A	N/A	N/A	U/L	XXX
Latex antibody	IU/mL	XXXX.XX	N/A	N/A	N/A
Lead	ug/dL	XX.X	0.04826	umol/L	X.XXX
Lipoprotein(a)	mg/dL	XXX	0.01	g/L	X.XX
Lutein/zeaxanthin	ug/dL	XXX	0.01758	umol/L	X.XX
Luteinizing hormone	N/A	N/A	N/A	IU/L	XX.X
Lycopene	ug/dL	XXX	0.01863	umol/L	X.XX
Mean cell hemoglobin	N/A	N/A	N/A	pg	XX.XX
Mean cell volume	N/A	N/A	N/A	fL	XXX.XX
Mean cell hemoglobin concentration	g/dL	XX.XX	10	g/L	XXX.X
Mean platelet volume	N/A	N/A	N/A	fL	XX.XX
Methylmalonic acid	ug/dL	N/A	0.085	umol/L	N/A

Appendix 3. NHANES III SI Table (continued)

Test (1)	NHANES Unit	NHANES Format	Conversion Factor	SI Unit	SI Format
Osmolality (2)	N/A	N/A	N/A	mmol/kg	XXX
Phosphorus (2)	mg/dL	XX.X	0.3229	mmol/L	X.XXX
Platelet count (3)	N/A	XXX.X	1	N/A	XXX.X
Potassium (2)	N/A	N/A	N/A	mmol/L	X.XX
Protein (total)(2)	g/dL	XX.X	10	g/L	XXX
Protoporphyrin	ug/dL	XXXX	0.0178	umol/L	XX.XX
Red blood cell distribution width	%	XX.XX	0.01	fraction	X.XXXX
Red blood cell count (3)	N/A	X.XX	1	N/A	X.XX
Retinyl esters	ug/dL	XXX	0.03491	umol/L	X.XX
Rheumatoid factor	N/A	N/A	N/A	N/A	N/A
Rubella	N/A	N/A	N/A	N/A	N/A
Selenium	ng/mL	XXX	0.0127	nmol/L	X.XX
Sodium (2)	N/A	N/A	N/A	mmol/L	XXX.X
Tetanus	U/mL	N/A	N/A	N/A	N/A
Thyroid stimulating hormone	uU/mL	XXX.XX	1	mU/L	XXX.XX
Thyroxine	ug/dL	XX.X	12.87	nmol/L	XXX.X
Total iron binding capacity	ug/dL	XXX	0.1791	umol/L	XXX.XX
Toxoplasmosis	N/A	N/A	N/A	N/A	N/A
Triglycerides	mg/dL	XXXX	0.01129	mmol/L	XX.XX
Triglycerides (2)	mg/dL	XXXX	0.01129	mmol/L	XX.XXX
Uric acid (2)	mg/dL	XX.X	59.48	umol/L	XXX.X
Varicella	N/A	N/A	N/A	N/A	N/A
Vitamin A	ug/dL	XXX	0.03491	umol/L	X.XX
Vitamin B12	pg/mL	XXXXX	0.7378	pmol/L	XXXXX.XX
Vitamin C	mg/dL	X.XX	56.78	mmol/L	XXX.XX
Vitamin D	ng/mL	XXX.X	2.496	nmol/L	XXX.X
Vitamin E	ug/dL	XXXX	0.02322	umol/L	XXX.XX
White blood cell count (3)	N/A	XX.XX	1	N/A	XX.XX

(1) Results are based on a serum sample unless otherwise noted.
(2) Biochemistry profile
(3) Units for white blood cell count, red blood cell count, platelet count, lymphocyte number, granulocyte number, and mononuclear number are referenced in the Manual for Medical Technicians p. 5-1 (U.S. DHHS, 1996).

Appendix 4. Laboratories and Diagnostic Centers

Component	Laboratory or Diagnostic Center
Cotinine Vitamin D	National Center for Environmental Health, CDC, Atlanta, GA
Homocysteine	Tufts University School of Medicine, Boston, MA
Thyroxine Thyroid stimulating hormone	White Sands Research Center, Alamogordo, NM
Antimicrosomal antibody Anti-thyroglobulin antibody	Endocrine Services Laboratory, University of Southern California, Los Angeles, CA
Helicobacter pylori	Vanderbilt University, Nashville, TN

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