

# National Health and Nutrition Examination Survey, 2015–2018: Sample Design and Estimation Procedures

Data Evaluation and Methods Research



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Center for Health Statistics

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## **National Health and Nutrition Examination Survey, 2015–2018: Sample Design and Estimation Procedures**

Data Evaluation and Methods Research

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Centers for Disease Control and Prevention  
National Center for Health Statistics

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# National Health and Nutrition Examination Survey, 2015–2018: Sample Design and Estimation Procedures

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## Abstract

### Background

The purpose of the National Health and Nutrition Examination Survey (NHANES) is to produce national estimates representative of the total noninstitutionalized civilian U.S. population. The sample for NHANES is selected using a complex, four-stage sample design. NHANES sample weights are used by analysts to produce estimates of the health-related statistics that would have been obtained if the entire sampling frame (i.e., the noninstitutionalized civilian U.S. population) had been surveyed.

Sampling errors should be calculated for all survey estimates to aid in determining their statistical reliability. For complex sample surveys, exact mathematical formulas for variance estimates that fully incorporate the sample design are usually not available. Variance

approximation procedures are required to provide reasonable, approximately unbiased, and design-consistent estimates of variance.

### Objective

This report describes the NHANES 2015–2018 sample design and the methods used to create sample weights and variance units for the public-use data files, including sample weights for selected subsamples, such as the fasting subsample. The impacts of sample design changes on estimation for NHANES 2015–2018 are described. Approaches that data users can use to modify sample weights when combining survey cycles or when combining subsamples are also included.

**Keywords:** sampling • weighting • variance estimation • mobile examination center (MEC)

## Introduction

The National Health and Nutrition Examination Survey (NHANES) is one of a series of health-related programs conducted by the National Center for Health Statistics (NCHS) to provide information on the health and nutritional status of the noninstitutionalized civilian resident population of the United States. This information is used to estimate the prevalence of various diseases and conditions and to provide information for use in planning health policy.

NHANES is unique in collecting person-level demographic, health, and nutrition information from personal interviews and a standardized physical examination in a mobile examination center (MEC). The examination includes objective measures of health status, including height, weight, blood pressure, and the collection of blood and urine specimens for laboratory testing.

The specific NHANES sample designs, including specifications for clustering, stratification, and oversampling population subgroups, have changed over time. Since 1999, the principal sample design has consisted of multiyear, stratified, clustered four-stage samples, with public-use

data release in 2-year cycles. The NHANES 2015–2018 sample design is summarized in [Table 1](#) and differs from the NHANES 2011–2014 sample design in three key ways: (a) The threshold to be sampled in the “non-Hispanic white and other low income” sampling domain changed from less than or equal to 130% to less than or equal to 185% of the federal poverty level; (b) The NHANES 2011–2014 sample design had five state health-related groupings, including California as a separate group. For the NHANES 2015–2018 sample design, California was not separated, only four state health-related groupings were created, and the health groups were re-evaluated based on updated data, so some states were in different groups compared with 2011–2014 groups; and (c) The sample design had 14 major strata with 4 minor strata each, and 4 certainty primary sampling units (PSUs) compared with 13 major strata with 4 minor strata each, and 8 certainty PSUs in the 2011–2014 sample design. Designs for earlier cycles from continuous NHANES are described in previous reports (1–3).

A previously published report, titled, “The National Health and Nutrition Examination Survey: Estimation Procedures, 2011–2014” (4) describes the methods that were used to



construct sample weights and variance units for NHANES 2011–2014. It also provides information for users on combining survey cycles, sample weights for subsamples, and using the strata and primary sampling unit information (variance units) provided in public-use files for variance estimation. Additional information for conducting data analysis can be found in the NHANES analytic guidelines (5,6).

This report describes the sample design and the construction of sample weights and variance units for NHANES 2015–2018. The “Sample Design” section describes the sample design specifications for NHANES 2015–2018. The “Weighting the Sample Data” section describes the creation of sample weights for the NHANES 2015–2018 sample and subsamples, with a focus on how NHANES 2015–2018 sample design features affect the sample weights. The “Variance Estimation” section describes the variance units on the public-use data files and appropriate variance estimation methods for analysis. [Appendix I](#) provides a glossary of terms and [Appendix II](#) contains tables of supporting material. For additional information regarding the calculation of NHANES sample weights, please refer to “National Health and Nutrition Examination Survey: Estimation Procedures, 2011–2014” (4).

Additional documentation of the survey content, data collection procedures, and methods for assessing nonsampling errors is provided elsewhere (<https://www.cdc.gov/nchs/nhanes.htm>).

## Sample Design

The NHANES sample represents the noninstitutionalized civilian population residing in the 50 states and the District of Columbia. Since 1999, the sample design has consisted of multi-year, stratified, clustered four-stage samples, with data release in 2-year cycles. The NHANES sample is drawn in four stages: (a) PSUs (counties, groups of tracts within counties, or combinations of adjacent counties), (b) segments within PSUs (census blocks or combinations of blocks), (c) dwelling units (DUs) (households) within segments, and (d) individuals within households. PSUs are sampled from all U.S. counties. Screening is conducted at the DU level to identify sampled persons (SPs), based on oversampling criteria.

NHANES 2015–2018 oversampled some subgroups to increase precision for subgroup estimates. The population subgroups chosen for oversampling directly determine the sampling domains used to select the sample at all stages. Specific NHANES sample designs, including specifications for clustering, stratification, and oversampling population subgroups, have changed over time. The set of domains for which specified reliability was desired in NHANES 2015–2018 consisted of sex-age groups for Hispanic persons; non-Hispanic black persons; and non-Hispanic, non-black Asian (referred to as non-Hispanic Asian) persons, and income-sex-age groups for the remainder of the U.S.

population. Specifically, the oversampled subgroups in the 2015–2018 survey were:

- Hispanic persons;
- Non-Hispanic black persons;
- Non-Hispanic, non-black Asian persons;
- Non-Hispanic white persons and persons of other races and ethnicities at or below 185% of the federal poverty level; and
- Non-Hispanic white persons and persons of other races and ethnicities aged 0–11 years or 80 years and over.

Race and Hispanic-origin domains used to create the sample design and weights differ from the categories used in variables in publicly released data files (e.g., RIDRETH3 and RIDRETH1 for NHANES 2015–2018). Race and Hispanic origin information used for sampling is based on census population estimates and obtained from the household screener to determine eligibility for inclusion in the survey. The race and Hispanic origin variables in publicly released data files are based on survey response. In addition, the variable RIDRETH3 in the public-use files includes only single-race categories for non-Hispanic white, black, and Asian groups, with all participants reporting belonging to other or multi-race groups coded into the “other races, including multiracial” category. In contrast, when collecting race and Hispanic origin information at screening for NHANES 2015–2018, the black category included persons reporting non-Hispanic black as a single race or in combination with other races, including Asian; the Asian screening category included non-Hispanic Asian persons as a single race and in combination with other races, except black.

In previous NHANES cycles, the low income threshold for oversampling non-Hispanic white and other persons was set at or below 130% of the federal poverty level, which is the threshold used to determine income eligibility for participation in the Supplemental Nutrition Assistance Program (SNAP, formerly known as the Food Stamp Program). This oversampling threshold was changed to 185% of the federal poverty level in NHANES 2015–2018, which is the threshold used to determine income eligibility for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). It was thought that increasing the sample of respondents with lower incomes may help reduce the amount of screening needed and increase response rates. The federal poverty levels are established 1 year before the year of data collection. Each annual federal poverty level referenced remained in place for the calendar year of data collection and was updated annually.

[Table A](#) lists the set of sampling domains in NHANES 2015–2018. Although data are released in 2-year cycles, at least 4 years of data must be combined to obtain an acceptable level of reliability for most of the sampling domains given in [Table A](#). To create estimates for 2-year samples, domains must be collapsed to produce adequate sample sizes for analysis.

**Table A. Sampling subdomains, by race and Hispanic origin, income, sex, and age: National Health and Nutrition Examination Survey, 2015–2018**

Hispanic	Non-Hispanic black	Non-Hispanic, non-black Asian	Non-Hispanic white and other	
			Low income <sup>1</sup>	Non-low income
All, age group (years)				
Under 1	Under 1	Under 1	Under 1	Under 1
1–2	1–2	1–2	1–2	1–2
3–5	3–5	3–5	3–5	3–5
Male, age group (years)				
6–11	6–11	6–11	6–11	6–11
12–19	12–19	12–19	12–19	12–19
20–39	20–39	20–39	20–29	20–29
...	...	...	30–39	30–39
40–49	40–49	40–49	40–49	40–49
50–59	50–59	50–59	50–59	50–59
60 and over	60 and over	60 and over	60–69	60–69
...	...	...	70–79	70–79
...	...	...	80 and over	80 and over
Female, age group (years)				
6–11	6–11	6–11	6–11	6–11
12–19	12–19	12–19	12–19	12–19
20–39	20–39	20–39	20–29	20–29
...	...	...	30–39	30–39
40–49	40–49	40–49	40–49	40–49
50–59	50–59	50–59	50–59	50–59
60 and over	60 and over	60 and over	60–69	60–69
...	...	...	70–79	70–79
...	...	...	80 and over	80 and over

... Category not applicable.

<sup>1</sup>Persons living in household at or below 185% of the federal poverty level.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

NHANES PSUs are selected with probabilities proportionate to size (PPS), where each PSU’s measure of size (MOS) is determined by criteria established in advance for obtaining health estimates for subgroups determined by age group, sex, race and Hispanic origin, and income. The MOS is a weighted average of population counts, where the weights, or  $A_k$ , are calculated to give relatively higher probabilities of selection to PSUs with higher proportions of individuals within the subgroups chosen for oversampling. For NHANES 2015–2018, the MOS weights were calculated to give relatively higher probabilities of selection to PSUs with higher proportions of black, Hispanic, Asian, or low-income white and other persons as was done for the NHANES 2011–2014 sample design (see reference 1 in this report for full details). The weights used to assign the relative contribution from each race-Hispanic origin group in the computation of the MOS are listed in [Table II](#).

Some counties have an MOS large enough that they are selected with certainty (certainty PSU, often referred to as self-representing or SR) (see reference 1 in this report for full details). The remaining counties are referred to as noncertainty PSUs (non-self-representing or NSR). The certainty PSUs are removed from the county frame before noncertainty PSU selection. The noncertainty PSUs are divided into strata before selection. There were 4 certainty PSUs for NHANES 2015–2018, one for each of the 4 years.

The stratification scheme for NHANES 2015–2018, as for NHANES 2011–2014, included state groups, major strata, and minor strata levels. As was done for

NHANES 2011–2014, a state health index was calculated for each state based on the combination of several state-level health-related variables: death rate, infant mortality rate, percentage of adults with high blood pressure, percentage of adults who are overweight or obese, percentage of adults with poor nutrition, and percentage of adults who smoke. State-level health statistics were available from the National Vital Statistics System (7,8) and the Behavioral Risk Factor Surveillance System (9–11). States with similar health index values were put into the same group, so the healthiest states were in Group A and the least healthy states were in Group D. The NHANES 2011–2014 sample design had five state groups, with California as its own separate state group because of interest in multiyear estimates for California. For NHANES 2015–2018, California was not separated, but was included in State Group A. The states in each NHANES 2015–2018 state group are listed in [Table III](#).

Each of the 4 state groups had 3 or 4 major strata, for a total of 14 major strata, defined by census region and percentage of the population living in a rural area. Each major stratum was divided into 4 minor strata, for a total of 56 minor strata. [Table IV](#) shows the characteristics of major strata formed for selection of PSUs for NHANES 2015–2018, and the [Figure](#) depicts the major strata and PSU information in a map with detailed PSU descriptions.

Over the 4-year sample, NHANES 2015–2018 surveyed 60 PSUs, including 4 certainty PSUs and 1 noncertainty PSU per minor stratum. Each year, the 15 sampled PSUs, including 1 PSU from each major stratum as well as 1 certainty PSU, formed a nationally representative sample. Within each PSU, the secondary sampling units (SSUs) were called segments, and comprised census blocks or combinations of blocks. As with PSUs, the SSUs were selected with PPS, where the MOS was a weighted average of population counts. The number of segments in the frame can vary widely by PSU; large

PSUs could have more than 5,000 segments in the frame, while small PSUs could have fewer than 100 segments in the frame. For survey operational purposes, the sample was designed to produce approximately equal sample sizes per PSU, so 24 segments are sampled within each noncertainty PSU. Certainty PSUs may have any number of segments sampled to ensure appropriate representation in the sample.

## Weighting the Sample Data

Weighting of the NHANES data produces estimates representative of the civilian resident noninstitutionalized U.S. population. The weighting of sample data permits analysts to produce estimates of the statistics that would have been obtained if the entire eligible population had been surveyed. Sample weights can be considered measures of the number of persons in the target population represented by the particular participant. Weighting takes into account several features of the survey: the differential probabilities of selection for the sampling domains, survey nonresponse, and differences between the final sample distribution and the target population distribution. Each of the three levels of data collection for NHANES (screening, interview, examination) has a response rate. As a result, sample weights are calculated for each level of data collection.

The NHANES sample weighting is carried out in three steps. The first step involves the computation of stage base weights to compensate for unequal probabilities of selection for the sampling domains. The second step adjusts for nonresponse to reduce the potential bias. In the third step, the sample weights are calibrated to the reference population. Calibration is used to compensate for possible coverage differences from the eligible population and to reduce variances in the estimation procedure. The nonresponse and calibration steps are performed at each level of data collection: the screening, interview, and examination. The new weight for each step in the adjustment is the product of the weight before the adjustment and the adjustment factor of the step.

Adjustment factors are calculated within adjustment cells defined by characteristics available for both sample participants and nonrespondents at that step. Because available information differs for each step, adjustment cells differ for each step.

## Calculating Base Weights

The initial base weight for each participant within a sampling domain is the same for all other participants in that domain and is equal to the inverse of the sampling rate ( $r_k$ ) within the sampling domain. The initial base weights by sampling domains are shown in [Table V](#). For NHANES 2015–2018, the initial base weights were adjusted to account for: (a) the proportion of DUs released for screening in a PSU,  $f_i(\text{release})$ , (b) the increase in DU sample size needed in some PSUs,

$f_i(\text{inc})$ , and (c) the number of years in the sample,  $f_i(\text{year})$ . The three base weight adjustment factors are described below. The screening base weights are calculated as the product of the initial base weights and the three adjustment factors.

$$W_{i(\text{base, screening})} = \frac{1}{r_k} (f_i(\text{release}) f_i(\text{inc}) f_i(\text{year}))$$

## Adjustment for number of sampled DUs released to the field

At screening, not all DUs can be screened and not all of those screened contain SPs. As a result, a larger sample than needed is deliberately drawn in each study location, and subsamples are released for screening as needed, with the objective of obtaining a relatively fixed sample size of completed examinations. For NHANES 2015–2018, the selected sample in each study location was 80% more than was expected to be needed, but the actual sample released varied depending on the characteristics of the location. To adjust for this approach, a subsample factor is calculated for each study location as the inverse of the proportion of sampled DUs released for screening ( $R_i$ ).

$$f_i(\text{release}) = \frac{1}{R_i}$$

## Adjustment for increased DU sample size

Due to declining response rates and varying levels of growth and decline in different PSUs, the DU sample size was sometimes increased to ensure that enough SPs could be identified and examined in the PSU. To adjust for this approach, an increase factor is calculated for each study location as the inverse of the percentage increase in the DU sample ( $I_i$ ).

$$f_i(\text{inc}) = \frac{1}{I_i}$$

The increase in DU sample size could effectively be canceled out by the amount released. For example, if the DU sample size was increased to 125% ( $I_i = 1.25$ ), and then 80% of the sample was released ( $R_i = 0.8$ ), then the resulting combined factor ( $f_i(\text{release}) \times f_i(\text{inc}) = 1$ ).

## Adjustment for number of years in the sample

NHANES 2015–2018 is a 4-year sample design. Operationally, this means that the selected sample of 60 locations on which the sampling rates were based was implemented over 4 years. Fifteen of the locations were allocated to each single-year sample, with 30 locations included in each 2-year public-use data release cycle. Each single-year and 2-year sample is nationally representative; access to single-year data is restricted to use in the NCHS Research Data Center (RDC, described in “Restricted Data Access in the NCHS Research Data Center” below).

As a result of the 4-year sample design, the initial base weights calculated from the original sampling rates correspond to 4-year samples. These initial base weights are based on the sampling probabilities and, as a result, pertain to the 4-year sample before its implementation. This means that the initial base weights sum to a national population estimate. To produce weights that sum to national population totals for 1- and 2-year samples, adjustment factors are needed. For example, to create the 2-year sample weights for NHANES 2015–2016 and NHANES 2017–2018 data released in the public-use files, the 4-year base weights were multiplied by 2 to account for the 2-year selection (the number of years in the design divided by the number of years in the sample, 4 divided by 2 = 2).

$$f_{i(\text{year})} = \frac{4}{\text{Number of years in sample}}$$

The interview base weights are set to the screening final weights, which are the product of the screening base weights and the three weighting adjustment factors described below. Similarly, the MEC examination base weights are set to the interview final weights, which are the product of the interview base weights and the three interview weighting adjustment factors described below.

## Nonresponse Adjustment

If every selected household was screened, and every SP agreed to complete the interview and the examination, weighted estimates using the base weights described in the “Calculating Base Weights” section would be approximately unbiased estimates of characteristics for the civilian noninstitutionalized U.S. population. However, some of the selected households are not screened, some of the SPs who are screened refuse to be interviewed, and some of the interviewed participants refuse the examination. If nonresponse rates do not vary at any stage across the sampling domains, using the base weights would still be approximately unbiased. However, these assumptions do not hold for NHANES. To reduce the potential for nonresponse bias, base weights are adjusted for nonresponse at each stage of the survey (screening, interview, and examination). The amount of information that can be used for these adjustments increases at each progressive stage; only the sampling information is available at the screening stage, while person-specific information from the interview is available to adjust examination weights.

The nonresponse adjustment procedure consists of computing adjustment factors,

$$f_{i(NR)} = \frac{\text{Sum of stage base weights in the adjustment cell}}{\text{Sum of stage base weights of the participants in the adjustment cell}}$$

and applying these to the survey weights as:

$$w_{i(NR.stage)} = w_{i(base.stage)} f_{i(NR.stage)}$$

separately within nonresponse cells, where nonresponse cells are defined by categorical characteristics known for both participants and nonrespondents.

Because little is known about households that do not complete the screener, the adjustment cells at the screening stage are just the segments, with the assumption that DUs in the same segment are similar. For the interview and examination nonresponse adjustments, a classification program is used to identify available variables most highly related to response propensity. Different variables are identified to form adjustment cells for the following age groups: 0–5 years, 6–19 years, 20–39 years, 40–59 years, and 60 years and over. The use of these variables differs by survey collection period. Variables used to form the nonresponse adjustment cells for interview weights are listed in [Table VI](#) and for examination weights in [Table VII](#).

Nonresponse adjustment reduces bias if response rates and survey characteristics vary from cell to cell and if participants and nonrespondents sharing the same characteristics are in the same cell.

An effect of nonresponse adjustment is that it increases the variability of the weights, which in turn increases the variance of estimates obtained from the data. When the nonresponse adjustment cells contain a sufficient number of cases and the adjustment factors are not too large, the effect on variances is modest. A large adjustment factor in a cell is usually the result of a small number of participants in that cell. To avoid having nonresponse adjustments based on very small sample sizes, or having large nonresponse adjustment factors, nonresponse adjustment cells can be collapsed to form larger cells. As with prior NHANES samples, cells with fewer than 30 participants were collapsed to create larger cells in NHANES 2015–2016 and NHANES 2017–2018. Due to increasing nonresponse to the interview, larger adjustment factors than in previous NHANES samples were allowed, which could result in higher variance for some survey estimates. The nonresponse adjustment factors for most cells were less than 2. The largest factor was 2.17 for NHANES 2015–2016 and 3 for NHANES 2017–2018. The nonresponse adjustment factors’ range for NHANES 2015–2016 was similar to NHANES 2013–2014.

## Trimming

Weight-trimming procedures are used to reduce the impact of any extreme weights on estimation. Nonresponse adjustment can contribute to extreme weights. Even a few unexpectedly large weights can seriously inflate the variance of survey estimates. However, trimming sample weights may introduce estimation bias, so trimming is not automatically used for all sample weights. The impacts of trimming on both variance and bias are considered when deciding whether or not to trim weights.

Trimming was not performed for any NHANES 2015–2016 sample weights, but was for the NHANES 2017–2018 interview weights and MEC weights.

To determine whether or not to trim weights for samples (or subsets of samples), the distribution of weights within each sampling domain was inspected. The threshold for the NHANES 2015–2016 sample weights was defined as three times the sampling domain mean, which was used in earlier cycles. This threshold was increased to four times the sampling domain mean for the 2017–2018 cycle. Any extreme weights that exceeded this threshold were identified. The values of these extreme weights were reduced to the threshold, and the weights of all cases in the sampling domain were adjusted so that the sum of the weights in each sampling domain equaled the corresponding weighted sum before trimming.

Trimmed sample weights are calculated as follows. Let  $t_i$  be the weight after trimming for  $SP_i$ , defined as:

$$t_i = \begin{cases} w_{i(NR)}, & \text{if } w_{i(NR)} \leq \text{threshold} \\ \text{threshold}, & \text{otherwise.} \end{cases}$$

Then the trimming factor,  $f_{i(TR)}$ , is calculated as:

$$f_{i(TR)} = \frac{t_i}{w_{i(NR)}} \times \frac{\sum_{i=1}^{n_b} w_{i(NR)}}{\sum_{i=1}^{n_b} t_i}$$

where  $n_b$  is the sample size of the  $b$ th race-Hispanic origin-income-sex-age sampling domain and

$$w_{i(TR,stage)} = w_{i(NR,stage)} f_{i(TR,stage)}$$

## Calibration

The final step in the weighting procedure for each survey stage is calibration to known population totals. Previous NHANES reports referred to this step as poststratification, which is a specific kind of calibration to a single set of population totals. As described below, calibration can also be done iteratively to multiple sets of population totals in a process called raking, which was done for the NHANES 2017–2018 weights. Calibration compensates for undercoverage or overcoverage of certain demographic groups and for any residual differential nonresponse among these groups. Like nonresponse adjustment, calibration is done at the screening, interview, and examination stages.

As mentioned previously, a participant's sample weight represents the number of persons with similar characteristics in the target population. The sum of all participants' weights in a demographic subgroup could be considered as the total number of persons NHANES participants represented for this particular subgroup. Calibration adjusts the individual sample weights so that the sum of the sample weights within a demographic subgroup equals the population from an independent source for that subgroup.

Similar to the adjustment factors for earlier steps, calibration involves applying a ratio adjustment to the survey weights. In this step, the denominator of the adjustment factor for a particular demographic subgroup is the sum of the nonresponse-adjusted sample weights from the nonresponse adjustment step within the demographic subgroup, and the numerator  $N_c$  is the reference population control total for the demographic subgroup.

$$f_{i(C)} = \frac{N_c}{\text{Sum of nonresponse adjusted weights of the demographic subgroup}}$$

The calibrated weights are then calculated as:

$$w_{i(C,stage)} = w_{i(NR,stage)} f_{i(C,stage)}$$

If trimming was performed, the calibration adjustment factor  $f_{i(C)}$  and calibration weights  $w_{i(C)}$  were calculated from trimmed weights instead of nonresponse-adjusted weights.

As in previous NHANES cycles, the NHANES 2015–2016 weights were calibrated (using a poststratification process) to race-Hispanic origin-age-sex demographic subgroups at each stage of the survey. Known population totals for the calibration were obtained from the 2015 1-year American Community Survey (ACS), conducted by the Census Bureau.

NHANES 2017–2018 weights were initially created following the same poststratification process as NHANES 2015–2016. However, a review of the NHANES 2017–2018 weights indicated a need for additional calibration to race-Hispanic origin-sex-education level subgroups for adults (aged 20 and over) and household income. Education and income are known to be correlated with health (12,13), so these additional adjustments were applied to reduce the risk of bias in the survey estimates due to undercoverage. Income is known to have relatively high item nonresponse and falsification rates (14,15), so area-level mean household income was used for calibration instead of person-level income.

Race, Hispanic origin, age, and sex are collected from all SPs in the screener, and area-level mean household income can be obtained for the area (census tract) where each SP lives, so the 2017–2018 screening weights were calibrated (using 2-dimensional raking) to race-Hispanic origin-age-sex demographic subgroups and area-level household income. Highest education level for an SP is collected in the interview, so that value is only known for interview participants. The 2017–2018 interview and MEC weights were calibrated (using 3-dimensional raking) to race-Hispanic origin-age-sex demographic subgroups, race-Hispanic origin-sex-education level subgroups, and area-level household income.

For NHANES 2017–2018, the 2017 1-year ACS was used as the source for the reference totals for each race-Hispanic origin-age-sex subgroup and each race-Hispanic origin-sex-education level subgroup. The 2017 5-year ACS was used to obtain the mean household income for each census tract,

and the tracts were then divided into deciles. The first decile contained the 10% of tracts with the lowest mean household incomes, and the tenth decile contained the 10% of tracts with the highest mean household incomes. The 2017 5-year ACS was then used as the source for the reference totals for each income decile.

Table B shows the variables used to calibrate the 2015–2016 and 2017–2018 weights, the sources of the data used for calibration, and the weighting stages where the calibration was applied.

The ACS population counts were adjusted to match the Census Bureau best estimates of the total noninstitutionalized civilian population of the United States, including people not counted in surveys or in the most recent decennial census. Calibration using ACS, therefore, brings the weighted totals up to the level of the presumed total noninstitutionalized civilian population in the United States. Detailed reports for ACS are available from the Census Bureau website (16).

A major effect of calibration is that it implicitly imputes survey characteristics for persons missed by the survey due to errors in the sampling frame and adjusts for residual nonresponse not previously corrected. The underlying assumption for calibration is that missed persons not covered by the survey have the same distribution of characteristics as surveyed persons within the calibration cells. This assumption is obviously an oversimplification; the missed persons are likely to be different. However, in the absence of information on the characteristics of the missed persons, calibration is a technique available for reducing bias due to undercoverage and residual nonresponse (17).

## Computing Final Weights

The final sample weight for each participant at each stage is calculated as the product of the base weight, the nonresponse adjustment, the trimming adjustment (if needed), and the calibration adjustment. That is:

$$W_{i,stage} = W_{i,(base,stage)} f_{i,(NR,stage)} f_{i,(TR,stage)} f_{i,(C,stage)}$$

The final screening weight was calculated as:

$$W_{i,screening} = W_{i,(base,screening)} f_{i,(NR,screening)} f_{i,(TR,screening)} f_{i,(C,screening)}$$

The final weights from the screening stage are the base weights for the interview stage, and the final interview weight was calculated as:

$$\begin{aligned} W_{i,interview} &= W_{i,(base,interview)} f_{i,(NR,interview)} f_{i,(TR,interview)} f_{i,(C,interview)} \\ &= W_{i,(base,screening)} f_{i,(NR,screening)} f_{i,(TR,screening)} f_{i,(C,screening)} \\ &\quad f_{i,(NR,interview)} f_{i,(TR,interview)} f_{i,(C,interview)} \end{aligned}$$

The final weights from the interview stage are the base weights for the MEC examination stage, and the final MEC examination weight was calculated as:

$$\begin{aligned} W_{i,MEC} &= W_{i,(base,MEC)} f_{i,(NR,MEC)} f_{i,(TR,MEC)} f_{i,(C,MEC)} \\ &= W_{i,(base,screening)} f_{i,(NR,screening)} f_{i,(TR,screening)} f_{i,(C,screening)} \\ &\quad f_{i,(NR,interview)} f_{i,(TR,interview)} f_{i,(C,interview)} \\ &\quad f_{i,(NR,MEC)} f_{i,(TR,MEC)} f_{i,(C,MEC)} \end{aligned}$$

The interview weight should be used for analyses of data from the household interview only when no variables from the examination are included. The examination weights should be used for analyses of data from the examination (including the MEC interview and some laboratory data) or in conjunction with the household interview data. In addition, there are special survey components and subsamples that require further adjustment of the examination weights due to specific inclusion criteria (e.g., morning fasting sample). Component-specific special weights, if needed, are released with the data for the component and described in the component’s documentation.

NHANES 2017–2018 weights have wider ranges than previous cycles with extended weights at both ends. Analysts should be aware of the potential influence of large weights, especially when extreme weights are associated with extreme data points. Trimming these weights can introduce bias into the estimates (18).

## Subsample Weights

Some laboratory or examination components are done on a subsample of NHANES participants. For example, some but not all NHANES 2015–2016 participants aged 12 years and over are selected to give blood samples for testing for lead and mercury in blood. The subsamples selected for

**Table B. Variables used to calibrate National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018 screening, interview, and mobile examination center examined weights**

Characteristic	2015–2016		2017–2018	
	Adjusted weights	Calibration source	Adjusted weights	Calibration source
Race-Hispanic origin-age-sex	Screening, interview, MEC	2015 ACS 1 year	Screening, interview, MEC	2017 ACS 1 year
Race-Hispanic origin-sex-education for those aged 20 years and over	...	...	Interview, MEC	2017 ACS 1 year
Census tract mean household income	...	...	Screening, interview, MEC	2017 ACS 5 year

... Category not applicable.

NOTES: MEC is mobile examination center. ACS is American Community Survey.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

these components are chosen at random with a specified sampling fraction (e.g., one-half of this examined age group), according to the protocol for that component. Each subsample is selected to be a nationally representative sample of the target population and has its own designated sample weight that accounts for the additional probability of selection into the subsample component, as well as any additional nonresponse to the component.

These subsample weights are included in the respective component data files. Because these weights differ from the examination weights, subsample weights must be used for statistical estimation of measures collected only in that sample and for analyses that include those measures (see [Table VIII](#) for a list of special component sample weights and information regarding their appropriate use.) See the respective survey protocol and documentation (<https://www.cdc.gov/nchs/nhanes.htm>) for more detail on the laboratory tests and health measurements completed for a subsample of participants.

There are caveats when trying to combine data sets with subsample weights. Some subsamples, like the three environmental subsamples, are mutually exclusive (i.e., no overlapping participants) and cannot be combined in the same data release cycle or across cycles. On the other hand, certain combinations of subsamples have some overlap; for example, each of the three environmental subsamples has overlap with the fasting subsample. These could be combined within the same data release cycle. These could also be combined across cycles if the overlapping sample is adequate and there are no differences in the estimates across the cycles. However, NHANES does not provide sample weights for these combined data sets.

To combine two or more subsamples for analysis, random overlap is needed between the subsamples, and appropriate weights need to be recalculated. While there are no specific recommendations regarding how to create combined sample weights for overlapping subsamples, there are calibration approaches to adjusting weights available within the SUDAAN software with the procedures WTADJUST and WTADJX (19,20). Adjustments to create sample weights for overlapping subsamples can be made by adjusting the sample weights to match population totals within adjustment cells defined by race and Hispanic origin, sex, and age group, demographic characteristics that are present in both subsamples. Additional adjustments specific to the analysis may also be made to the sample weights using characteristics common to both subsamples. The selection and categorization of the variables used for adjustment will depend on the size of the combined sample and the purpose of the analysis. Because the overlapping subsamples are typically small, coarser adjustment cells than those used for the original sample weight creation are often required.

Note that sample weight adjustments using the public-use data files would use one of the released race and Hispanic origin variables (RIDRETH3 or RIDRETH1) available in the file

for the calculations. As described earlier, sample weights created by NCHS use the sampling race and Hispanic origin information.

Because all NHANES participants are eligible for the MEC 24-hour dietary recall interview, analysts should treat this component like any other full sample (e.g., interviewed or examined sample) when combining with a subsample and use the sample weights of the smallest subpopulation that includes all of the analytic variables, in this case, the subsample weights. However, the analyst should consider recalculating the subsample weight to account for the day of the week of reported consumption, which was originally accounted for in the 24-hour dietary weights but is not reflected in the subsample weight.

## Combining Survey Cycles

Two-year sample weights are provided in public-use files for NHANES 2015–2016 and 2017–2018. To combine these cycles to produce 4-year estimates, a new 4-year weight can be calculated by dividing the 2-year weights by two, the number of 2-year cycles. Six-year weights can similarly be created for estimates from any three combined survey cycles for 2001–2002 or later by dividing the 2-year weights for each cycle by three. Additional cycles can be added using these same methods (i.e., divide all the weights by the number of 2-year cycles). When 1999–2000 data are included, double the 4-year weights for 1999–2002 first, and then divide all the weights by the number of 2-year cycles.

However, as a result of sample design changes initiated in 2011, it is important to consider changes in race and Hispanic origin sampling and the corresponding variables in the public-use files when calculating estimates based on data from combined cycles that overlap 2011, such as the 6-year period 2009–2014. RIDRETH3 was created to account for the non-Hispanic Asian category starting in 2011 and is not available in public-use files for earlier cycles. Before 2011, Asian participants were grouped in the “non-Hispanic white and other” category for sampling and the “other race—including multiracial” race category for race and Hispanic origin variables in public-use files. Therefore, for combined data sets that use cycles before and after 2011, non-Hispanic Asian cannot be analyzed as a separate race and Hispanic origin category, and this group should be added to the “other” category. Similarly, estimates from combined cycles should only be made for the total Hispanic subgroup from 2007 onward. Additional information for race and Hispanic origin changes over time and combining sample weights can be found in the NHANES analytic guidelines (5,6).

When adjusting the sample weights to combine data for multiple survey cycles, the sum of combined weights will be reasonably close to an independent estimate of the U.S. civilian noninstitutionalized population at the midpoint of the combined interval. The estimate from combined years of data will be the average over the time period. Using multiple

cycles to create combined estimates is useful for increasing sample sizes, particularly for analysis of rare events and small subgroups. However, estimation using combined cycles is based on the assumption that there are no differences in the estimates across cycles, including increasing or decreasing trends, other than observed differences due to random variation.

## Variance Estimation

This section introduces design-based methods of variance estimation for complex sample survey data and describes the creation of variables necessary for variance estimation on the public- and restricted-use data files for the NHANES 2015–2018 samples.

Sampling errors should be calculated for all survey estimates to aid in determining the statistical reliability of those estimates. For complex sample surveys, exact mathematical formulas for variance estimates are not available. Variance approximation procedures are necessary to provide reasonable, approximately unbiased, and design-consistent estimates of variance. These routines require special software that accounts for the survey design. Standard statistical software routines that assume a simple random sample should not be used for computing variances for NHANES. Although each 2-year sample is nationally representative, it is selected from only 30 PSUs. This small number of PSUs sometimes poses challenges for variance estimation. First, the sample sizes for some specific race-Hispanic origin-income-sex-age domains may be small. Second, with a small number of PSUs, direct design-based variance estimates may be unstable for some measures.

Two variance approximation procedures that account for the complex sample design and allow for the computation of design effects are replication methods and Taylor series linearization. Replication methods provide a general means for estimating variances for the types of complex sample designs and weighting procedures usually encountered in practice. The basic idea behind the replication approach is to select subsamples (or “replicates”) repeatedly from the whole sample to calculate the statistic of interest for each of these subsamples, and then use the variability among these replicate statistics to estimate the variance of the full-sample statistic. The jackknife and Fay’s adjusted balanced repeated replication (Fay’s BRR) methods are two common procedures for deriving replicates from a full sample. The jackknife procedure drops a small part of the sample in each replicate and adjusts the weights for the sample that is retained. The Fay’s BRR approach retains the entire sample in each replicate, but adjusts the weights so that part of the sample has increased weights and part of the sample has decreased weights (21).

For the linearization approach, nonlinear estimates are approximated by linear estimates for the purpose of variance estimation. The linear approximation is derived by taking

the first-order Taylor series approximation for the estimator. Standard variance estimation methods for linear statistics are then used to estimate the variance of the linearized estimator. Currently, NCHS recommends using Taylor series linearization methods for variance estimation in analyses of NHANES data for 2-year cycles or combined cycles and replication methods for single-year data. SUDAAN, Stata, R, and SAS survey procedures can be used to obtain variance estimates by these methods.

## Variance Units for Publicly Released Data

Noncertainty PSUs are grouped into major strata defined by state-level health-related variables as discussed in the “Sample Design” section. In any 2-year sample there are two noncertainty PSUs sampled from each major stratum. These strata are used as variance strata to estimate sampling error in the Taylor series linearization approach. Within each variance stratum, the two sampled PSUs are generally defined as variance units. Certainty PSUs are not selected within strata. Variance strata for these PSUs are formed based on the relative size of the PSU compared with the other PSUs. As a result, some of these variance strata may have one PSU split into multiple variance units, while other variance strata may comprise three PSUs for variance estimation, depending on the number and size of the certainty locations that year.

Risks of data disclosure that may compromise participants’ confidentiality include the small number of PSUs in a 2-year NHANES sample, geographic data and other characteristics of the geographic area in the data files, and local publicity campaigns while the survey is in the field. As a result, masked variance units (MVUs) are provided for use with the public-use data files to reduce the chance of matching PSUs in the sample to PSUs in the geographic areas, while minimizing the bias in the variance caused by altering the PSU structure. Collectively, the masked variance units (pseudo-PSUs) formed by the noncertainty and certainty locations can be used for variance estimations and to estimate sampling error. Though they are not the “true” design PSUs, the pseudo-PSUs produce variance estimates that closely approximate the variances that would have been estimated using the true design PSUs. MVUs have been created for all 2-year survey cycles from NHANES 1999–2000 through 2017–2018 and can be used for analyzing any 2-year data set or any combined 4- to 20-year data set. Analysts can compute replicate weights for variance estimation based on MVUs.

## Restricted Data Access in the NCHS Research Data Center

For the current sample design, NHANES data are released to the public in 2-year cycles. In addition to public-use data files, there are special data sets with restricted access that are available only through the NCHS RDC. These include data sets with (a) data items that were collected from a



single-year sample or collected for any time period other than a public release 2-year cycle (identified as such in the component description), (b) data merged geographically to some other contextual data files (often supplied by the data user), and (c) data items that are determined to be too sensitive or too detailed to be released to the public due to confidentiality restrictions. NHANES data linked with administrative data (e.g., Medicare, Medicaid or CHIP, and Social Security Administration) are only available in the RDC.

Some of these data files have special sample weights that should be used when these nonpublic data sets are analyzed within the confines of the RDC environment. For example, single-calendar-year data files have single-year interview and examination weights. These single-year sample weights can be combined with sample weights provided in the 2-year public-use file to create 3-year sample weights. All 1-year sample weights were calculated in the same manner as the public-use 2-year sample weights described above in “Weighting the Sample Data.”

If a special data file involves subsampling, then special subsample weights that reflect the number of calendar years in the data file and the rate of subsampling were created for that file. For all special data files, appropriate documentation is provided in the RDC to describe the necessary sample weights.

Unmasked PSU and variance stratum codes (which differ from the MVU codes provided for the public-use files) can be provided for variance estimation for restricted data files in the RDC. These unmasked variance codes are necessary for studies that use geographically defined variables or for studies that geographically merge NHANES data with external data sets. In addition, Fay’s BRR weights for 2-year data and jackknife weights for single-year data with unmasked variance units are available in the RDC. If replication methods are to be used for combined survey years or cycles with unmasked variance units, replicate weights must be computed by the analyst in the RDC. Providing the unmasked PSU and stratum codes poses no disclosure risk because of the access restrictions in place at the RDC. Further, any subnational estimate that is generated from an RDC analysis must be reviewed and approved by NCHS staff to protect the confidentiality of participants.

More information on the RDC and lists of commonly used restricted NHANES data files and variables are available from the NCHS website at: <https://www.cdc.gov/rdc/>. Other restricted variables not listed here may be available upon request. Information on proposals for use of stored specimens is available from: <https://www.cdc.gov/nchs/nhanes/biospecimens/biospecimens.htm>.

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# Appendix I. Glossary

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**Calibration**—A statistical method that adjusts sample estimates of totals or percentages of target characteristics (e.g., sex, race and Hispanic origin, and age) to equal the target population totals or percentages. The adjustment cells for calibration are similar to the domains used for sample selection but can include variables that were not used for the original sampling frame.

**Demographic subgroup**—A demographic group defined by race and Hispanic origin, age, and sex, which might be a single sample domain or a combination of multiple sample domains.

**Domain**—A demographic group of analytic interest (analytic domain). Analytic domains may also be sampling domains if a sample design is created to meet goals for those specific demographic groups. For the National Health and Nutrition Examination Survey (NHANES), sampling domains are defined by race and Hispanic origin, income, age, and sex. See *Sampling domain*.

**Dwelling unit (DU)**—Also called a “housing unit.” A house, apartment, mobile home or trailer, group of rooms, or single room occupied as separate living quarters or, if vacant, intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants live separately from other individuals in the building and which have direct access from outside the building or through a common hall. In this report, the term generally means those DUs that are eligible for the survey (i.e., excluding institutional group quarters), or that could become eligible (e.g., vacant at the time of sampling but could be occupied when screening begins).

**Household**—All the persons who occupy a housing unit as their usual place of residence.

**Masked variance units (MVUs)**—A collection of secondary sampling units aggregated into groups for the purpose of variance estimation and designed to prevent disclosure of the identity of the selected primary sampling units (PSUs). For NHANES, rather than using the units as sampled, some pseudo units are created. The resulting units produce variance estimates that closely approximate the “true” design variance estimates. MVUs have been created for all 2-year survey cycles from NHANES 1999–2000 through 2017–2018. They can also be used for analyzing any combined 4- to 20-year data set.

**Measure of size (MOS)**—A value assigned to every sampling unit in a sample selection, usually a count of units associated with the elements to be selected. For NHANES, the MOS is actually a weighted average of estimates of population counts for the race-Hispanic origin-income groups of interest.

**Noninstitutionalized civilian population**—Includes all people living in households and noninstitutional group quarters who are not active members of the military. This is the target population for NHANES.

**Participant**—A person selected into the NHANES sample during screening (sample person) who agrees to participate in the survey. In NHANES, persons agreeing to complete the in-home interview are considered “interview participants.” Persons agreeing to complete both the in-home interview and an examination in a mobile examination center (MEC) are considered “MEC participants.”

**Primary sampling unit (PSU)**—The first-stage selection unit in a multistage area probability sample. In NHANES, PSUs are counties or groups of counties in the United States. Some PSUs are so large that they are selected into the survey with a probability of one. These are referred to as PSUs selected with certainty (“certainty PSUs” or often referred to as self-representing [SR] PSUs); all other PSUs are selected without certainty (“noncertainty PSUs” or non-self-representing PSUs).

**Probability proportionate to size (PPS) sampling**—In this method, the probability of selecting any unit varies with the size of the unit, giving larger units a greater probability of selection and smaller units a lower probability. NHANES uses PPS sampling in the selection of PSUs and secondary sampling units.

**Public-use data file**—An electronic data set containing respondent records from a survey with a subset of variables collected in the survey that have been reviewed by analysts within the National Center for Health Statistics (NCHS) to ensure that participant identities are protected. NCHS disseminates these files to encourage public use of the survey data.

**Race and Hispanic origin**—Unless otherwise specified, race and Hispanic origin in this report is used as it was used in NHANES sample selection and sample weight construction. It refers to Hispanic persons; non-Hispanic black persons; non-Hispanic, non-black Asian persons; and a fourth group that includes non-Hispanic white and all other persons. This is in contrast to the race and Hispanic origin categories in the public-use data files as reported by participants in the interview (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, Mexican American, other Hispanic, and other race including multiracial).

**Replicates**—Subsamples selected repeatedly from a sample used in some variance estimation approaches. With these approaches, the statistic of interest is calculated for each subsample, and the variability among the replicate

statistics is used to estimate the variance of the full sample statistic. The jackknife and Fay's adjusted balanced repeated replication (Fay's BRR) methods are two common procedures for the derivation of replicates from a full sample. The Fay's BRR method was used in the creation of replicate weights for most of the NHANES 2015–2018 multiyear samples. Replicate weights are available through the Research Data Center (RDC).

**Response rate**—The number of survey respondents divided by the number of persons selected into the sample.

**Restricted-use data file**—An electronic data set of survey respondent records, containing some information that may, if released to the public, risk disclosing individual survey respondents. These data are available only through the NCHS RDC. These include data sets with (a) data items collected from a single year; (b) data geographically linked to other contextual data files (often supplied by the data user); (c) data items determined to be too sensitive or too detailed to be released to the public due to confidentiality restrictions.

**Sample weight**—The estimated number of persons in the target population that an NHANES respondent represents. For example, if a man in the sample represents 12,000 men in his race-Hispanic origin-sex-age domain, then his sample weight is 12,000. The NHANES sample weights were adjusted for different sampling rates (of the race-Hispanic origin-income-sex-age groups), different response rates, and different coverage rates among persons in the sample, so that accurate national estimates could be made from the sample. The product of all of these adjustments is sometimes called the "final" sample weight.

**Sampled person**—A person selected for the NHANES sample based on oversampling targets for certain demographic subgroups. Sampled persons may become participants (agree to take part in the survey) or nonrespondents.

**Sampling domain**—NHANES 2015–2018 included 87 sampling domains, which were defined by race and Hispanic origin, income, age, and sex. Every person in the NHANES target population can be classified into exactly one of the 87 sampling domains. See *Domain*.

**Sampling error**—The portion of the difference between the sample estimate and true population value due to only observing a sample rather than the entire population.

**Sampling rate**—The rate at which a unit is selected from a sampling frame. For NHANES, the rates required for sampling persons in the race-Hispanic origin-income-sex-age domains were designed to achieve the designated number of MEC examinations in each of those domains. The sampling rates are the driving force in all stages of sampling.

**Screener**—An interview (usually short) containing a set of questions asked of a household member to determine whether the household contains anyone who could be selected into the sample for the survey. In NHANES, the

screener consisted of compiling a household roster and collecting the income level of the household and the race and Hispanic origin, age, and sex of all household members. For NHANES, only persons aged 18 and over can answer the screener.

**Screening**—The process of conducting, or attempting to conduct, the screener interview in selected DUs (households). Occupied DUs are screened using the screener. Other units can also be screened; the process for these units is simply verification that they are either vacant or not DUs. See *Screener*.

**Secondary sampling unit**—The second-stage selection unit in a multistage area probability sample. For NHANES, these are typically referred to as "segments." See *Segment*.

**Segment**—A group of housing units located near each other, all of which were considered for selection into the sample. For NHANES, segments consist of a census block, or group of blocks, and their selection makes up the second stage of sampling. Within each segment, a sample of DUs was selected.

**Stratification; Strata**—The partitioning of a population of sampling units into mutually exclusive categories (strata). Typically, stratification is used to increase the precision of survey estimates for subpopulations important to the survey's objectives. To select the PSUs fielded in 2015–2018, PSUs were stratified based on health status, metropolitan statistical area status, and various population demographics.

**Study location**—The set of segments within a PSU that were fielded together, with all MEC examinations conducted at the same physical location. The distinction between a PSU and a study location is necessary because some large certainty PSUs were divided into multiple study locations and fielded at different times.

**Target population**—The population to be described by estimates from the survey. In NHANES, the target population is the resident civilian noninstitutionalized population of the United States, which excludes all persons in supervised care or custody in institutional settings, all active-duty military personnel, active-duty family members living overseas, and any other persons residing outside the 50 states and the District of Columbia.

**Undercoverage**—The result of failing to include all of the target population within the sampling frame.

**Variance**—A measure of the dispersion of a set of numbers. In this report, the variance is specifically the sample variance, which is a measure of the variation of a statistic, such as a proportion or a mean, calculated as a function of the sampling design and the population parameter being estimated. Many common statistical software packages compute "population variances" by default; these may underestimate the sampling variance because they do not incorporate any effects of having taken a sample instead

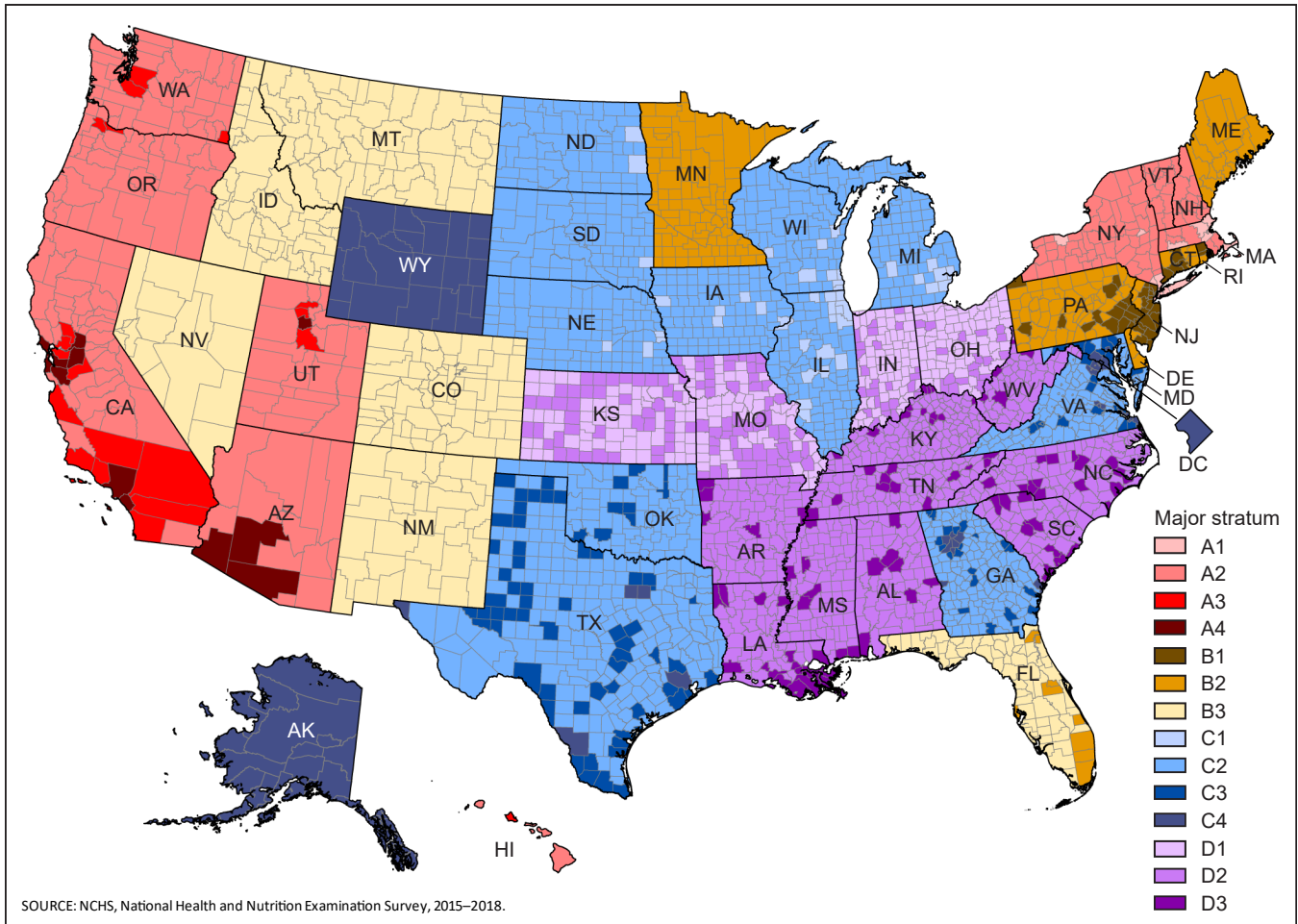
of collecting data from every person in the full population. Estimating the variance in NHANES requires special statistical software, as discussed in this report.

*Variance stratum*—The cluster of variance units used when forming a replicate for variance estimation. For NHANES, the PSU sampling strata usually correspond to the variance strata.

*Variance unit*—A collection of secondary sampling units aggregated into groups and excluded when forming a replicate for variance estimation. For NHANES, an entire PSU usually corresponds to a variance unit.

*Weight*—See *Sample weight*.

**Figure. Primary sampling unit major strata: National Health and Nutrition Examination Survey, 2015–2018**



Major stratum	Primary sampling unit description	Major stratum	Primary sampling unit description
A1	State Group A with less than 8.6% of the population living in rural areas in the Northeast	C1	State Group C with less than 17.5% of the population living in rural areas in the Midwest
A2	State Group A with 8.6% or more of the population living in rural areas in the Northeast, or with 10.5% or more of the population living in rural areas in the West	C2	State Group C with 17.5% or more of the population living in rural areas in the Midwest, or with 29.5% or more of the population living in rural areas in the South
A3	State Group A with 3.1% to less than 10.5% of the population living in rural areas in the West	C3	State Group C with 4.5% to less than 29.5% of the population living in rural areas in the South
A4	State Group A with less than 3.1% of the population living in rural areas in the West	C4	State Group C with less than 4.5% of the population living in rural areas in the South or the West
B1	State Group B with less than 24.6% of the population living in rural areas in the Northeast	D1	State Group D with less than 69.2% of the population living in rural areas in the Midwest
B2	State Group B with 24.6% or more of the population living in rural areas in the Northeast or the Midwest, or with less than 3.4% of the population living in rural areas in the South	D2	State Group D with 69.2% or more of the population living in rural areas in the Midwest, or with 28.5% or more of the population living in rural areas in the South
B3	State Group B with 3.4% or more of the population living in rural areas in the South or the West	D3	State Group D with less than 28.5% of the population living in rural areas in the South

# Appendix II. Supporting Tables

**Table I. Selected sample design parameters: National Health and Nutrition Examination Survey, 2011–2014 and 2015–2018**

Characteristic	2011–2014	2015–2018
Age of noninstitutionalized civilian target population	All ages	All ages
Geographic area	United States <sup>1</sup>	United States <sup>1</sup>
Average number of sampled persons per eligible household	2	2
Number of study locations	60	60
Domains for oversampling	<p>Predesignated: 87 domains of sex-age groups for non-Hispanic black persons; non-Hispanic, non-black Asian persons; and Hispanic persons, and income-sex-age groups for other persons</p> <p>Oversampled: Hispanic persons; non-Hispanic black persons; non-Hispanic, non-black Asian persons; low-income white and other persons (at or below 130% of federal poverty level); and adults aged 80 and over</p>	<p>Predesignated: 87 domains of sex-age groups for non-Hispanic black persons; non-Hispanic, non-black Asian persons; and Hispanic persons, and income-sex-age groups for other persons</p> <p>Oversampled: Hispanic persons; non-Hispanic black persons; non-Hispanic, non-black Asian persons; low-income white and other persons (at or below 185% of federal poverty level); children aged 0–11 years; and adults aged 80 and over</p>
Number of selected persons	27,763	31,538
Number of interviewed persons	19,931	19,225
Number of examined persons	19,151	18,248

<sup>1</sup>Includes 50 states and the District of Columbia. U.S. territories are not included in the National Health and Nutrition Examination Survey sample.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2011–2018.

**Table II. Race and Hispanic origin and income group sampling fractions ( $A_k$ ) used in calculating primary sampling unit measure of sizes: National Health and Nutrition Examination Survey, 2015–2018**

Race and Hispanic origin	$A_k$ value
Hispanic	0.000206
Non-Hispanic black	0.000287
Non-Hispanic, non-black Asian	0.000453
Non-Hispanic, low income, white and other	0.000184
Non-Hispanic, non-low income, white and other	0.000086

NOTE: For in-depth information on the calculation of  $A_k$ , see reference 1 in this report.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

**Table III. State grouping for primary sampling unit stratification: National Health and Nutrition Examination Survey, 2015–2018**

State group	State abbreviation
A	AZ, CA, HI, MA, NH, NY, OR, UT, VT, WA
B	CO, CT, DE, FL, ID, ME, MN, MT, NJ, NM, NV, PA, RI
C	AK, DC, GA, IA, IL, MD, MI, ND, NE, OK, SD, TX, VA, WI, WY
D	AL, AR, IN, KS, KY, LA, MO, MS, NC, OH, SC, TN, WV

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

**Table IV. Characteristics of 14 major strata formed for selection of primary sampling units: National Health and Nutrition Examination Survey, 2015–2018**

State group	Major stratum	Number of minor strata	Number of primary sampling units per major stratum <sup>1</sup>	Census region	Mean percent rural population <sup>2</sup>
A	A1	4	17	Northeast	1.6
	A2	4	220	Northeast, West	28.4
	A3	4	20	West	4.1
	A4	4	12	West	2.1
B	B1	4	41	Northeast	6.0
	B2	4	170	Northeast, Midwest, South	21.6
	B3	4	232	South, West	16.8
C	C1	4	45	Midwest	5.3
	C2	4	897	Midwest, South	53.2
	C3	4	103	South	11.4
	C4	4	66	South, West	3.7
D	D1	4	246	Midwest	20.2
	D2	4	738	Midwest, South	60.9
	D3	4	90	South	13.5

<sup>1</sup>For a 4-year sample, 4 primary sampling units are chosen for each major stratum, 1 for each of its 4 minor strata, for a total of 56 primary sampling units plus the additional 4 primary sampling units chosen with certainty, for a grand total of 60 primary sampling units.

<sup>2</sup>Weighted by 2012 civilian noninstitutional population estimates of noncertainty primary sampling units.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.



**Table V. Final sampling rates and initial base weights: National Health and Nutrition Examination Survey, 2015–2018**

Race and Hispanic origin-income-sex-age sampling domain <sup>1</sup>	Numerator of sampling rate <sup>2</sup>	Initial base weight	Race and Hispanic origin-income-sex-age sampling domain <sup>1</sup>	Numerator of sampling rate <sup>2</sup>	Initial base weight
<b>Non-Hispanic black</b>			<b>Non-Hispanic white or other, low income</b>		
All:			All:		
Under 1	1.00	1,814.82	Under 1	1.00	1,814.82
1–2	0.84	2,158.28	1–2	0.60	3,033.38
3–5	0.60	3,005.41	3–5	0.37	4,849.75
Male:			Male:		
6–11	0.62	2,915.84	6–11	0.40	4,502.70
12–19	0.50	3,638.12	12–19	0.33	5,419.49
20–39	0.39	4,623.63	20–29	0.22	8,324.09
40–49	0.50	3,644.75	30–39	0.30	6,059.67
50–59	0.48	3,762.67	40–49	0.33	5,431.33
60 and over	1.00	1,814.82	50–59	0.33	5,552.45
Female:			60–69	0.38	4,776.97
6–11	0.64	2,826.73	70–79	0.84	2,153.25
12–19	0.51	3,524.72	80 and over	1.00	1,814.82
20–39	0.33	5,434.63	Female:		
40–49	0.40	4,506.67	6–11	0.45	4,022.33
50–59	0.37	4,842.46	12–19	0.38	4,761.14
60 and over	0.67	2,703.47	20–29	0.13	13,588.21
<b>Hispanic</b>			30–39	0.19	9,309.00
All:			40–49	0.26	7,019.96
Under 1	0.93	1,950.64	50–59	0.22	8,247.26
1–2	0.47	3,865.98	60–69	0.28	6,469.73
3–5	0.34	5,286.79	70–79	0.31	5,780.92
Male:			80 and over	0.52	3,479.10
6–11	0.34	5,299.42	<b>Non-Hispanic white or other, non-low income</b>		
12–19	0.29	6,155.91	All:		
20–39	0.25	7,347.30	Under 1	0.78	2,332.29
40–49	0.28	6,398.99	1–2	0.50	3,597.49
50–59	0.42	4,317.43	3–5	0.29	6,214.22
60 and over	1.00	1,814.82	Male:		
Female:			6–11	0.26	7,012.11
6–11	0.38	4,806.88	12–19	0.17	10,528.23
12–19	0.32	5,660.18	20–29	0.11	16,229.23
20–39	0.23	7,960.54	30–39	0.11	16,493.76
40–49	0.28	6,374.51	40–49	0.10	17,502.40
50–59	0.39	4,696.32	50–59	0.09	20,224.32
60 and over	0.88	2,055.93	60–69	0.10	18,446.86
<b>Non-Hispanic, non-black Asian</b>			70–79	0.19	9,634.63
All:			80 and over	0.45	4,067.35
Under 1	0.95	1,917.73	Female:		
1–2	1.00	1,814.82	6–11	0.26	7,043.13
3–5	1.00	1,814.82	12–19	0.19	9,501.80
Male:			20–29	0.14	13,400.71
6–11	1.00	1,814.82	30–39	0.11	17,060.86
12–19	1.00	1,814.82	40–49	0.09	19,706.19
20–39	0.63	2,874.44	50–59	0.08	21,360.31
40–49	0.80	2,260.34	60–69	0.09	19,617.21
50–59	1.00	1,814.82	70–79	0.18	10,014.45
60 and over	1.00	1,814.82	80 and over	0.39	4,655.36
Female:					
6–11	1.00	1,814.82			
12–19	1.00	1,814.82			
20–39	0.60	3,004.83			
40–49	0.68	2,687.58			
50–59	0.77	2,370.10			
60 and over	1.00	1,814.82			

<sup>1</sup>Age in years.

<sup>2</sup>Corresponds to a 180% sample; sampling rates may be calculated by dividing the numerator by 1,815.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

**Table VI. Variables used in forming nonresponse adjustment cells for weighting interview samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
0–5 years		
Census region	...	Northeast, Midwest, South, West
Health-based state groups	...	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Household composition	1 SP in HH under age 16 years, more than 1 SP in HH all under 16, more than 1 SP in HH mixed ages	...
Household size	...	1–2, 3–4, 5–6, 7 or more
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Race and Hispanic origin and income level of sampled person	...	Hispanic; non-Hispanic black; non-Hispanic Asian; non-Hispanic, other low income; non-Hispanic other, non-low income
Sex of household reference person	Male, female	Male, female
Tract-level median income (by quartile)	First quartile, second, third, fourth	...
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 25 years and over with a college education or higher	First quartile, second, third, fourth	...
Tract-level percentage of the population born in the United States	...	First quartile, second, third, fourth
Tract-level percentage of the population that is Asian	...	First quartile, second, third, fourth
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
Urbanicity of the PSU	Urban, suburban, rural	...
6–19 years		
Census region	Northeast, Midwest, South, West	Northeast, Midwest, South, West
Health-based state groups	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Household size	1–2, 3–4, 5–6, 7 or more	1–2, 3–4, 5–6, 7 or more
Number of sampled persons in household	1–2, 3, 4, 5 or more	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Population size of the PSU	...	Less than 100,000, greater than or equal to 100,000 to less than 250,000, greater than or equal to 250,000 to less than 1,000,000, greater than or equal to 1,000,000
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Race and Hispanic origin and income level of sampled person	...	Hispanic; non-Hispanic black; non-Hispanic Asian; non-Hispanic, other low income; non-Hispanic other, non-low income
Sex of household reference person	Male, female	Male, female
Tract-level median age	...	First quartile, second, third, fourth
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population aged 25 years and over with a college education or higher	First quartile, second, third, fourth	First quartile, second, third, fourth
Tract-level percentage of the population born in the United States	...	First quartile, second, third, fourth
Tract-level percentage of the population that is Asian	...	First quartile, second, third, fourth

See footnotes at end of table.

**Table VI. Variables used in forming nonresponse adjustment cells for weighting interview samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018—Con.**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
20–39 years		
Census region	Northeast, Midwest, South, West	...
Health-based state groups	...	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Household composition	1 SP in HH at least aged 16 years, more than 1 SP in HH all at least 16, more than 1 SP in HH mixed ages	...
Household size	1–2, 3–4, 5–6, 7 or more	...
Number of sampled persons in household	...	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Population size of the PSU	...	Less than 100,000, greater than or equal to 100,000 to less than 250,000, greater than or equal to 250,000 to less than 1,000,000, greater than or equal to 1,000,000
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Sex of household reference person	Male, female	Male, female
Sex of sampled person	Male, female	Male, female
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 25 years and over with a college education or higher	First quartile, second, third, fourth	First quartile, second, third, fourth
Tract-level percentage of the population born in the United States	...	First quartile, second, third, fourth
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
Whether any children aged 0–17 years live in dwelling unit	...	Yes, no
40–59 years		
Health-based state groups	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Household composition	1 SP in HH at least aged 16 years, more than 1 SP in HH all at least 16, more than 1 SP in HH mixed ages	...
Household size	1–2, 3–4, 5–6, 7 or more	1–2, 3–4, 5–6, 7 or more
Number of sampled persons in household	...	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Race and Hispanic origin and income level of sampled person	...	Hispanic; non-Hispanic black; non-Hispanic Asian; non-Hispanic, other low income; non-Hispanic other, non-low income
Sex of household reference person	...	Male, female
Sex of sampled person	...	Male, female

See footnotes at end of table.

**Table VI. Variables used in forming nonresponse adjustment cells for weighting interview samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018—Con.**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
40–59 years—Con.		
Tract-level median age	...	First quartile, second, third, fourth
Tract-level median income (by quartile)	First quartile, second, third, fourth	...
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population born in the United States	...	First quartile, second, third, fourth
Urbanicity of the PSU	Urban, suburban, rural	...
60 years and over		
Census region	Northeast, Midwest, South, West	Northeast, Midwest, South, West
Household composition	1 SP in HH at least aged 16 years, more than 1 SP in HH all at least 16, more than 1 SP in HH mixed ages	...
Household size	...	1–2, 3–4, 5–6, 7 or more
Number of sampled persons in household	...	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Population size of the PSU	...	Less than 100,000, greater than or equal to 100,000 to less than 250,000, greater than or equal to 250,000 to less than 1,000,000, greater than or equal to 1,000,000
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Race and Hispanic origin and income level of sampled person	...	Hispanic; non-Hispanic black; non-Hispanic Asian; non-Hispanic, other low income; non-Hispanic other, non-low income
Sex of household reference person	Male, female	...
Tract-level median age	...	First quartile, second, third, fourth
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
Urbanicity	Very large, urban, suburban, rural	...
Whether any children aged 0–17 years live in dwelling unit	...	Yes, no

... Category not applicable.

NOTES: SP is sampled person. HH is household. PSU is primary sampling unit.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

**Table VII. Variables used in forming nonresponse adjustment cells for weighting mobile examination center examination samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
0–5 years		
Home ownership	Own, rent, some other arrangement	...
Household composition	1 SP in household under age 16 years, more than 1 SP in household all under 16, more than 1 SP in household mixed ages	...
Household size	1–2, 3–4, 5–6, 7 or more	1–2, 3–4, 5–6, 7 or more
Number of sampled persons in household	...	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Population size of the PSU	...	Less than 100,000, greater than or equal to 100,000 to less than 250,000, greater than or equal to 250,000 to less than 1,000,000, greater than or equal to 1,000,000
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Race-Hispanic origin and income level of sampled person	...	Hispanic; non-Hispanic black; non-Hispanic Asian; non-Hispanic, other low income; non-Hispanic other, non-low income
Sex of sampled person	...	Male, female
Tract-level median age	...	First quartile, second, third, fourth
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population that is Asian alone or in combination	First quartile, second, third, fourth	First quartile, second, third, fourth
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
6–19 years		
Health-based state groups	...	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Highest education level of any person in the household	...	Less than high school, high school or GED, more than high school
Home ownership	Own, rent, some other arrangement	...
Household composition	1 SP in household under age 16 years, 1 SP in household over 16, more than 1 SP in household all under 16, more than 1 SP in household all over 16, more than 1 SP in household mixed ages	1 SP in household under age 16 years, 1 SP in household over 16, more than 1 SP in household all under 16, more than 1 SP in household all over 16, more than 1 SP in household mixed ages
Household size	1–4, 5–6, 7 or more	...
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Sex of household reference person	Male, female	...
Tract-level median income (by quartile)	First quartile, second, third, fourth	...
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population born in the United States	First quartile, second, third, fourth	...
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
Urbanicity	Very large, urban, suburban, rural	...

See footnotes at end of table.

**Table VII. Variables used in forming nonresponse adjustment cells for weighting mobile examination center examination samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018—Con.**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
20–39 years		
Census region	...	Northeast, Midwest, South, West
Education level of the sampled person	...	Less than high school, high school or GED, more than high school
Highest education level of any person in the household	...	Less than high school, high school or GED, more than high school
Home ownership	Own, rent, some other arrangement	...
Household composition	1 SP in household at least aged 16 years, more than 1 SP in household all at least 16, more than 1 SP in household mixed ages	...
Household size	1–2, 3–4, 5–6, 7 or more	...
Number of sampled persons in household	...	1, 2, 3, 4, 5, 6, 7, 8, 9 or more
Population size of the PSU	...	Less than 100,000, greater than or equal to 100,000 to less than 250,000, greater than or equal to 250,000 to less than 1,000,000, greater than or equal to 1,000,000
Race and Hispanic origin of household reference person	...	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other
Sampled person perceived health status	Good, not good	...
Self-reported height and weight indicated sampled person was overweight	...	Yes, no
Sex of household reference person	Male, female	...
Sex of sampled person	...	Male, female
Tract-level median age	First quartile, second, third, fourth	...
Tract-level median income (by quintile)	...	First quintile, second, third, fourth, fifth
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population born in the United States	First quartile, second, third, fourth	...
40–59 years		
Census region	...	Northeast, Midwest, South, West
Education level of the sampled person	...	Less than high school, high school or GED, more than high school
Health-based state groups	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Highest education level of any person in the household	High school or less, more than high school	...
Home ownership	Own, rent, some other arrangement	...
Household size	...	1–2, 3–4, 5–6, 7 or more
Whether any children aged 0–17 years live in household	Yes, no	...
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Sampled person perceived health status	...	Excellent, very good or good, fair or poor
Sex of sampled person	...	Male, female
Tract-level median age	First quartile, second, third, fourth	...
Tract-level percentage of the population born in the United States	First quartile, second, third, fourth	...
Tract-level percentage of the population with no health insurance	...	First quartile, second, third, fourth
See footnotes at end of table.		

**Table VII. Variables used in forming nonresponse adjustment cells for weighting mobile examination center examination samples: National Health and Nutrition Examination Survey, 2015–2016 and 2017–2018—Con.**

Variables considered for nonresponse, by age group	Categories of variables cross-classified to form nonresponse adjustment cells	
	2015–2016	2017–2018
60 years and over		
Activity status of the respondent	Yes, no	...
Census region	...	Northeast, Midwest, South, West
Health-based state groups	...	Healthiest states, 2nd healthiest, 3rd healthiest, least healthy
Highest education level of any person in the household	Less than high school, high school, more than high school	Less than high school, high school or GED, more than high school
Household composition	1 SP in household at least aged 16 years, more than 1 SP in household all at least 16, more than 1 SP in household mixed ages	1 SP in household at least aged 16 years, more than 1 SP in household all at least 16, more than 1 SP in household mixed ages
Race and Hispanic origin of sampled person	Hispanic, non-Hispanic black, non-Hispanic Asian, non-Hispanic other	...
Sampled person perceived health status	Good, not good	Excellent, very good or good, fair or poor
Self-reported height and weight indicated sampled person was overweight	...	Yes, no
Tract-level median age	First quartile, second, third, fourth	...
Tract-level median income (by quartile)	First quartile, second, third, fourth	...
Tract-level percentage of the population aged 25 years and over with a college education or higher	First quartile, second, third, fourth	...
Tract-level percentage of the population aged 18 years and over with a disability	...	First quartile, second, third, fourth
Tract-level percentage of the population that is Asian	...	First quartile, second, third, fourth
Urbanicity	Very large, urban, suburban, rural	...

... Category not applicable.

NOTES: SP is sample person. PSU is primary sampling unit.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

**Table VIII. Most common survey sample weights and their appropriate use: National Health and Nutrition Examination Survey, 2015–2018**

Sample weight	Application	Notes
Full sample		
Interview weights (WTINT2YR)	Use when analyzing data from the home interview only. Do not use if the analysis includes variables that were also collected on examined persons in the MEC.	...
Examination weights (WTMEC2YR)	Use when analyzing data from the MEC examination. Do not use if the analysis includes variables collected as part of one of the dietary interviews or part of one of the subsamples (e.g., fasting or environmental).	...
Dietary Day 1 sample weights (WTDRD1)	Use when analyzing data from sample with completed Day 1 24-hour dietary recall or the Flexible Consumer Behavior Survey telephone follow-up module.	Instead of adjusting for race and Hispanic origin-age-day of the week (weekdays, Fridays, Saturdays, and Sundays) where totals are aligned for each of the 48 cells defined by the full crosstabulation of these factors, as done in NHANES 2013–2014, NHANES 2015–2016, and NHANES 2017–2018, Day 1 dietary weights were marginally calibrated to race and Hispanic origin, age group, sex, and four categories of day of the week, where the best adjustment was determined by aligning population totals for each variable separately using an iterative method.
Dietary Day 1 and Day 2 completed sample (WTDR2D)	Use when analyzing data from the smaller sample with 2 days of completed 24-hour dietary recall.	Dietary 2-day sample weights were marginally calibrated to race and Hispanic origin, age group, sex, and Day 1 and 2 day weekday-weekend categories.
One-half subsample		
Blood metals subsample weights (WTSH2YR)	Use when analyzing blood lead, cadmium, total mercury, selenium, and manganese, etc.	Blood metals one-half subsample weights are only for 12 years and over in 2015–2016. MEC weights should be used for children aged 1–11 years in 2015–2016 and all ages in 2017–2018.
Fasting subsample weights (WTSF2YR)	Use when analyzing the plasma fasting glucose, insulin levels, triglycerides, and low-density lipoprotein cholesterol (lipids) only for examined persons assigned to and meeting the criteria for the fasting subsample.	Fasting subsample weights are for participants aged 12 years and over who were examined in a morning session and fasted 8–23 hours. Diagnosed diabetes is a separate poststratification category (to the interview weights).
Folates subsample weights (WTSF2YR)	Use when analyzing whole blood folate and serum total folate.	Folates subsample weights are for participants aged 1 year and over who were MEC-examined in 2017–2018. MEC weights should be used for all ages in 2015–2016.
OGTT subsample weights (WTSOG2YR)	Use when analyzing only OGTT glucose levels or OGTT glucose levels with other data such as insulin or fasting levels for examined persons assigned to and meeting the criteria for the OGTT.	OGTT subsample weights are for participants aged 12 years and over who were examined in a morning session, fasted 9–23 hours, and had valid glucose test results, except for women stating that they were pregnant. Women stating that they were not pregnant, but who were later determined to be pregnant from the laboratory results, were eligible and are included. Diagnosed diabetics were not given the OGTT, but nonpregnant diagnosed diabetics are included in the OGTT file with a weight equal to their fasting weight. OGTT was discontinued in 2017–2018.
VOC subsample weights (WTSVOC2Y)	Use when analyzing data from VOC one-half laboratory subsample for examined persons assigned to and meeting the criteria for this subsample.	VOC subsample weights are for participants aged 12 years and over. For 2015–2016, WTSVOC2Y equals to WTSH2YR for participants 12 years and over.
VOC smoking weights (WTSVS2YR)	Use when analyzing the VOC smoking special sample.	VOC smoking weights are for participants in the VOC subsample plus current smokers. Current smokers were identified based on the smoking questions asked of all participants aged 18 years and over for 2015–2016. The VOC smoking special sample was discontinued in 2017–2018.

See footnotes at end of table.



**Table VIII. Most common survey sample weights and their appropriate use: National Health and Nutrition Examination Survey, 2015–2018—Con.**

Sample weight	Application	Notes
One-third subsample		
Environmental chemicals A weights (WTS2YR)	Use when analyzing data from the one-third laboratory environmental subsample A for examined persons assigned to and meeting the criteria for this subsample.	Environmental subsample A, B, and C weights are each for a one-third subsample of examined participants aged 6 years and over. Participants are assigned to one of the three mutually exclusive one-third environmental subsamples based on the sampling scheme. The analytes in each of the three subsamples are varied depending on what is included in the cycle. The names Subsample A, Subsample B, and Subsample C are for convenience and are not representative of any ordering. The proper subsample weights attached in the data set should be used to analyze the subsample. As the same analytes might be in different subsamples, it is important to check the weight.
Environmental chemicals B weights (WTSB2YR)	Use when analyzing data from the one-third laboratory environmental subsample B for examined persons assigned to and meeting the criteria for this subsample.	See Environmental chemicals A weights.
Environmental chemicals C weights (WTSC2YR)	Use when analyzing data from the one-third laboratory environmental subsample C for examined persons assigned to and meeting the criteria for this subsample.	See Environmental chemicals A weights.
Smoking weights (WTSFM)	Use when analyzing the smoking special sample.	These weights apply to the participants in environmental chemicals subsample A plus all examined adults who were current smokers. Current smokers were identified based on the smoking questions asked of all participants aged 18 years and over for 2015–2016. The smoking special sample was discontinued in 2017–2018.

... Category not applicable.

NOTES: MEC is mobile examination center. NHANES is National Health and Nutrition Examination Survey. OGTT is oral glucose tolerance test. VOC is volatile organic compound.

SOURCE: NCHS, National Health and Nutrition Examination Survey, 2015–2018.

# Vital and Health Statistics Series Descriptions

## Active Series

- Series 1. Programs and Collection Procedures**  
Reports describe the programs and data systems of the National Center for Health Statistics, and the data collection and survey methods used. Series 1 reports also include definitions, survey design, estimation, and other material necessary for understanding and analyzing the data.
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Reports present new statistical methodology including experimental tests of new survey methods, studies of vital and health statistics collection methods, new analytical techniques, objective evaluations of reliability of collected data, and contributions to statistical theory. Reports also include comparison of U.S. methodology with those of other countries.
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Reports present data analyses, epidemiological studies, and descriptive statistics based on national surveys and data systems. As of 2015, Series 3 includes reports that would have previously been published in Series 5, 10–15, and 20–23.

## Discontinued Series

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Reports contain findings of major committees concerned with vital and health statistics and documents. The last Series 4 report was published in 2002; these are now included in Series 2 or another appropriate series.
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