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Design and Estimation for the National Health Interview Survey, 2006–2015

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
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Data Evaluation and Methods Research

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

Hyattsville, Maryland
April 2014
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Preface

This report presents a detailed description of the sample design, and brief description of redesign research, performed for the National Health Interview Survey (NHIS) for 2006–2015.

NHIS is one of the major surveys sponsored by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). Through NHIS, information concerning the health of the U.S. civilian noninstitutionalized population is collected in household interviews throughout the United States. NHIS has been in continuous operation since July 1957, and its sample design has been reevaluated and modified following each of the last five decennial censuses of the U.S. population.

Overall responsibility for development of the NHIS redesign following the 2000 decennial census was carried out by the Survey Design Staff (SDS), now part of the Statistical Research and Survey Design Staff of the Office of Research and Methodology, in collaboration with the Division of Health Interview Survey. Statisticians and survey methodologists from SDS performed extensive research on various aspects of the redesign. Statisticians from the U.S. Census Bureau, which has been contracted by NCHS to field NHIS since its inception, were also involved with the redesign research. Trena Ezzati-Rice, formerly Chief of SDS, had primary responsibility for directing the 2006–2015 NHIS redesign research (1), which began in 1998.

Redesigning a survey as complex as NHIS was a major undertaking, and many persons contributed to this effort. Most of the persons who contributed to the redesign are named in the publications referenced at the end of this report.

This report is organized into four major sections providing different levels of detail about the NHIS design. The first section presents a general overview of NHIS and its sample design. The second section describes the redesign process and the new directions to be taken by NHIS during 2006–2015, and includes major research findings. The third section provides more detailed description of the sample design and how the sample was selected. The fourth section presents a description of the estimators used in NHIS for analyzing and summarizing survey results.

Abstract

Objectives

This report presents an overview, a detailed description of the sample design features, and estimation structures for the 2006–2015 National Health Interview Survey (NHIS). It fulfills the same role for the current 2006–2015 NHIS design as NCHS Series 2, No. 130, "Design and Estimation for the National Health Interview Survey, 1995–2004" provided for the previous design, which was extended through 2005.

Methods

The 2006–2015 NHIS sample design uses cost-effective complex sampling techniques including stratification, clustering, and differential sampling rates to achieve several objectives, among them improved reliability of racial, ethnic, and geographical domains. This report describes these methods.

Results

This report presents operating characteristics of NHIS 2006–2015. The general sampling structure is presented, along with a discussion of weighting and variance estimation techniques. This report is intended for general users of NHIS data systems.

Keywords: sampling • weighting • nonresponse adjustment • variance estimation

Design and Estimation for the National Health Interview Survey, 2006–2015

by Van L. Parsons, Ph.D., and Chris Moriarity, Ph.D., National Center for Health Statistics; Kimball Jonas and Thomas F. Moore, U.S. Census Bureau; Karen E. Davis, Agency for Healthcare Research and Quality; and Linda Tompkins, National Center for Health Statistics

Overview of the National Health Interview Survey

The National Health Interview Survey (NHIS) is the nation's primary source of general health information for the resident civilian noninstitutionalized population. NHIS is sponsored by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). In accordance with NCHS specifications, the U.S. Census Bureau, under a contractual agreement, participates in the planning and collection of data for NHIS. NHIS has continuously collected data since July 1957. This continuous data collection has administrative, operational, and data quality advantages because fieldwork and data processing can be handled on a continuous basis with an experienced, stable staff.

Data from NHIS provide estimates of health indicators, health care utilization and access, and health-related behaviors for the U.S. resident civilian noninstitutionalized population. Summary reports and reports on special topics are prepared by the NCHS Division of Health Interview Statistics for publication in Series 10 of the *Vital and Health Statistics* report series, in other NCHS publications, in professional journal articles, and elsewhere. The NHIS Early Release Program, begun in 2001, provides several online analytic reports during each data collection year. Beginning in 2010, the NHIS Early Release Program also has made preliminary microdata files available to researchers via the NCHS Research Data Center.

NCHS releases NHIS public-use microdata files annually. The NHIS website at http://www.cdc.gov/nchs/nhis.htm is the main conduit for releasing public-use microdata and where all public-use microdata files for NHIS can be found.

NCHS supplies variance estimation information [pseudo-stratum, pseudo-primary sampling unit (PSU)] for the public-use microdata files to allow data users to compute direct estimates of sampling errors that are consistent with the complex survey design of NHIS. Public-use microdata files since 1980 contain this variance estimation information, and NCHS supplies auxiliary files with the information that can be linked to pre-1980 files. NCHS also supplies variance estimation guidance for users of software such as SUDAAN, Stata, SAS survey procedures, R, and SPSS.

NCHS withholds variables from NHIS public-use data files that could permit explicit or implicit identification of survey participants. One of the major risks underlying inadvertent participant identification is the inclusion of identifiers on public-use files that place respondents in small geographic areas (for example, census block, census block group, county, or state). Thus, variables identifying specific geographic areas smaller than one of the four census regions are withheld from the public-use files to protect participant confidentiality. Other variables are recoded to provide additional protection of participant confidentiality.

Sample Design and Basic Subsamples

NHIS is based on a stratified multistage sample design. The design's specific parameters, however, have changed over time; a new sample design is implemented following each decennial census.

The 2006–2015 NHIS has been designed to produce estimates for the nation, for each of the four census regions, and within census regions by areas determined by metropolitan and nonmetropolitan status. Although the 2006–2015 survey draws samples from all of the states and the District of Columbia, it is not designed to produce precise state-level estimates for every state.

For the 2006–2015 survey design, the NHIS sample was partitioned into a number of subsamples. First, the sample was partitioned into annual subsamples that are assigned for data collection each year from 2006 through 2015. Moreover, for survey administration, data collection, and processing, the NHIS annual sample was further assigned to four calendar quarters. The portion of the survey sample assigned to each calendar quarter of the year is a probability sample of the target population. For 2006–2010, the sample was assigned to individual weeks, and the definition of ''calendar quarter'' was set at 13 weeks. For 2006–2010, the portion of the survey sample assigned to each week also was a probability sample of the target population, although estimates based on weekly samples tend to be unstable. (Two reasons for the instability are a small sample size and the fact that each sample PSU represented in a quarterly sample is not necessarily represented in the weekly sample. This reduces the precision of variance estimators based on weekly samples.) Beginning in 2011, the smallest time interval for assignment, which constitutes a probability sample, was changed from 1 week to 1 month, and the definition of ''calendar quarter'' was changed from 13 weeks to 3 months.

The assignment of subsamples to specific data collection periods permits the NHIS sample to be used to obtain estimates for large population groups from a short period of data collection. Other measures sometimes can be obtained by accumulating the survey sample for longer periods of time, including more than 1 year.

Assignment of the NHIS sample to weekly or monthly and quarterly subsamples also has a number of operational and administrative benefits. For example, assigning weekly or monthly subsamples results in the field staff having a continuous workload, which enhances the quality of the resultant data.

Beginning with the 1985–1994 survey design, the annual NHIS samples have been partitioned into four panels (subsamples), each having approximately the same number of sample households and conceptually similar statistical features. Each panel can be considered a probability sample of the U.S. population. (Note that ''panels'' and ''calendar quarters'' are not the same; the set of four panels is a partition of the annual survey samples that encompasses the four calendar quarters.) The panels have several anticipated uses. They provide a mechanism to make large cuts in the survey sample size if sufficient funds are not available to support full-scale data collection. Because the sample is reused as a sampling frame for other surveys, the panels also provide a mechanism for NHIS to provide nonoverlapping samples for reuse as sampling frames for other studies. After the 2006–2015 survey design sample was selected, the new sample was partitioned into a new set of four panels. NCHS assigned each PSU to one or more panels (PSUs with large populations were assigned to either two or all four panels). When a PSU was assigned to more than one panel, Census Bureau staff partitioned the sample within that PSU among the panels to which the PSU had been assigned.

Data Collection Instruments

The NHIS data collection instrument for 1995 and 1996 was similar to the instrument used before 1995, because the last major revision of the instrument occurred in 1982. Another major revision of the instrument occurred in 1997. The data collection instruments for 1995 and 1996, and 1997 and beyond, are described in this section.

NHIS data collection is conducted by the Census Bureau under an interagency agreement with NCHS. NHIS interviewers are Census Bureau employees who receive extensive training and whose work is monitored through a quality assurance program. Data are collected from each family in the survey sample using a face-to-face interview. If a sampled household contains more than one family, most aspects of the interview are repeated for each family in the household.

For 1995 and 1996, the data collection instrument had three components: a basic health and demographic ''core'' questionnaire, a health condition list, and one or more supplemental questionnaires that addressed health topics of special public health interest. The core questionnaire consisted of a fixed set of health and sociodemographic questions. Additionally, each household was randomly assigned one of six condition lists. The core questionnaire and condition list responses were used to develop annual estimates of various health variables, including acute and chronic conditions, hospital stays, medical visits, and limitations of activities.

The supplemental questionnaires addressed health issues or topics identified as being of particular interest. From 1985 through 1994, these supplemental questionnaires on topics such as cancer control and cancer epidemiology, AIDS knowledge and awareness, and health promotion and disease prevention were administered to a randomly selected adult in each family of the survey sample. For several years in the early 1990s, the supplemental questionnaires on health insurance and access to health care were administered to the entire survey sample. In 1994 and 1995, NHIS included a supplement on disability that was administered to the entire sample. For the last few years prior to 1997, several supplements, such as ''Family Resources'' and ''Childhood Immunization,'' were included in the survey annually.

Prior to 1997, the basic strategy for data collection was for the interviewer to assemble all available household members aged 19 and over at a sample address. A knowledgeable adult could report for absent adults. In most cases, proxy reporting by a knowledgeable adult was used for persons under age 19, although persons aged 18 could report for themselves, and persons aged 17 could report for themselves under some circumstances. As part of the enumeration of each household in the survey sample, persons in an individual household were partitioned into separate families if multiple families were present. A separate core questionnaire was administered to members of each individual family in the household.

In 1996, NHIS began testing the use of computer-assisted personal interviewing (CAPI), which was based on a revised data collection instrument. Beginning in 1997, the survey switched to a CAPI system and a revised data collection instrument that was restructured and shortened to reduce respondent burden. Many of the questions formerly asked of all persons in the core questionnaire are now administered on a sample basis to a single sample adult per family, and to a single sample child per family (if the family contains children).

The 1997–present NHIS questionnaire has core questions and supplements. The core questions remain largely unchanged from year to year and allow for trends analysis and for data from more than 1 year to be pooled to increase sample size for analytic purposes. The core contains four major components: Household, Family, Sample Adult, and Sample Child.

The Household Core component collects limited demographic information on all of the individuals living in the interviewed household. The Family Core component verifies and collects additional demographic information on each member of each family in the household and collects data on topics including health status and limitations, injuries, health care access and utilization, health insurance, and income and assets. The Family Core component allows NHIS to serve as a sampling frame for additional integrated surveys as needed.

The Family Core component is administered in a manner similar to that of the core questionnaire prior to 1997. All adult members of the household aged 17 and over who are home at the time of interview are invited to participate and respond for themselves. For children and adults not at home or unable to respond for themselves during the interview, information is provided by a responsible adult family member (aged 18 or over) residing in the household.

From each family in NHIS, one adult (sample adult) and one child (sample child, if any children are present) are randomly selected, and information on each is collected with the Sample Adult Core and the Sample Child Core questionnaires. Because some health issues are different for children and adults, these two questionnaires differ on some items, but both collect basic information on health status, health care services, and health behaviors. For the Sample Adult Core component, the selected individual responds for himself or herself to the questions in this section (i.e., no proxy response is allowed, except when the person is unable to respond due to physical or mental condition). Information for the Sample Child Core component is obtained from a knowledgeable adult in the household.

Not all interviews are completed during the initial interviewer visit. If the interviewing cannot be completed via additional personal visits, telephone interviewing is used to complete portions of the interview not completed during the personal visit(s).

From 1997 through 2005, all eligible adults in a family had the same chance of being selected as the sample adult. A new feature of the 2006–2015 sample design is that adults aged 65 and over who are black, Hispanic, or Asian have an increased chance of being selected for the Sample Adult Core, compared with adults aged under 65 or 65 and over who are not black, Hispanic, or Asian.

Supplements to the core components are used to respond to new public health data needs as they arise. As with NHIS supplements prior to 1997, the questionnaires are sometimes fielded only once or are repeated over time. These questionnaires may be used to provide additional detail on a subject already covered in the core or on a different topic not covered in other parts of NHIS. The first supplement from the 1997–present questionnaire design was fielded in 1998 and focused on data needed to track the Healthy People 2000 and 2010 objectives. Other topics covered in the supplements are cancer screening, complementary and alternative medicine, children's mental health, and health care utilization. Supplements usually are sponsored by other federal agencies.

Reuse of Survey Sample

The 1996 Medical Expenditure Panel Survey (MEPS), sponsored by the Agency for Healthcare Research and Quality (AHRQ), was based on reusing a portion of the 1995 NHIS sample. Subsequent years of the MEPS are based on reuse of a portion of the previous year's NHIS sample.

Sample Redesign

Since its inception in July 1957, the NHIS sample has been redesigned following each decennial census of the population to accommodate changes in survey requirements and to take into account changes in the population and its distribution (2–6). For the 2006–2015 NHIS sample design implemented in 2006, NCHS conducted research on issues related to the sample design. See the section ''Redesigning NHIS'' for more details.

Although the main goals in the 2006–2015 NHIS sample design were improving the reliability of statistics for racial, ethnic, economic, and geographic domains, other issues also were addressed in the research. The results often led to conflicting sample allocations; that is, a sample allocation optimal for one type of domain would be far from ideal for another type of domain. The final sample allocation was a compromise between ideal allocations for the various domains.

The primary features of the 2006–2015 NHIS sample design implemented in January 2006 are:

1. *Use of an all-area sampling frame*—The 2006–2015 survey is based on an area sampling frame for housing units in place at the time of U.S. Census 2000. Each of the other current demographic surveys conducted by the Census Bureau (e.g., Current Population Survey and National Crime Victimization Survey) uses a combination of sampling frames. The combination consists of an address sampling frame (i.e., addresses compiled for the preceding decennial census) and an area sampling frame, where the address information is incomplete. The use of an all-area frame sample for NHIS permits NCHS to release the survey sample addresses to its contractors for additional data collection, and to AHRQ for MEPS. Census Bureau confidentiality constraints do not permit the release of addresses that were obtained through listings compiled for the preceding decennial census. For this reason, the NHIS survey sample has been based on an all-area sampling frame starting with the 1985–1994 sample design.

   In parts of the country where local governments issue building permits, the Census Bureau supplements the NHIS area sample with a sample of permits for residential housing units built after April 2000. In the rest of the country, units constructed after April 2000 are included in the area frame.
2. *State stratification*—The first-stage sampling strata almost always do not straddle state boundaries. This state stratification enhances the ability of the survey to make reliable state-level estimates for the largest states. The state stratification and the increase in the number of PSUs also will allow easier integration of a telephone survey within NHIS as a dual-frame survey to make reliable subnational estimates, if this type of integration is sought in the future.
3. *Oversampling of black, Hispanic, and Asian persons*—The sample design implemented in 2006 oversamples black, Hispanic, and Asian persons using two features. First, the Census Bureau selected a larger initial sample for NHIS than would otherwise be required. A subsample of the initial sample was selected for interviewing, with housing units in areas having higher concentrations of black, Hispanic, and Asian persons in U.S. Census 2000 being retained at higher rates. Second, all households in the subsample with one or more black, Hispanic, or Asian eligible (i.e., civilian) members were retained in the survey, and only a subsample of other households were retained. Determination of a household's race and ethnicity status was accomplished through administration of a brief screening interview. (The screening interview consists of the initial steps of the regular interview. After the household roster is determined, the decision is made to ''screen in'' or ''screen out.'')

   Approximate oversampling rates are 2:1 for Hispanic, black, and Asian persons. Note that oversampling of black persons and Hispanic persons was done during the 1995–2005 survey design. Oversampling of Asian persons is new to the current design.

   An overview of research for the NHIS 2006–2015 sample design follows in the section ''Redesigning NHIS.'' Additional detail on the NHIS 2006–2015 sample design is included in the section ''2006–2015 NHIS Sample Design.'' The section ''Design and Estimation Structures for 2006–2015 NHIS'' provides a detailed description of estimation procedures for the NHIS 2006–2015 sample design.

Redesigning NHIS

Objectives

The first step in designing any survey is to define its analytical objectives. In redesigning a survey that has been in continuous operation for more than 40 years, the task of defining objectives involves evaluating current objectives, identifying new objectives, assessing the feasibility of implementing the new objectives, and concluding with a final set of objectives. To develop a set of objectives for NHIS, the NCHS Office of Research and Methodology (ORM) requested input from both internal and external NCHS stakeholders. ORM formed a committee in 1998 to carry out and oversee the sample design research. The committee membership consisted primarily of NCHS personnel, along with several members from the Census Bureau and representatives from AHRQ. A memorandum of understanding for the redesign research was implemented between NCHS and the Census Bureau in 1999.

The objectives for the NHIS redesign are summarized as:

- To continue to produce descriptive statistics about the health and health-related parameters of the civilian noninstitutionalized population of the United States, and to monitor change in these variables over time. The basic variables of interest are extent and nature of illness, both acute (e.g., disability days and work loss) and chronic (e.g., limitation of activity); extent and nature of disability (acute and chronic); incidence and prevalence of acute and chronic morbidity; utilization of health care services; health care expenditures; utilization of health facilities and health resources; and other health-related variables.
- To implement a cost-neutral design for 2006–2015.
- To retain current precision levels (or better) for non-Hispanic black and Hispanic persons.

- To improve the precision of NHIS statistics for the Asian population.

These broad objectives were used as the primary criteria for redesigning NHIS.

Major Research Areas

Major design features and research areas for the NHIS redesign are listed in Table 1.

Research Results

The research investigations conducted for the major design features follow. The research was conducted by NCHS and Census Bureau staff.

Sampling frame

The research focus in this area quickly was limited to subcounty PSUs; decisions were made in 1999 not to pursue other areas. Subcounty PSUs were thought to have several possible research advantages, compared with PSUs formed at the county level or above, such as:

- Allowing the selection of more PSUs into the sample, improving precision of estimates and variance estimator stability.
- Making it easier to create PSUs of roughly equal size, reducing between-PSU variance.
- Possibly allowing more flexibility in the release of geographic information in public-use microdata.

The subcounty research team recognized that software would be required to implement subcounty PSU formation algorithms. Two existing software packages were identified as being potentially useful for the research: Statistics Canada's Generalized Area Delineation System (GArDS) package, and the Census Bureau's Stratification Search Program (SSP). The research team was not able to reach a satisfactory working arrangement with Statistics Canada to access GArDS. The SSP's focus was to use existing PSUs to create optimal sampling strata rather than to create PSUs, so additional enhancements would have been required before SSP would have been useful for the research. Thus, the research team decided to develop in-house software for the research.

The software developed during 1999–2000 implemented two main principles:

- Geographic contiguity
- Controls for population size (both maximum and minimum) and land area (maximum)

One important principle not implemented during this period was maximizing heterogeneity within PSU.

The following evaluation criteria were developed, but not implemented, during the active development period:

- Assessing the expected amount of demographic change over a 10-year period (required to develop PSU definition criteria that are robust over the entire sample design period).
- Developing a procedure to evaluate each prototype PSU set and compare it with other prototype PSU sets (required to fine-tune the PSU definition criteria).

Active development in this area of research ended in August 2000 due to insufficient resources.

The research showed that subcounty PSUs could be formed by an automated process, using building blocks such as census tracts, while meeting important criteria such as being contiguous. Although the focus of the research was to partition counties with large populations into subcounty PSUs, in principle the same algorithm, once fully developed, could also be employed to aggregate counties with sparse populations into multicounty PSUs with sufficient population size to support a decade of survey samples.

Within-PSU sampling

Density substrata were an important feature of the 1995–2005 NHIS sample design. The density substrata play an important role in oversampling race and ethnicity groups of special interest, such as black and Hispanic populations. A total of 20 different density substrata were defined, using 1990 census concentrations of black and Hispanic persons.

Density substratum definitions needed to be developed for the NHIS redesign that would continue to support the oversampling of non-Hispanic black and Hispanic persons, as well as support the oversampling of Asian persons.

The 1995–2005 density substrata were adequate to achieve these oversampling goals. However, certain features of the substrata were less than ideal:

- Empty substrata—No PSU contained blocks that fell into all 20 substrata. In most PSUs, only a few density substrata were nonempty. None of the PSUs selected into the sample contained any blocks that represented substratum 20.
- Lack of robustness over time—As predicted in Chapter 18 of NCHS report Series 2, No. 126 (7), and confirmed by internal research carried out in 2001, 2006, and 2007, the race and ethnicity composition of the density substrata drifted substantially during the sample design period, making the substrata less efficient over time in meeting the oversampling goals.

Two separate groups conducted active research on density substratum definitions. One group used a model-based approach for its research. The other group used 2000 census data and conducted simulations for its research. Trena Ezzati-Rice, former Chief of the Survey Design Staff at NCHS, decided in 2002 that the model-based group would specify the density substratum definitions for the 2006–2015 sample design. The findings of the model-based group appear in Parsons et al. (8).

The model-based group's density substratum definitions varied from PSU to PSU and were defined using a subjective manual process. The other group's structure began as a fixed number of substrata with consistent definitions in all PSUs, and then was collapsed by an automated process in each PSU as necessary to eliminate empty substrata.

Both groups concluded that it was worthwhile to include the Asian population in the density substratum definitions.

Neither group conducted research on methods explicitly designed to enhance robustness over time, although both groups' methods achieved a related goal: eliminating empty substrata within each sample PSU.

Oversampling small subdomains

One objective that NHIS has continuously emphasized has been publication of detailed descriptive health statistics for the U.S. population. This is the rationale for having a cross-sectional sample design that can be accumulated from year to year. However, a number of small subdomains of the U.S. population are of special interest, because they are extremely important in analyzing health disparities within the population. Oversampling of black persons began with the 1985 NHIS; oversampling of Hispanic persons began with the 1995 NHIS. For the NHIS redesign, NCHS investigated ways in which the precision of estimates for Asian persons could be improved without too much loss of precision in other NHIS estimates, and without adding significantly to the cost of NHIS.

Internal research in 2001 examined details of the current precision level of subdomain estimates, with a focus on annual estimates of health characteristics with prevalence levels of 10% or more. The precision levels for non-Hispanic black and Hispanic persons were considered to be satisfactory. This was not true for Asian persons, however. For the three most populous Hispanic subgroups (Mexican, Puerto Rican, and Cuban), no precision levels were satisfactory using only 1 year of data. When combining 2 years of NHIS, the only group for which satisfactory estimates could be produced was the Mexican population. For the two most populous Asian subgroups (Chinese and Filipino), no precision levels were satisfactory using only 1 year of data, 2 combined years of data, or even 3 combined years of data.

Research to improve estimate precision for Asian persons led to several findings. The most important finding was that retaining Asian persons during the screening process (see subsection ''Overview of NHIS Sample Design'' in section ''2006–2015 NHIS Sample Design'') would increase the Asian sample size by 75% or more, and that this procedure could be implemented in a cost-neutral manner with little adverse impact on the precision of other NHIS estimates. Another research finding was that including the concentration of Asian persons in density substratum definitions could increase the Asian sample size, and that this could also be implemented in a way that the precision of other NHIS estimates would not be too adversely affected.

NCHS implemented a data use agreement with the Centers for Medicare & Medicaid Services in 2000 to obtain an enrollment file, to conduct research on the feasibility of using this type of resource as a supplemental sample frame of elderly minority persons. Internal research indicated this type of resource could serve as a supplemental frame, but several issues would have to be addressed to do so. Overlap was found between the enrollment file and NHIS sample persons. Thus, either unduplication would be needed or weights would have to be constructed to account for some persons having a chance to be selected from more than one sampling frame. In addition, the enrollment file contained institutionalized persons, who are not eligible for inclusion in NHIS. Thus, either attempts would have to be made to remove institutionalized persons from the file, or allowance would have to be made for some sample persons from the supplemental source being declared out of scope. The enrollment file also contained some race and ethnicity information that appeared to be inconsistent with NHIS, making the file less efficient as a supplemental frame for selecting elderly persons from a specific subdomain.

Two methods were considered for increasing the number of minority elderly persons to be the sample adult:

1. Select multiple sample adults when minority elderly persons were present.
2. Give elderly minority persons a higher probability of selection.

Early research findings indicated that increasing the probability of selection would increase sample yield adequately, while not requiring a change in the NHIS sample adult protocol to interview multiple persons in some instances. Later findings determined that doubling the probability of selection was a robust choice.

Survey cost

A sophisticated model for survey cost could not be developed due to the lack of credible information that would have been necessary to support such a model. A key survey cost parameter—the cost of a screening interview relative to a full interview—remained undetermined. A simple model [Shimizu and Lan (9)] suggested that the parameter value was approximately 0.8—much higher than one-third, the assumed value for the 1995–2005 design (7).

Decisions on Sample Design

The research results provided useful information for a number of decisions for the 2006–2015 sample design, as shown in the following subsections.

PSU definition

The PSU definitions remained essentially the same. The option of selecting groups of three noncertainty sample PSUs into the sample as a group, and rotating the annual NHIS sample on a 3-year cycle in the group, was dropped in 1999. Resources were not available to conduct sufficient research to consider the possibility of subcounty PSUs in counties with large populations. Research on subcounty PSUs ended in 2000.

Explicit state-level stratification was continued.

PSU selection

The methodology used for selecting PSUs in noncertainty strata was similar to the 1985 and 1995 procedures. In noncertainty strata, pre-2000 census population estimates determined a measure of size for each universe PSU. In strata where two PSUs were selected, NCHS selected two PSUs without replacement using the Durbin method. No attempt was made to maximize or minimize overlap of selected PSUs with the PSUs selected for the 1995–2005 NHIS design. In some small strata, only one sample PSU was selected with probability proportional to size.

Within-PSU sampling

Density substrata and screening were retained. Some of the density substrata included non-Hispanic Asian persons in the definition criteria.

Oversampling small domains

The Hispanic-Asian sample proportion was increased by retaining households containing them during the screening process. Additional gains in the non-Hispanic Asian sample were expected from density substratum definitions. No supplemental frames were used to oversample minority persons aged 65 and over. Minority persons aged 65 and over were given double the chance for selection as the sample adult, compared with adults who were under age 65 or not from a minority group.

Survey cost

The overall NHIS sample size was reduced by approximately 13% to meet the goal of trying to keep the NHIS survey cost constant.

Sample design decision memoranda chronology

Some sample design decisions were documented formally in internal memoranda, as follows:

August 1999: Do not consider linking to the American Community Survey; do not consider sharing PSUs with other surveys conducted by the Census Bureau; do not consider having rotating noncertainty sample PSUs.

November 1999: Do not require unduplication of sample addresses between NHIS and other surveys conducted by the Census Bureau.

March 2000: Do not consider expanding the sample to the military and incarcerated populations.

April 2000: Retain state-level stratification (the memorandum recommending relaxation of state-level stratification was rejected by the NCHS Director).

September 2000: Do not consider including Puerto Rico.

August 2001: Use independent sampling for NHIS PSUs, instead of a controlled selection methodology that would maximize the overlap of PSUs with the 1995–2005 design.

March 2002: Retain weekly samples.

June 2002: Increase the number of elderly minority persons selected to be the NHIS sample adult by giving them double the selection probability for other adults.

Once all of the major design features had been identified for NHIS, the specific parameters for the NHIS design had to be determined. This process is described in the following section.

2006–2015 NHIS Sample Design

The current NHIS sample design was implemented in 2006 and is scheduled to be used through 2015. NHIS is redesigned each decade to align the sample design with demographic shifts occurring in the U.S. population between two decennial censuses. This also creates an opportunity for further refinements based on new or modified objectives.

The basic design objectives for the 2006–2015 design are quite similar to those for the 1995–2005 NHIS [Botman et al. (2), Judkins et al. (7)], but the current design now also aims for reliable estimates of persons of Asian descent, even though funding constraints did not permit the same level of precision as is currently achieved for black and Hispanic persons. Additionally, estimates of black, Hispanic, and Asian persons aged 65 and over have been targeted for improved reliability over the past designs. The increased focus on minority populations dictated that additional sampling resources be directed toward areas with high minority concentrations at the expense of areas with low minority concentrations.

As in most previous designs, all 50 states and the District of Columbia are sampled (henceforth, the District of Columbia is referred to as a state for sampling purposes), although certain state-level estimates continue to be unreliable due to insufficient annual sample sizes. It may be possible in such states to combine the NHIS sample with other state surveys [for instance, the Behavioral Risk Factor Surveillance System (10)], depending on the statistic of interest. Starting in 2011, a state-level sample augmentation has been implemented in selected states. This augmentation will continue through 2015 if sufficient funding is available.

Oversampling areas with higher concentrations of minorities, along with screening households for minority occupants, resulted in the full sample having a higher proportion of sampled minorities than would be attained by an equal probability of selection method (EPSEM) [Kish (11)]. The computer hardware and software advances, along with the ease with which 2000 census information could be processed and shared, allowed for a more efficient implementation of the sampling methods than in the previous redesign.

In recent years, NCHS and the U.S. Census Bureau have become increasingly concerned about the confidentiality of survey data and design information that could be used to identify a respondent. Since 1997, NHIS has been releasing less design information on the public-use data sets than in previous releases, and frequently masking or omitting design identifiers that could lead to geographical disclosure. The following sections describe NHIS sampling procedures, but some details are omitted to minimize disclosure risk.

Overview of NHIS Sample Design

NHIS involves a multistage stratified sampling plan. Because data are collected via face-to-face interviewing, geographic clustering is essential for controlling the cost of field operations. The first stage of sampling is the selection of primary sampling units (PSUs) within each state. PSUs are counties or groups of contiguous counties. (The term ''county'' includes county equivalents such as parishes in Louisiana and independent cities in Virginia, Maryland, Missouri, and Nevada.) Outside of New England, metropolitan statistical areas (MSAs), defined at the county level, were used in PSU construction. Because work on the 2006 NHIS design was begun before the 2003 metropolitan area definitions were published, June 1999 definitions were used. At the time the PSUs were being created, metropolitan areas (MAs) were still defined at a subcounty level in New England, so New England County Metropolitan Areas (NECMAs), which were defined at the county level, were used as PSUs instead of MAs. Some of the PSU county components were changed from the 1995–2005 NHIS definitions. The universe of PSUs was partitioned into state-level strata. Large population PSUs were considered strata and sampled with certainty, while smaller PSUs were placed into strata from which one or two were sampled.

After PSUs were selected, U.S. Census 2000-defined blocks therein, which are exhaustive across the United States, were stratified by the 2000 census minority concentration status for implementing differential sampling rates. These stratified blocks were sampled using a systematic method based, in part, on each block's number of housing units (HUs) taken as a measure of size. These sampled blocks were consolidated to form secondary sampling units (SSUs). Each SSU is part of a *super-SSU*, consisting of 12 geographic clusters of an annual SSU sample, one for each year of the design. The design has the potential to cover a 12-year period, to allow for delays in implementation of the next design and other exigencies. Sampled blocks were constructed to form SSUs whose annual clusters might contain an expected 8, 12, or 16 sample HUs, depending on which minority stratum was being sampled. The actual count of housing units in a cluster varies, since the sampling was based on static 2000 census measures of size (MOS) for each block, rather than the updated Title 13-protected address list (Master Address File). To keep current with construction after April 1, 2000, the PSUs also had SSUs defined by a new construction building permit frame where available. In nonpermit-issuing areas, changes in the HU composition of each block were captured by listing prior to interview.

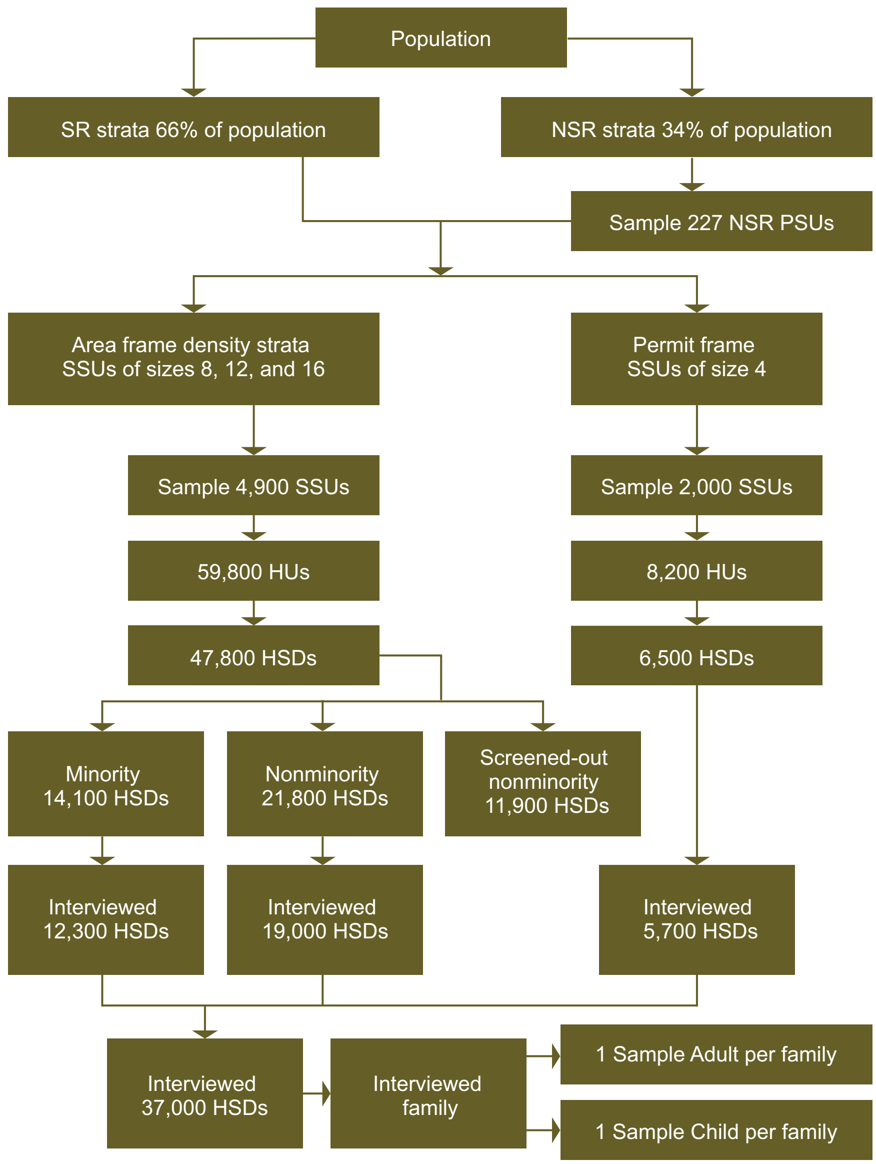
Each HU in the sample is randomly assigned, using different probabilities based on the HU's within-PSU minority substratum, to either *I* (interview) or *S* (screen) interview status prior to being sent to the field for interviewing. An *I* unit goes through the complete interview process. An *S* unit is screened for minorities: This unit completes the interview process only when a member of one of the three minority domains—black, Hispanic, or Asian—is present; otherwise, the interview is terminated. Note also that all permit frame sample cases are assigned to *I* status.

The complete interview process includes family, sample child (if children are present), and sample adult questions, where one adult and one child are randomly selected per family for the last two sets of questions. Black, Hispanic, or Asian adults aged 65 and over are targeted for oversampling as the sample adult to increase the sample sizes of those domains. A flowchart of the conceptual 2006–2015 NHIS sample appears in the Figure.

Tables 2 and 3 summarize details about the 2006–2015 NHIS design alongside previous designs, all the way back to when NHIS began in 1957. Some of the terms used in the table are defined in the glossary or are described later in this section.

Note that the term PSU refers to a geographical area designated for possible sample, but historically, different survey operations have referenced and defined PSU in different ways. For sampling specifications, the design PSU typically refers to a larger MA or possibly its components that were sampled with certainty, or to a county singleton or aggregate county geographical cluster that was sampled from a stratum. For field operations, the design PSU is partitioned into smaller administrative components called ''field PSUs.'' (For the current design, field PSUs are no longer used.) The structural components of design PSUs may be based on consolidated or nonconsolidated geography. For example, in the 1985–1994 design, the New York MA consisted of 12 counties but was labeled as one PSU. In recent designs, this MA was labeled as multiple PSUs. Counts of self-representing (SR) design PSUs can be very misleading when compared with nonself-representing (NSR) PSU counts. For example, based on Table 3, the ratio of NSR-to-SR PSU counts for the 1995–2005 NHIS is 2.77 (263/95), but the corresponding ratio of NSR-to-SR population or sample sizes would be closer to 0.56. Furthermore, the components of design PSUs also change over different design periods, and MAs have had their design PSUs designated with both consolidated and nonconsolidated labels. Given the noncomparability issues of the PSU units, comparisons of PSU counts both within and across design periods should be avoided.

The totals given in Tables 2 and 3 for designated HUs per year, screened households per year, interviewed households per year, and interviewed persons per year are all projections based on a full 52-week sample at the midpoint (year) of the design period. ''Designated housing units'' refers to the initial designation of HUs for interviewing, and includes vacant and other ineligible units and households where noninterviews occur (e.g., refusals). ''Screened'' refers to households where a successful interview has taken place up to the screening stage. ''Interviewed'' refers to households retained after screening (if applicable) where the interview process



NOTES: Values are by order of magnitude for the 2010 National Health Interview Survey (NHIS) and based on both realized and hypothesized characteristics for NHIS. SR is self-representing, NSR is non-self-representing, PSU is primary sampling unit, SSU is secondary sampling unit, HU is housing unit, and HSD is household; see Glossary at the end of this report for definitions.

SOURCE: CDC/NCHS, National Health Interview Survey, 2006–2015.

Figure. Conceptual sample allocation: National Health Interview Survey, 2006–2015

has been completed. Note that these definitions are not the same as those discussed previously when referring to the *S* and *I* unit statuses.

PSU Creation and Stratification

The three tasks that led to the PSU creation and selection were: 1) forming a county-based partition of the United States into a universe of PSUs, 2) stratifying the universe of PSUs, and 3) choosing a sampling procedure.

Given that the 2006–2015 NHIS design objectives were somewhat consistent with those of the 1995–2005 NHIS design, the existing 1995–2005 defined universe of PSUs offered a reasonable starting point for creating PSUs. Therefore, the 2006–2015 PSUs were created by fine-tuning the 1995–2005 PSUs. This saved substantial resources. Changing the definition of the primary area clusters from counties to a subcounty level (e.g., census tracts) had been discussed for the more populous counties. However, at least 65% of the U.S. population resides in MAs where the NHIS sampling was already based upon selecting HUs within stratified and sorted census-defined blocks, a finer defined level than a tract-based level. Any advantages to using a tract-based PSU definition would most likely occur in the nonmetropolitan areas of the nation. For these reasons, county-level PSU definitions were maintained.

The stratification objectives were similar for both design periods as well. The primary objective of the 2006–2015 NHIS design was to produce reliable minority subdomain statistics at the national level. A secondary objective was to produce state-level statistics. This secondary objective imposed the constraint of strict state stratification, which limits the flexibility in forming first-stage strata within a state.

Although objective quantitative methods were used, in part, to justify the first two tasks, personal judgment necessarily became a factor. The Census Bureau observes that,

> Although personal judgment can have no place in the actual selection of sample units (known probabilities of selection can be achieved only through a random selection process), there are a large number of ways in which a given population can be structured and arranged prior to sampling. Personal judgment legitimately plays an important role in devising an optimal arrangement; that is, one designed to minimize the variances of the sample estimates subject to cost constraints. [U.S. Census Bureau (12), p. 3–3]

While personal judgment was used to define the NHIS universe of PSUs and strata, randomly selecting the PSUs involved probability proportional to size (PPS) sampling strategies. The Durbin selection method (13) was used whenever a stratum supported the sampling of two PSUs.

One problem faced in redesigning NHIS was that the time frames for producing design specifications and release of the appropriate new decennial census files were not well-synchronized. The 2000 census county civilian noninstitutional population (CNP) tabulations were not released until fall 2001, and new Office of Management and Budget (OMB)-defined Core Based Statistical Area definitions based on U.S. Census 2000 were not completed until 2003. To allow sufficient time to meet project deadlines, a decision was made to use pre-2000 census estimates for first-stage stratification and PSU sampling, but to use 2000 census tabulations for the second-stage block stratification and MOS for higher orders of sampling. The idea of projecting the existing 1990 county CNP to 2010 was rejected because no production method existed for it, and projections 20 years out were considered to be too unreliable. Because of these limitations, NCHS staff used the pre-2000 census projections of county populations available in 2000 to define an MOS for first-stage PSU sampling. The census database CO-99–10.txt, ''Population Estimates for Counties: Race by Hispanic Origin Annual Time Series, July 1, 1990 to July 1, 1999'' (available from: https://www.census.gov/popest/data/counties/asrh/1990s/files/CO-99-10.txt) provided county MOS components for first-stage stratification and sampling. The within-PSU sampling used 2000 census CNP MOS.

Additional justifications for using this off-year target MOS are:

- The first-stage sampling covers only about 35% of the population.
- The base weight estimators are still unbiased but having some increased variation over those produced by a 2000 decennial-based CNP MOS.
- The first- and second-stage ratio adjustments on the base weights should serve to stem variance increases and adjust weights to the more accurate, known population totals.
- Sampling in advance for a 10-year survey cycle has been a procedure used by many surveys administered by the Census Bureau. For the 1995–2005 NHIS, the projected county CNP MOS was not a highly fine-tuned projection. In fact, projections missed the explosive Hispanic growth between 1990 and 2000.

Some concluding points regarding PSU definitions include:

- PSUs are single or combined contiguous counties (or equivalents) as defined by the Census Bureau's 1999 Federal Information Processing Standards (FIPS) definitions. As of July 1999, counties totaled 3,141.
- PSU component counties almost always do not cross state boundaries.
- With the exception of the New England PSUs, the PSU component counties have the 1999 MSA status as defined by OMB on June 30, 1999.
- For the 2006–2015 defined PSUs, most non-MSA PSUs correspond to the definition that was used in the early 1990s to define the 1995 NHIS universe PSUs.
- MSA PSUs from the 1995–2005 design were subject to change due to area growth in surrounding counties. In many such cases, a 2006–2015 defined PSU is the 1995–2005 defined PSU plus the expansion. During the previous redesign, cases occurred where some counties were projected to change from non-MSA to MSA status and aggregated as part of a larger 1995–2005 NHIS PSU. Those component cases for which the transition did not materialize (as of 1999) were removed from the 1995–2005 defined PSU.
- A few, relatively small-area and small-population ''orphan'' counties were combined with an adjacent PSU. In one situation, a multistate PSU was formed. This fine-tuning was carried out using personal judgment.
- A final universe of 1,842 PSUs was created by NCHS and approved by the Census Bureau.

Idealized PSU stratification and selection

Defining an efficient stratification of the PSU universe depends upon survey objectives, costs, and targeted precision, but the overall complexity of the objectives and costs make it difficult to stratify by a strict mathematical algorithm. NCHS staff's approach was instead to first consider NHIS in a somewhat idealized framework and then modify that structure to meet as many needs as possible given real-world constraints.

NCHS staff first defined a hypothetical all-purpose design structure that was somewhat consistent with the 1995–2005 design. Here, a static universe was hypothesized, based on pre-2000 census population estimates and about 70,000 HUs in the sample. To summarize:

1. The United States consists of 350 uniform strata, each with 780,000 persons.
2. Strata consist of three types:
    - Large-population contiguous MSAs that form SR strata from which SSUs are sampled.
    - Smaller MSA PSU areas that form NSR strata from which two PSUs are sampled, then SSUs sampled within PSUs.
    - Non-MSA PSU areas that form NSR strata from which two PSUs are sampled, then SSUs sampled within PSUs.
3. Each NSR PSU has 390,000 or fewer persons (less than one-half the stratum size).
4. Each stratum has roughly 18 sampled SSUs and 200 sampled HUs, which can be divided into nine field assignments. About two assignments would be made per quarter in a stratum, and each NSR PSU would have at least one assignment per quarter. This would provide a seasonal PSU balance and typical NSR PSU assignment workload.

The hypothetical structure would yield a sample with cluster sizes and costs in the same order of magnitude as the 1995 design and would appear to cover all national domains of interest. This structure served as the starting point in defining a stratification strategy for the 2006–2015 design.

Actual PSU stratification and selection

The coarsest level of stratum definition is the state level. This facilitates state-level estimation and was requested by the Office of the Center Director (OCD) at NCHS. Historically, MSA status has been regarded as a good low-level stratification variable. Large-population MSA PSUs with sizes greater than 780,000 persons were designated as SR strata, and small-population MSA PSUs and non-MSA PSUs were designated as NSR.

The NSR PSUs within each state were first partitioned into coarse MSA and non-MSA strata, based on the 1999 OMB MSA definitions (except in New England, where the NECMA definitions were used). Within each state, these two coarse MSA and non-MSA strata were further stratified by using a principal component analysis based on the 1999 projections of PSU minority demographics, poverty, median income, and population size. Additional stratification emphasis was placed on avoiding large NSR PSU size variability, which can potentially increase between-PSU sampling variability. A requirement for national stratification to start at the state level resulted in very little flexibility to partition the universe PSUs by characteristics. In fact, in only eight states could the coarse MSA and non-MSA stratum be further partitioned into four or more final strata. One or two PSUs were to be selected from each more finely defined NSR stratum. The highly variable sizes of states and PSU components within states required flexible definitions of size-cuts for large SR strata and sizes for NSR strata. Personal judgments were essential to fine-tune the stratification.

The stratification design parameters have changed somewhat with each redesigned NHIS. Table 4 summarizes those changes from design periods between 1973 and 2006.

The 1973–1984 design used a subsample of the Current Population Survey (CPS) sample PSUs, and the Census Bureau's list frame was used as the basis for the household sample. The 1985–1994 design was the first NHIS to use an area sample frame. No state-level estimation objectives were developed, and areas of concentrated black populations were targeted for oversampling but screening was not used. The 1995–2005 design targeted states, black populations, and Hispanic populations as domains of interest and implemented a screening process to increase the number of black and Hispanic persons sampled.

For the 2006–2015 design, NCHS staff used a first-stage structure similar to that used in the 1973–1984 and 1995–2005 designs—that is, the design has a large MSA SR stratum component along with geographically focused NSR strata resulting in many sampled NSR PSUs. Some additional rationales for this structure are:

- The large SR MSA strata, which contain the major metropolitan areas of the nation, are best thought of as coarse strata having a block-based PSU structure. Estimators for SR strata tend to have smaller variances than those for NSR strata, because no between-PSU component of variance exists.
- The large MSA strata contain much greater concentrations of black, Hispanic, and Asian persons than the complementary strata. These SR strata support efficient design-based variance estimation strategies, unlike the NSR strata.
- Field sampling costs in these MSA areas should be less than those of a typical NSR PSU [Shimizu and Lan, 2001 (9)]. Additionally, sample expansions or deletions may prove more manageable in this component than in the rest of the nation.
- This first-stage structure provides a more diverse rural sample than would a design having features of, for example, the 1985–1994 period. Having more distinct non-MSA geographical areas should improve the efficiency of both state and rural estimation.
- Modern model-based methods for small-area estimation should benefit from having an NHIS that has a geographically dispersed sample.
- The 1995–2005 and 1985–1994 designs were cost-neutral. Funding for a 2006–2015 design with similar first-stage structures as occurred in 1995–2005 should then be feasible, given constant funding. Because the Census Bureau performs continuous face-to-face interviewing across the nation for other surveys, added cost is marginal for a more dispersed data collection assignment.

In the past, in many of the large MSA areas such as New York City and Los Angeles, the MSA's component PSUs were consolidated under a common label (e.g., the New York metropolitan PSU). For the current design, the smaller PSUs that comprise the large MSAs are kept intact without consolidation. These component PSUs are defined at the state level and sampled as SR strata. The counts of SR PSUs in this report reflect this nonconsolidated definitional feature, while SR counts in earlier documents reflect a consolidated definition. This artificial definition makes the historical SR PSU counts in Tables 2 and 3 incomparable. For example, for the most part, the respective SR PSU counts of 358 and 428 for the 1995–2005 and 2006–2015 designs, respectively, reflect the definitional change.

Within most NSR strata, two PSUs were selected without replacement with probability proportional to pre-2000 census PSU population size, using Durbin's procedure (13). In 19 NSR strata, however, only one PSU was selected with probability proportional to size for the sample. Table 5 breaks out sampling strata by sample PSU counts and select size characteristics.

Table 6 shows the distribution of the SR and NSR PSUs by census region.

Additional Details of PSU Definitions

Basic PSU components

For large-scale sample surveys, it is rare to implement basic sample rules without modifications for special circumstances. In the case of NHIS, to coordinate sampling with other ongoing surveys administered by the Census Bureau, some PSUs were partitioned. This occurred mainly within SR PSUs for the largest MAs that had components in several states, so they were broken into finer units called basic PSU components (BPCs) prior to selection of SSUs. BPCs are always defined within a single state and, thus, consistent with the required state-level stratification.

Rotating PSUs and crowded BPCs

Two infrequent situations—rotating PSUs and crowded BPCs—can occur where a sampled area may have an inadequate number of HUs to provide the targeted sample sizes over the decade.

A rotating PSU is a PSU that is too small to provide a decade's worth of sampling, so it is paired with a demographically similar PSU before PSU selection. The pair is treated as a single PSU for purposes of PSU sampling. If the pair is selected, one PSU provides the sample for part of the design period, and the other PSU is substituted for it during the latter part. NHIS currently has no rotating PSUs in the 2006–2015 design, although they were utilized in previous designs, including 1995–2005.

A crowded BPC is one with too little sample to provide a decade's worth of HUs for all demographic surveys in that BPC using normal sampling ratios. In such cases, the sampling ratios were reduced equally for all affected surveys to ameliorate the problem. Four PSUs in the NHIS sample were crowded with respect to old construction, but in all four cases, the crowding adjustment was small enough that an increase in the NHIS area frame subsampling rates sufficed to eliminate the need for any NHIS sample reduction.

Only one PSU in the NHIS sample was crowded with respect to the permit frame, but because no subsampling takes place in the permit frame, the crowding adjustment resulted in a 4% reduction in sample within that PSU. To adjust for this, the permit base weight for that PSU was increased by the inverse of the crowding factor.

Substratification Within PSUs

All geographical areas in the United States can be partitioned by the Census Bureau into well-defined blocks for which associated 2000 census demographic characteristics are available. To help meet the objective of an increased sample of black, Hispanic, and Asian populations, blocks were substratified within PSUs based on target minority concentrations, and then substratum-specific oversampling rules were applied. A more thorough description of the methodology appears in Parsons et al. (8). Only a broad description is given here.

The four main substratification objectives are:

1. Substratification should be PSU-specific.
2. Any defined substratum should support an NHIS sample and be somewhat consistent in demographic characteristics over time.
3. Stratification should be based on black, Hispanic, and Asian person concentrations at the block level.
4. Any substratum construction must be easy to implement by the Census Bureau.

For the previous 1995–2005 design, only the last two objectives were built into the methodology. The substrata had rigid definitions (e.g., black concentration between 30% and 60%, and Hispanic concentration between 5% and 10%), which were based on minority concentrations and easy to use. One negative consequence of this rigidity, however, was that many substrata had small expected sample sizes—frequently less than one—that could lead to one or zero sample SSUs. If a substratum has less than one expected SSU, then any realized blocks from these sparse substrata would be in SSUs with blocks having different substrata characteristics. As discussed in the ''SSU Selection'' section that follows, a sampled SSU is a cluster of HUs contained in an aggregation of blocks within a sorted list of universe blocks. An SSU can accommodate up to 12 years of potential NHIS sample. The status of the aggregate is determined by only one initially selected block, and base-weighting factors for the initial block are carried over to the aggregate. Thus, this step of the weighting process may be slightly imprecise.

Another issue is the degradation of SSU composition over time. Substrata with few universe blocks may noticeably change characteristics due to population mobility. While the entire weighting process still leads to unbiased estimation, the variability of the estimators may increase.

To mitigate these problems, substrata have flexible definitions in the 2006–2015 design. The PSU block universe consists of substrata that could be best described as one of four types of minority concentrations: *low*, *medium*, *high*, or *mixed*. The first three are characterized by concentration level along with a targeted low between-block variation, but mixed substrata have medium-to-high between-block variation. Each type is subsequently classified by (specific) minority composition. The high concentration substrata are classified as non-Hispanic black, Hispanic, or non-Hispanic Asian. The medium and mixed substrata are classified by the dominant minority group(s). The low substrata have, in general, low concentrations of all targeted minority groups. In all, classifications of substrata total 20. More details on substratification are in the later section ''Method for PSU Substratification.''

Tables 7 and 8 provide the nationwide distribution of minority concentrations within substrata, based on estimates from the 2000 decennial census. (Note that in Tables 7–9, several high concentration types have been consolidated; thus, only 16 substrata are listed.)

Reading down the rows in Table 7, the justification becomes apparent for the substratum type definition. For example, substratum 20, labeled *Medium–HBA*, has about 22% minority composition but no dominant minority—that is, Hispanic, non-Hispanic black, and non-Hispanic Asian compositions are approximately 8%, 7%, and 6%, respectively. In contrast, substratum 40, labeled *High–H*, has about 66% Hispanic composition. Table 8 shows where the minorities live across the different types of substrata. For example, more than 50% of the non-Hispanic black persons (about 57%) are concentrated in the two substrata labeled *High–B*, (about 30%) and *Mixed–B* (about 28%). The last column of Table 8 shows an estimated percent composition of the density substrata over the U.S. population as of year 2000.

In all PSUs, addresses corresponding to dwelling units built prior to April 1, 2000, are subject to sampling from these substrata. In areas where governmental units issue and maintain building permits, dwelling units built since April 1, 2000, are subject to sampling only from the list of building permits; therefore, if a dwelling unit built since April 1, 2000, is encountered in the area frame, the interview is terminated, and the unit is considered to be out of scope. (This rule does not appy to group quarters.) When the permit frame is used in a PSU, it is considered to be a distinct sampling substratum in that PSU, and all units constructed after April 1, 2000, are subject to sampling from that substratum. However, in areas that do not issue building permits, all dwelling units, regardless of when they were built, are subjected to sampling in the substrata of the area sample.

SSU Selection

Sampling parameters

Table 9 presents the baseline within-density substrata sampling parameters proposed with the assumption of no change in funding from the previous design and a hypothetical baseline self-weighting survey to achieve 47,000 interviewed households. NCHS staff also aimed to construct simple additive forms to analyze survey costs, but disentangling components of the overall cost has proven difficult because NHIS is just one of several ongoing data collection efforts conducted by Census Bureau field staff.

The methodology used in developing the sampling SSU parameters is outlined as follows:

1. Target population sizes included the expected number of HUs in year 2000 area frame plus projected new-construction permit frame HUs between the 2000 census and year 2010.
2. A self-weighting sampling interval of value 2331.02 was established as the baseline, because it was thought most likely to result in a cost-neutral design producing 47,000 interviews. Annual area clusters of size 8 and permit clusters of size 4 were assumed. For a self-weighting design, these cluster sizes would define a baseline structure somewhat consistent with past NHIS sampling experiences.
3. The hypothetical SSUs were clusters of HUs that were a multiple of four. These would have constant size within each density substratum but not necessarily across substrata.
4. Those areas outside the low-density substratum would have SSUs oversampled with respect to the baseline sampling interval, and those areas within the low-density substratum would have SSUs undersampled. This strategy would result in oversampling areas in which 85% of the minorities in the population live.

All oversampling and undersampling at the SSU level is expressed as a multiplicative factor, r_d, where d references a particular density substratum within a PSU. The within-density substratum SSU sampling weight can then be expressed as

$$SSU_d wt = 2331.02\, r_d \Pr(\text{PSU selection})$$

where $r_d < 1$ implies that SSUs are oversampled in density stratum d, and $r_d > 1$ implies that SSUs are undersampled.

The multiplicative factor Pr(PSU selection) applied to within-PSU sampling cancels out when the inverse of Pr(PSU selection) is used as a PSU weight inflation factor.

The multiplicative PSU $SSU_d wt$ is, thus, $2331.02\ r_d$.

The r_d factor is presented in Table 9. Originally, the permit frame was to have the same r_d factor as for the *low*-density stratum, but a slight oversampling was implemented.

5. After an SSU is sampled, all minority HUs are targeted for sampling, but only a subsample of the nonminority households is taken. This is based, in part, on a random allocation of the HUs to the *I* and *S* partitions discussed in the previous section ''Overview of NHIS Sample Design.'' Thus, the SSU sampling weight, $SSU_d wt$, is equal to the minority household sampling weight. The density stratum subsampling or retention rate, β_d, in column 3, Table 9, for the *I* partition becomes a reciprocal weighting factor for the nonminority households. Thus,

   $HSD_d wt = SSU_d wt$ for minority households

   $HSD_d wt = (SSU_d wt) / \beta_d$ for non-minority households

   These values are also presented in columns 5 and 6 of Table 9.

   To keep the nonminority component self-weighting, the value of β_d / r_d is fixed at 0.70 for the area frame density substrata.

6. Within PSUs, a total cost was considered proportional to a model having three major cost components:

   I = cost of a complete interview household with an *SSU*

   G = cost of a noncomplete interview household within an *SSU*

   T = cost of travel to an *SSU*

   A simple additive model for total cost is, thus,

   $$Cost = I \bullet n(HU_{ci}) + G \bullet [n(HU) - n(HU_{ci})] + T \bullet n(SSU)$$

   where

   $n(HU_{ci})$ = number of complete interview HUs in the sample

   $n(HU)$ = number of all HUs in the sample, regardless of status *n(SSU)* = number of SSUs in the sample

7. The theoretical variance of an estimator of total or linearized estimator of proportion can be decomposed into between-PSU components and within-PSU components of variance. The sample sizes for the numbers of *SSUs* and the numbers of HUs only contribute to the within-component of variance. Thus, treating the between-component of variance as having fixed magnitude and cost, the focus turns to cost-variance trade-offs resulting from changes in sample sizes of numbers of *SSUs* and numbers of HUs when applied to within-PSU sampling. Using the standard techniques of simple random sampling applied at several levels [Cochran (14)], along with an assumed intraclass correlation coefficient, ρ, formulas can be derived for the within-PSU variance of a domain proportion. The resulting variance can be written as an expression depending on density stratum size, *SSU* length within density stratum, oversampling parameters r_d, β_d, and *SSU* intraclass correlation, ρ. The variance can then be evaluated over hypothetical domains and assumed cost parameters *I*, *G*, and *T*. After examining the modeled variance and costs evaluated for numerous cases of sampling parameters, a set of final parameters was chosen as reasonably meeting the survey's objectives; this set is displayed in Table 9. However, cost reductions and sampling component changes required for data collection year 2006 required some modifications to the proposed sampling. Originally, 42,000 interviewed households were projected to be fielded in a full 52-week NHIS, but a reassessment based on 2006–2009 survey operations suggested that obtaining 37,000 interviewed households seemed more reasonable.

Example of within-substratum sampling rates

Consider SSU sampling within density substratum 30, Mixed HBA, for an SR PSU. Begin with the baseline self-weighting sampling interval of 2331.02. Per Table 9, this stratum has an oversampling factor, r_d, of approximately 0.5335. Multiplying 2331.02 by this oversampling factor produces a sampling interval of 1243.62. This is the inverse of the probability of SSU selection.

The nonminority retention rate, β_d, given in Table 9 for this substratum is 0.373456. This is the fraction of the sampled households in the stratum that are selected for the *I* status and that will therefore be interviewed regardless of the minority status of household members. Dividing the substratum sampling interval by β_d gives the nonminority sampling rate of 3330.03. The rest of the sampled households will have *S* status, with interviewing continuing only if at least one civilian member of the household is of a targeted minority.

SSU formation and sampling

Table 9 presents the within-PSU sampling in a structured, but somewhat conceptual, sense. In practice, the methodology for implementation is quite involved.

The ultimate sampling unit (USU) consists of a cluster containing an expected 4 HUs or equivalents. These clusters may be empty or include ineligible units (e.g., vacant HUs) at the time of interview. For cost and statistical efficiency, the expected number of HUs to be covered annually by screening and sampling within an SSU was planned to be 8, 12, or 16 HUs for the area frame substrata and 4 HUs for the permit frame substratum. For the area frame substrata, these *annual SSUs* were created by joining together 2–4 USUs of expected size 4. The actual number of units, however, may vary from the expected number, especially in PSUs where NHIS does not use a permit frame. Moreover, about 20% of the addresses in a national area frame sample do not include any persons eligible for the survey.

Each annual SSU within a substratum is actually part of a *super-SSU*, consisting of 12 annual SSUs. Again, one annual SSU is allocated to each of the 10 anticipated design years and 2 years' worth of reserves. No HU within a super-SSU can be in the sample more than once in a design period, even if the reserve sample is used.

The sampling process used to form the super-SSUs within the PSU substrata is outlined below, with the following simplifications:

A. Subsampling is described as *within-PSU*, rather than *within-BPC*.

B. The generic term *block* denotes single decennial census blocks, and *combined blocks* denotes the grouping of 2000 census blocks containing a small number of HUs with an adjacent block.

1. All of the blocks within a PSU's density substrata are sorted in a geographic order using 2000 census variables tract and block number. Each block is assigned an associated measure of size defined as the number of HUs enumerated in the 2000 census.
2. Each block contains an integer number of measures, with each measure containing about 4 HUs. The total number of measures varies among blocks, and the block is not partitioned into measures unless the block is actually sampled.
3. Using systematic sampling procedures, a sequence of *hit* measures is selected. Each hit defines the first measure in a super-SSU, the other measures being the next consecutive 23, 35, or 47 measures—to yield a total of 8, 12, or 16 expected HUs per year. The number of measures in the super-SSU varies by type of density substratum; it is the substratum's entry in the last column of Table 9, multiplied by 3. This last column in Table 9 gives the expected number of households in the

annual SSU; divide by 4 to get the number of measures in the annual SSU, and then multiply by 12 to get the measures in the super-SSU or, equivalently, just multiply by 3. At this stage of sampling, every measure has the same probability of being hit.

The sampling process could be characterized as a systematic sample of sets of super-SSUs or measures from a hypothetical universe listing. Explaining the complexities of the systematic sampling procedures actually used by the Census Bureau is beyond the scope of this report, but two possible conceptualizations of systematic sampling for either measures or super-SSUs can be made:

- A sampling interval SI_{mea} on a population M_{mea} of measures yields a sample of (M_{mea} / SI_{mea}) super-SSUs of size k measures each.
- Another possibility is a corresponding population of (annual or super-) SSUs of size $M_{SSU} = (M_{mea} / k)$. Here, a sampling interval of $SI_{SSU} = SI_{mea} / k$ on M_{SSU} yields the same sample size.

A representation of systematic sampling as a single sampling interval (SI) for either measures or SSUs will satisfy the following self-weighting criterion: For density substratum type j within PSU i sampled with probability π_i,

$\pi_i / SI_{SSU(j,i)}$ = a constant that depends only on j

where $SI_{(j,i)}$ is the sampling interval for density substratum type j within PSU i.

By the definition of a sampling interval, the conditional probability that a super-SSU is selected from substratum j, given that PSU i was selected, is either $1/SI_{SSU(j,i)}$ or $k/SI_{mea(j,i)}$, where k is the number of consecutive measures.

Thus, the unconditional probability that a super-SSU from substratum type j is in the sample is

$\pi_i \bullet [1/SI_{SSU(j,i)}]$

which simplifies to the inverse of the minority weight constant in the row of Table 9 that corresponds to substratum type j.

4. The annual SSUs within each selected super-SSU are constructed by combining every 2, 3, or 4 consecutive measures, depending upon classification of density substratum.
5. A ''declustering'' operation is performed on the sample. Because the purpose of this operation is to make it harder to identify units that are in the sample, it will not be discussed further in this report.

Example of SSU sampling

The following example illustrates the formation of super-SSUs as outlined in Steps 1–5 above (Table 10).

1. Let Blocks A–H represent 8 blocks in a PSU density substratum, listed in consecutive order as a result of sorting on selected characteristics. The column ''Housing Unit Count'' in Table 10 shows the 2000 census HU count for each block. A number is assigned to each HU in the block to illustrate how HUs would be assigned to different measures within the block.
2. The column ''Measure Count'' in Table 10 shows the number of measures each block contains. For example, Block B consists of 19 HUs that are partitioned into 5 measures.
3. Suppose that measure 2 in Block B is a *hit* (or sampled) measure from the population of measures. Starting with measure 2 in Block B, the super-SSU will include measures from Blocks B–G. If this substratum requires an expected 96 HUs for the 12-year NHIS design period (i.e., the expected annual SSU size is 8 HUs), then the next 23 measures plus the hit measure will be used to form the super-SSU.
4. A well-defined listing process partitions the selected Blocks B–G into the specified number of measures. The HUs within selected Blocks B–G are listed by some adjacent or neighbor order. (In this example, it is not necessary to list the HUs in Blocks A or H.) Assignment of the actual measure labels will look somewhat as presented in Table 10—that is, the first 6 adjacently listed HUs in Block B are initially assigned to measures 1,2,3,4,5,1, respectively. To form the annual SSUs, the 24 measures labeled (B,2) to (G,1) are consecutively paired. Thus, prior to declustering:

   SSU (year 1) = measures (B,2), (B,3)
   SSU (year 2) = measures (B,4), (B,5)
   SSU (year 3) = measures (C,1), (C,2)
   SSU (year 4) = measures (C,3), (C,4)
   SSU (year 5) = measures (D,1), (D,2)
   SSU (year 6) = measures (D,3), (D,4)
   SSU (year 7) = measures (D,5), (E,1)
   SSU (year 8) = measures (E,2), (E,3)
   SSU (year 9) = measures (E,4), (F,1)
   SSU (year 10) = measures (F,2), (F,3)
   SSU (year 11) = measures (F,4), (F,5)
   SSU (year 12) = measures (F,6), (G,1)

5. The declustering operation is performed.

Subsampling due to larger-than-expected SSU size

During the address listing operation that takes place prior to NHIS interviewing, a larger-than-expected number of HUs is sometimes identified in an SSU. If the NHIS address lister finds more than twice the number of expected units within an SSU, the lister subsamples the units. This causes an adjustment in the probability of sample selection for all units in that SSU.

Sometimes the NHIS interviewer encounters extra units at a sample address that were not identified during the listing operation. Often, when 3 or more additional units are identified, the interviewer subsamples one of the units. This causes an adjustment in the probability of sample selection for the particular unit that is selected. This type of subsampling is quite rare and carried out to maintain reasonable interviewer workloads.

Assignment of Screening Code

After an initial sample of HUs within an SSU is selected, an oversampling strategy that targets minorities is implemented. This procedure involves eliminating some sample households that do not contain any black, Hispanic, or Asian persons. First, screening codes are assigned to sample addresses, as described in this section. Then, the elimination is carried out using screening interviews, as described in the next section.

Prior to data collection, but after the address listing operation and SSU-level subsampling (if necessary) described above, some of the addresses from each SSU are randomly assigned a screening code of *I* (interview) by the Census Bureau. Others are assigned a screening code of *S* (screen). The proportion of addresses assigned to either *I* or *S* depends on the sampling substratum from which the SSU was drawn (refer to the ‘‘beta (retention)’’ column, Table 9). The *S* cases are spread out as much as possible within the SSU. As indicated in Table 9, all permit frame sample cases are assigned an *I* code.

The assignment of screening codes is automated, as it has been since 1997. A single sampling interval is used in each substratum, and integer-length sampling intervals are not needed.

Implementation of Sampling Rule

The interviewers conduct the usual NHIS basic health and demographic interview for every address that contains a household and has a screening code of *I*.

For every household found at addresses with a code of *S*, the interviewers conduct the NHIS screening interview by collecting the household roster and the race and ethnicity for each household member. If the *S* household contains one or more eligible black, Hispanic, or Asian persons, then the household is retained in the NHIS sample and the interviewer completes the remainder of the NHIS interview. If the *S* household does not contain any eligible black, Hispanic, or Asian persons, the reverse happens—the household is not retained in the NHIS sample, the interviewer does not complete the remainder of the NHIS interview, and the household is then coded as ‘‘screened out.’’

Because *I* and *S* codes are assigned prior to interviewing, discrepancies can occur between expected subsampling rates and actual subsampling rates. (Note that it is the expected sampling rate that is used in the sample weighting process.) For example, the addresses to which all of the *I* codes in an SSU are assigned could contain households, while the addresses to which all of the *S* codes in the SSU are assigned could be vacant HUs. In this case, no subsampling would occur in the SSU. Another situation that can occur is that all of the households in an SSU that do not contain any black, Hispanic, or Asian persons are assigned *I* codes; in this case, no subsampling would occur. Presumably, subsample fluctuations at the SSU level balance out over the entire sample.

Since 1997, information from neighbors has not been used for screening purposes. During 1995–1996, if a household proved difficult to contact, information was solicited from neighbors regarding the race and ethnicity of the household members to determine whether to continue attempts to interview a household with an *S* code.

Sampling of Persons Within Households

One sample adult and one sample child (if children under age 18 are present) are selected from each family residing in an NHIS sample household for administration of a large portion of the NHIS adult and child interviews. Most sample households contain only one family. The adults (aged 18 and over) are assigned within-family measure-of-size weights, with any black, Hispanic, or Asian persons aged 65 and over given a weight of 2 and all other adults given a weight of 1. Using these weights, one sample adult is selected by the field representative’s computer using an automated sampling system. The child is selected at random, and no differential sampling probabilities are applied to the children.

For example, if the adults in a household consist of a 68-year-old non-Hispanic white person and black persons aged 71, 32, and 28, then the 71-year-old black person would be given a weight of 2, and the three other adult members of the household would each be given weights of 1. The 71-year-old black person would have a 2/5 likelihood of being selected as the sample adult, and each of the other adults in the household would have a 1/5 likelihood of being selected.

Logistics and Special Sampling Scenarios

Panels

Since 1985, the NHIS sample has been partitioned into four self-representing subdesigns, referred to as *panels*. The four panels have identical marginal sampling properties; in particular, each is able to produce unbiased population estimates. Each panel has roughly the same interviewer workload. Each NSR PSU is assigned to only one panel.

The primary objective for creating NHIS subdesigns is a contingency to handle potential budget cuts. Large sample reductions can be made, if necessary, by dropping one or more panels, either on a quarterly basis or for the entire year’s data collection. This is much more practical and cost-efficient than dropping weeks of interviewing or dropping randomly chosen finer-level sample units. The secondary objective was to provide a subsample that could be used as a sampling frame for any smaller survey linked to NHIS. For instance, the Medical Expenditure Panel Survey (MEPS) sampling frame is derived from two NHIS panels. Note that in MEPS, ‘‘panel’’ is used as a longitudinal data descriptor rather than for referencing a subdesign.

For the design of the panels, the original first-stage NHIS sampling strata were collapsed within region into super-strata by similarity of SR and NSR status, stratum size, geography, U.S. Census 2000 race and ethnicity characteristics, and MSA or non-MSA status using the June 1999 definitions. Each super-stratum was designed to hold four panels. The definitions of the super-strata were deterministic, in that sampled PSUs were not used in defining these super-strata.

The original NSR strata were collapsed with other similar NSR strata, while the SR strata were first designated as *large*, *medium*, or *small*. In general, SR strata with populations greater than 3 million were designated as large, between 1.5 million and 3 million as medium, and less than 1.5 million as small. Large SR strata were considered a self-contained super-stratum, and four panels were created by randomly partitioning the work assignments. On the other hand, medium SR strata were partitioned into two panels, and small SR strata formed a single panel. These small and medium strata were then collapsed into super-strata containing a total of four panels.

In the end, each super-stratum had its sample designated with panel codes 1–4. Codes were assigned such that panel pairs (1,4), (2,3), (1,3), or (2,4) would capture one sample PSU from any original NSR stratum containing two sampled PSUs. For the 2006–2015 design, panel codes 1 and 4 were assigned to MEPS.

During the 2006–2015 sample design period, several budget-driven decisions were made to temporarily drop panels. For example, the sample associated with panels 2 and 3 was not fielded in quarter 3 for both 2006 and 2007, and further not fielded during quarter 4 of 2008 and quarter 1 of 2009. (The two panels cut in quarter 1 of 2009 were reinstated in quarter 4 of 2009.)

Interviewer assignments

NHIS sample areas have been divided into 299 assignment areas of one or more counties. The areas were defined by the Census Bureau's Field Division. Generally, a single interviewer is assigned to an assignment area, although larger assignment areas require several interviewers. NHIS sample SSUs for each quarter were divided into approximately 920 weekly interviewer assignments as part of the input to the balancing procedure. Interviewers had an anticipated workload of 10–12 completed interviews per week. When possible, SSUs were grouped such that weekly interviewer assignments were contained within the same county to minimize travel costs. But when the workload was not sufficient within one county, SSUs from adjacent counties were drawn in.

Balancing the sample

The balancing described at the beginning of this section applies to the 2006–2010 period, when interviewer assignments were weekly.

For operational reasons, the specific weeks in which each interviewer receives an assignment should be as evenly spaced throughout all 52 weeks of the year, not just within the 13 weeks of each quarter. Because some assignment areas had more than 13 weekly interviewer assignments and more than one interviewer, the weekly interviewer assignments in each assignment area were distributed evenly among the interviewers and weeks in the year.

For estimation purposes, the weekly interviewer assignments were distributed among the 13 weeks in a quarter so that the variation among the weeks in the number of measures and number of expected completed interviews was minimized across the following dimensions:

- Census Regional Office (12 in the United States, but reduced to 6 by 2013).
- Census region (Northeast, Midwest, South, and West).
- Census region and the total United States by type of PSU, SR compared with NSR.
- Census region and the total United States by the geographic categories C, B, U, R (where C is the central cities of an MA, B is the urbanized area not in category C, U is the urban places not in an urbanized area and not in category C, and R is all other areas) and by new construction.

The Census Bureau has used in-house software to balance the sample within these operational and estimation constraints.

In 2011, NHIS began fielding its assignments on a monthly, rather than a weekly, basis. As part of the transition from weekly to monthly assignments, the workload was freshly balanced in the manner described, but over the 3 months in each quarter rather than over the 13 weeks in each quarter. The methods used for monthly balancing should allow NHIS to produce unbiased monthly estimates for major statistics.

Sampling from permit frame

The proportion of the overall NHIS sample selected from the permit frame is about 6% at the beginning of the anticipated 10-year design cycle and increases by about 1% each year thereafter. Hypothetical measures are selected during within-PSU sampling in anticipation of the construction of new HUs. Identifying the addresses for these permit measures involves a listing operation conducted at building permit offices, clustering addresses to form measures, and associating those addresses with the hypothetical measures in the sample.

The Census Bureau conducts the Building Permit Survey, which collects information monthly from all permit offices in the United States about the number of HUs authorized to be built. The survey results are converted to measures with an expected size of four HUs. These measures are continuously accumulated and linked with the frame of hypothetical measures used to select the NHIS sample. This linking identifies which building permit offices contain measures that are in the sample.

Field representatives then visit the permit offices to obtain address lists of units authorized to be built, which are used to identify the sample units. To the extent possible, sample units are grouped geographically. Permit sampling will be discontinued in 2016.

Group quarters

Noninstitutional nonmilitary group quarters such as college dormitories contain persons eligible for inclusion in NHIS. The sampling of group quarters is done exclusively from the area frame; any group quarters encountered among permit frame sample cases are considered out of scope. Group quarters encountered in the area frame are retained in the NHIS sample regardless of when they were built. If a group quarters unit is encountered during the address listing operation that takes place prior to NHIS interviewing, the lister uses reference materials to determine whether the group quarters unit is noninstitutional and nonmilitary. If so, it is included in the address list; otherwise, it is excluded. The within-group quarters sampling procedures are conducted in a fashion similar to those used in a traditional HU area. Before the first interviews at a group-quarters address can be conducted, a field representative visits the group quarters to establish a list of eligible units (e.g., rooms, beds, or persons). A systematic sampling pattern is applied to the listing to identify the persons to be interviewed. In the 2000 census, less than 3% of the target population resided in group quarters.

Method for PSU Substratification

This section outlines the method used to define the PSU substratification. For each PSU, let p_B, p_H, p_A be the block proportions for the targeted minorities non-Hispanic black, Hispanic, and non-Hispanic Asian persons, respectively, and let $p_M = p_B + p_H + p_A$ be the total minority proportion within the block.

The following procedures are applied:

1. Conceptually, for each PSU, the blocks are partitioned by minority concentration, as in:
   PSU block universe ={low concentration blocks] + {high concentration blocks} + {residual blocks}
   More specifically, using the notation$\{p_D \geq d_1\}$ to denote the set of blocks for which $p_D \geq d_1$, where *D* is one of the domains and d_1 a threshold, the PSU block partition above is expressed generically as
   PSU block universe = $\{p_M \leq m_l\}$ U $\{p_B \geq b_l\}$ U $\{p_H \geq h_l\}$ U $\{p_A \geq a_l\}$ U {residual blocks}
   where the cut points m_1, b_1, h_1, and a_1 are defined to create mutually exclusive sets.

2. To identify blocks with the highest concentrations of specific targeted minorities, threshold cut points greater than 0.50 for the sets $\{p_B \geq b_l\}$, $\{p_H \geq h_l\}$, and $\{p_A \geq a_l\}$ were examined to determine whether such a threshold would produce a substratum having the number of sampled SSUs, *NSSU*, satisfying expected count, E(*NSSU*) ≥ 3. At this stage of the redesign work, NCHS staff used a baseline cost-neutral assumption and an SSU size of 8 expected HUs to establish coarse estimates of E(*NSSU*) on potential substrata. It was felt that these assumptions would provide very good SSU sample-size estimates for a self-weighting sample, and be within 25% of the potential sample sizes achieved by the differential-rate sampling rules to be considered. If the threshold satisfied the sample size requirement, then those blocks were designed as a pre-substratum as long as the residual also satisfied E(*NSSU*) ≥ 3. For a large majority of PSUs, these ''extremely high'' concentration blocks did not have sufficient numbers to support sampling. In these cases, the individual domain target criteria were dropped and the universe partition reduced to PSU block universe = $\{p_M \leq m_1\}$ U{residual blocks}. The m_1 value was typically started in the range of 0.10 to 0.15. The decision rule was based upon magnitudes of E(*NSSU*) and the between-block variation discussed in item 3 below. For many low-minority population PSUs, this process often led to no partitioning of the PSU (i.e., the PSU itself had one substratum).

3. A major goal of the substratification was to target blocks for minority oversampling. For any sample of SSUs (i.e., blocks) within the candidate substratum, the between-block variation for the targeted minority sample size should be small. For each pre-substratum, the ratio, r, of between-block variation to the total variation for the proportion of a target minority group can be computed using a standard sum-of-squares decomposition. These r values can be assessed for different threshold cut values and used to determine cuts to avoid large between-block sampling variation.

4. These pre-substrata with:
   E(*NSSU*) ≥ 6
   were again evaluated for further splitting, for example, a partition of the form $\{p_M \leq m_1\}$ U {residual blocks} may lead to $\{p_M \leq m_1\}$ U $\{m_1 < p_M \leq m_2\}$ U {residual blocks}.
   All new substrata would require E(*NSSU*) ≥ 3.

5. The procedure above is iterative in nature. It can be automated to some degree to provide reasonable pre-strata, but considering that this process was to be done just once in the decade, fine-tuning was determined by manual inspection. Many NSR PSUs with few minorities would tend to have only 1 or 2 substrata, and most effort was concentrated on the MA PSUs.
   After processing, the PSU block universe would consist of substrata best described as being of four types of minority block concentrations: *low*, *medium*, *high*, or *residual–mixed*. The first three are characterized by a low between-block variation, but the residual–mixed has medium-to-high between-block variation.

6. After a substratum has been finalized, its type is subclassified by its composition. The high-concentration substrata are classified as black, Hispanic, or Asian. The medium and residual–mixed substrata are subclassified by dominant domain(s) according to the following sequential rules:
   a. Observe the ordering of the proportions p_H, p_B, p_A, say, $p_H > p_B > p_A$.

b. If ordering a. holds and $p_H > 2(p_B + p_A)$, then define the subtype as ''H dominant.''

c. If ordering a. holds, but the relation of b. does not hold, then if $p_B > \max(0.10, 2p_A)$, define the subtype as ''HB dominant.''

d. If there is no dominating group, then define the subtype as ''HBA.''

The subtypes for other orderings are similarly defined.

Design and Estimation Structures for 2006–2015 NHIS

NHIS is designed to make inferences about the civilian noninstitutionalized population of the United States. Although a general description of the NHIS sample design is presented in the section ''2006–2015 NHIS Sample Design'' of this report, this section focuses on the design and estimation structures. The NHIS program at NCHS is focused on making design-based inferences about the health of persons and households in the target population. This is accomplished by inflating the responses of each surveyed person or household in NHIS, referred to as elementary units, by a national weight factor that permits an (approximately) unbiased design-based estimator of any U.S. target population total. With this weight, an unbiased estimator, $\hat{X}$, for any given true population characteristic total, X, can be expressed as a weighted sum over all elementary units:

$$\hat{X} = \sum_{u} W_f(u)\, x(u) \qquad [1]$$

where

u indexes the elementary units of NHIS

$x(u)$ is the characteristic or response for unit u

$W_f(u)$ is the final national weight for unit u

This estimator is used to generate NHIS estimates of population totals, as well as numerators and denominators of percentages and rates that appear in official publications. The final national weight is provided on NHIS public-use microdata files, which allow users to directly create estimators of the form in equation 1. In the following sections, the technical aspects of the procedures used to create weights and estimate the variances of NHIS estimators are discussed.

Complex estimation techniques are required for NHIS because the survey is based on a stratified multistage probability sample. The true sampling distributions of any survey implementing complex clustering structures, implicit stratification, and systematic sampling tend to be mathematically intractable. For this reason, the NHIS design is conceptualized in a somewhat simplified framework, to provide a tractable model that still captures the most important design features. The primary sampling unit (PSU) and within-PSU sampling steps discussed in the section ''2006–2015 NHIS Sample Design'' can be expressed as a hierarchical sampling design with levels and probabilities provided by Table 11.

Note that the number of super-secondary sampling units (super-SSUs) in NHIS is a random variable that has very little variability; hence, super-SSU sample sizes are treated as fixed.

The number of eligible households in an SSU is treated as a random variable. A housing unit (HU) may be classified as eligible or ineligible (e.g., vacant dwellings or no civilian members). Nationally, about 20% of all addresses yield an ineligible classification. New construction or destruction of HUs within a block 5 years or more after the 2000 census results in a gradual degradation of the frame. At the time of sampling, it is possible, although rare, that either no eligible households exist or too many new HUs exist within an SSU (use of a permit frame or field subsampling, as discussed in section ''2006–2015 NHIS Sample Design,'' dampen the effect of the latter condition). The annual number of persons in NHIS also is a random variable. As a consequence, the year-to-year NHIS sample counts of households and persons exhibit variation.

NCHS applies three broad estimation criteria when deciding on estimation strategies to use for NHIS data:

1. The basic estimation methods are *design-based* for finite populations. That is, the randomness of the data is a result of sampling finite universes having no imposed distributional assumptions. This is in contrast to a *model-based* approach, where the data typically have imposed distributional assumptions. The design-based methods may be thought of as nonparametric and robust.
2. The design-based methods should be practical and permit (approximately) unbiased estimators of population totals.
3. The design-based methods should permit practical variance estimation strategies to assess the stability of the estimator.

To satisfy these criteria, NCHS, as well as many other sponsors of large government surveys, has been using standard, accepted design-based methods discussed in such classic references as Cochran (14), Kish (11), and Hansen, Hurwitz, and Madow (15).

Creating Respondent Weights

The NHIS estimator of a characteristic total, as presented in equation 1, uses methodology based on the features of the complex multistage probability sample to define a national weight, W_f, for each responding unit, which is the product of up to four weighting factors:

- Inverse of the probability of selection
- Household nonresponse adjustment
- First-stage ratio adjustment
- Second-stage ratio adjustment (poststratification)

When the elementary unit is a person, all four weighting factors contribute to the individual's final weight. Because the NHIS ratio adjustments are based on person-level characteristics, only the first two weighting factors are used to define a national household weight.

NCHS creates weights for each calendar quarter of the NHIS sample, using information provided by the U.S. Census Bureau. These weights permit national estimates to be made for each quarter. Resulting quarterly weights are divided by 4 to create annual weights, which are used when making national estimates from a calendar year of the NHIS sample.

Base weight

The overall probability that a unit is in the sample is the product of the conditional selection probabilities presented in Table 11. This *basic inflation weight* is defined as:

$$W_I(u) = 1 / \text{Prob(unit } u \text{ is in sample)}$$

Generally, based on probabilistic sampling, unit u represents $W_I(u)$ population units. This weight depends in part on the minority status of the household and the substratum class to which unit u belongs. W_I is the first component weight of W_f in equation 1. Table 9 presents the target household inflation weights in the columns labeled, ''Annual Minority HSD Weight'' and ''Annual Nonminority HSD Weight.''

Infrequently, this base sampling weight, W_I, will be modified. If, during the HU selection process of Step 4 in Table 11, an SSU is determined to contain too many HUs for interview, then a subsample will be selected. If the subsample consists of less than 1/4 of all HUs in the SSU, then the conditional probability of selection will be truncated by the Census Bureau at 1/4. This is a rare occurrence, and the biases introduced by such a modification should be small.

In an ideal, hypothetical sampling situation having no nonsampling error components (e.g., frame problems, nonresponse, or interviewer effects), equation 1 with W_I substituted for W_f becomes

$$\hat{X}_1 = \sum_u W_I(u)\, x(u) \qquad [2]$$

which will provide an unbiased estimator for the true population total X. Such an estimator is referred to as a *base weight estimator*, or Horvitz-Thompson estimator.

Factors contributing to year-to-year fluctuations in weights

Complex sampling implemented by specified guidelines is difficult to achieve in the real world. Below are certain special situations that may occur when conducting NHIS and that may have an influence on weighting procedures for a given year:

- Initial start-up problems during the first year of the survey may result in minor deviations from the sampling plan.
- NHIS budgetary changes may result in additional subsampling to reduce the sample (see subsection ''Panels'' in section ''2006–2015 NHIS Sample Design''), or supplemental funding may result in sample augmentation.
- Phase-in of new field operations may modify the sample.
- In recent years, NHIS has used 1 or more weeks at the beginning of the year (during quarter 1) for interviewer training. During this period, no data are collected for release. In this situation, all sampled units for quarter 1 have their basic inflation weight increased by an appropriate factor to inflate to 13 weeks. For example, if 1 week was used for training, the factor is 13/12; if 2 weeks were used for training, the factor is 13/11. Note that a new monthly interviewing period began in 2011, and since then, interviewer training (moved to December) has not interrupted NHIS data collection.
- Unexpected onetime events may alter the design.

This report discusses only the anticipated weighting adjustments for a full-sample NHIS.

Household nonresponse adjustment

During the first year of the current NHIS design, 2006, the household nonresponse rate for NHIS was about 12.7%. This form of nonresponse will most likely exert a downward bias on an estimator of total, such as in equation 2; consequently, a weighting adjustment for household nonresponse is justified. To correct this bias, a second weight factor, the *household nonresponse adjustment*, is applied.

The standard household nonresponse adjustment inflates the sampling weights for all responding households within a segment to compensate for the nonresponding households within the same segment. However, the adjustment does not address a particularly special situation: Typically, 5–15 segments in a quarter have 100% nonresponse. In such situations, no adjustment has been made since 1985, because the poststratification ratio adjustment is assumed to compensate for the nonresponse. NCHS likely will add another nonresponse adjustment factor to the weighting process sometime in the future to compensate for the 100% segment nonresponse situation (16).

In the 1985–1994 NHIS design, when all eligible households in an SSU were sampled with certainty (i.e., no screening occurred), NCHS used the nonresponse adjustment

$$\sum \text{all eligible households in SSU} \,/\, \sum \text{all responding households in SSU}$$

Note that this unweighted sum usually is equivalent to the sum obtained using the base weights, because the base weight is constant within an SSU except for the rare event in which the NHIS interviewer discovers three or more additional units at a sample address.

In the 2006–2015 NHIS design, non-Asian, non-black, non-Hispanic households are subsampled at the segment level in the area frame, as described in section ''2006–2015 NHIS Sample Design.'' This is similar to what was done for the 1995–2005 design, except that the subsampling was applied only to non-black, non-Hispanic households. The subsampling occurs after all HUs in the segment have been randomly divided by the Census Bureau into two groups, coded *I* and *S*, prior to interviewing. All sampled non-Asian, non-black, non-Hispanic households are assigned to the *I* (interview) group; those in the *S* (screen) group are screened out. All Asian, black, and Hispanic households in either group are interviewed. This within-segment subsampling creates two issues that did not require attention in NHIS designs prior to 1995:

1. The race and ethnicity of persons within some households cannot be determined because the interviewer never succeeds in making contact with the household. If the true status is Asian, black, or Hispanic, then these are nonresponding households. If the true status is ''other,'' then the household is a nonresponding eligible household if in the *I* group, or an ineligible household if in the *S* group.
2. Even without nonresponse, the base weight's estimated total number of households within the segment, based on the interviewed sample, may not be equal to the true total number of households within the segment. (The estimator, however, is unbiased.) As a hypothetical example, suppose that the *I/S* sampling rule requires that within every substratum, a subsample of one of every two HUs within a segment must be taken. The two possible weights for HUs containing no Asian, black, or Hispanic persons are 0 or 2. Thus, the sum of these sampling weights will be an even number, which may not agree with the true value.

Household nonresponse adjustment: Methodology for 2006 and beyond

Beginning with the 2006 design period, the 1997–2005 household nonresponse adjustment method was modified slightly to account for oversampling Asian persons.

All of the households in a given segment that belong to one of the following four groups are eligible:

$M_I = I$ screening code household contains Asian, black, or Hispanic persons

$M_S = S$ screening code household contains Asian, black, or Hispanic persons

$O_I = I$ screening code household contains no Asian, black, or Hispanic persons (referred to as ''other'' race and ethnicity status persons)

$U_I = I$ screening code household contains persons of unknown status

None of the households in the segment in the following group are eligible:

$O_S = S$ screening code household persons

Some, none, or all of the households in the segment in the following group are eligible:

$U_S = S$ screening code household contains persons of unknown status

Let W_H = conditional inflation weight restricted to Step 5 of Table 11 (and any other special inflation factors, as discussed in the previous ''Base weight'' section).

The following weighted sums (with respect to W_H) are computed across the segment:

$W_H(M_I)$ = weighted sum of sample class M_I households

$W_H(M_S)$ = weighted sum of sample class M_S households

$W_H(O_I)$ = weighted sum of sample class O_I households

$W_H(O_S)$ = weighted sum of sample class O_S households

$W_H(M_I\,(res))$ = weighted sum of *responding* sample class M_I households

$W_H(M_S\,(res))$ = weighted sum of *responding* sample class M_S households

$W_H(O_I\,(res))$ = weighted sum of *responding* sample class O_I households

If the number of households in the U_S group is nonzero, the proportion of eligible households in the segment is estimated using information from households having persons with known race and ethnicity. The eligible proportion is estimated by summing the weighted number of M_I, M_S, O_I, and O_S households in the segment, and then computing

$$\text{MINPROP} = \frac{[W_H(M_I) + (W_H(M_S)]}{[W_H(M_I) + W_H(M_S) + W_H(O_I) + W_H(O_S)]}$$

whenever the denominator is nonzero; otherwise, MINPROP is set equal to 0. Once MINPROP is defined, the complementary proportion OTHPROP is defined as [1– MINPROP] if the denominator of MINPROP is nonzero; OTHPROP is set equal to zero if the denominator of MINPROP is zero.

Then the nonresponse factor for the SSU is computed as

$$NR = [W_H(M_I) + W_H(M_S) + W_H(O_I) + f_1(U_I) + f_2(U_S)] \,/\, [W_H(M_I\,(res)) + W_H(M_S\,(res)) + W_H(O_I\,(res))]$$

where

$f_1(U_I)$ denotes a partition of the households in U_I using MINPROP and OTHPROP, with appropriate W_H factors applied to each piece, and

$f_2(U_S)$ denotes estimation of the Asian-black-Hispanic households in U_S using MINPROP, and with the appropriate W_H factor applied to that piece.

More specifically,

$$f_1(U_I) = W_{H(\text{OTH})}\,(\text{OTHPROP} \bullet U_I) + W_{H(\text{MIN})}\,(\text{MINPROP} \bullet U_I)$$

$$f_2(U_S) = W_{H\,(\text{MIN})}\,(\text{MINPROP} \bullet U_S)$$

where

$W_{H(OTH)}$ (OTHPROP • U_I) = weighted sum of the other race estimated proportion of U_I households, where the weight $W_{H(OTH)}$ is the weight applied to other race households in the SSU

$W_{H(MIN)}$ (MINPROP • U_I) = weighted sum of the Asian-black-Hispanic estimated proportion of U_I households, where the weight $W_{H(MIN)}$ is the weight applied to Asian-black-Hispanic households in the SSU

$W_{H(MIN)}$ (MINPROP • U_S) = weighted sum of the Asian-black-Hispanic estimated proportion of U_S households, where the weight $W_{H(MIN)}$ is the weight applied to Asian-black-Hispanic households in the SSU

In essence, the nonresponse factor *NR* has a numerator that is an estimate of the total number of eligible households in a given segment, and a denominator that is the total number of interviewed households. Weight factors that account for subsampling within the SSU are included as appropriate.

The final household nonresponse adjustment factor for the segment W_{nr} is defined as:

$$W_{nr} = minimum(NR, 2.0)$$

That is, the final factor is truncated to 2 to control the potentially increased variability in the weights due to this factor. Typically, less than 0.5% of segments require use of the truncated factor.

Estimator based on product of W_I and W_{nr}

The estimator produced by substituting the product of W_I and W_{nr} for W_f in equation 1,

$$\hat{X}_2' = \sum_u W_I(u) \bullet W_{NR}(u) \bullet x(u) \quad [3]$$

should produce approximately unbiased estimators for the population total, *X*, as long as the true nonresponding population does not differ significantly from the responding population.

The weight $W_I(u) \bullet W_{NR}(u)$ is used to define a final national weight for households and to produce estimates of household characteristics.

Ratio adjustments for person-level weights

The third and fourth weighting factors to be defined are ratio adjustments. Statistical sampling theory has demonstrated that in many situations, the estimators obtained using a ratio estimation procedure often have smaller mean squared error (MSE) than the base weight estimators expressed by equation 2. More precisely, if *X'* and *Y'* are base weight estimators of two population characteristic totals, *X* and *Y*, respectively, and if the "true" total *Y* is known, then the ratio estimator $X'' = (X'/Y') \bullet Y$ for *X* will have smaller MSE than the estimator *X'* when there is a high positive correlation between *X'* and *Y'* and the sample size is large.

The ratio adjustment also is used to help correct survey bias due to systematic undercoverage. Note that an observed survey estimator of the form in equation 3 may be larger or smaller than the true value just by chance alone. In this regard, the U.S. Census Bureau has identified some populations as difficult to sample. For example, historically, survey undercoverage of the young black male population has occurred in NHIS, and the estimator of equation 3 may be negatively biased in estimating young black male population characteristic totals. Such a bias due to undercoverage is often reduced by the use of ratio adjustments.

Note that the ratio adjustments are applied at the person level, which can introduce variation in the person-level weights within a given sampled household. The previous two components of the weights—the inverse of the probability of selection and the household nonresponse adjustment—are equal for all persons in a given sampled household.

First-stage ratio adjustment

The first-stage ratio adjustment is used in an attempt to reduce the between-PSU variance component of sampling variation among the nonself-representing (NSR) PSUs. First-stage ratio adjustment factors are created by the U.S. Census Bureau for each of eight residence and race and ethnicity classes within each of the four census regions presented in Table 12.

The 32 residence and race and ethnicity classes in the United States defined across the NSR PSUs are indexed by the letter *c*, where $c = 1,2,..,32$.

Let Z_c equal the projected population total for class *c* over all NSR PSUs in the population. Considering only the first stage of sample selection as presented in the conceptual design (see Step 1, Table 7), the sample of NSR PSUs can produce an unbiased estimator of Z_c,

$$\hat{Z}_c = \sum_{NSR\ PSU_{si}} Z_{sic} / \pi_{si}$$

where

Z_{sic} = projected population total for class *c* in sample NSR PSU *i* of stratum *s*

π_{si} = the selection probability of PSU *i* of stratum *s*

Note that Z_{sic} is based on Census Bureau totals as of the date of the census and not on the fielded sample.

The first-stage ratio adjustment factor associated with class *c* is defined as:

$$F_c = Z_c / \hat{Z}_c$$

where truncation occurs if the factor falls outside of an interval [*L*, *U*].

The Census Bureau suggested that the lower and upper bounds should satisfy the symmetric equations $L = 1/(2–(1/U))$ and $U = 1/(2–(1/L))$. With the upper bound specified at $U = 1.3$, the lower bound is determined to be $L = 0.8125$.

If a class *c* is subject to truncation, then a complementary class (say, *d*) will be inflated to compensate for loss of population count. The first-stage ratio adjustment factor associated with class *d* will then be defined as the solution, F_d, to the equation

$$F_c \hat{Z}_c + F_d \hat{Z}_d = Z_c + Z_d$$

For the 2006–2015 full design, this truncation-compensation adjustment occurred twice for the class groups denoted in Table 12.

A universal *first-stage ratio adjustment*, W_{r1}, can be defined for each sample person by defining a new class index, $c = 0$, to denote all persons not receiving the F_c ratio adjustment:

$$W_{r1} = W_{r1(c)} = F_c$$
if $c = 1,2,...,32$ for NSR PSUs

$$W_{r1} = W_{r1(c)} = 1$$
if $c = 0$ for SR PSUs

A first-stage ratio-adjusted national estimator, $\hat{X}_3$, of a population total, X, is defined by equation 1 when the weight W_f is replaced with the product of the first three component weights:

$$\hat{X}_3 = \sum_u W_I(u) \cdot W_{NR}(u) \cdot W_{r1}(u) \cdot x(u) \quad [4]$$

As shown in Table 5, about 66% of the U.S. population resides in the SR strata, which do not receive the first-stage ratio adjustment. The research of Parsons and Casady (17) on the 1985–1994 NHIS design has shown that inclusion of the first-stage ratio adjustment factor had very little impact on NHIS estimates.

Table 12 shows the first-stage ratio adjustment factors for 2007. These are typical values for the entire 2006–2015 NHIS design; however, small changes may occur when one NSR PSU rotates out and another NSR PSU rotates in (see subsection ''Rotating PSUs and Crowded BPCs'' in the section ''2006–2015 NHIS Sample Design''). The current NHIS sample design has no rotating PSUs. New NSR PSUs were added to NHIS beginning in 2013 as part of the sample augmentation process; some of the first-stage ratio adjustment factors for weighting that include the augmentation sample in the new PSUs will differ from the entries in Table 12.

Second-stage ratio adjustment (poststratification)

The main advantages of the ratio-estimation process are exploited by the introduction of a second ratio factor, the poststratification adjustment weight. This weight assures that NHIS estimates for 100 age-sex-race and ethnicity classes of the civilian non-institutionalized population of the United States (Table 13) agree with independently determined population controls prepared by the Census Bureau. Furthermore, these independent controls are the same controls used for the Current Population Survey (CPS). Thus, national population estimates for any combination of the age-sex-race and ethnicity groups from the two surveys are the same, which greatly enhances comparability of the two surveys.

In the 2006–2015 NHIS sample design period, the independent controls have a U.S. Census 2000 base through 2011. The independent controls have a 2010 census base beginning in 2012.

Each month, the Census Bureau produces national estimates for the 100 age-sex-race and ethnicity classes. Although NHIS is conducted weekly (and monthly starting in 2011), the poststratification adjustment is computed only for NHIS quarterly estimates. NHIS quarters and the dates of the population estimates used as the controls are:

NHIS quarter	Population estimates
January–March	February 1
April–June	May 1
July–September	August 1
October–December	November 1

For each NHIS quarter, 100 age-sex-race and ethnicity adjustment weights are computed, for a total of 400 adjustment weights annually. If a represents one of the 100 age-sex-race and ethnicity classes, $Y(a)$ represents the Census Bureau population estimate for class a, and $\hat{Y}''(a)$ represents the NHIS first-stage ratio adjusted national total for class a, that is,

$$\hat{Y}''(a) = \sum_u W_I(u) \cdot W_{NR}(u) \cdot W_{r1}(u) \cdot I_a(u)$$

where $I_a(u) = 1$ if person u is in class a, 0 otherwise, then the *second-stage ratio adjustment* for class a, W_{r2}, is defined as

$$W_{r2}(a) = Y(a) \,/\, \hat{Y}''(a)$$

In implementing this second-stage ratio adjustment, NCHS generally requires each class a to contain at least 30 sample persons. If a class contains too few sample persons, that class will be pooled with an adjacent age class. Similarly, pooling occurs if a factor falls outside of the interval [0.7, 2.0]. The two-stage ratio adjusted national estimate, $\hat{X}$, of a population total, X, is defined by formula 1 with the weight W_f defined by the product of the four component weights:

$$W_I(u) \cdot W_{NR}(u) \cdot W_{r1}(u) \cdot W_{r2}(u)$$

Thus,

$$\hat{X} = \sum_u W_I(u) \cdot W_{NR}(u) \cdot W_{r1}(u) \cdot W_{r2}(u) \cdot x(u) \quad [5]$$

In the previous 1995–2005 NHIS design, both the first-stage and poststratification ratio adjustments were structured similarly to the structures presented in Tables 12 and 13, but the racial classes used were Hispanic, non-Hispanic black, and non-Hispanic other. The introduction of oversampling Asian households in 2006 has resulted in an increase in the number of poststratification cells from 88 to 100.

Creation of other weights

The preceding discussion outlined the procedure for creating household-level and person-level weights for NHIS. Beginning in 1997, other weights also were created for sample adult, sample child, and family-level files. The basic strategy for creating these other weights is very similar to the preceding discussion. Some form of the household-level weight or the person-level weight always is the starting point for creation of the other weights.

The family weight corresponds to the person weight for one of the persons in the family. A person-level ratio adjustment is used as a proxy for the NHIS family-level ratio adjustment. The research of Davis (18) has shown that the person weight with the smallest ratio adjustment within each family—that is, the smallest poststratification factor between the interim and final person weights within the family—provides a more accurate estimate of the total number of U.S. families than a weight that does not include a poststratification factor.

Creation of the Sample Adult weight and the Sample Child weight begins with the person-level weight prior to poststratification. An inflation factor is applied to account for selection of the Sample Adult and Sample Child within the family, and then a poststratification process is undertaken. Prior to the 2010 NHIS, any nonresponse to the Sample Adult Core and Sample Child Core is assumed to be adjusted for via the poststratification process. The Sample Adult and Sample Child poststratification adjustment factors are modified (i.e., collapsed with another class) if the factors fall outside of the interval [0.7, 3.0]. The Sample Adult and Sample Child weights use a smaller set of poststrata than the 100 poststrata listed in Table 13, because of the subsampling processes for the Sample Adult and the Sample Child. A total of 52 Sample Adult poststrata and 30 Sample Child poststrata exist. Beginning with the 2010 NHIS, NCHS added a nonresponse adjustment for the Sample Adult and Sample Child weights that uses methodology similar to that used for the geographic household nonresponse adjustment. The nonresponse adjustment is calculated after the inflation factor for selection of the Sample Adult and Sample Child is applied, and prior to poststratification.

Variance Estimation

Most of the estimates produced by NCHS from NHIS are totals and ratios of totals, such as means, percentages, and rates. All such totals and ratios of totals are produced using the final national weight described in the previous sections. These estimators are subject to both sampling and nonsampling errors. The nonsampling errors such as response errors, defective sample frames, nonresponse, and undercoverage are difficult quantities to measure, but every effort is made to minimize such errors at each step of the NHIS operation. The sampling error, however, can be measured by the variance of the estimator.

Although equation 1 provides a functional form that permits simple computation of point estimates, the variances of such estimators are more difficult to compute. The functional form of a variance estimator depends on the nature of the survey design and methods used to adjust the weights. Some complexities in the NHIS survey design require special techniques:

1. The successive levels of sampling (e.g., selection of SSUs within a PSU) are the result of a very complicated process involving the partitioning of block groups, estimating measures of size, and applying systematic sampling techniques. Even given the census information about the PSU, defining a ''user friendly'' sampling mechanism that captured the system's true stochastic structure and could be implemented with a standard variance estimation procedure would be extremely difficult.
2. Some density strata have only one sampled SSU, and some NSR strata have only one sampled PSU.
3. Some SR strata are small. They are part of large multistate metropolitan areas but are sampled as distinct areas.
4. To protect the confidentiality of survey respondents, NCHS does not release design information that could be used to identify smaller geographical areas in which NHIS was conducted. Small sample areas with rare socioeconomic or demographic characteristics must not be explicitly or implicitly identifiable by design information.
5. With weighting adjustments applied to the base weight, estimates of totals become nonlinear in nature. This complicates the variance estimation procedure.
6. In practice, data analysts who study NHIS data use large-sample theory when making inferences about populations. Variance estimation procedures suitable for large subpopulations may be unstable for smaller subpopulations. NCHS targets stable, all-purpose variance estimation structures that should be easy to implement with existing computer software.
7. Adjacent years of NHIS data are often combined for pooled analysis (e.g., 2006, 2007, and 2008) to increase the sample sizes for some small subpopulations. The sampling weights for pooled data should be adjusted; otherwise, annualized estimates of totals will be too high. A valid weight adjustment procedure that NCHS recommends is to divide each sample weight in the pooled data set by the number of years that are being pooled: for instance, divide by 3 when 3 years of data are combined. Estimates produced from different years of data within the same sample design period are dependent, while estimates produced from different years in different sample design periods are independent for variance estimation purposes. Further discussion on variance estimation for pooled analyses when the years fall into different sample design periods, or when changes occur to the public-use design variables, is available from: http://www.cdc.gov/nchs/nhis/methods.htm.

Simplified design structures for variance estimation

Wolter (19) and Rust (20) offer comprehensive discussion of design-based variance estimation for complex surveys. Of the available methods, the three most commonly used are Taylor series linearization, balanced repeated replication (BRR), and the jackknife. Software for analysis of complex surveys includes the R survey package, SAS survey procedures, SPSS, Stata, SUDAAN, and VPLX. A comparison of these software packages is beyond the scope of this report, but an online document titled ''Summary of Survey Analysis Software,'' available from http://www.hcp.med.harvard.edu/statistics/survey-soft/, provides references and discussion.

NHIS public-use micro files currently contain design information suitable for the Taylor series linearization method, which is also suitable for some replication software.

In the following discussion, simplified design structures are developed that allow design-based variance estimation for NHIS. First, a variance estimation structure is developed for SR PSUs. Then, a structure is developed that accounts for the sampling of NSR PSUs. The two structures are then combined to give a variance estimator for national estimators.

SR PSUs: Conceptual NHIS within-PSU sampling and estimation structures

Under the following conditions 1 and 2, a variance estimator can be developed for the estimated total at the substratum level:

1. The super-SSU is considered to be a well-defined population cluster, where the within super-SSU sampling inflation weights (Table 11, Steps 3–6) produce an unbiased estimator of super-SSU total.
2. The super-SSU sampling (Table 11, Step 2) can be treated as a traditional *with-replacement* sampling procedure from a large population of super-SSUs within a substratum. All population super-SSUs within a substratum have the same selection probability, but the probabilities can vary by substrata. Sampling is independent over substrata.

The following indices are used to denote the levels of nesting within the NHIS design:

s = stratum
i = PSU
j = substratum
k = sampled annual SSU
u = sampled elementary unit within annual SSU k

For substratum j, $j = 1,2,...,L_i$ (number of substrata within PSU i) nested within PSU i, nested within stratum s, let:

N_{sij} = the number of population super-SSUs in substratum j
n_{sij} = the number of super-SSUs sampled in substratum j
= the probability in Table 11, Step 2, times N_{sij}
$W_{k|sij}$ = N_{sij} / n_{sij} = conditional super-SSU selection weight for SSU unit k within substratum j
$W_{u|sijk}$ = within super-SSU conditional selection weight for unit u in annual-SSU k computed using the inverses of probabilities of selection as specified in Table 11, Steps 3–6

An unbiased estimator of the total of a characteristic, X, for substratum j may be expressed as

$$\hat{X}_{sij} = \sum_{k=1}^{n_{sij}} \left(\sum_{u \,\varepsilon\, SSU\,k} W_{jk\,|\,sij} \bullet W_{u\,|\,sijk} \bullet x_u \right)$$

$$= \sum_{k=1}^{n_{sij}} \hat{X}_{sijk}$$

where x_u is a response variable from unit u within an SSU, and an unbiased estimator of its variance is

$$Var(\hat{X}_{sij}) = n_{sij}\,\hat{S}^2_{sij}$$

where

$$\hat{S}^2_{sij} = \sum_{k=1}^{n_{sij}} (\hat{X}_{sijk} - \bar{X}_{sij.})^2 / (n_{sij} - 1)$$

and

$$\bar{X}_{sij.} = \sum_{k=1}^{n_{sij}} \hat{X}_{sijk} / n_{sij}$$

These functional forms can be extended over all the substrata within the PSU to obtain an unbiased estimate of the PSU total and its corresponding variance estimator:

$$\hat{X}_{si} = \sum_{j=1}^{L_i} \sum_{k=1}^{n_{sij}} \hat{X}_{sijk}$$

and

$$Var(\hat{X}_{si}) = \sum_{j=1}^{L_i} n_{sij}\,\hat{S}^2_{sij} \qquad [6]$$

Treating the sampling as *with replacement* when it actually is *without replacement* usually results in a slightly positive variance estimator bias. If the number, n, of sampled super-SSUs within a density stratum is small, its corresponding $\hat{S}^2$ component in formula 6 may be unstable. In this situation, such substrata may be collapsed with other substrata having similar minority populations to form fewer substrata within the PSU. Using these new substrata will typically result in a more stable variance estimator, but with a slight upward bias in variance estimation.

Typically, the variance estimator with a reduced set of substrata will be:

$$\sum_{j \,\varepsilon\, C_{si}} n_{Csi(j)}\,\hat{S}^2_{Csi\,(j)} \qquad [7]$$

where C_{si} indicates any collapsing of substrata within PSU i in stratum s, with the n and S^2 terms defined as in equation 6 but on the newly collapsed substrata.

NSR PSUs: Variance estimator accounts for PSU sampling

The preceding variance estimators presented in equations 6 and 7 appear reasonable for totals restricted to self-representing strata. In the nonself-representing strata, the variance estimator should also reflect the first-stage selection of PSUs. First, consider a hypothetical NHIS having 100% response and using only the weights determined in Table 11, steps 1–6. The basic inflation estimator of equation 2 is:

$$\hat{X}_1 = \sum_u W_I(u) \bullet x(u)$$

which can also be expressed as

$$\hat{X}_1 = \sum_{s:stratum} \sum_{i:PSU} \frac{\hat{X}_{si}}{\pi_{si}} = \sum_{s:stratum} \sum_{i:PSU} \hat{X}_{wsi}$$

Here, $\hat{X}_{wsi}$ is the estimator of a PSU total, inflated by $1/\pi_{si}$. The variance estimator of $\hat{X}_{wsi}$ corresponding to equation (6) will be denoted as:

$$\sum_{j=1}^{L_i} n_{sij}\,\hat{S}^2_{wsij}$$

where

$$\hat{S}^2_{wsij} = \sum_{k=1}^{n_{sij}} (\hat{X}_{wsijk} - \bar{X}_{wsij.})^2 / (n_{sij} - 1)$$

using the SSU totals based on the entire inflation weight, W_I.

Variance estimators for national estimators: Combining across NSR and SR PSUs

An estimator for the variance of $\hat{X}_1$ is

$$\hat{Var}(\hat{X}_1) = \sum_{s \,\varepsilon\, NSR2} \Bigg[\left(\frac{\pi_{s1}\pi_{s2} - \pi_{s12}}{\pi_{s12}} \right) \bullet (\hat{X}_{ws1} - \hat{X}_{ws2})^2 + \sum_{i=1}^{2} \pi_{si} \sum_{j \,\varepsilon\, C_{si}} n_{Csi\,(j)}\,\hat{S}^2_{wCsi(j)} \Bigg] + \sum_{C_{str} \in NSR1} \sum_{i \in C_{str}} m(C_{str(i)})\,\hat{S}^2_{wC_{si(i)}} + \sum_{s \in SR} \sum_{j \in C_{si}} n_{C_{si(j)}}\,\hat{S}^2_{wC_{si(j)}} \qquad [8]$$

The set *NSR2* is the set of NSR strata with two sampled PSUs. The variance estimators for these strata are the so-called *Yates-Grundy-Sen* 2-stage forms, with *Csi(j)* representing the collapsed PSU substrata in equation 7. Some NSR strata have only one sampled unit, a situation that may occur in low-population states having one SR and one NSR stratum. In this situation, such an NSR stratum may be collapsed with another NSR stratum in the same national region but having similar metropolitan status and minority composition. In equation 8, the set *NSR1* is a union of collapsed original NSR strata (denoted by C_{str}). Here, $m(C_{str(i)})$ is the number of PSUs in a given set, and the PSUs are treated as being sampled with replacement from this collapsed stratum. Only the first-stage unit will be used for variance computation. The S^2 form is the variance of PSU totals, $\hat{X}_{wsi..}$, within a $C_{str(i)}$ collapsed set. The set *SR* is a set of SR strata, with possibly collapsed original strata or substrata, defined in an analogous manner.

About 87% of NHIS households responded in 2006—allowing the nonresponse-adjusted weight to be treated as an inflation weight within the SSU sampling level with little bias. Furthermore, for national NHIS estimators, previous research by Parsons and Casady (17) has shown that the first-stage adjustment seems to have little impact on the magnitude of the estimated variances. With this in mind, equation 8 is extended to cover the nonresponse and first-stage ratio weighting adjustments. For the nonresponse-adjusted estimator of $\hat{X}_2$ in equation 3, or the first-stage ratio-adjusted national estimator, $\hat{X}_3$, of equation 4, an approximate variance estimator is provided by equation 8, but with the W_I weight multiplied by the W_{nr} and W_{r1} weights.

Estimating variances for poststratified totals and nonlinear statistics

The final national weight estimator, $\hat{X}$, of equations 1 and 5 incorporates a poststratification adjustment. This is the form of the estimator presented in official NCHS publications and the one that most analysts study. This estimator is nonlinear because of the poststratification adjustment. A commonly used method for estimating the variance of a nonlinear statistic is to *linearize* the statistic using Taylor series methods and then to apply equation 8 to the linearized form. Basically, equation 8 is used to estimate the variance of the linearized total, but a pre-poststratification inflation weight is used in its computation.

Several of the variance estimation methods just discussed are examined using NHIS data in Tables 14, 16, and 17. A set of NHIS variables that were used for the tables is described below. The full text for the variables appears in Tables 14 and 16, and the abbreviations appear in Table 17.

- LA1AR = persons with activity limitation
- NOTCOV = persons without health insurance
- HLT–FP = persons with fair or very poor health
- PHCDV2W = persons who saw health professional, based on 2-week recall of event
- AUSUALPL = persons with usual place to go for medical care
- TDV = number of doctor visits in past year
- OBMI = obese persons
- LEISURE = persons who engaged in regular leisure-time physical activity
- SMOKE = current smoking status
- DIBEV = persons with diagnosed diabetes
- AASMYR = persons with current asthma

In practice, implementation of computer software packages based on linearization often requires treating the final weight, W_f, which may include a poststratification adjustment, to be treated as an inflation weight. For example, in the SUDAAN (21) version 10.0 software, regression statistics can be linearized, but not with a simultaneous linearization of the poststratification weights. Thus, SUDAAN regression computations for variance assume that the final poststratification weight is an inflation weight. For estimated totals, this practice tends to lead to somewhat inflated variance estimators. For ratios of totals (e.g., means or percentages), the impact varies. Table 14 presents some comparisons of variance estimates from the 2006 NHIS, obtained by treating final weights as inflation weights, compared with a linearization of the final weight. (For reference, Table 15 presents unweighted and weighted sample sizes for the groupings presented in Table 14.) For many health variables, empirical evidence suggests that the inflation in the estimated standard errors of means may be of little practical importance. The treatment of the final weight, W_f, as an inflation weight may be reasonable if software limitations warrant such a simplification. Note that population domains that are aggregates of several component poststratification classes should be expected to have a greater variance reduction than population domains covered by few poststratification classes. In general, economic-type variables may exhibit a greater impact than health-type variables. For regression-type analysis, the inclusion of age-sex-race and ethnicity predictors tends to reduce the impact of treating the final weight as an inflation weight.

Public-use NHIS data and limitations on design structures

NCHS forbids the disclosure of information that may compromise the confidentiality promised to survey respondents. These concerns about confidentiality require the omission or concealment of some design information from public-use data sets. Policies on release of design information often change, however, so NHIS data users should check database documentation for the available design information. The following types of information have been subject to omission or concealment:

1. Most of the distinct probabilities of selection from Table 11 are not released, although some products of sequential weights are released. In particular, the π_{si} and π_{sij} probabilities have not been released.
2. Original strata, density substrata, and PSUs may have been collapsed with others to avoid implicit or explicit geographical disclosure, or

to create convenient forms for variance estimation. For example, the PSU counts in Table 5 do not agree with tabulations from public-use microdata files.

Without knowledge of π_{si} and π_{sij}, equation 8 must be replaced with a reasonable substitution. In this case, all *NSR2*-type strata can be treated as the *NSR1*-type strata—that is, the strata having two sampled PSUs are treated as being sampled with replacement. No second-stage component would be included in the functional form for these *NSR1*-type strata, because the variance is expected to be overestimated on average. In the SR strata, the second-stage variation would still be used. Thus, with this limited information, an approximation for equation 8 is

$$\hat{V}ar(\hat{X}_1) = \sum_{s\,\varepsilon\,NSR2} (\hat{X}_{ws1} - \hat{X}_{ws2})^2 + \sum_{C_{str}\,\varepsilon\,NSR1} \sum_{i\,\varepsilon\,C_{str}} m(C_{str(i)})\,\hat{S}^2_{wC_{str(i)}} + \sum_{s\,\varepsilon\,SR} \sum_{j\,\varepsilon\,C_{si}} n_{C_{si(j)}}\,\hat{S}^2_{wC_{si(j)}} \qquad [9]$$

where

*NSR*2 is a set of original NSR strata, each with two sampled PSUs.

*NSR*1 is the set of collapsed strata, C_{str}, defined analogous to the discussion that followed equation 7

SR is a set of SR strata, possibly collapsed original strata

The above form can be expressed in a condensed form:

$$\hat{V}ar(\hat{X}_1) = \sum_{c} m_c\,\hat{S}^2_{wc} \qquad [10]$$

where c represents a (collapsed) stratum, either NSR or SR, and $\hat{S}^2_{wc}$ is the sample variance of the w_c-weighted PSU totals within an NSR stratum, or of the w_c-weighted SSU totals within an SR stratum. For both means and totals, using equation 8 tends to yield slightly smaller standard errors than those resulting from using equation 9. Poststratification implementation also appears to have greater impact than either equation 8 or 9, especially for the standard errors of totals.

Beginning with the 1997 NHIS, some geographical disclosure concerns resulted in a further coarsening of the released public-use design information. The techniques of stratum collapsing, stratum partitioning, and SSU mixing were used to coarsen the SR design structures with little anticipated bias, but at the expense of loss of *degrees of freedom*. These techniques are discussed somewhat in Parsons and Moriarity (22), Eltinge (23), and Parsons and Eltinge (24). The result was a design structure with an imposed *two PSUs per stratum* and more than 300 nominal degrees of freedom. The variance estimator takes the generic form of the first term of equation 9 and can be implemented by many software packages.

Table 16 shows comparisons between using the in-house design information with equation 8 and using public-use design information with equation 9. Because the information needed for poststratification weighting adjustments is also available for public release, each variance estimation method is demonstrated both with and without a direct implementation of the poststratification.

Precision comparisons of 1995–2005 NHIS with 2006–2015 NHIS

In planning the 2006–2015 NHIS, the general cost and precision requirements were:

1. The 2006–2015 design would have funding comparable with the 1995–2005 design.
2. The precision of estimators for Hispanic and black domains would be comparable with the previous design.
3. The precision of estimators for Asian domains would be improved over the previous design.
4. The precision for other race and total domains could be allowed to drop to compensate for meeting objectives 1, 2, and 3.

A budget reduction in 2006 resulted in one-half of the sample being dropped in quarter 3 of the 2006 data collection year. This sample reduction resulted in the survey weights for quarter 3 of 2006 having an additional multiplicative factor of 2 relative to the other three quarters and most likely increased the design effects for the 2006 survey. Thus, precision is reduced from having a smaller sample and survey weights with increased variability.

Table 17 presents a comparison between the estimates produced using the 2005 NHIS and the 2006 NHIS. For this table, SUDAAN version 10.0 software was used, along with a design corresponding to equation 8; the final weight was treated as an inflation weight. The estimates of the means appear somewhat stable in magnitude. For smaller domains (e.g., aged 65 and over), the larger coefficients of variation (CVs) will suggest more fluctuation over different years of the survey. As just discussed, some consequences of the 2006 budget reduction were larger sampling weight variations and increased design effects for the 2006 NHIS. Thus, comparison of CVs between data years 2005 and 2006 should not be generalized as a comparison between the respective NHIS design cycles for 1995–2005 and 2006–2015.

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Table 1. Major design features and research areas for redesign of National Health Interview Survey

Design feature	Research area
Sampling frame	• Evaluation of sampling unit definition for first stage of sampling; investigation of potential for subcounty primary sampling units (PSUs) in counties with sufficiently large populations to support them • Evaluation of NHIS sample linkage with sample of other U.S. Census Bureau-conducted surveys, of sharing of PSUs, and of rotating noncertainty PSUs • Evaluation of duplication compared with unduplication of households between NHIS and other U.S. Census Bureau-conducted surveys
Within-PSU sampling	• Density substratum definitions
Oversampling small population subdomains	• Evaluation of subdomain statistics (non-Hispanic black and Hispanic populations) • Methods for expanding oversampling to non-Hispanic Asian population • Using administrative data as supplemental sample frame for minority elderly persons • Greater probability of selecting adults from small domains of special interest (differential sampling) to be sample adult
Survey cost	• Estimate relative cost of screening interview compared with full interview • Develop cost model for survey

Table 2. National Health Interview Survey designs: 1957–1958, 1959–1962, 1963–1972, and 1973–1984

Characteristic	1957–1958	1959–1962	1963–1972	1973–1984
	Sampling frame			
	Area		List and area	4-frame
	One or more counties			
PSU definitions	1950 SMAs	1950 SMAs	1960 SMSAs	1970 SMSAs
SR sample design PSUs[1]	110 (138)	178 (213)	119 (146)	156 (201)
NSR sample design PSUs[1]	262 (268)	320 (327)	245 (255)	220 (227)
Total sample design PSUs[1]	372 (406)	[2]498 (540)	364 (401)	376 (428)
Sample PSUs per NSR stratum	1	1	1	1
First level of stratification	Four census regions	Four census regions	Four census regions	Four census regions
Designated housing units per year	- - -	- - -	- - -	51,000
Screened households per year	. . .	. . .	. . .	. . .
Interviewed households per year	36,000	38,000	42,000	40,000
Interviewed persons per year	115,000	121,000	134,000	108,000
SSU size (except permit frame):				
Expected number of housing units	6	6	[3]9	4
Permit frame SSU size-expected number of housing units	. . .	. . .	. . .	4
Number of panels	Not defined	Not defined	Not defined	Not defined
Minority sampling techniques	None	None	None	None

- - - Data not available.
. . . Category not applicable.
[1]Field PSU count in parentheses.
[2]Design PSUs totaled 498 prior to 1960; 3 were added in 1960 for Alaska and Hawaii.
[3]Reduced to 6 in 1968.

NOTES: PSU is primary sampling unit; SMA is standard metropolitan area; SMSA is standard metropolitan statistical area; SR is self-representing; NSR is nonself-representing; and SSU is secondary sampling unit.

SOURCES: Sampling frame—Health Interview Survey Procedure, 1957–74 (HISP), see reference 5; PSU definitions—HISP, Technical Paper 7, see reference 25; total sample PSUs, designated housing units per year, and SSU size—HISP; SR and NSR sample PSUs, 1957–1958—The Statistical Design of the Health Household Interview Survey, July 1958 (SDHHIS), see reference 6; and sample PSUs per NSR stratum (first level of stratification) and interviewed households (persons per year, 1957–1958)—SDHHIS.

Table 3. National Health Interview Survey designs: 1973–1984, 1985–1994, 1995–2005, and 2006–2015

Characteristic	1973–1984	[1]1985–1994	[2]1995–2005	2006–2015
	Sampling frame			
	Address, area, permit, and group quarters	Area and permit		
	One or more counties			
PSU definitions	1970 SMSAs	1983 MSAs	1990 MAs	1999 MSAs
SR sample design PSUs[3]	156 (201)	52 (127)	95(117)	201
NSR sample design PSUs	220 (227)	146 (156)	263(263)	227
Total sample design PSUs	376 (428)	198 (283)	358(380)	428
Sample PSUs per NSR stratum	1	2	Normally 2, sometimes 1	Normally 2, sometimes 1
First level of stratification	Four census regions	Four census regions	50 states and D.C.	50 states and D.C.
Designated housing units per year	51,000	61,400	70,000	64,000
Screened households per year	. . .	. . .	57,000	55,000
Interviewed households per year	40,000	49,000	41,000	37,000
Interviewed persons per year	108,000	132,000	107,000	96,000
SSU size (except permit frame): Expected number of housing units	4	8	8, 12	8, 12, 16
Permit frame SSU size-expected number of housing units	4	4	4	4
Number of panels	Not defined	4	4	4
Minority sampling techniques: Housing unit selection	None	Oversample for black persons	Oversample and screen for black and Hispanic persons	Oversample and screen for black, Asian, and Hispanic persons
Minority sampling techniques: Within household	None	None	None	Sample adult: Oversample for elderly black, Asian, and Hispanic persons

. . . Category not applicable.

[1]In 1985 and 1986, the National Health Interview Survey (NHIS) sample was reduced 25% and 50%, respectively, for budgetary reasons.

[2]In 1996, NHIS was reduced 37% to allow for computer-assisted personal interview phase-in.

[3]Previously, within some of the largest MSA areas (e.g., New York City and Los Angeles), component PSUs were often consolidated under a common label, such as the New York metropolitan PSU. For the current design, the smaller PSUs comprising the largest MSAs are kept intact without consolidation. These component PSUs are defined at the state level and sampled as SR strata. Counts of SR PSUs reflect this nonconsolidated feature, while SR counts in earlier documents reflect a consolidated definition; consequently, Table 2 historical SR PSU or Total PSU counts are not directly comparable with the current design.

NOTES: PSU is primary sampling unit; SMSA is standard metropolitan statistical area; MSA is metropolitan statistical area; MA is metropolitan area; SR is self-representing; NSR is nonself-representing; D.C. is District of Columbia; and SSU is secondary sampling unit.

Table 4. Stratification and sample design parameters: National Health Interview Survey, 1973–2015

Design period	SR (percent)	NSR PSU representation size (thousands)[1]	Full-interview sample NSR PSUs	Households
	Percent	Number		
1973–1984	64	440	220	40,000
1985–1994	53	870	146	49,000
1995–2005	64	370	263	41,000
2006–2015	66	400	227	42,000

[1]Each sampled PSU represents a number of persons, based on 1998 U.S. resident population of 272 million.

NOTES: NSR is non-self-representing, PSU is primary sampling unit, and SR is self-representing.

Table 5. Sampling strata characteristics: National Health Interview Survey, 2006–2015

Stratum type	Strata	Universe coverage by population	Universe coverage by land area	Sample PSUs	Size of strata by population
	Number	Percent		Number	
SR	201	66	10	201	45,000–9,500,000
NSR	. . .	34	90	. . .	. . .
NSR, 2 PSUs	104	. . .	. . .	208	570,000–1,100,000
NSR, 1 PSU	19	. . .	. . .	19	260,000–730,000
Total	324	100	100	428	. . .

. . . Category not applicable.

NOTES: SR is self-representing, NSR is nonself-representing, and PSU is primary sampling unit.

Table 6. Primary sampling units, by census region: National Health Interview Survey, 2006–2015

PSU type	Census region				Total
	Northeast	Midwest	South	West	
SR	44	42	69	46	201
Large	21	9	20	17	67
Medium	8	16	8	9	41
Small	15	17	41	20	93
NSR	22	66	104	35	227
Total	66	108	173	81	428

NOTES: PSU is primary sampling unit, SR is self-representing, and NSR is nonself-representing.

Table 7. Area frame household-level race and ethnicity concentrations, within area frame density substrata

Density stratum	Black		Asian		Hispanic other	Minority	Nonminority	U.S. population
	Hispanic	Non-Hispanic	Hispanic	Non-Hispanic				
	Percent							
10 Low	0.03	2.15	0.01	1.17	2.10	5.46	94.54	100.00
20 Medium–HBA	0.15	7.41	0.05	5.99	8.28	21.88	78.12	100.00
24 Medium–H	0.08	2.15	0.05	1.91	17.59	21.78	78.22	100.00
25 Medium–HB	0.24	16.76	0.01	0.49	10.31	27.80	72.18	100.00
26 Medium–B	0.12	22.38	0.01	0.70	1.59	24.79	75.21	100.00
28 Medium–A	0.03	0.59	0.70	34.72	5.30	41.34	58.66	100.00
29 Medium–HA	0.19	2.94	0.07	10.74	9.58	23.53	76.47	100.00
30 Mixed–HBA	0.48	17.27	0.09	12.59	18.07	48.49	51.51	100.00
34 Mixed–H	0.31	7.21	0.07	3.01	36.42	47.03	52.97	100.00
35 Mixed–HB	0.57	25.16	0.04	3.02	17.97	46.76	53.24	100.00
36 Mixed–B	0.32	51.88	0.02	1.82	3.79	57.83	42.17	100.00
38 Mixed–A	0.08	1.98	0.72	64.35	3.65	70.77	29.23	100.00
39 Mixed–HA	0.12	3.46	0.12	24.24	17.23	45.17	54.83	100.00
40 High–H	0.90	8.19	0.09	3.54	65.50	78.22	21.78	100.00
60 High–B	0.89	81.37	0.02	1.06	4.69	88.02	11.98	100.00
80 High–A	0.15	3.17	0.16	58.72	11.86	74.06	25.94	100.00
All	0.19	11.49	0.03	3.06	8.53	23.30	76.70	100.00

NOTES: Low is nonminority domination, Medium and Mixed are moderate minority domination, and High is high minority domination. The dominant minority racial or ethnic group is designated by sequence: Hispanic (H), non-Hispanic black (B), and non-Hispanic Asian (A) populations are shown within a density stratum, with multiple codes representing more than one group.

Table 8. Area frame household-level race and ethnicity concentrations, across density substrata

Density stratum	Hispanic black	Non-Hispanic black	Hispanic Asian	Non-Hispanic Asian	Hispanic other	Minority	Nonminority	U.S. population
				Percent				
10 Low	9.77	11.09	20.13	22.62	14.55	13.87	73.01	59.23
20 Medium–HBA	4.44	3.58	8.76	10.88	5.39	5.21	5.66	5.55
24 Medium–H	1.17	0.51	4.33	1.70	5.61	2.55	2.78	2.72
25 Medium–HB	0.20	0.22	0.07	0.02	0.19	0.18	0.14	0.15
26 Medium–B	1.85	5.89	0.78	0.69	0.56	3.22	2.96	3.02
28 Medium–A	0.02	0.01	2.76	1.20	0.07	0.20	0.09	0.11
29 Medium–HA	1.28	0.32	2.97	4.41	1.41	1.27	1.25	1.26
30 Mixed–HBA	16.73	9.87	20.20	27.03	13.90	13.67	4.41	6.57
34 Mixed–H	4.81	1.82	7.46	2.86	12.41	5.87	2.01	2.91
35 Mixed–HB	8.06	5.84	3.38	2.64	5.62	5.36	1.85	2.67
36 Mixed–B	10.40	27.92	3.66	3.69	2.75	15.34	3.40	6.18
38 Mixed–A	0.08	0.04	5.19	4.42	0.09	0.64	0.08	0.21
39 Mixed–HA	0.29	0.14	1.90	3.56	0.91	0.87	0.32	0.45
40 High–H	20.91	3.13	13.86	5.09	33.69	14.74	1.25	4.39
60 High–B	19.66	29.52	2.34	1.44	2.29	15.74	0.65	4.17
80 High–A	0.32	0.11	2.22	7.66	0.55	1.27	0.13	0.40
All	100	100	100	100	100	100	100	100

NOTES: Low is nonminority domination, Medium and Mixed are moderate minority domination, and High is high minority domination. The dominant minority racial or ethnic group is designated by sequence: Hispanic (H), non-Hispanic black (B), and non-Hispanic Asian (A) populations are shown within a density stratum, with multiple codes representing more than one group.

Table 9. Sampling rules within primary sampling unit: National Health Interview Survey, 2006

Density stratum[1]	r_d[2]	Beta (retention)	Annual minority HSD weight (SSU wt)	Annual nonminority HSD weight	Length of annual SSU
10 Low	1.0714	0.750000	2,497.52	3,330.03	16,12
20 Medium–HBA	0.7671	0.536943	1,788.03	3,330.03	12
24 Medium–H	0.7196	0.503709	1,677.37	3,330.03	12
25 Medium–HB	0.7671	0.536943	1,788.03	3,330.03	12
26 Medium–B	0.8275	0.579226	1,928.84	3,330.03	12
28 Medium–A	0.7196	0.503709	1,677.37	3,330.03	12
29 Medium–HA	0.7196	0.503709	1,677.37	3,330.03	12
30 Mixed–HBA	0.5335	0.373456	1,243.62	3,330.03	12
34 Mixed–H	0.5335	0.373456	1,243.62	3,330.03	12
35 Mixed–HB	0.5335	0.373456	1,243.62	3,330.03	12
36 Mixed–B	0.8275	0.579226	1,928.84	3,330.03	8
38 Mixed–A	0.5144	0.360061	1,199.01	3,330.03	12
39 Mixed–HA	0.5144	0.360061	1,199.01	3,330.03	12
40 High–H	0.4662	0.326343	1,086.73	3,330.03	8
60 High–B	0.7671	0.536943	1,788.03	3,330.03	8
80 High–A	0.5144	0.360061	1,199.01	3,330.03	8
Permit	0.9438	1.000000	2,200.00	2,200.00	4

[1]Low is nonminority domination, Medium and Mixed are moderate minority domination, and High is high minority domination. The dominant minority racial or ethnic group is designated by sequence: Hispanic (H), non-Hispanic black (B), and non-Hispanic Asian (A) populations are shown within a density stratum, with multiple codes representing more than one group.

[2]With a self-weighting sampling interval of 2,331.02.

NOTES: HSD is household, and SSU is secondary sampling unit.

Table 10. Housing unit distribution by measure and annual secondary sampling unit: National Health Interview Survey, 2006

Block	Housing unit count	Measure count	Housing unit measure within-block identification																					
Block A	8	2	1	2	1	2	1	2	1	2	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Block B[1]	19	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	. . .	. . .	. . .
Block C	14	4	1	2	3	4	1	2	3	4	1	2	3	4	1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Block D	21	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	. . .
Block E	16	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	. . .	. . .	. . .	. . .	. . .	. . .
Block F	22	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4
Block G	17	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	. . .	. . .	. . .	. . .	. . .
Block H	9	2	1	2	1	2	1	2	1	2	1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .

. . . Category not applicable.

[1]Measure (B,2) contains the four housing units in Block B labeled 2.

NOTES: Blocks ordered by a sorted list are a subset of eight blocks shown for illustration. Housing units are ordered by adjacent units within each block.

Table 11. Components of conceptual National Health Interview Survey sampling design

Sample step	Sample unit	Within-level units	Conditional probability of selection
1.	PSU[1]	Stratum	π_{si}, (PSU i from stratum s) π_{sij}, (joint selection probability for PSUs *i, j* from stratum s)
2.	Super-SSU[1]	PSU substratum	Pr (Super-SSU ∣ substratum)
3.	Annual SSU[1]	Super-SSU	1/12
4.	HU[2]	SSU	Pr (HU ∣ SSU)
5.	Household[2]	HU	1 if Asian-black-Hispanic household Pr (other) if non-Asian, non-black, non-Hispanic household
6.	Sample Adult/Sample Child	Household	Pr (Sample Adult/Sample Child ∣ household)

[1]See ''2006–2015 NHIS Sample Design'' section for details.

[2]HU is the residential dwelling selected as the household unit, without regard to its occupants (if any); household is the collection of occupants selected by characteristics within the HU; see the ''2006–2015 NHIS Sample Design'' section for details.

NOTES: PSU is primary sampling unit, SSU is secondary sampling unit, and HU is housing unit.

Table 12. First-stage ratio adjustment factors: National Health Interview Survey, 2007

Residence and race and ethnicity	Census region			
	East	Midwest	South	West
CBSA				
Hispanic	0.995986	1.01583	1.23773	[1]1.3
Non-Hispanic:				
Black	0.974668	0.947794	1.095412	1.26082
Asian	1.116528	0.903724	1.009949	1.147082
Other	0.965773	1.009789	1.038955	1.066556
Non-CBSA				
Hispanic	0.814659	0.838901	1.005845	[3]1.13269
Non-Hispanic:				
Black	[2]0.812500	0.849496	0.910805	0.889167
Asian	0.920991	0.985561	0.949706	1.006606
Other	[4]1.044991	1.002862	0.941044	0.868835

[1]Adjustment factors adjusted to 1.3 when observed to be larger.
[2]Adjustment factors adjusted to 0.8125 when observed to be smaller.
[3]Adjusted to compensate for the restriction of the West CBSA Hispanic factor to 1.3.
[4]Adjusted to compensate for the restriction of the East non-CBSA black factor to 0.8125.
NOTE: CBSA is core-based statistical area.

Table 13. The 100 age, sex, race and ethnicity classes used for poststratification: 2006 National Health Interview Survey

Age (years)	Hispanic		Non-Hispanic black		Non-Hispanic Asian		Non-Hispanic other	
	Male	Female	Male	Female	Male	Female	Male	Female
Under 1 year	X	X	X	X	...	...	X	X
Under 5	...	...	...	...	X	X	...	...
1–4	X	X	X	X	...	...	X	X
5–17	...	...	...	...	X	X	...	...
5–9	X	X	X	X	...	...	X	X
10–14	X	X	X	X	...	...	X	X
15–17	X	X	X	X	...	...	X	X
18–24	...	...	...	...	X	X	...	...
18–19	X	X	X	X	...	...	X	X
20–24	X	X	X	X	...	...	X	X
25–44	...	...	...	...	X	X	...	...
25–29	X	X	X	X	...	...	X	X
30–34	X	X	X	X	...	...	X	X
35–44	X	X	X	X	...	...	X	X
45–64	...	...	...	...	X	X	...	...
45–49	X	X	X	X	...	...	X	X
50–54	X	X	X	X	...	...	X	X
55–64	X	X	X	X	...	...	X	X
65 and over	X	X	...	...	X	X	...	...
65–74	...	...	X	X	...	...	X	X
75 and over	...	...	X	X	...	...	X	X

. . . Category not applicable.

Table 14. Impact of poststratification on variance estimation: National Health Interview Survey, 2006

Domain and variable	Estimated totals				Estimated means			
		CV		Ratio		CV		Ratio
	Number (thousands)[1]	CV_{post}[2]	CV_{base}[3]	CV_{base} / CV_{post}	Mean[4]	CV_{post}[5]	CV_{base}[6]	CV_{base} / CV_{post}
All persons								
Has activity limitation	35,776	1.53	2.02	1.32	0.12	1.53	1.62	1.06
Without health insurance	43,730	1.58	2.10	1.33	0.15	1.57	1.70	1.09
Has fair or poor health	27,766	1.74	2.12	1.22	0.09	1.74	1.81	1.04
Saw health professional, 2-week recall	42,913	1.21	1.80	1.49	0.15	1.21	1.25	1.04
Doctor visits in past year	1,626,668	1.59	2.19	1.38	5.58	1.59	1.66	1.05
Usual place to go for medical care	181,636	0.42	1.45	3.46	0.82	0.42	0.45	1.07
Obese persons	54,050	1.40	1.94	1.39	0.25	1.40	1.43	1.02
Regular leisure-time physical activity	65,776	1.51	2.09	1.38	0.30	1.51	1.51	1.00
Current smoking status	45,296	1.65	2.14	1.30	0.21	1.65	1.67	1.01
Diagnosed with diabetes	17,110	2.73	3.07	1.13	0.08	2.73	2.81	1.03
Current asthma	8,372	3.92	4.18	1.06	0.04	3.92	3.96	1.01
All females								
Has activity limitation	18,919	1.74	2.29	1.32	0.13	1.74	1.90	1.09
Without health insurance	19,709	1.92	2.30	1.20	0.13	1.90	1.94	1.02
Has fair or poor health	15,132	1.96	2.35	1.20	0.10	1.95	2.03	1.04
Saw health professional, 2-week recall	24,908	1.42	1.97	1.39	0.17	1.42	1.45	1.03
Doctor visits in past year	952,786	1.91	2.46	1.28	6.41	1.92	1.97	1.03
Usual place to go for medical care	99,180	0.44	1.64	3.74	0.87	0.44	0.45	1.03
Obese persons	27,504	1.93	2.45	1.27	0.24	1.93	1.96	1.01
Regular leisure-time physical activity	31,804	2.10	2.67	1.27	0.28	2.10	2.05	0.98
Current smoking status	20,249	2.29	2.72	1.19	0.18	2.29	2.29	1.00
Diagnosed with diabetes	8,906	3.57	3.92	1.10	0.08	3.57	3.64	1.02
Current asthma	5,794	4.51	4.78	1.06	0.05	4.51	4.48	0.99
Currently employed persons								
Has activity limitation	6,869	3.16	3.49	1.11	0.05	3.13	3.13	1.00
Without health insurance	25,557	1.68	2.24	1.33	0.18	1.72	1.84	1.07
Has fair or poor health	7,992	2.74	3.00	1.09	0.06	2.75	2.76	1.01
Saw health professional, 2-week recall	17,869	1.93	2.41	1.25	0.13	1.91	1.88	0.98
Doctor visits in past year	661,923	2.48	3.01	1.21	4.66	2.44	2.44	1.00
Usual place to go for medical care	114,042	0.80	1.57	1.96	0.80	0.55	0.58	1.07
Obese persons	34,616	1.82	2.25	1.24	0.24	1.78	1.79	1.01
Regular leisure-time physical activity	46,241	1.78	2.30	1.29	0.32	1.68	1.68	1.00
Current smoking status	30,720	2.03	2.48	1.22	0.21	1.97	2.00	1.01
Diagnosed with diabetes	6,602	4.27	4.52	1.06	0.05	4.25	4.39	1.03
Current asthma	4,392	5.68	5.81	1.02	0.03	5.60	5.62	1.00
Family income over $35,000								
Has activity limitation	1,762	5.93	6.07	1.02	0.04	5.81	5.80	1.00
Without health insurance	2,596	5.54	5.62	1.01	0.06	5.34	5.25	0.98
Has fair or poor health	1,665	5.79	5.91	1.02	0.04	5.74	5.80	1.01
Saw health professional, 2-week recall	6,605	3.14	3.44	1.09	0.15	2.89	2.86	0.99
Doctor visits in past year	252,585	4.69	5.10	1.09	5.76	4.27	4.32	1.01
Usual place to go for medical care	42,299	1.72	2.28	1.33	0.87	0.66	0.68	1.02
Obese persons	12,971	3.28	3.53	1.08	0.27	2.82	2.84	1.00
Regular leisure-time physical activity	19,243	3.01	3.44	1.14	0.40	2.31	2.28	0.99
Current smoking status	8,437	3.88	4.04	1.04	0.17	3.76	3.78	1.00
Diagnosed with diabetes	2,264	7.29	7.50	1.03	0.05	7.19	7.39	1.03
Current asthma	1,458	9.49	9.59	1.01	0.03	9.20	9.19	1.00

See footnotes at end of table.

Table 14. Impact of poststratification on variance estimation: National Health Interview Survey, 2006—Con.

Domain and variable	Estimated totals				Estimated means			
		CV		Ratio		CV		Ratio
	Number (thousands)[1]	CV_{post}[2]	CV_{base}[3]	CV_{base} / CV_{post}	Mean[4]	CV_{post}[5]	CV_{base}[6]	CV_{base} / CV_{post}
College graduate, aged 35–44								
Has activity limitation	720	8.78	8.90	1.01	0.04	8.80	8.89	1.01
Without health insurance	1,341	6.74	6.90	1.02	0.08	6.73	6.80	1.01
Has fair or poor health	537	8.89	9.03	1.02	0.03	8.97	9.09	1.01
Saw health professional, 2-week recall	2,212	4.70	5.19	1.10	0.13	4.59	4.65	1.01
Doctor visits in past year	87,576	6.74	7.28	1.08	5.15	6.64	6.77	1.02
Usual place to go for medical care	15,743	2.54	3.52	1.38	0.87	0.99	1.00	1.01
Obese persons	3,489	5.53	6.00	1.08	0.19	5.18	5.21	1.01
Regular leisure-time physical activity	7,607	4.07	4.78	1.17	0.42	3.22	3.28	1.02
Current smoking status	2,072	7.76	8.11	1.04	0.12	7.52	7.65	1.02
Diagnosed with diabetes	647	14.90	15.20	1.02	0.04	14.59	14.71	1.01
Current asthma	708	13.07	13.37	1.02	0.04	13.08	13.29	1.02
Non-Hispanic black, aged 65–74								
Has activity limitation	603	5.99	7.54	1.26	0.33	5.93	5.91	1.00
Without health insurance	34	32.08	31.86	0.99	0.02	32.08	31.60	0.99
Has fair or poor health	661	6.33	8.07	1.28	0.36	6.21	6.10	0.98
Saw health professional, 2-week recall	443	7.65	9.10	1.19	0.24	7.63	7.60	1.00
Doctor visits in past year	16,531	9.74	10.56	1.08	9.05	9.61	9.38	0.98
Usual place to go for medical care	1,952	1.90	6.48	3.41	0.94	1.39	1.45	1.04
Obese persons	795	6.69	9.46	1.41	0.38	6.72	7.00	1.04
Regular leisure-time physical activity	423	12.63	15.20	1.20	0.20	12.54	13.00	1.04
Current smoking status	293	13.53	14.95	1.10	0.14	13.53	14.27	1.05
Diagnosed with diabetes	661	7.95	9.97	1.25	0.32	7.86	8.31	1.06
Current asthma	49	31.59	32.06	1.01	0.02	31.61	31.86	1.01

[1]Estimated total is based on poststratification weight.

[2]Estimated CV of total using linearized final weight, shown as a percentage; uses equation (8) Yates-Grundy-Sen variance estimator along with linearization for poststratification.

[3]Estimated CV of total using final poststratification weight treated as an inflation weight, shown as a percentage; uses equation (8) Yates-Grundy-Sen variance estimator.

[4]Estimated based on poststratification weight.

[5]Estimated CV of mean using linearized final weight, shown as a percentage; uses equation (8) Yates-Grundy-Sen variance estimator along with linearization for poststratification.

[6]Estimated CV of mean using linearized final weight, shown as a percentage; uses equation (8) Yates-Grundy-Sen variance estimator.

NOTES: CV is coefficient of variation. Person File variables are persons with activity limitation; those without health insurance; those with fair or poor health; those who saw a health professional, based on a 2-week recall of the event; and the number of doctor visits in the past year. Sample Adult File variables are persons with a usual place to go for medical care; obese persons; those who engaged in regular leisure-time physical activity; a current smoking status; persons with diagnosed diabetes; and those with current asthma.

Table 15. Sample size and weighted size of survey populations, by domain: National Health Interview Survey, 2006

Domain	Sample size	Weighted size[1]
All persons	75,456	293,756,000
All females	39,108	149,937,000
Currently employed	35,356	142,902,000
Family income over $35,000.	10,055	43,884,000
College graduate, aged 35–44	4,077	17,054,000
Black, aged 65–74	714	1,855,000

[1]Rounded to the nearest thousand.

Table 16. Comparison of variance estimates obtained by several methods: National Health Interview Survey, 2006

Variable	All persons	Sex		Age (years)			
		Male	Female	0–17	18–44	45–64	65 and over
Persons with activity limitation							
Sample size	75,266	36,259	39,007	20,813	27,974	18,112	8,367
Weighted size[1]	293,000,000	143,480,000	149,519,000	73,148,000	110,261,000	74,114,000	35,476,000
Mean	0.12210	0.11749	0.12653	0.07462	0.05782	0.16222	0.33599
Standard error (full-post)	0.00186	0.00223	0.00220	0.00246	0.00184	0.00351	0.00740
Standard error (full)	0.00197	0.00230	0.00241	0.00244	0.00185	0.00355	0.00747
Standard error (public-post)	0.00189	0.00222	0.00225	0.00252	0.00183	0.00348	0.00735
Standard error (public)	0.00204	0.00226	0.00254	0.00247	0.00184	0.00353	0.00748
Total	35,776,000	16,857,000	18,919,000	5,459,000	6,375,000	12,023,000	11,919,000
Standard error (full-post)	545,691	319,396	329,361	179,647	202,642	260,333	262,579
Standard error (full)	723,608	389,839	434,067	199,026	226,546	324,181	363,126
Standard error (public-post)	551,687	318,410	335,691	184,078	201,826	257,512	260,686
Standard error (public)	780,953	401,572	472,559	197,875	234,024	323,714	384,098
Persons without health insurance							
Sample size	74,578	35,921	38,657	20,723	27,629	17,906	8,320
Weighted size	290,524,000	142,202,000	148,323,000	72,904,000	108,951,000	73,334,000	35,335,000
Mean	0.15052	0.16892	0.13288	0.09494	0.24601	0.13222	0.00876
Standard error (full-post)	0.00236	0.00274	0.00253	0.00334	0.00411	0.00328	0.00138
Standard error (full)	0.00256	0.00311	0.00258	0.00343	0.00438	0.00337	0.00128
Standard error (public-post)	0.00241	0.00282	0.00252	0.00364	0.00425	0.00331	0.00136
Standard error (public)	0.00263	0.00322	0.00258	0.00376	0.00453	0.00337	0.00126
Total	43,730,000	24,021,000	19,709,000	6,921,000	26,803,000	9,696,000	310,000
Standard error (full-post)	688,832	389,940	377,545	243,094	454,917	241,459	48,601
Standard error (full)	916,461	543,793	453,098	275,217	596,507	279,084	45,626
Standard error (public-post)	705,311	403,853	376,393	265,755	471,209	243,591	48,174
Standard error (public)	1,012,506	596,226	489,038	301,388	660,627	297,167	44,709
Self-reported fair or poor health							
Sample size	75,248	36,256	38,992	20,870	27,945	18,076	8,357
Weighted size	292,835,000	143,425,000	149,410,000	73,358,000	110,132,000	73,911,000	35,434,000
Mean	0.09482	0.08809	0.10128	0.01918	0.05654	0.15363	0.24770
Standard error (full-post)	0.00164	0.00188	0.00197	0.00135	0.00191	0.00342	0.00600
Standard error (full)	0.00172	0.00198	0.00206	0.00134	0.00191	0.00349	0.00606
Standard error (public-post)	0.00167	0.00190	0.00198	0.00132	0.00201	0.00337	0.00592
Standard error (public)	0.00179	0.00199	0.00216	0.00133	0.00201	0.00342	0.00601
Total	27,766,000	12,634,000	15,132,000	1,407,000	6,227,000	11,355,000	8,777,000
Standard error (full-post)	482,310	269,177	295,233	98,739	210,464	253,246	212,493
Standard error (full)	589,808	315,491	356,320	101,447	230,142	301,406	267,226
Standard error (public-post)	490,111	271,851	297,412	96,700	221,640	249,570	209,507
Standard error (public)	612,181	318,678	369,142	98,551	246,256	303,452	277,633
Number of doctor visits in past year							
Sample size	74,854	36,070	38,784	20,768	27,814	17,983	8,289
Weighted size	291,299,000	142,691,000	148,607,000	73,008,000	109,640,000	73,504,000	35,146,000
Mean	5.58419	4.72266	6.41143	3.66685	4.12412	7.08454	10.98402
Standard error (full-post)	0.08868	0.10514	0.12295	0.11884	0.11378	0.19161	0.33406
Standard error (full)	0.09296	0.10889	0.12659	0.12050	0.11517	0.19181	0.34139
Standard error (public-post)	0.09708	0.10366	0.13627	0.12173	0.11417	0.19651	0.34973
Standard error (public)	0.10398	0.10877	0.14217	0.12157	0.11471	0.19795	0.35812
Total	1,626,668,000	673,882,000	952,786,000	267,710,000	452,170,000	520,741,000	386,047,000
Standard error (full-post)	25,789,382	15,012,004	18,223,951	8,685,473	12,460,538	13,995,093	11,750,883
Standard error (full)	35,575,972	18,382,715	23,411,041	9,850,077	15,070,482	16,373,331	15,508,758
Standard error (public-post)	28,162,537	14,787,242	20,148,232	8,902,640	12,450,846	14,362,014	12,363,319
Standard error (public)	40,130,610	18,497,364	27,088,932	9,815,007	15,099,218	17,324,013	17,202,829

[1]Weighted sizes and totals rounded to the nearest thousand.

NOTES: The following NHIS design structures and SUDAAN were used for variance estimation: (Full) uses equation (8) of this report, with final weight treated as inflation weight; (full-post) uses equation (8) of this report, along with linearization for poststratification; (public) uses equation (9) of this report, with final weight treated as inflation weight; and (public-post) uses equation (9) of this report, along with linearization for poststratification.

Table 17. Precision comparisons between two survey designs: National Health Interview Survey, 1995–2005 and 2006–2015

Domain and variable[1]	Mean 2005	Mean 2006	CV 2005	CV 2006	CV change 2006–2005	Deft 2005	Deft 2006
All persons				Percent			
LA1AR	0.12	0.12	1.36	1.63	20	2.52	2.77
NOTCOV	0.14	0.15	1.48	1.72	16	3.60	3.92
HLT-FP	0.09	0.09	1.57	1.82	16	2.50	2.61
PHCDV2W	0.15	0.15	1.03	1.31	27	1.85	2.22
AUSUALPL	0.83	0.82	0.36	0.47	31	2.06	2.48
BMI	0.24	0.25	1.33	1.43	8	1.75	1.61
LEISURE	0.29	0.30	1.30	1.57	21	2.22	2.55
SMOKE	0.21	0.21	1.52	3.08	103	1.89	1.69
DIBEV	0.07	0.08	2.33	2.80	20	1.37	1.61
AASMYR	0.04	0.04	3.21	3.94	23	1.30	1.31
Aged 65 and over:							
LA1AR	0.35	0.33	1.58	2.23	41	1.48	2.11
NOTCOV	0.01	0.01	10.70	14.56	36	1.00	1.56
HLT-FP	0.26	0.25	2.04	2.46	21	1.69	1.66
PHCDV2W	0.28	0.27	1.64	2.25	37	1.19	1.56
AUSUALPL	0.82	0.85	0.99	0.99	0	1.59	1.42
BMI	0.24	0.26	3.72	4.13	11	1.54	1.54
LEISURE	0.30	0.30	2.93	3.88	32	1.34	1.73
SMOKE	0.21	0.18	3.90	4.93	26	1.49	1.42
DIBEV	0.08	0.07	6.17	8.03	30	1.17	1.34
AASMYR	0.04	0.03	9.88	12.64	28	1.40	1.29
Black							
LA1AR	0.13	0.13	3.27	3.36	3	2.10	2.02
NOTCOV	0.17	0.16	3.40	3.29	–3	3.04	2.45
HLT-FP	0.12	0.13	3.49	3.68	5	2.28	2.33
PHCDV2W	0.13	0.13	2.36	3.02	28	1.10	1.63
AUSUALPL	0.83	0.81	0.83	1.03	24	1.39	1.75
BMI	0.25	0.23	3.24	3.80	17	1.44	1.68
LEISURE	0.29	0.31	2.84	3.28	15	1.32	1.83
SMOKE	0.20	0.22	3.82	3.89	2	1.47	1.61
DIBEV	0.07	0.08	6.03	6.17	2	1.18	1.17
AASMYR	0.04	0.04	8.71	9.28	7	1.28	1.51
Aged 18–44:							
LA1AR	0.07	0.07	6.33	5.86	–7	1.44	1.17
NOTCOV	0.26	0.24	3.34	3.53	6	1.85	1.76
HLT-FP	0.08	0.09	6.16	6.23	1	1.57	1.59
PHCDV2W	0.11	0.10	4.55	5.08	12	1.17	1.32
AUSUALPL	0.83	0.82	1.36	1.56	15	1.34	1.59
BMI	0.25	0.22	5.43	6.56	21	1.48	1.68
LEISURE	0.30	0.30	4.74	5.00	5	1.46	1.50
SMOKE	0.20	0.22	6.28	6.25	0	1.52	1.54
DIBEV	0.07	0.07	9.47	10.45	10	1.05	1.07
AASMYR	0.03	0.05	15.01	15.46	3	1.17	1.69
Aged 65 and over:							
LA1AR	0.40	0.42	4.95	4.43	–11	1.96	1.56
NOTCOV	0.01	0.01	31.96	29.40	–8	1.45	1.32
HLT-FP	0.41	0.39	4.03	5.09	26	1.31	1.83
PHCDV2W	0.28	0.26	4.16	5.93	43	0.80	1.35
AUSUALPL	0.82	0.82	3.02	2.87	–5	1.58	1.30
BMI	0.26	0.25	9.92	11.13	12	1.33	1.41
LEISURE	0.29	0.33	9.04	9.15	1	1.27	1.41
SMOKE	0.18	0.21	14.20	12.57	–11	1.70	1.44
DIBEV	0.08	0.08	18.63	21.67	16	1.16	1.44
AASMYR	0.02	0.05	33.81	33.03	–2	1.02	1.84

See footnotes at end of table.

Table 17. Precision comparisons between two survey designs: National Health Interview Survey, 1995–2005 and 2006–2015—Con.

Domain and variable[1]	Mean 2005	Mean 2006	CV 2005	CV 2006	CV change 2006–2005	Deft 2005	Deft 2006
Hispanic			Percent				
LA1AR	0.08	0.08	3.13	3.85	23	1.95	2.17
NOTCOV	0.31	0.33	1.98	2.23	13	4.18	4.36
HLT-FP	0.09	0.10	3.06	3.88	27	2.29	2.87
PHCDV2W	0.10	0.09	2.87	3.00	5	2.15	1.68
AUSUALPL	0.84	0.83	0.65	0.80	23	1.62	1.69
BMI	0.24	0.24	2.70	2.78	3	1.68	1.41
LEISURE	0.30	0.31	2.21	2.65	20	1.55	1.75
SMOKE	0.21	0.20	2.80	3.41	22	1.53	1.64
DIBEV	0.07	0.07	4.70	5.91	26	1.20	1.52
AASMYR	0.04	0.03	7.36	8.54	16	1.62	1.49
Aged 18–44:							
LA1AR	0.04	0.04	5.50	7.00	27	1.22	1.48
NOTCOV	0.45	0.48	2.00	2.22	11	3.27	3.48
HLT-FP	0.07	0.08	4.74	5.64	19	1.66	2.01
PHCDV2W	0.08	0.06	4.36	5.16	18	1.56	1.37
AUSUALPL	0.83	0.83	1.02	1.18	16	1.66	1.62
BMI	0.24	0.24	3.77	4.64	23	1.47	1.68
LEISURE	0.30	0.30	3.33	3.79	14	1.51	1.51
SMOKE	0.22	0.20	6.44	4.69	–27	1.34	1.38
DIBEV	0.07	0.07	7.28	9.74	34	1.33	1.87
AASMYR	0.04	0.04	11.82	14.12	19	1.93	1.91
Aged 65 and over:							
LA1AR	0.33	0.30	4.58	6.94	52	1.29	1.79
NOTCOV	0.04	0.06	16.58	24.92	50	1.33	3.25
HLT-FP	0.38	0.34	4.63	6.11	32	1.65	1.63
PHCDV2W	0.24	0.23	6.13	6.82	11	1.48	1.19
AUSUALPL	0.84	0.86	2.79	2.67	–4	1.52	1.24
BMI	0.28	0.25	9.72	12.27	26	1.42	1.41
LEISURE	0.29	0.34	9.64	10.32	7	1.41	1.57
SMOKE	0.22	0.18	11.38	14.47	27	1.37	1.31
DIBEV	0.07	0.08	20.30	25.98	28	1.09	1.70
AASMYR	0.03	0.02	32.71	37.64	15	1.42	0.87
Asian							
LA1AR	0.05	0.06	8.98	7.15	–20	1.65	1.52
NOTCOV	0.16	0.13	6.55	6.61	1	2.84	3.15
HLT-FP	0.06	0.06	9.31	9.22	–1	1.85	2.59
PHCDV2W	0.11	0.10	5.99	5.05	–16	1.52	1.39
AUSUALPL	0.83	0.83	1.67	1.42	–15	1.64	1.50
BMI	0.25	0.24	6.00	5.43	–10	1.43	1.42
LEISURE	0.29	0.31	5.45	4.96	–9	1.43	1.68
SMOKE	0.20	0.21	7.16	6.35	–11	1.48	1.59
DIBEV	0.07	0.07	12.31	10.29	–16	1.34	1.27
AASMYR	0.04	0.04	14.85	14.43	–3	1.03	1.23
Aged 18–44:							
LA1AR	0.02	0.02	17.73	16.98	–4	1.22	1.40
NOTCOV	0.19	0.17	6.85	7.37	8	1.71	2.24
HLT-FP	0.02	0.03	18.82	18.37	–2	1.37	2.12
PHCDV2W	0.09	0.08	9.10	8.17	–10	1.19	1.19
AUSUALPL	0.83	0.85	2.32	2.01	–13	1.36	1.41
BMI	0.26	0.24	8.43	8.25	–2	1.29	1.34
LEISURE	0.29	0.33	8.08	6.87	–15	1.35	1.46
SMOKE	0.22	0.20	10.52	9.52	–10	1.57	1.43
DIBEV	0.09	0.08	15.73	15.13	–4	1.32	1.28
AASMYR	0.05	0.05	23.89	20.81	–13	1.50	1.33

See footnotes at end of table.

Table 17. Precision comparisons between two survey designs: National Health Interview Survey, 1995–2005 and 2006–2015—Con.

Domain and variable[1]	Mean 2005	Mean 2006	CV 2005	CV 2006	CV change 2006–2005	Deft 2005	Deft 2006
Aged 65 and over:				Percent			
LA1AR	0.26	0.25	12.85	9.75	–24	1.85	1.46
NOTCOV	0.05	0.03	26.33	33.08	26	1.21	1.42
HLT-FP	0.27	0.23	13.07	9.33	–29	2.06	1.20
PHCDV2W	0.26	0.24	12.45	10.90	–12	1.70	1.71
AUSUALPL	0.81	0.81	5.26	4.74	–10	1.24	1.28
BMI	0.22	0.30	22.05	14.81	–33	1.50	1.22
LEISURE	0.37	0.32	17.09	14.77	–14	1.84	1.34
SMOKE	0.09	0.19	32.49	20.82	–36	1.17	1.38
DIBEV	0.06	0.07	49.62	36.25	–27	1.73	1.30
AASMYR	0.05	0.01	46.41	70.84	53	1.16	0.73
All females							
LA1AR	0.13	0.13	1.57	1.96	25	1.81	2.17
NOTCOV	0.13	0.13	1.70	1.96	15	2.18	2.28
HLT-FP	0.10	0.10	1.66	2.05	23	1.56	1.85
PHCDV2W	0.18	0.17	1.16	1.53	32	1.47	1.82
AUSUALPL	0.88	0.87	0.38	0.46	21	1.86	1.89
BMI	0.23	0.24	1.76	1.95	11	1.65	1.63
LEISURE	0.28	0.28	1.69	2.13	26	1.94	2.37
SMOKE	0.18	0.18	1.99	2.28	15	1.53	1.53
DIBEV	0.07	0.08	3.24	3.65	13	1.47	1.53
AASMYR	0.05	0.05	3.63	4.47	23	1.27	1.45
Aged 65 and over:							
LA1AR	0.37	0.36	1.90	2.51	32	1.37	1.66
NOTCOV	0.01	0.01	14.13	20.93	48	0.99	1.78
HLT-FP	0.27	0.25	2.22	2.91	31	1.19	1.32
PHCDV2W	0.29	0.26	2.07	2.89	40	1.11	1.43
AUSUALPL	0.86	0.89	1.12	1.07	–4	1.60	1.34
BMI	0.23	0.24	4.62	6.10	32	1.32	1.74
LEISURE	0.29	0.28	4.23	5.38	27	1.50	1.63
SMOKE	0.20	0.15	5.26	7.26	38	1.37	1.39
DIBEV	0.07	0.06	8.80	11.14	27	1.25	1.25
AASMYR	0.05	0.04	11.20	14.68	31	1.43	1.28
White female							
LA1AR	0.14	0.14	1.91	2.31	21	1.71	1.78
NOTCOV	0.09	0.10	2.61	2.94	13	2.02	1.89
HLT-FP	0.09	0.10	2.24	2.67	19	1.53	1.55
PHCDV2W	0.19	0.18	1.34	1.82	36	1.23	1.53
AUSUALPL	0.88	0.88	0.47	0.54	15	1.64	1.52
BMI	0.23	0.25	2.31	2.55	10	1.63	1.53
LEISURE	0.27	0.27	2.29	2.44	7	2.00	1.62
SMOKE	0.18	0.17	2.57	3.13	22	1.47	1.49
DIBEV	0.08	0.08	4.23	4.66	10	1.48	1.39
AASMYR	0.05	0.05	5.05	5.67	12	1.35	1.21
Aged 18–44:							
LA1AR	0.07	0.07	4.28	5.37	25	1.27	1.43
NOTCOV	0.15	0.16	3.07	3.38	10	1.64	1.52
HLT-FP	0.05	0.05	5.09	6.17	21	1.47	1.51
PHCDV2W	0.17	0.16	2.34	2.93	25	1.12	1.17
AUSUALPL	0.88	0.86	0.74	1.02	38	1.48	1.58
BMI	0.23	0.26	3.58	4.26	19	1.32	1.56
LEISURE	0.27	0.27	3.70	3.93	6	1.82	1.42
SMOKE	0.17	0.19	4.50	5.45	21	1.50	1.64
DIBEV	0.08	0.09	6.95	7.83	13	1.50	1.40
AASMYR	0.06	0.06	7.90	10.17	29	1.28	1.53

See footnotes at end of table.

Table 17. Precision comparisons between two survey designs: National Health Interview Survey, 1995–2005 and 2006–2015—Con.

Domain and variable[1]	Mean 2005	Mean 2006	CV 2005	CV 2006	CV change 2006–2005	Deft 2005	Deft 2006
Aged 65 and over:				Percent			
LA1AR	0.37	0.35	2.24	2.89	29	1.39	1.50
NOTCOV	0.00	0.00	26.38	40.57	54	1.01	1.44
HLT-FP	0.25	0.22	2.74	3.57	30	1.17	1.20
PHCDV2W	0.29	0.27	2.39	3.26	36	1.12	1.29
AUSUALPL	0.86	0.90	1.23	1.22	–1	1.44	1.36
BMI	0.23	0.24	5.07	7.37	45	1.19	1.79
LEISURE	0.29	0.27	5.31	6.44	21	1.76	1.58
SMOKE	0.20	0.14	5.83	8.96	54	1.31	1.37
DIBEV	0.07	0.07	10.04	13.61	36	1.20	1.35
AASMYR	0.06	0.03	12.29	16.51	34	1.40	0.94
Black female							
LA1AR	0.13	0.13	3.84	4.23	10	1.59	1.83
NOTCOV	0.15	0.14	4.41	3.93	–11	2.53	1.68
HLT-FP	0.13	0.14	3.73	4.13	11	1.57	1.83
PHCDV2W	0.15	0.15	2.99	3.54	18	1.15	1.49
AUSUALPL	0.88	0.85	1.01	1.31	30	1.67	2.10
BMI	0.23	0.23	4.63	4.80	4	1.49	1.53
LEISURE	0.27	0.28	4.09	4.96	21	1.44	2.09
SMOKE	0.17	0.19	5.29	5.23	–1	1.35	1.42
DIBEV	0.08	0.08	7.55	8.18	8	1.08	1.23
AASMYR	0.06	0.05	9.40	11.22	19	1.22	1.60
Aged 18–44:							
LA1AR	0.07	0.07	7.71	7.99	4	1.24	1.25
NOTCOV	0.22	0.20	4.56	4.72	4	1.63	1.47
HLT-FP	0.09	0.09	6.78	6.90	2	1.18	1.28
PHCDV2W	0.14	0.14	5.04	5.55	10	1.12	1.31
AUSUALPL	0.87	0.85	1.55	2.15	39	1.33	2.05
BMI	0.23	0.21	7.69	8.78	14	1.49	1.64
LEISURE	0.27	0.26	6.98	6.86	–2	1.53	1.32
SMOKE	0.15	0.21	9.51	8.42	–11	1.35	1.45
DIBEV	0.08	0.06	12.56	14.62	16	1.18	1.04
AASMYR	0.04	0.06	18.61	18.30	–2	1.35	1.67
Aged 65 and over:							
LA1AR	0.43	0.47	5.16	4.92	–5	1.41	1.45
NOTCOV	0.00	0.01	26.38	45.56	73	1.01	1.18
HLT-FP	0.42	0.40	4.95	6.02	22	1.23	1.65
PHCDV2W	0.29	0.27	6.30	6.96	10	1.12	1.23
AUSUALPL	0.87	0.87	3.25	2.99	–8	1.42	1.20
BMI	0.25	0.21	14.00	17.08	22	1.37	1.54
LEISURE	0.34	0.29	11.72	13.53	15	1.43	1.44
SMOKE	0.19	0.19	18.44	16.88	–8	1.64	1.33
DIBEV	0.08	0.07	28.60	28.61	0	1.47	1.15
AASMYR	0.03	0.07	43.05	37.53	–13	1.33	2.18
Hispanic female							
LA1AR	0.08	0.08	4.27	4.49	5	1.90	1.53
NOTCOV	0.28	0.29	2.25	2.46	9	2.30	2.23
HLT-FP	0.10	0.10	3.34	4.04	21	1.54	1.71
PHCDV2W	0.13	0.12	3.23	3.67	14	1.79	1.57
AUSUALPL	0.89	0.87	0.65	0.83	28	1.40	1.48
BMI	0.23	0.24	3.45	3.90	13	1.47	1.51
LEISURE	0.30	0.28	2.96	3.97	34	1.57	1.99
SMOKE	0.19	0.18	3.90	4.64	19	1.47	1.46
DIBEV	0.07	0.07	6.62	8.20	24	1.33	1.58
AASMYR	0.05	0.05	8.38	10.22	22	1.60	1.80

See footnotes at end of table.

Table 17. Precision comparisons between two survey designs: National Health Interview Survey, 1995–2005 and 2006–2015—Con.

Domain and variable[1]	Mean 2005	Mean 2006	CV 2005	CV 2006	CV change 2006–2005	Deft 2005	Deft 2006
			Percent				
Aged 18–44:							
LA1AR	0.04	0.04	7.67	10.45	36	1.24	1.61
NOTCOV	0.39	0.41	2.39	2.72	14	1.82	1.98
HLT-FP	0.08	0.08	5.63	6.01	7	1.34	1.21
PHCDV2W	0.11	0.09	4.60	5.93	29	1.36	1.40
AUSUALPL	0.88	0.86	1.11	1.36	23	1.65	1.60
BMI	0.22	0.23	5.17	6.25	21	1.39	1.66
LEISURE	0.31	0.29	4.77	5.34	12	1.85	1.63
SMOKE	0.17	0.19	6.33	6.87	9	1.55	1.52
DIBEV	0.07	0.08	10.67	13.34	25	1.48	2.16
AASMYR	0.05	0.06	13.86	16.16	17	2.05	2.21
Aged 65 years:							
LA1AR	0.38	0.30	5.24	7.84	50	1.14	1.31
NOTCOV	0.04	0.07	22.80	31.52	38	1.51	3.63
HLT-FP	0.40	0.34	5.13	7.52	47	1.24	1.43
PHCDV2W	0.27	0.22	7.16	8.89	24	1.29	1.10
AUSUALPL	0.87	0.90	3.61	3.26	–10	1.86	1.45
BMI	0.26	0.23	13.51	16.95	25	1.38	1.33
LEISURE	0.26	0.31	12.51	15.06	20	1.13	1.58
SMOKE	0.19	0.16	15.54	21.92	41	1.23	1.39
DIBEV	0.08	0.04	24.30	49.23	103	1.11	1.62
AASMYR	0.04	0.04	37.12	37.42	1	1.14	0.95
Asian female							
LA1AR	0.06	0.06	12.19	9.34	–23	1.73	1.40
NOTCOV	0.14	0.12	7.41	7.63	3	1.71	1.93
HLT-FP	0.07	0.06	11.03	10.16	–8	1.57	1.70
PHCDV2W	0.13	0.12	7.21	6.54	–9	1.45	1.42
AUSUALPL	0.86	0.87	2.11	1.58	–25	1.88	1.40
BMI	0.25	0.24	8.14	7.86	–3	1.47	1.57
LEISURE	0.27	0.31	8.01	7.34	–8	1.55	2.02
SMOKE	0.16	0.19	10.81	9.47	–12	1.45	1.68
DIBEV	0.06	0.09	17.11	14.23	–17	1.35	1.55
AASMYR	0.06	0.05	17.31	17.38	0	1.21	1.36
Aged 18–44:							
LA1AR	0.02	0.02	26.32	24.80	–6	1.18	1.41
NOTCOV	0.17	0.15	9.07	8.75	–4	1.33	1.36
HLT-FP	0.03	0.03	22.53	22.35	–1	1.26	1.36
PHCDV2W	0.12	0.11	10.24	10.53	3	1.09	1.35
AUSUALPL	0.86	0.87	2.84	2.48	–13	1.50	1.47
BMI	0.29	0.22	11.01	11.44	4	1.42	1.28
LEISURE	0.25	0.30	11.50	10.08	–12	1.31	1.58
SMOKE	0.16	0.18	16.59	13.07	–21	1.55	1.35
DIBEV	0.08	0.09	20.34	19.12	–6	1.09	1.29
AASMYR	0.07	0.06	28.73	26.38	–8	1.83	1.46
Aged 65 and over:							
LA1AR	0.29	0.26	15.00	11.81	–21	1.72	1.25
NOTCOV	0.06	0.03	28.90	40.49	40	0.99	1.11
HLT-FP	0.28	0.24	14.32	12.52	–13	1.49	1.25
PHCDV2W	0.29	0.25	13.52	12.66	–6	1.43	1.39
AUSUALPL	0.86	0.78	6.35	7.52	18	1.48	1.47
BMI	0.15	0.33	33.81	17.70	–48	1.23	1.11
LEISURE	0.38	0.30	24.40	20.56	–16	2.20	1.30
SMOKE	0.11	0.21	39.89	27.05	–32	1.21	1.37
DIBEV	0.10	0.06	55.76	43.50	–22	2.00	0.92
AASMYR	0.09	0.01	45.63	99.88	119	1.22	0.73

[1]LA1AR is the proportion of persons with activity limitation; NOTCOV is the proportion of persons without health insurance; HLT-FP is the proportion of persons with fair or very poor health; PHCDV2W is the proportion of persons who saw a health professional, based on a 2-week recall of the event; AUSUALPL is the proportion of persons with a usual place to go for medical care; TDV is the mean number of doctor visits per in the past year; BMI is the proportion of persons who were obese; LEISURE is the proportion of persons who engaged in regular leisure-time physical activity; SMOKE is the proportion of persons with current smoking status; DIBEV is the proportion of persons with diagnosed diabetes; and AASMYR is the proportion of persons with current asthma.

NOTES: CV is coefficient of variation, and deft is design effect.

Appendix I. Glossary

Acronyms

CAPI	Computer-assisted personal interviewing
CD–ROM	Compact disk–read-only memory
CMSA	Consolidated metropolitan statistical areas
CPS	Current Population Survey
CV	Coefficient of variation
DHIS	Division of Health Interview Statistics
DSMD	Demographic Statistical Methods Division
HU	Housing unit
MA	Metropolitan area
MEPS	Medical Expenditure Panel Survey
MSA	Metropolitan statistical area
MSE	Mean square error
NCHS	National Center for Health Statistics
NECMA	New England County Metropolitan Area
NHIS	National Health Interview Survey
NSR	Nonself-representing
OMB	Office of Management and Budget
ORM	Office of Research and Methodology
PSU	Primary sampling unit
SI	Sampling interval
SR	Self-representing
SSU	Secondary sampling unit

Definition of terms

The following definitions are commonly used in this report.

Area frame—A portion of the 2006–2015 NHIS sample frame, consisting of geographic areas where address listing operations are conducted to obtain a list of addresses from which NHIS sample cases are selected.

Civilian noninstitutionalized population—Persons who currently reside in one of the 50 states or the District of Columbia, who do not reside in institutions (e.g., penal and mental facilities or homes for the aged) and who are not on active duty in the Armed Forces.

Family—An individual or a group of two or more related persons who are living together in the same household, for example, the reference person, his or her spouse, foster son, daughter, son-in-law, their children, and the wife's uncle. Unmarried couples (same-sex and opposite-sex couples) are considered as belonging to the same family. Additional groups of persons living in the household who are related to each other, but not to the reference person, are considered to be separate families; for example, a lodger and his or her family, or a household employee and his or her spouse, or a single boarder with no one related to him or her living in the household. Hence, more than one family may live in a household, or a family can consist of only one person. Note that each family is considered a separate case and interviewed separately.

Group quarters—A type of living quarters where the residents share common facilities or receive authorized care or custody (e.g., dormitories, boardinghouses, or convents). A group quarters does not meet the regular housing unit definition.

Household—An entire group of persons who live in one housing unit or one group quarters unit, composed of one or more families. It may constitute several persons living together or one person living alone. A household includes the reference person and any relatives living in the unit, and may also include roomers, live-in domestic workers, or other persons not related to the reference person.

Housing unit (HU)—A group of rooms or a single room occupied or intended for occupancy as separate living quarters. An HU may be occupied by a family or one person, as well as by two or more unrelated persons who share the living quarters. An HU does not need to be a structure; for example, trailers, tents, boats, trucks, buses, and caves, among others, may be HUs if they are used as separate living quarters.

Listing—The field process where interviewers are sent to selected sampled areas to list all housing units.

Metropolitan area (MA)—A large population nucleus together with adjacent communities that have a high degree of economic and social integration with that nucleus. Some MAs are defined around two or more nuclei; for more information, visit http://www.census.gov/population/metro/about/.

Metropolitan statistical area (MSA)—Constitutes an MA that is not closely associated with other MAs. MSAs typically are surrounded by nonmetropolitan counties (county subdivisions in New England prior to 2003).

Nonself-representing (NSR) PSU—A PSU that is selected from a sampling stratum containing other PSUs; that is, a PSU selected with probability less than 1.

Oversample—A sampling procedure designed to give a demographic or geographic population a larger proportion of representation in the sample than the population's proportion of representation in the overall population.

Permit frame—A portion of the 2006–2015 NHIS sample frame, consisting of residential building permits.

Screening—An interviewing procedure whereby households that do not meet specified criteria (e.g., not containing civilian Asian, black, or Hispanic members) are not administered a full-length interview. In NHIS, the screening procedure consists of the initial portion of the NHIS interview, up to and including the point where the household composition is determined.

Self-representing (SR) primary sampling unit—A PSU that is the only member of its sampling stratum; that is, a PSU selected with certainty.

Title 13 survey—A survey that can only be shared with U.S. Census Bureau employees or special sworn-status employees.

Title 15 survey—A survey that can be shared with sponsors.

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Series 4. **Documents and Committee Reports**—These are final reports of major committees concerned with vital and health statistics and documents. The last Series 4 report was published in 2002. As of 2009, this type of report is included in Series 2 or another appropriate series, depending on the report topic.

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Series 16. **Compilations of Advance Data From Vital and Health Statistics**—The last Series 16 report was published in 1996. All reports are available online, and so compilations of Advance Data reports are no longer needed.

Series 22. **Data From the National Mortality and Natality Surveys**—The last Series 22 report was published in 1973. Reports from these sample surveys, based on vital records, are published in Series 20 or 21.

Series 24. **Compilations of Data on Natality, Mortality, Marriage, and Divorce**—The last Series 24 report was published in 1996. All reports are available online, and so compilations of reports are no longer needed.

For answers to questions about this report or for a list of reports published in these series, contact:

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