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Investigation of Nonresponse Bias: Hispanic Health and Nutrition Examination Survey

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This report presents an investigation of potential nonresponse bias in the Hispanic Health and Nutrition Examination Survey (HHANES) conducted during the period 1982–84. Data from a household and medical history interview were used to investigate factors related to examination status. The study includes a comparison of data for examinees in HHANES with data from interviewees in the National Health Interview Survey during 1982, 1983, and 1984.

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0.0	Quantity more than zero but less than 0.05
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Investigation of Nonresponse Bias: Hispanic Health and Nutrition Examination Survey

by Michael L. Rowland, Division of Health Examination Statistics, National Center for Health Statistics, and Ronald N. Forthofer, Ph.D., Biostatistician, Boulder, Colorado

Introduction

From 1960 through 1980 the National Center for Health Statistics (NCHS) conducted five population-based National Health Examination Surveys (table A). As with all surveys, the representativeness of the sample to the target population has been a primary concern. The first of a series of NCHS publications based on these surveys focused on an evaluation of "the similarity between the sample and universe it represents and the impact of nonresponse (1)." This concern has been echoed in a number of NCHS studies since then (2–4) and is the topic of the present paper—an evaluation of response status for Hispanics selected for examination in the Hispanic Health and Nutrition Examination Survey (HHANES), conducted from July 1982 through December 1984.

As shown in figure 1 and table 1, the relatively high examination response rates of the first, second, and third National Health Examination Surveys of adults, children, and youths, respectively, conducted during the 1960's have been followed by lower examination response rates in the first and second National Health and Nutrition Examination Surveys (NHANES I and NHANES II) in the 1970's and HHANES in the early 1980's.

In a health examination survey, as well as any survey involving volunteer participation, the survey meets one of its severe problems after the sample is identified and the sample persons are requested to participate in the examination. A sizable number of sample persons who initially are willing to complete the household information, and possibly some of the medical history questionnaires (which are done in the household), usually will not participate in the examination. Full participation by individuals is determined by many factors, some of them uncontrollable by either the sample person or the survey personnel. For example, family health beliefs and practices, employment status, and access to transportation could affect participation in the survey.

Because nonresponse is a potential source of bias, intensive efforts were made in HHANES to develop and to implement procedures and inducements to reduce the number of nonrespondents and thereby reduce the potential of bias due to nonresponse. Among these were remuneration (that is, sample persons were given $20.00 after receiving the examination, as well as either taxi fare or milage costs of driving to and from the examination center), community outreach programs (a HHANES public affairs task force designed, developed, implemented, and coordinated a public affairs initiative, which was an integral part of the survey operations), Spanish-language translated questionnaires, and bilingual and/or bicultural household interviewers. These procedures are discussed in a Vital and Health Statistics series report (5).

Despite response rates of 87, 79, and 89 percent at the household interview stage for Mexican American, Cuban, and Puerto Rican subsamples of the HHANES and intensive efforts of persuasion, only 76, 61, and 75 percent of sample persons for these groups, respectively, were examined. Consequently, the potential for a sizable bias exists in the estimates from these subsamples.

Using data from HHANES and from the National Health Interview Survey (NHIS), efforts have been made to examine possible demographic and health-related differences between examined and nonexamined persons. In addition to nonresponse to the examination (unit nonresponse), nonresponse to a particular examination component (component nonresponse) and nonresponse to particular items within an examination component (item nonresponse) are treated here in an estimation of potential nonresponse bias.

For the analyst who must evaluate nonresponse bias, both the results of the exploratory analysis presented here for the HHANES and the analytic approach used here involving questionnaire data internal to the HHANES survey and external to the HHANES data (comparable National Health Interview Survey questionnaire data) will be of interest. The methodologies used here find their

Table A. Health examination surveys conducted by the National Center for Health Statistics, by years of survey and ages of persons examined, 1960–80

Survey	*Date*	*Ages*
First National Health Examination Survey (NHES I)	1960–62	18–79 years
Second National Health Examination Survey (NHES II)	1963–65	6–11 years
Third National Health Examination Survey (NHES III)	1966–70	12–17 years
First National Health and Nutrition Examination Survey (NHANES I)	1971–74	1–74 years
Second National Health and Nutrition Examination Survey (NHANES II)	1976–80	6 months–74 years

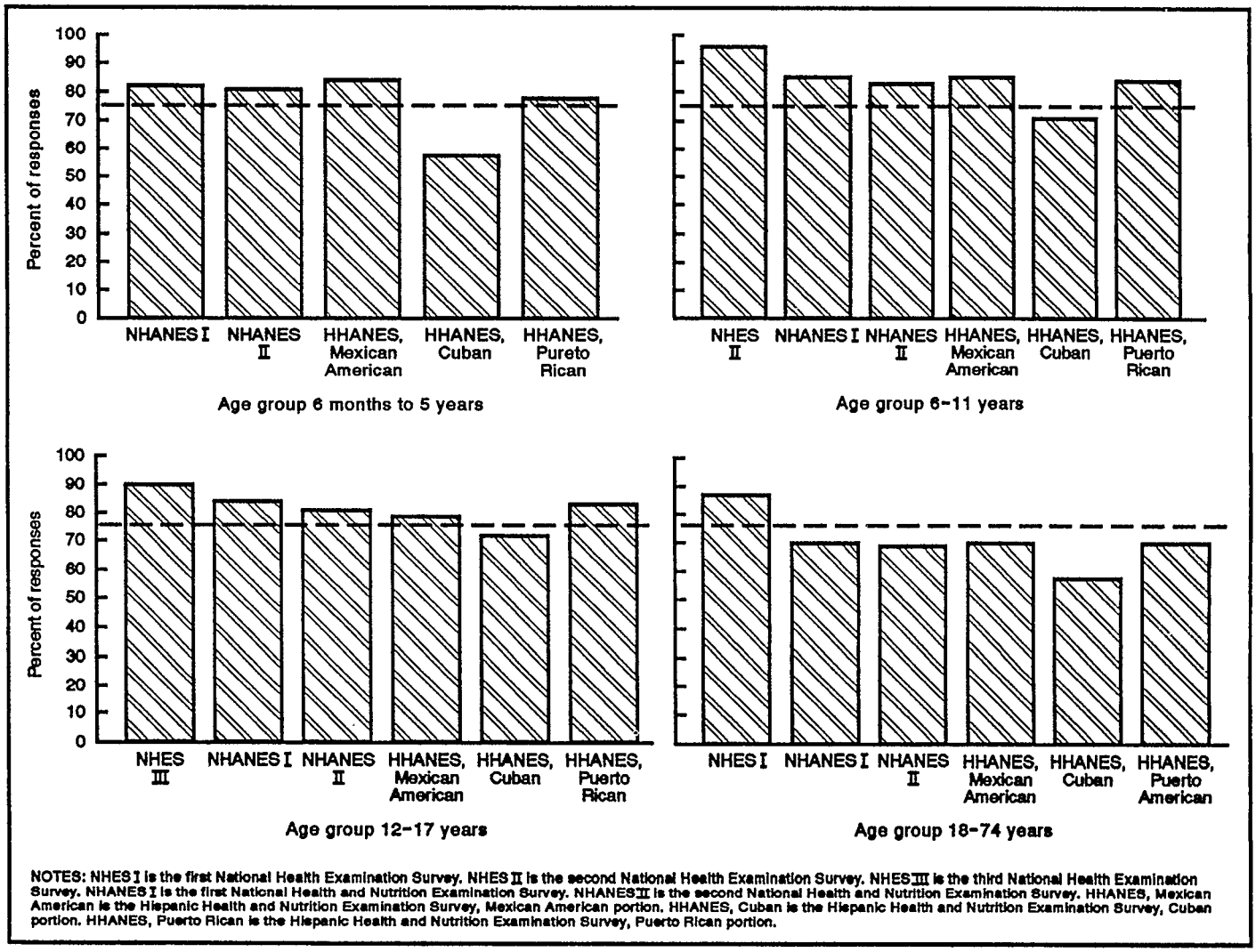

Figure 1. Examination response rates by age groups for surveys conducted by the National Center for Health Statistics from 1960 through 1984

antecedents in previous nonresponse studies, and the findings presented here can be placed in the context of those studies. More information on methodologies used in nonresponse adjustment have been published previously (6).

As with any methodology, the assumptions made are critical to an evaluation of the results. All methods dealing with nonresponse adjustment, including statistical weighting, imputation, and probability approaches, find it necessary at some stage to make an assumption about the similarity of respondents and nonrespondents. For example, a common practice is to employ interview questionnaire data in evaluating examination nonresponse (5). The assumption is made that any residual reporting bias of demographic and health history data is similar for respondents and nonrespondents. Where there is evidence to the contrary, differential reporting bias could confound a nonresponse evaluation such as the present one.

The interpretation of nonresponse bias analyses must also be made in the context of other issues such as measurement error and other methodologic biases. For example, in a survey like HHANES, the results from the physical examination measurements may not coincide with the results from the interview. This could be the result of bias in either of the components or both. Careful review and interpretation of both the statistical and methodological (physiologic or substantive) issues are as important in the analysis of nonresponse bias as they are in the basic descriptive or multivariate analysis.

Reviews of nonresponse studies were conducted in Cycle I of the Health Examination Survey, 1960–62, and in the first National Health Nutrition Examination Survey, 1971–74, by Landis et al. (7). They summarize,

> During the early stages of NHANES I, when it became apparent that the response rate for the examinations was lower than in the preceding health examination surveys, a study of the effect of remuneration upon response in NHANES I was undertaken. The findings, published by NCHS (4), included remuneration as a routine procedure in NHANES I starting with the 21st and 22d examination locations.

Using data from NHANES I and from an earlier survey, efforts have been made to examine possible health-related differences between examined and nonexamined persons. An investigation of reasons for participation and nonparticipation in NHANES I was conducted by interviewing a sample of 406 people composed of 290 examined persons, 35 persons who had made appointments for the examination but who never came to the mobile examination center for the examination, and 81 persons who refused to participate in the survey (8)...They were asked to indicate why they did not choose to be examined in NHANES I. The primary reasons given were that they had no need for a physical examination (48 percent), or that the examination times were inconvenient because of work schedules or other demands (15 percent). Only 6 percent of those persons who were not examined indicated that they refused the examination because of sickness, and 3 percent based their refusal on a fear of possible findings.

Data on both examined and nonexamined (but interviewed) persons were analyzed by using information from the first 35 survey locations of NHANES I (9). For the health characteristics compared, the two groups were quite similar. For example, 20 percent of the examined people reported that a doctor had told them they had arthritis compared with 17 percent of the unexamined people. Similarly, 18 percent of both the examined and nonexamined persons had been told by a doctor that they had high blood pressure. Twelve percent of both groups reported that they were on a special diet and 6 percent of both groups said that they regularly used medication for nerves.

In another study of factors relating to response in Cycle I of the Health Examination Survey, 36 percent of the nonexamined people viewed themselves as being in excellent health compared with 31 percent of the examined people (2). A self-appraisal of poor health was made by 5 percent of the nonexamined persons and by 6 percent of those who were examined. In a different study of Cycle I findings, those who participated in the survey with no persuasion and those who participated only after a great deal of persuasion generally had few differences for numerous selected examination and questionnaire items (10).

Forthofer evaluated nonresponse in NHANES II (11). This study used the Automatic Interaction Detection (AID) procedure (12) for identification of variables associated with nonresponse. Another analysis included a comparison with estimates from the NHIS. This study also included a review of previous health examination surveys and the factors associated with nonresponse in those surveys as well as in the NHANES II. Forthofer found that the factor most highly associated with examination status is whether people had problems that they wished to discuss with a physician. In his survey of the nonresponse literature, Forthofer found that response rates were highest for those subjects reporting a health care need or condition (1,2,13–15).

Another report provides an overview of nonresponse bias in NHANES II and, to a lesser extent, HHANES (16). This report included an evaluation of techniques for reducing item nonresponse bias. In addition, some preliminary investigations of nonresponse in HHANES have appeared in the literature (17–19).

Sources of data and analytical issues

Sources

The Hispanic Health and Nutrition Examination Survey (HHANES), conducted from July 1982 through December 1984, is one of a series of health examination surveys conducted by NCHS. The major difference between HHANES and other health examination surveys is that HHANES was a survey of three special subgroups of the population in selected areas of the United States rather than a national probability sample. The target population for HHANES ideally would have included all households with at least one member of Hispanic origin. However, the United States includes States and counties with very small numbers or proportions of Hispanic persons. Therefore, HHANES was restricted to those counties in the three target areas of the country that had a sufficient number or proportion of Hispanic persons to permit the efficient operation of the survey. Thus, 97 percent of the 1980 Mexican-American population in the five Southwest States, 96 percent of the Cuban population in the Dade County, Florida, area, and 90 percent of the Puerto Rican population in the New York City area were eligible for inclusion in HHANES.

Although HHANES was not designed to be representative of all Hispanics residing in the United States, the survey universe included approximately 76 percent of the 1980 Hispanic-origin population in the United States. The three Hispanic subgroups and the areas covered were: Mexican Americans residing in five southwestern States (Arizona, California, Colorado, New Mexico, and Texas); Cuban Americans residing in Dade County, Florida; and Puerto Ricans residing in the New York City metropolitan area, including parts of New York, New Jersey, and Connecticut.

Selected households were screened to identify eligible Hispanic families and to select sample persons from these families to be interviewed and examined. Eligibility for the survey was determined by the family unit. A family was considered eligible if at least one family member's reported national origin or ancestry met the criteria for eligibility appropriate to the survey location. These criteria were as follows:

Survey area	*National origin or ancestry*
Southwest area	Mexican or Mexicano, Mexican American, Chicano, Hispano, Spanish American or Spanish (when no other country of origin was mentioned)
Dade County, Fla., area	Cuban or Cuban American
New York City area.....	Puerto Rican or Boricuan

In cases where multiple origins were reported for the same individual on different questionnaires, the person was considered eligible if any one of the reported origins met these criteria.

If a family were eligible for the survey, all members of that family were eligible to be selected for the interview and examination components. Therefore, some non-Hispanic persons residing in Hispanic households and some Hispanic persons not meeting the above criteria were selected and examined in each of the three geographic areas. For this report, however, all findings are based on the examined persons within the households who were defined as being of Mexican origin or ancestry in the Southwest, of Cuban origin or ancestry in Dade County, Florida, and of Puerto Rican origin or ancestry in the New York City area. This report, therefore, excludes persons in the total sample who were non-Hispanic or of an origin that did not meet the eligibility criteria. Appendix II presents a more detailed description of how the Hispanic-origin recode used for this report was determined.

Tables B and C show the sample sizes and response rates for each of the three survey areas in HHANES. In table B, the results are presented for both the total sample (including non-Hispanic persons) and for the specific-origin sample. Table C shows the sample sizes and response rates for Hispanic adults in the fasting sample. The fasting sample consisted of a randomly selected half sample of the examined adults ages 20–74 years. This "morning half sample" or "fasting half sample" was also designed to be representative of Hispanics in the designated areas. Persons in the half sample were asked to fast overnight for 10–16 hours and were examined in the morning session. No fasting instructions were given to those in the afternoon half sample or nonfasting half sample. The focus of this paper is on the full sample and the fasting half sample since these data sets provide the basis for the majority of analytic studies completed for the HHANES.

HHANES, like previous examination surveys, consisted of two major components. Household interviews formed the first component; the second consisted of physical examinations and additional interviews in examination

centers. All interviews, examinations, tests, procedures, and laboratory determinations were performed following standardized protocols.

Household interviews

The household interview component involved collecting socioeconomic and demographic information from the family and sample persons within the family and completing a medical history questionnaire for sample persons. Interviewers employed by the contract agency conducting the HHANES performed the initial household interviews and aided in the scheduling of appointments for examination. This information was obtained prior to the examination and was usually obtained from the sample person, or, when necessary, from a knowledgeable household member or a neighbor.

Child and adult medical history interviews were also conducted in the household. Persons at least 18 years old responded for themselves unless they were physically or mentally unable to be interviewed. For sample persons 12–17 years of age, either self- or proxy-response was accepted. For sample persons under the age of 12, proxy respondents were required, except for a few questions addressed directly to children 6–11 years of age. An examination appointment was also made at the time of interview.

In both the household interview and the examination, sample persons were given the choice of participating in either English or Spanish. Interviewers were bilingual and Spanish language questionnaires were available.

Examination

The examination component was performed in mobile examination centers specially designed for this study. The examination environment and equipment were standardized to minimize differences in findings among sample locations. The full-time examination teams were specifically trained to follow the study protocols, which provided for standardization, quality control, and evaluation of team members' performance. The examination consisted of a series of standardized tests and procedures that included the following:

- General medical examination and screening by a physician, including additional medical history information
- Body measurements
- Dietary interview
- Selected diagnostic tests such as electrocardiograms, x rays, hearing, and diagnostic ultrasound for detection of gallstones
- Laboratory tests on whole blood, serum, and urine specimens

Thus, HHANES provided the opportunity to assess key aspects of the Hispanic population's health and nutritional status during a 2 1/2-year period and to collect baseline data that could be used to assess changes over time in selected Hispanic subgroups living in the United States.

Table B. Sample size and response rates for Hispanic persons 6 months–74 years of age, by survey area and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982–84

Survey area and Hispanic origin	Sample size	Interviewed		Examined	
		Number	Percent	Number	Percent
Southwest area					
All persons	9,894	8,554	86.5	7,462	75.4
Mexican American	9,455	8,222	87.0	7,197	76.1
Dade County, Florida, area					
All persons	2,244	1,766	78.7	1,357	60.5
Cuban	2,125	1,677	78.9	1,291	60.8
New York City area					
All persons	3,786	3,369	89.0	2,834	74.9
Puerto Rican	3,525	3,137	89.0	2,645	75.0

NOTE: See appendix II for the definition of Hispanic origin.

Table C. Sample size and response rates for Hispanic persons 20–74 years of age in the fasting sample, by survey area and specified Hispanic origin: Hispanic Health and Nutrition Examination Survey, 1982–84

Survey area and Hispanic origin	Sample size	Interviewed		Examined	
		Number	Percent	Number	Percent
Southwest area					
Mexican American	2,360	1,969	83.4	1,655	70.1
Dade County, Florida, area					
Cuban	741	565	76.2	426	57.5
New York City area					
Puerto Rican	881	751	85.2	596	67.7

More detailed information on selected tests and procedures referred to in this report are given as follows:

Blood pressure—Two blood pressure measurements were taken on one occasion in the mobile examination center as part of a physician's examination. Both measurements were taken with the patient seated, 5 minutes into the examination and 5 minutes apart. The average of the two readings was used for the estimates presented here. Systolic (first phase) and diastolic (fifth phase) blood pressure were measured to the nearest even digit using a standard mercury sphygmomanometer.

Ultrasonography of the gallbladder—Real-time ultrasonography of the gallbladder was performed by health technicians using an instrument with a 3-MHz rotary mechanical sector scanning transducer. Examinations were conducted with sample persons in both supine and left decubitus positions. A diagnosis of gallstones was made by commonly used criteria of echoes within the gallbladder with shadowing or movement of echoes. If a right upper quadrant or epigastric scar was observed and the gallbladder was not seen, it was concluded that a cholecystectomy had been performed. Ultrasonography was done on the fasting half sample described previously in the text.

Iron (Fe) status based on biochemical data—Impaired Fe status is used in combination with low hemoglobin as

an indicator of anemia. Impaired Fe status was calculated using the MCV model (20), which was developed by an expert panel for use with Health and Nutrition Examination Survey (HANES) data. Measures are based on the results of venipuncture blood drawn from subjects at the time of the examination. Pregnant women were excluded from analyses because pregnancy affects the interpretation of Fe status indicators. Also, persons who lacked values for any of the Fe status indicators were excluded from the analytic sample.

Total serum cholesterol—Serum total cholesterol was measured in venous blood specimens and corrected to the Abell-Kendall reference values (21).

Height and weight—Technicians measured several anthropometric dimensions, including standing height and weight. Body mass index (see definition in table D) was used as a measure of overweight.

Definitions

The cutpoints and variables used to define the conditions referred to in this report were obtained from previously published studies (20–24) based on the HHANES and are given in table D. Demographic and socioeconomic terms used in this paper are defined in appendix III. Items on the child and adult sample person questionnaires used in the nonresponse analysis are given in appendices IV and V, respectively.

Analytical issues

Survey design

The Mexican American, Cuban, and Puerto Rican portions of the HHANES were each designed to be complex, multistage, stratified, probability cluster samples of persons 6 months–74 years of age. There was oversampling of eligible Hispanics 6 months–19 years of age and 45–74 years of age. For more detail see appendix I.

Statistical weighting

To take into account oversampling and other sample design features, sample weights are provided with the HHANES survey data. Basic weights accounting for the probability of selection and oversampling of selected age groups were further adjusted for other factors related to nonresponse and noncoverage (table E).

For Mexican Americans, weights were further adjusted as follows:

- adjustments for interview nonresponse within categories of age, income, household size, and geographical location
- adjustments for examination nonresponse within categories of age, household size, and location
- adjustment for noncoverage within primary sampling units (PSU's) according to family income group; and
- poststratification ratio adjustments by age and sex made to produce the final sample estimates of the population that correspond to the 1983 Bureau of the Census estimates of the civilian noninstitutionalized target population of Mexican Americans in the Southwest (17)

For Cubans, weights were further adjusted as follows:

- adjustments for interview nonresponse within categories of age, gender, and income
- adjustments for examination nonresponse within categories of age, gender, and household size
- adjustment for noncoverage within PSU's (25)

Table D. Study variable definitions

Variables	*Definitions*
Hypertension (based on examination)	Defined as average of two blood pressure measurements ≥ 140/90 mmHg or currently taking antihypertensive medication.
Hypertension (based on interview)	Defined as those subjects who reported in the medical interview that a doctor had told them that they had high blood pressure or hypertension.
Gallstone disease (based on examination)	Defined as subjects having gallstones or evidence of a previous cholecystectomy upon ultrasonography.
Gallstones (based on interview)	Defined as those subjects who reported in the medical history interview a doctor had told them they had gallstones.
Impaired Fe status (based on examination)	Defined as subjects with at least two of three Fe status indicators, namely, mean corpuscular volume <80fL, erythrocyte protoporphyrin >1245nmol/L RSC, transferrin saturation <16%. Pregnant women excluded from analysis.
Anemia (based on interview)	Defined as those subjects who reported in the medical history interview that a doctor had told them they had anemia. Pregnant women excluded from analysis.
Elevated cholesterol (based on examination)	Defined as those subjects with a serum cholesterol level of 240 mg/dl or more.
Overweight (based on examination)	Defined as a body mass index (BMI) (weight in kilograms divided by height in meters squared) equal to or greater than that at the 85th percentile of men or women aged 20–29 years from the NHANES II, 1976–80. Men are categorized as "overweight" when their BMI equals or exceeds 27.8. For women, the cutoff point is 27.3. Pregnant women excluded from analysis.

Table E. Variables used in weighting adjustment for interview nonresponse, examination nonresponse, noncoverage, and poststratification, according to Hispanic subpopulation: Health and Nutrition Examination Survey, 1982–84

Variable	*Interview (nonresponse)*			*Examination (nonresponse)*			*Noncoverage*			*Poststratification*		
	MA	*C*	*PR*	*MA*	*C*	*PR*	*MA*	*C*	*PR*	*MA*	*C*	*PR*
Sex		X			X	X				X	...	...
Age	X	X	X	X	X	X				X	...	...
Household size	X		X	X	X	X					...	...
Income	X	X	X				X		X		...	...
Primary sampling unit	X			X			X	X	X		...	...

NOTES: MA = Mexican American, C = Cuban, PR = Puerto Rican. Poststratification was not done for the Cuban or Puerto Rican survey portions due to lack of adequate population estimates.

For Puerto Ricans, weights were further adjusted as follows:

- adjustments for interview nonresponse within categories of age, household size, and income
- adjustments for examination nonresponse within categories of gender, age, and household
- adjustment for noncoverage within PSU's according to family income (26)

Statistical methodology

The investigation of the potential nonresponse bias in the HHANES consisted of four parts.

Part 1: Interview status—This investigation was limited to variables that the interviewer could obtain during the screener interview from the sample person, an adult household member, or a neighbor and to seasonal and geographic location information. Variables used in this part of the study were age, season of the year, gender, family size, language of the screener interview, and mobile examination center location (table 2).

Because sample persons within a family tended to have the same interview status, the family was also used as the unit of analysis. The demographic data included in the family nonresponse analysis are those of the head of the family.

The Chi-Square Automatic Interaction Detection (CHAID) (27) technique was used to summarize the data. CHAID is a descriptive procedure that provides the researcher with information about the relationships between the dependent variable (the interview status) and the predictor variables (other classification or descriptive variables) by calculating the chi-square measure of association between the dependent and each independent variable. The predictor variable that has the most significant chi-square, after a Bonferroni adjustment (28) for the number of variable categories, is used to split the sample into groups. This process is repeated for each of the new groups until there are too few observations for further splitting. The result is a tree-like structure that suggests which predictor variables may be important and need future investigation (see appendix VII).

Part 2: Examination status—In this stage of the analysis, the interview-weighted examination response rate was studied in relation to demographic and screener variables from the screener and family questionnaires and medical history variables from the child and adult medical history questionnaires (table 2).

The CHAID technique was used to summarize the data in two steps. In the first step, the same set of variables used in the CHAID analysis of interview nonresponse was screened to identify relationships between examination status (the dependent variable) and a series of other variables commonly used in nonresponse weighting adjustments. In the second step, additional variables, selected from the family questionnaire and the child and adult medical history questionnaires (table 2), were included in the analysis as an aid to researchers in identifying potential sources of bias in analyses.

Part 3: Comparison between HHANES and 1982–84 NHIS—This part of the study compared the HHANES with the combined 1982, 1983, and 1984 NHIS for the Mexican American, Cuban, and Puerto Rican subpopulations.

The comparison consists of a display of the survey weighted proportion of various conditions or attributes for each sample. See appendix VI for more details on the HHANES-NHIS comparison.

Part 4: Estimating possible bias in disease prevalence—In this, the final stage of the nonresponse bias analysis, an estimate of possible nonresponse bias is given for selected variables (diseases) that have appeared in published studies.

For each variable, a bias-adjusted estimate is compared with a survey estimate based on the analytic sample. The conditional probability approach used to compute bias-adjusted estimates is described in detail in appendix VIII. Briefly, probabilities of the disease are computed conditional on the level of variables found to be associated with both the respondent status and the disease under study.

Socioeconomic status was one of several variables from the medical history questionnaire found to be associated with respondent status in the HHANES and it has also been shown to be related to disease prevalence. Therefore, socioeconomic status, measured as below poverty or at or above the poverty level, was selected to be used in the creation of an adjusted prevalence estimate of the various diseases. Differences between the survey estimates and the bias-adjusted estimates measure the effect

of poverty status (Note, subjects with missing poverty status were excluded from the analysis).

Since this method assumes that respondents and nonrespondents have similar disease prevalence within each poverty status level, this assumption was examined empirically (see appendix VIII).

Variable (disease) definitions, cutpoints, and age groupings have been made comparable to those used in the studies. The dependent variables include hypertension (22), gallstone disease (23), impaired Fe status (20), elevated cholesterol (21), and overweight (24).

In both the bias-adjustment analysis using examination data and the empirical analysis using medical history data, estimates were computed using basic weights (the reciprocal of the probability of selection). Using the final nonresponse adjusted weights would have confounded any comparison between survey and adjusted estimates. Thus, because neither the survey weighting nonresponse adjustments nor the poststratification ratio adjustments (for Mexican Americans only) to the 1983 Bureau of the Census age-sex marginal distribution were included in the tabulations of survey estimates, and the survey estimates given in the tables will differ from the weighted published estimates. As was stated previously, the difference between the adjusted estimate and the survey estimate is meant to measure the effect of nonresponse related to poverty status and independent of possible confounding of other nonresponse or poststratification weighting adjustments.

Significance testing

Testing for statistical significance was done at the 95-percent confidence level. The complex survey design used in the HHANES tended to increase the estimated variance of prevalence estimates over that which would have been obtained through simple random sampling (29). Average design effects (the ratio of the complex sample variance to the simple random sample variance) have been calculated for many analytic variables for the three Hispanic subgroups. In general, the average design effects for the Mexican American and Puerto Rican subgroups tend to average 1.5, while those for the Cuban subgroup tend to be about 1.0. Thus, in these analyses, the weighted simple random sample standard errors were multiplied by the square root of the design effect.

All data analyses were done using SAS procedures (30) or programs accessible through SAS (31).

Criteria for presentation of data

The following guidelines were used for the reporting of percents for the HHANES data. If the sample size in an analytic cell is less than 45, the percent was not reported. If the sample size is 45 or more, the percent is presented without caveat.

Criteria for determination of bias

Consistency and a measure of relative bias were the two criteria used in determining whether there was evidence of possible bias. Assuming that the adjusted estimate is the "true" prevalence, bias is defined as the difference between the survey estimate and the adjusted estimate. Variables that were identified as having the same directional bias across age groups within gender and that had a relative bias of at least 25 percent were considered to have shown evidence of possible bias. Relative bias was defined as bias relative to the standard error of the estimate expressed as a percent

$$\text{relative bias} = 100 \bullet \frac{\text{bias}}{\text{standard error of the estimate}}$$

Hansen, Hurwitz, and Madow (32) demonstrate that when biases can be shown to be relatively small, say, less than 25 percent of the standard error of an estimate, they can be neglected without any serious effect on the interpretation of the results.

The estimated standard error (SE) of the survey estimate was computed as follows:

$$\text{SE} = \sqrt{\text{deff}} \bullet \sqrt{p \bullet \frac{1-p}{n}}$$

where deff is the design effect, p is the survey prevalence estimate, and n is the sample size.

Findings

Findings are presented separately for Mexican Americans, Cubans, and Puerto Ricans, for each stage of the analysis identifying factors associated with nonresponse, comparison between HHANES and the 1982–84 NHIS, and bias estimation for selected disease conditions. Results from a screening of potential predictors of interview response and examination response in the Mexican American, Cuban, and Puerto Rican HHANES are summarized in text tables F, G, and H, respectively. Details of the Mexican American, Cuban, and Puerto Rican analyses are provided in the following paragraphs and in tables 3–17. Results from the bias estimation analysis for selected disease conditions are given in tables 18–41.

Mexican Americans

Factors associated with nonresponse

Figure 2 shows the distribution of the Mexican American sample according to respondent status. Seventy-six percent completed the examination as well as all interview components. Of the remaining 24 percent who did not receive an examination, medical history and demographic interview data were collected on 11 percent and demographic information only was collected on 13 percent. Thus, in the following analysis, demographic information is used to evaluate interview response status, and demographic together with medical history data are used to evaluate examination response status.

Interview status—As shown in table 3, 87 percent of Mexican-American sample persons completed either the Child Sample Person Questionnaire or the Adult Sample Person Questionnaire. Interview rates differed the most by age, family size, location, and season. There was an inverse association between age and interview rate, ranging from 79 percent in the oldest group to 92 percent in the youngest group. For family size, there was a positive association between the number of family members and the interview rate. The response rates in the startup location (San Antonio, Texas) and the California locations were generally lower than response rates for the other locations. The response rate in summer was lower than in the other three seasons of the year.

A CHAID analysis was also performed to examine the multiway relation between interview status and the predictor variables. The age variable had the largest association

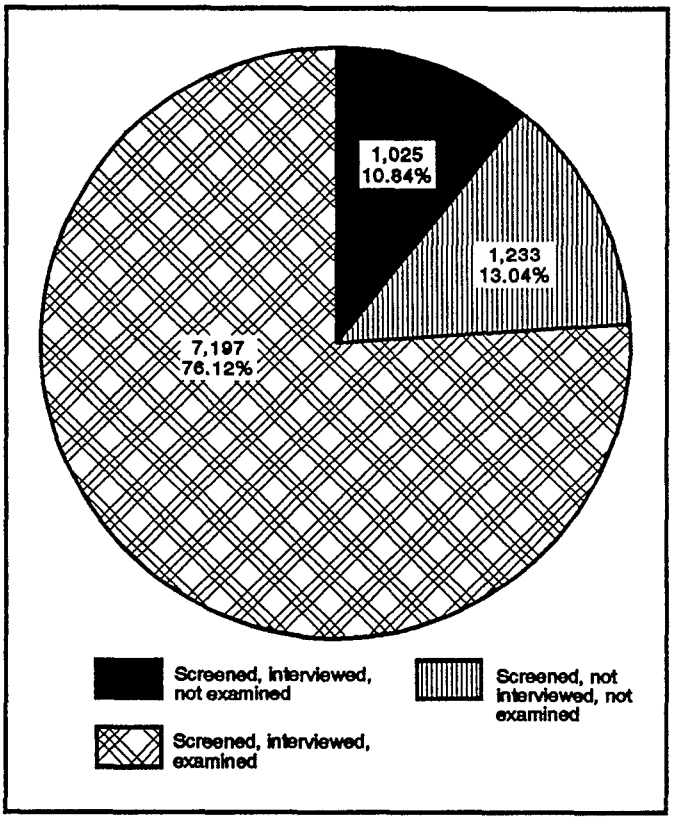

Figure 2. Distribution of sample persons according to respondent status in the Mexican American subsample of the HHANES

with interview status and was selected at the first level of variable selection. At the second level of variable selection, family size, season, and stand location were the most important predictors. Response rates increased with family size for all age groups. The response rate was lowest for teenagers in the summer months, and response rates varied considerably by stand for the age groups 20–44 and 45–74 years. Subsequent levels of variable selection included the gender and language of the screener interview and interviewer variables. The response rate for females was slightly higher than for males, and rates were higher for Spanish interviews compared with English interviews.

The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. In order of predictive ability, family size, season, geographic loca-

tion, interviewer, and language of screener interview were found to be predictors of nonresponse to the interview.

Examination status—Of the interviewed Mexican American sample, 87 percent completed at least one component of the examination. The distribution of examination response rates for the variables with the largest variation, as defined by the CHAID procedure, as a proportion of the interview sample is shown in tables 4–6 for children, adolescents, and adults, respectively. (Note, all examination response rates were interview weighted; that is, interview sampling weights were applied to all examination respondents and nonrespondents when calculating examination response rates to account for interview nonresponse and noncoverage.)

A two-stage CHAID analysis was also performed to examine the multiway relation between examination status and the predictor variables:

- Stage 1, screener variables, only—The family size and age variables showed the largest differences in examination response rates among categories. The CHAID analysis for the screener variables showed that family size was the most important predictor of examination status. Response rates ranged from 78 percent for small families (1 to 2 people) to 90 percent for large families (5 or more people). The variables age and gender were found to be important predictors at the second level of selection. The variables location, season, and language of interview were selected at subsequent levels of selection.

  The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. The candidate demographic predictor variables were those of the family head. In order of predictive ability, family size, completed education of the head of household, poverty level (the poverty level variable was a dichotomization of those at or above and those below the poverty index cutpoint (see appendix III)), age of the head of household, and location were found to be predictors of nonresponse to the examination.

- Stage 2, all variables—For children 6 months–11 years, the variables location, language parent usually uses at home, education of the head of household, and family size showed the largest differences in examination response rates. For adolescents 12–19 years of age, the family having received food stamps and family size showed the largest differences in response rates. For adults 20–74 years of age, gender, family size, and major activity during the previous 12 months showed the largest differences in response rates. The CHAID analysis showed that geographic location, having received food stamps, and gender were most important predictors for children, adolescents, and adults, respectively.

Comparison between HHANES and 1982–84 NHIS

The comparison among Mexican Americans in the HHANES interview and examination weighted samples and the 1982–84 NHIS weighted data are shown in table 7. Distributions of the HHANES examination and interview samples are similar. In general, the distributions for age, sex, and body mass index for adults in all three samples were similar. Differences between the two HHANES (overlapping) subsamples and the NHIS occurred for the variables family income, education of head of household, health status, smoking status, and hypertension. Family income and education of the head of household were higher in the NHIS than in the HHANES. A higher percent of Mexican Americans in the NHIS population considered themselves in excellent or very good health than in the corresponding HHANES population. Fewer Mexican Americans reported being former or current smokers and fewer reported having hypertension in the NHIS compared with HHANES. Although the differences in prevalence for the health conditions shown here for the two surveys were not statistically significant, possibly due to the relatively small sample size in the NHIS, the observed estimates for the NHIS are generally lower than estimates for the HHANES.

Possible bias

The CHAID analysis and the HHANES–NHIS comparison for Mexican Americans suggest that respondents and nonrespondents differ with respect to the distribution of socioeconomic status. Since disease prevalence may vary with socioeconomic status, it is important to evaluate potential bias that may have occurred due to differential response. In particular, 28.6 percent of the examined sample were living below poverty compared with 26.6 percent for the nonexamined (but interviewed) sample. For the fasting half sample, 30.2 percent of the examined sample were living below poverty compared with 28.5 percent for the nonexamined (but interviewed) sample. The probability approach described in appendix VIII is used to estimate possible bias due to differential response by poverty level for a number of disease conditions reported in the research literature.

As shown in tables 18–25, there is no evidence of nonresponse bias due to the greater response by subjects living below the poverty level for prevalence estimates of overweight, elevated cholesterol, self-reported anemia, self-reported hypertension, gallstone disease, and self-reported gallstone disease.

However, prevalence estimates in females for the variables hypertension and impaired Fe status show differences between the survey estimates and the bias-adjusted estimates. For hypertension in females, the survey estimates consistently underestimate by 1 percentage point or less. The bias expressed as a percent of the standard error is greater than 25 percent for the age groups 20–44 years and 45–55 years. For impaired Fe status in females, the survey estimates consistently overestimate by 1 percentage point or less. The bias expressed as a percent of the standard error is greater than 25 percent for the age groups 11–19 years, 45–64 years, and 65–74 years.

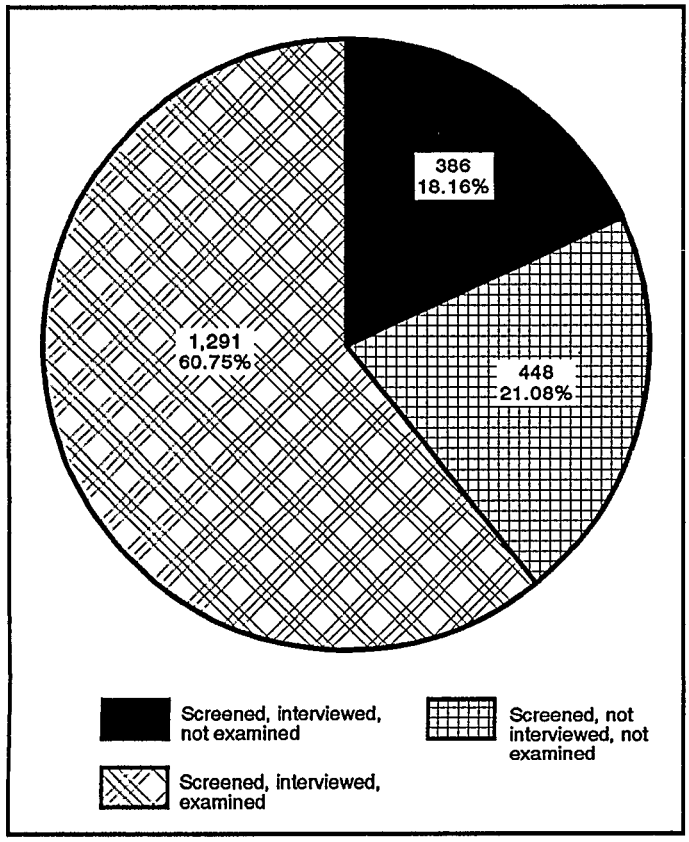

Figure 3. Distribution of sample persons according to respondent status in the Cuban subsample of the HHANES

Cubans

Factors associated with nonresponse

Figure 3 shows the distribution of the Cuban sample according to respondent status. Sixty-one percent completed the examination as well as all interview components. Of the remaining 39 percent who did not receive an examination, medical history and demographic interview data were collected on 18 percent and demographic information only was collected on 21 percent. Thus, in the following analysis, demographic information is used to evaluate interview response status, and demographic together with medical history data are used to evaluate examination response status.

Interview status—As shown in table 8, 79 percent of Cuban sample persons completed either the Child Sample Person Questionnaire or the Adult Sample Person Questionnaire. Interview rates differed the most by interviewer, age, location, language of screener interview, and family size. Response rates among interviewers varied from a low of 67 percent to a high of 90 percent. There was an inverse association between age and interview rate, ranging from 76 percent in the oldest age group to 85 percent in the youngest age group. Rates were higher for Spanish interviews compared with English interviews. For family size, there was a positive association between the number of family members and the interview rate.

A CHAID analysis was also performed to examine the multiway relation between interview status and the predictor variables. The interviewer variable had the largest association with interview status and was selected at the first level of variable selection. At the second level of variable selection, age, location, and family size were the most important predictors. The relation of each of these variables with interview status was the same as shown in the univariate case discussed above.

The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. Family size was the only variable found to be a predictor of nonresponse to the interview.

Examination status—Of the interviewed Cuban sample, 77 percent completed at least one component of the examination. The distribution of examination response rates for the variables with the largest variation, as defined by the CHAID procedure, as a proportion of the interview sample is shown in tables 9–11 for children, adolescents, and adults, respectively. (Note, all examination response rates were interview weighted; that is, interview sampling weights were applied to all examination respondents and nonrespondents when calculating examination response rates to account for interview nonresponse and noncoverage.)

A two-stage CHAID analysis was also performed to examine the multiway relation between examination status and the predictor variables:

- Stage 1, screener variables, only—The total family income and interviewer variables showed the largest differences in examination response rates among categories. The CHAID analysis for the screener variables showed that total family income was the most important predictor of examination status. The response rate was 80 percent for sample persons from families with an income less than $20,000 compared with 75 percent for those with an income of $20,000 or more. Education of head of household and interviewer were found to be important predictors at the second level of selection. Response was inversely associated with educational level.

  The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. The candidate demographic predictor variables were those of the family head. In order of predictive ability, family size and season were found to be predictors of nonresponse to the examination. Family size was positively associated with response. Response was higher in the winter compared with the spring.

- Stage 2, all variables—For children 6 months–11 years, the variables age, geographic location, SMSA, central city/SMSA, not central city, and education of head of household showed the largest differences in examination response rates. For adolescents 12–19 years of age, education of head of household, language of Adult Sample Person Questionnaire interview, self-perceived condition of teeth, and poverty status showed the largest differences in response rates. For adults

20–74 years of age, poverty status, self-perceived health status, self-report of ever having had anemia, self-perceived condition of teeth, geographic location, and having had trouble seeing showed the largest differences in response rates. The CHAID analysis showed that age, education of head of household, and poverty status were the most important predictors for children, adolescents, and adults, respectively.

Comparison between HHANES and 1982–84 NHIS

The comparison among Cubans in the HHANES interview and examination weighted samples and the 1982–84 NHIS weighted data are shown in table 12. Distributions of the HHANES examination and interview samples are similar. In general, the differences in the distributions for age, sex, and body mass index can be attributed to sampling variability. Differences between the two HHANES data sets and the NHIS occurred for the variables family income, education of head of household, and self-perceived health status. Family income was higher in the HHANES than in the NHIS. Conversely, education of the head of household was higher in the NHIS than in the HHANES. A higher percent of Cubans in the NHIS population considered themselves in excellent or very good health than in the corresponding HHANES population.

Possible bias

The CHAID analysis and the HHANES-NHIS comparison for Cubans suggest that respondents and nonrespondents differ with respect to the distribution of socioeconomic status. Since disease prevalence may vary with socioeconomic status, it is important to evaluate potential bias that may have occurred due to differential response. In particular, 20.4 percent of the examined sample were living below poverty compared with 14.3 percent of the nonexamined (but interviewed) sample. For the fasting half sample, 22.3 percent of the examined sample were living below poverty compared with 16.2 percent of the nonexamined (but interviewed) sample. The probability approach described in appendix VIII is used to estimate possible bias due to differential response by poverty level for a number of conditions reported in the research literature.

As shown in tables 26–33, there is no evidence of nonresponse bias due to the greater response by subjects living below poverty level for prevalence estimates of elevated cholesterol, impaired Fe status, hypertension, self-reported hypertension, gallstone disease, and self-reported gallstone disease.

However, prevalence estimates for overweight and self-reported anemia (females only) show differences between the survey estimates and the bias-adjusted estimates. For overweight in females, the survey estimates underestimate by no more than 5 percentage points. In males the survey estimates overestimate no more than 4 percentage points, although only the estimate for females is statistically reliable. The bias expressed as a percent of the standard error is greater than 25 percent for the age groups 20–44 years, 55–64 years, and 65–74 years. For self-reported anemia in females, the survey estimates overestimate by no more than 7 percentage points. The bias expressed as a percent of the standard error is greater than 25 percent for the age groups 15–19 through 65–74 years.

Puerto Ricans

Factors associated with nonresponse

Figure 4 shows the distribution of the Puerto Rican sample according to respondent status. Seventy-five percent completed the examination as well as all interview components. Of the remaining 25 percent who did not receive an examination, medical history and demographic interview data were collected on 14 percent and demographic information only was collected on 11 percent. Thus, in the following analysis, demographic information is used to evaluate interview response status, and demographic together with medical history data are used to evaluate examination response status.

Interview status—As shown in table 13, 89 percent of Puerto Rican sample persons completed either the Child Sample Person Questionnaire or the Adult Sample Person Questionnaire. Interview rates differed the most by interviewer, geographic location, age, family size, and language

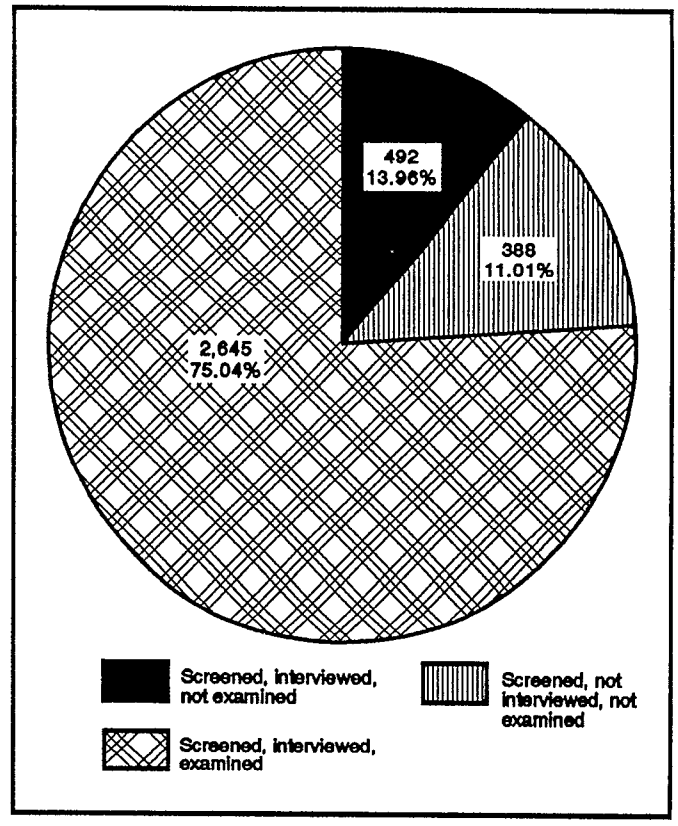

Figure 4. Distribution of sample persons according to respondent status in the Puerto Rican subsample of the HHANES

of the screener interview. Response rates ranged from 67 percent to 96 percent among interviewers. There was an inverse association between age and interview rate, ranging from 87 percent in the oldest group to 92 percent in the youngest group. Response rates ranged from 79 percent to 96 percent among geographic locations. For family size, there was a positive association between the number of family members and the interview rate ranging from 83 percent for 1–2 member families to 91 percent for families of 5 or more. Rates were higher for Spanish interviews compared with English interviews, 92 percent versus 86 percent, respectively.

The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. In order of predictive ability, family size, interviewer, language of screener interview, and geographic location were found to be predictors of response to the interview.

Examination status—Of the interviewed Puerto Rican sample, 84 percent completed at least one component of the examination. The distribution of examination response rates for each of the 10 variables with the largest variation, as defined by the CHAID procedure, as a proportion of the interview sample is shown in tables 14–16 for children, adolescents, and adults, respectively. (Note, all examination response rates were interview-weighted; that is, interview sampling weights were applied to all examination respondents and nonrespondents when calculating examination response rates to account for interview nonresponse and noncoverage.)

A two-stage CHAID analysis was also performed to examine the multiway relation between examination status and the predictor variables:

- Stage 1, screener variables, only—The total family income, family size, poverty status, age, education of head of household, geographic location, and language of screener interview showed the largest differences in examination response rates among categories.

  The CHAID analysis for the screener variables showed that total family income was the most important predictor of examination status. The variables geographic location and family size were found to be important predictors at the second level of selection. The CHAID analysis was repeated using the family rather than the individual as the unit of analysis. The candidate demographic variables were those of the family head. In order of predictive ability, family size, age of head of household, sex of head of household, and geographic location were found to be predictors of response to the examination. Highest response rates were found for those families with the largest size, with a head of household less than 45 years of age, and with a female head of household.
- Stage 2, all variables—For children 6 months–11 years, the variables air-conditioning present, poverty status, language of screener interview, health insurance, received food stamps, size of place, family size, ever having had anemia, age, and SMSA showed the largest differences in examination response rates. For adolescents 12–19 years of age, the family having received food stamps and poverty status showed the largest differences in response rates. For adults 20–74 years of age, having received food stamps, generation in United States, poverty status, major activity during previous 12 months, family size, gender, self-perceived health status, education of head of household, ever had trouble hearing, and having health insurance showed the largest differences in response rates. The CHAID analysis showed having air-conditioning present, having received food stamps, and poverty status were the most important predictors for children, adolescents, and adults, respectively.

Comparison between HHANES and 1982–84 NHIS

The comparison among Puerto Ricans in the HHANES interview and examination weighted samples and the 1982–84 NHIS weighted sample are shown in table 17. Distributions of the HHANES examination and interview samples are similar. In general, differences in the observed distributions for age, sex, and income for the three samples can be attributed to sampling variability. Differences between the two HHANES data sets and the NHIS occurred for the variables education of head of household, body mass index, and self-perceived health status. A higher percent had at least a high school education in the NHIS than in the HHANES. A higher percent of Puerto Ricans in the NHIS population considered themselves in excellent or very good health than in the corresponding HHANES population.

Possible bias

The CHAID analysis and the HHANES-NHIS comparison for Puerto Ricans suggest that respondents and nonrespondents differ with respect to the distribution of socioeconomic status. Since disease prevalence may vary with socioeconomic status, it is important to evaluate potential bias that may have occurred due to differential response. In particular, 42.4 percent of the examined sample were living below poverty compared with 36.0 percent of the nonexamined (but interviewed) sample. For the fasting half sample, 45.4 percent of the examined sample were living below poverty compared with 38.6 percent of the nonexamined (but interviewed) sample. A probability approach described in appendix VIII is used to estimate bias due to differential response in poverty groups for a number of conditions reported in research literature.

As shown in tables 34–41, there is no evidence of nonresponse bias due to overresponse by subjects living below poverty level for prevalence estimates of the variables considered in this study.

Discussion

Areas of potential bias

This study is meant to suggest to analysts possible sources of bias. An attempt has been made to identify the demographic, socioeconomic, and medical history variables that are most strongly associated with interview and examination nonresponse. However, their relative importance will vary from analysis to analysis depending on the strength of association with the analytic variable of interest.

The analyses reported here suggest that there are a number of factors related to interview and examination status. A comparison of statistical weighting adjustment factors shown in table E with variables found to be significant predictors of respondent status in tables F, G, and H suggest where potential for nonresponse bias exists. This comparison is done for each Hispanic subpopulation according to variable type—demographic, socioeconomic, and medical history.

For Mexican Americans the combination of nonresponse and poststratification adjustments in the interview weight takes age, gender, household size, income, and geographic location into account. The combination of nonresponse and poststratification adjustments in the examination weight takes location, age, household size, and gender into account. An additional noncoverage adjustment was made to compensate for the somewhat higher undercoverage of high-income Hispanic households. For these variables, the adjustments cause the weighted interview and examination samples to be distributed similarly to the civilian Mexican-American population residing in the southwestern region of the United States.

Some predictor variables were not taken into account in weighting adjustments. Among demographic variables, language of interview was not accounted for in the weighting process. Among socioeconomic variables, education of the head of household, poverty index, and having received food stamps were not accounted for in adjustments for nonresponse to the examination. Some perceived medical problems were found more prevalent in respondents than in nonrespondents among children, adolescents, and adults.

For Cubans nonresponse adjustments in the interview weight take gender, age, and income into account. Nonresponse adjustments in the examination weight take gender, age, and household size into account. An additional noncoverage adjustment was made to compensate for undercoverage of neighborhoods with few Hispanic residents.

Predictor variables that were not taken into account in the interview nonresponse weighting adjustments included location within Dade County, family size, and language of interview. Predictors that were not taken into account in the examination nonresponse weighting adjustments included geographic location, family income, poverty level, education of head of household, self-perceived condition of teeth in adolescents, and several health status variables for adults (self-perceived health status, self-report of having had anemia, self-perceived condition of teeth, and having had trouble seeing without glasses or contact lenses). Although location was statistically significant, its substantive importance is questionable.

For Puerto Ricans, nonresponse adjustments in the interview weight take age, household, and income into account. Nonresponse adjustments in the examination weight take gender, age, and income into account. An additional noncoverage adjustment was made to compensate for somewhat higher undercoverage of high-income Hispanic households.

A predictor variable that was not taken into account in the interview nonresponse weighting adjustments included language of interview. Predictors that were not taken into account in the examination nonresponse weighting adjustments included family size, gender of head of household, family income, poverty level, education of household, language of interview, self-report of having had anemia in children, self-report of health status, and self-report of trouble hearing.

In summary, for the three Hispanic subpopulations, response rates were highest for those reporting a health care need or condition. This is consistent with evaluations of nonresponse in earlier health surveys (1,2,11,13–15). It should be noted that although the association of these variables with examination response was statistically significant, the magnitude of differential nonresponse was probably not large enough to cause a large bias in prevalence rates (6).

The generally good agreement between the HHANES and the NHIS for the marginal distributions of age and sex contrasts with the differences in the distributions of socioeconomic status (for Mexican Americans and Cubans) and self-perceived health status (for Mexican Americans, Cubans, and Puerto Ricans) as well as differences noted for the variables smoking status and self-reported hypertension (for Mexican Americans).

Table F. Summary of significant predictors, as identified by the CHAID procedure, of response to the interview and examination: Mexican American HHANES, 1982–84

Survey component and age group	Variable		
	Demographic-design	*Socioeconomic*	*Medical history*
Interview:			
6 months–74 years	age (A,I) family size (D) geographic location season of year interviewer language of interview (S>E)		
Examination:			
6 months–74 years	family size (A,D) age (I) sex (F>M) geographic location season	language of interview (S>E) education of head of household (I) poverty index ratio (I)	
6 months–11 years	stand location (A) family size (D) SMSA/nonSMSA season	language parent uses at home (S>E) education of head of household (I) poverty index ratio (I) language of medical history interview (S>E) language child uses at home (S>E)	time since last physical (D) health status (I)
12–19 years	family size (D) education (I) season population concentration ever did farm work	received food stamps (A) acculturation generation in United States (I)	ever had trouble seeing without glasses condition of teeth
20–74 years	sex (F>M, A) family size (D) major activity geographic location SMSA/nonSMSA	received food stamps language preference (S>E) marital status	ever had anemia body mass index (I)

NOTES: A = most important predictor; I = inverse association with response rate; D = direct association with response rate; F>M = female response rate greater than male response rate; and S>E = Spanish response rate greater than English response rate.

The differences noted here suggest that the NHIS represents a more well-to-do and healthier population of Hispanics than does the HHANES. Differences may be attributed in part to the tendency of those most likely to be medically underserved—those who are economically depressed, those who are without access to health care, and those with language barriers—to be most likely to respond to a health examination survey; and, conversely, those with adequate financial resources and with adequate health care are less likely to respond to a health examination survey.

These differences between the HHANES and the NHIS suggest that the HHANES interview nonresponse and noncoverage adjustments to the basic statistical weights may not have adequately compensated for the somewhat lower representation and undercoverage of high-income Hispanic households. This seems plausible since those adjustments were based in large part on imputed values for missing income (not obtained on the family questionnaire) obtained as the 1980 Census median income of the neighborhood where the household was located (17).

There are a number of variables that are related to response status at the interview and examination level. The adjustments have dealt successfully with a number of these variables and reduced the possibility of bias. Despite this, analysis of data internal to the surveys (CHAID) and comparison with data external to the surveys (NHIS) suggest that the weighted examined groups overrepresents the poorer less educated and those with lower health status and more health problems.

The authors have elsewhere (6) estimated the effect that this overrepresentation of low socioeconomic status may have on two variables associated with income status, self-reported health status, and measured hypertension in Mexican Americans. The results indicate that bias was minimal.

Bias estimation

Estimates of the effect that this overrepresentation of low socioeconomic status individuals may have on variables in the Mexican American, Cuban, and Puerto Rican samples have been made.

For Mexican Americans there is evidence of slight nonresponse bias (less than 1 percentage point) due to the greater response of subjects living below poverty level for hypertension and impaired Fe status.

For Cubans there was evidence of nonresponse bias for the variables overweight and self-reported anemia, due to overresponse of subjects living below poverty level. The

Table G. Summary of significant predictors, as identified by the CHAID procedure, of response to the interview and examination: Cuban HHANES, 1982–84

Survey component and age group	Variable		
	Demographic-design	*Socioeconomic*	*Medical history*
Interview:			
6 months–74 years	interviewer (A) age (I) geographic location language of interview (S>E) family size (D)		
Examination:			
6 months–74 years	interviewer geographic location family size (D) season	family income (I, A) poverty index ratio (I) education of head of household (I)	
6 months–11 years	age (A, D) geographic location SMSA,central city/SMSA, not central city	education of head of household (I)	
12–19 years		education of head of household (A, I) language of Adult Sample Person Questionnaire interview (S>E) poverty index ratio (I)	self-perceived condition of teeth
20–74 years	geographic location	poverty index ratio (A, I) received food stamps (D) air-conditioning present (I)	self-perceived health status (I) self-report of having had anemia self-perceived condition of teeth have had trouble seeing without glasses or contacts

NOTES: A = most important predictor; I = inverse association with response rate; D = direct association with response rate; and S>E = Spanish response rate greater than English response rate.

survey prevalence estimates of overweight, shown in table 26, are similar to published estimates (24). A comparison of the bias-adjusted estimates with the survey estimates and with the published estimates suggest that the prevalence of overweight was underestimated in females 65–74 years by 5 percentage points, and prevalence was overestimated in males 65–74 years by 4 percentage points. However, only the results for females were statistically reliable.

For Puerto Ricans there is no evidence of nonresponse bias for the variables considered in this study.

Limitations and implications of the methodology

The guiding philosophy in this paper has been an exploratory approach. Because of this, the model-free CHAID approach was used in this study instead of model fitting using logistic regression.

The CHAID method does not produce an overall goodness-of-fit test statistic. Other limitations of this procedure are that it is not well suited for identifying interactions among variables; it requires a large sample size; and it does not accommodate low-prevalence predictors well. The above considerations influenced variable selection, but these factors were the tradeoff for allowing the data to speak for themselves. No preconceptions about how the data ought to behave were brought to the original screening of variables to identify those related to response status.

The final stage of the analysis concerned the estimation of nonresponse bias using a conditional probability approach. The limitations of this approach concern the assumption that must be made regarding the similarity of respondents and nonrespondents within adjustment categories. This approach has been used before at NCHS (6,33–36); and the customary approach has been to assume that examined and nonexamined persons are similar with regard to the dependent variable within adjustment categories. This is, in fact, the same assumption underlying nonresponse adjustments to survey weights.

Table H. Summary of significant predictors, as identified by the CHAID procedure, of response to the interview and examination: Puerto Rican HHANES, 1982–84

Survey component and age group	*Variable*		
	Demographic-design	*Socioeconomic*	*Medical history*
Interview:			
6 months–74 years	interviewer (A) geographic location age (I) family size (D) language of interview (S > E)		
Examination:			
6 months–74 years	family size (D) age (I) geographic location sex of head of household (F > M)	family income (A) poverty index ratio (I) education of head of household (I) language of interview (S > E)	
6 months–11 years	size of place (I) family size (D) age (D) SMSA/nonSMSA	air-conditioning present (A,I) poverty index ratio (I) language of screener interview (S > E) health insurance (I) received food stamps (D)	self-report of having had anemia
12–19 years		received food stamps (A,D) poverty index ratio (I)	
20–74 years	major activity family size (D) sex (F > M)	received food stamps (A,D) generation in United States (I) poverty index ratio (I) education of head of household (I) have health insurance (I)	self-perceived health status (I) self-report of trouble hearing (D)

NOTES: A = most important predictor; I = inverse association with response rate; D = direct association with response rate; F > M = female response rate greater than male response rate; and S > E = Spanish response rate greater than English response rate.

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List of detailed tables

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Table 1. Interview and examination response rates for health examination surveys of the National Center for Health Statistics

Survey and age group	Survey date			Response rate		Sample size		
	Beginning	Ending	Midsurvey	Interview	Exam	Sample	Interview	Exam
NHES I (18–79 years)	Oct 1959	Dec 1962	---	---	87	7,710	---	6,672
NHES II (6–11 years)	Jul 1963	Dec 1965	Aug 1, 1964	---	96	7,417	---	7,119
NHES III (12–17 years)	Mar 1966	Mar 1970	Mar 9, 1968	---	90	7,514	---	6,768
NHANES I	Apr 1971	June 1974	Nov 1, 1972					
1–74 years				99	74	28,043	27,753	20,749
1–5 years				100	82	3,530	3,516	2,895
6–11 years				99	85	2,415	2,401	2,057
12–17 years				99	84	2,526	2,505	2,126
18–74 years				99	70	19,572	19,331	13,671
18–54 years				99	73	12,289	12,131	8,925
55–74 years				99	65	7,283	7,200	4,746
NHANES II	Feb 1976	Feb 1980	Mar 1, 1978					
6 months–74 years				91	73	27,801	25,286	20,322
6 months–5 years				96	81	5,069	4,876	4,118
6–11 years				94	83	2,085	1,963	1,725
12–17 years				95	81	2,438	2,304	1,975
18–74 years				89	69	18,209	16,143	12,504
18–54 years				91	72	10,129	9,181	7,333
55–74 years				86	64	8,080	6,962	5,171
HHANES Mexican American	Jul 1982	Nov 1983	Mar 1, 1983					
6 months–74 years				87	76	9,455	8,222	7,197
6 months–5 years				92	84	1,492	1,377	1,250
6–11 years				92	85	1,508	1,384	1,287
12–17 years				90	79	1,325	1,188	1,053
18–74 years				83	70	5,130	4,273	3,607
18–54 years				84	71	4,183	3,520	2,983
55–74 years				80	66	947	753	624
HHANES Cuban	Jan 1984	Apr 1984	Feb 1984					
6 months–74 years				79	61	2,125	1,677	1,291
6 months–5 years				84	58	165	139	95
6–11 years				85	71	178	152	126
12–17 years				86	72	222	191	159
18–74 years				77	58	1,560	1,195	911
18–54 years				76	59	1,070	816	630
55–74 years				77	57	490	379	281
HHANES Puerto Rican	May 1984	Dec 1984	Sept 1984					
6 months–74 years				89	75	3,525	3,137	2,645
6 months–5 years				91	78	496	451	389
6–11 years				92	84	501	463	420
12–17 years				94	83	586	550	484
18–74 years				86	70	1,942	1,673	1,352
18–54 years				86	71	1,544	1,332	1,094
55–74 years				86	65	398	341	258

NOTES: NHES I is the first National Health Examination Survey. NHES II is the second National Health Examination Survey. NHES III is the third National Health Examination Survey. NHANES I is the first National Health and Nutrition Examination Survey. NHANES II is the second National Health and Nutrition Examination Survey. HHANES, Mexican American is the Hispanic Health and Nutrition Examination Survey, Mexican American portion. HHANES, Cuban is the Hispanic Health and Nutrition Examination Survey, Cuban portion. HHANES, Puerto Rican is the Hispanic Health and Nutrition Examination Survey, Puerto Rican portion.

Table 2. Variables from the screener, family, and medical history interview included in the analysis of nonresponse to the examination

Screener 6 months–74 years	*Family 6 months–74 years*	*Child medical history 6 months–11 years*	*Adult medical history 12–74 years*
Sex	Health insurance	Language of interview	Language of interview
Family size	WIC program[1]	Health status	Health status
Age	Education	Dental care	Dental care
Language of interview	Air-conditioning	Anemia	Anemia
SMSA	Food stamps	Weight status	Weight status
Size of place	Marital status	Vision problems	Vision problems
Season of year	Income	Hearing problems	Hearing problems
Telephone present	Place of birth	Breastfed	Farm work
Interviewer		Asthma	Last physical exam
		Language child usually speaks	Acculturation—Southwest only
		Language parents usually speak	Generation in United States
			Language usually spoken
			Language preferred
			Work status
			Recreation and exercise
			Activity level
			Diabetes
			High blood pressure
			Kidney stones
			Chest pain
			Smoker
			Gallstones
			Kidney problems
			Coughing

[1]WIC = Women, Infants, and Children.

NOTE: Variables shown are a topical summary of questions.

Table 3. Interview response rates by level of the predictor screener variables for Mexican Americans in the Hispanic Health and Nutrition Examination Survey, 1982–83

Variable	*n*[1]	*Rate*[2]	*Variable*	*n*[1]	*Rate*[2]
Total	9,455	87	Geographic location:[3]		
			1 San Antonio, TX	492	80
Age:[3]			3 Houston, TX	611	87
6 months–11 years	3,000	92	5 Greeley, CO	626	89
12–19 years	1,720	89	7 Midland, TX	648	91
20–44 years	2,828	86	9 Tucumcari, NM	542	93
45–74 years	1,907	79	11 Brownsville, TX	605	91
			13 Beeville, TX	513	88
			15 El Paso, TX	571	88
Season:[3]			17 Tucson, AZ	576	88
Winter	1,660	88	19 San Diego, CA	602	87
Spring	1,829	89	21 Los Angeles, CA	640	91
Summer	2,693	83	23 Los Angeles, CA	587	88
Fall	3,273	88	25 Los Angeles, CA	557	85
			27 Los Angeles, CA	576	80
			29 San Jose, CA	457	85
Sex:[3]			31 Oakland, CA	485	79
Male	4,589	86	33 Concord, CA	367	83
Female	4,866	88			
			Interviewer:[3]		
			1	480	91
			2	539	88
Family size:[3]			3	479	83
1–2	1,254	81	4	702	88
3–4	3,641	85	5	496	85
5 or more	4,560	90	6	390	84
			7	649	89
			8	669	87
			9	540	94
			10	468	87
			11	417	84
Language of screener			12	387	93
interview:[3]			13	459	86
English	7,491	86	14	571	87
Spanish	1,964	89	All others	2,209	85

[1]*n* is sample size.

[2]As a proportion of the unweighted total sample.

[3]Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p < .05$.

Table 4. Examination response rates for Mexican-American children 6 months–11 years – 10 variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–83

Variable	n[1]	Weighted rate[2]
Total	2,761	92
Geographic location:[3]		
1	119	94
3	197	97
5	192	90
7	227	94
9	141	100
11	188	95
13	142	94
15	150	99
17	164	88
19	150	92
21	214	84
23	189	90
25	165	89
27	151	90
29	137	87
31	142	92
33	93	89
Language parent usually uses at home:[3]		
English	990	89
Spanish	1,249	94
Both equally	518	94
Unknown	4	84
Education of head of household:[3]		
None	64	99
Grade school	1,008	95
High school	1,155	91
College	466	90
Unknown	68	84
Family size:[3]		
1–2	66	84
3–4	1,102	90
5 or more	1,593	94
Poverty index ratio:[3]		
Above poverty	1,597	91
Below poverty	955	94
Unknown	209	87
SMSA/nonSMSA:[3]		
SMSA, central city	1,357	92
SMSA, not central city	1,118	90
Not in SMSA	286	97
Language of medical history interview:[3]		
English	1,653	91
Spanish	1,108	94
Perceived health status:[3]		
Excellent	828	89
Very good	606	93
Good	916	93
Fair	380	92
Poor	29	97
Unknown	2	100
Season of year:[3]		
Winter	456	93
Spring	553	88
Summer	769	91
Fall	983	93
Language child usually uses at home:[3]		
English	1,241	90
Spanish	863	94
Both equally	409	94
Unknown	248	92

[1] *n* is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.

Table 5. Examination response rates for Mexican-American adolescents 12–19 years—10 variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–83

Variable	n[1]	Weighted rate[2]
Total	1,526	87
Received food stamps:[3]		
Yes	360	94
No	1,150	86
Unknown	16	69
Family size:[3]		
1–2	85	72
3–4	449	85
5 or more	992	90
Acculturation:[3]		
Strong Spanish	100	85
Intermediate	532	91
Strong English	860	86
Unknown	34	70
Season of year:[3]		
Winter	268	93
Spring	305	87
Summer	415	86
Fall	538	86
Population concentration:[3]		
Largest	396	85
2d largest	232	94
3d largest	764	86
4th largest	134	89
Ever had trouble seeing without glasses:[3]		
Yes	517	91
No	1,008	86
Unknown	1	100
Condition of teeth:[3]		
Excellent	182	85
Very good	248	87
Fair	535	85
Poor	431	91
No teeth	128	92
Unknown	2	45
Education of head of household:[3]		
None	53	90
Grade school	670	89
High school	569	88
College	177	82
Unknown	57	81
Birthplace of self, mother, and father:[4]		
1st generation	301	91
2d generation	410	89
3d generation	786	86
Unknown	29	71
Poverty index ratio:[4]		
Above poverty	842	86
Below poverty	519	90
Unknown	165	84

[1] *n* is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.

[4] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.10$.

Table 6. Examination response rates for Mexican-American adults 20–74 years—10 variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–83

Variable	n[1]	Weighted rate[2]
Total	3,935	84
Sex:[3]		
Male	1,797	81
Female	2,138	88
Family size:[3]		
1–2	866	78
3–4	1,534	84
5 or more	1,535	87
Major activity in previous 12 months:[3]		
Working	2,370	83
Keeping house	1,192	88
Going to school	98	80
Something else	178	80
Unknown	97	78
SMSA/nonSMSA:[3]		
SMSA, central city	2,023	83
SMSA, not central city	1,425	84
Not in SMSA	487	89
Marital status:[3]		
Married, spouse in household	2,723	85
Married, spouse not in household	74	91
Widowed	193	82
Divorced or separated	401	84
Never married	488	80
Unknown	56	49
Language preference:[3]		
Spanish only	851	86
Mostly Spanish	742	88
No preference	1,570	83
Mostly English	518	83
English only	226	80
Unknown	28	52
Ever had anemia:[3]		
Yes	679	88
No	3,222	83
Unknown	34	77
Stand:[3]		
1	189	79
3	246	84
5	270	79
7	266	84
9	258	91
11	262	84
13	225	88
15	253	93
17	259	82
19	271	87
21	259	78
23	233	82
25	209	86
27	232	88
29	188	76
31	169	84
33	146	80
Received food stamps:[3]		
Yes	674	88
No	3,216	84
Unknown	45	43
Body mass index:[4]		
Less than 20	159	84
20–27	2,313	85
28–30	777	85
More than 30	380	79
Unknown	306	81

[1] *n* is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p < .05$.

[4] Reported weight in kilograms divided by height in meters squared.

Table 7. Weighted percent distribution of selected variables for Mexican Americans 20–74 years of age for 1982–84 NHIS and 1982–84 HHANES data

Variable	HHANES[1] Examination n=3,326	HHANES[1] Interview n=3,935	NHIS[2] n=2,511
	Percent		
Age:			
20–34 years	53	53	54
35–44 years	19	19	20
45–54 years	13	13	14
55–64 years	9	9	9
65–74 years	5	5	4
Female	50	50	51
Family income:[3]			
Less than $20,000	62	62	57
$20,000 or more	34	34	39
Unknown	4	4	4
Education of head of household:[3]			
Less than 12 years	60	60	52
12 years	20	20	28
More than 12 years	17	17	19
Unknown	3	3	2
Body mass index:[4]			
Less than 20	6	6	7
20–27	63	62	67
28–30	10	10	10
More than 30	14	15	13
Unknown	7	7	4
Self-perceived health status:[3]			
Excellent	14	13	32
Very good	18	18	20
Good	34	35	34
Fair	29	29	10
Poor	6	6	4

Variable	HHANES[1] Examination n=3,326	HHANES[1] Interview n=3,935	NHIS[2] n=245
	Percent		
Smoking status:[5]			
Never smoked[3]	48	48	55
Former smoker	19	18	16
Current smoker	33	34	28
History of—			
Hypertension[5]	20	19	16
Diabetes[5]	6	5	4
Heart attack[5]	2	2	1
Stroke[5]	1	1	1

[1]HHANES is the Hispanic Health and Nutrition Examination Survey.

[2]NHIS is the National Health Interview Survey.

[3]NHIS was significantly different from the HHANES examination and interview samples $p<.05$.

[4]Reported weight in kilograms divided by height in meters squared.

[5]From NHIS 1983 Alcohol Questionnaire Supplement.

Table 8. Interview response rates by level of the predictor screener variables for Cubans in the Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Rate[2]	Variable	n[1]	Rate[2]
Total	2,125	79	Geographic location:[3]		
Age:[3]			35 Miami, FL, I	541	73
6 months–11 years	343	85	37 Miami, FL, II	530	80
12–19 years	301	84	39 Miami, FL, III	539	81
20–44 years	610	77	41 Miami, FL, IV	515	81
45–74 years	871	76	Interviewer:[3]		
			1	133	89
			2	128	67
			3	122	75
Season:			4	115	86
Winter	1,610	78	5	113	90
Spring	515	81	6	108	84
			7	106	77
			8	103	90
			9	102	84
			10	97	82
			11	93	83
Sex:			12	81	81
Male	999	79	13	81	90
Female	1,126	79	14	70	76
			All others	673	71
			Telephone present in household:		
Family size:[3]			Yes	1,899	82
1–2	576	75	No	67	85
3–4	1,002	79	Unknown	159	38
5 or more	547	83			
Language of screener interview:[3]					
English	788	76			
Spanish	1,337	81			

[1] *n* is sample size.

[2] As a proportion of the unweighted total sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.

Table 9. Examination response rates for Cuban children 6 months–11 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]	Variable	n[1]	Weighted rate[2]
Total	291	76	SMSA/nonSMSA:[3]		
Age:[3]			SMSA, central city	95	67
6 months–5 years	139	68	SMSA, not central city	196	80
6–11 years	152	84	Education of head of household:[3]		
			None	1	100
Geographic location:[3]			Grade school	86	80
35 Miami, FL, I	84	81	High school	100	83
37 Miami, FL, II	77	85	College	90	66
39 Miami, FL, III	64	65	Unknown	14	71
41 Miami, FL, IV	66	68			

[1] *n* is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.

Table 10. Examination response rates for Cuban adolescents 12–19 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]	Variable	n[1]	Weighted rate[2]
Total	252	82	Poverty index ratio:[4]		
			Above poverty	171	79
Education of head of household:[3]			Below poverty	65	89
None	2	100	Unknown	16	86
Grade school	102	87			
High school	68	88			
College	71	73			
Unknown	9	52			
Language of Adults Sample Person Questionnaire interview:[3]					
English	71	74			
Spanish	181	85			
Self-perceived condition of teeth:[4]					
Excellent	78	84			
Very good	40	77			
Good	78	75			
Fair	45	93			
Poor	11	92			

[1] n is sample size.
[2] As a proportion of the weighted interview sample.
[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.
[4] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.10$.

Table 11. Examination response rates for Cuban adults 20–74 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]	Variable	n[1]	Weighted rate[2]
Total	1,134	76	Geographic location:[3]		
			35 Miami, FL, I	249	76
Poverty index ratio:[3]			37 Miami, FL, II	273	83
Above poverty	828	76	39 Miami, FL, III	320	74
Below poverty	196	83	41 Miami, FL, IV	292	72
Unknown	110	60			
			Ever have trouble seeing without glasses or contacts:[3]		
Self-perceived health status:[3]			Yes	784	78
Excellent	233	71	No	350	72
Very good	142	68			
Good	455	77	Received food stamps[4]		
Fair	266	82	Yes	177	82
Poor	38	87	No	940	75
Self-report of ever having had anemia:[3]			Air-conditioning present:[4]		
Yes	224	84	Yes	1,038	76
No	902	74	No	80	86
Unknown	8	75	Unknown	16	32
Self-perceived condition of teeth:[3]					
Excellent	119	72			
Very good	95	73			
Good	299	72			
Fair	333	76			
Poor	171	87			
Has no teeth	113	73			
Unknown	4	100			

[1] n is sample size.
[2] As a proportion of the weighted interview sample.
[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.
[4] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.10$.

Table 12. Weighted percent distribution of selected variables for Cubans 20–74 years of age for 1982–84 NHIS and 1982–84 HHANES data

Variables	HHANES[1] Examination n=865	HHANES[1] Interview n=1,134	NHIS[2] n=391
	Percent		
Age:			
20–34 years	30	30	33
35–44 years	21	22	21
45–54 years	23	22	20
55–64 years	16	17	15
65–74 years	10	10	11
Female	55	55	50
Family income:[3]			
Less than $20,000	56	54	61
$20,000 or more	41	42	35
Unknown	2	4	4
Education of head of household:[3]			
Less than 12 years	49	48	38
12 years	18	18	20
More than 12 years	31	31	41
Unknown	2	3	1
	Percent		
Body mass index:[4]			
Less than 20	7	7	8
20–27	69	70	73
28–30	11	11	8
More than 30	11	10	11
Unknown	2	2	1
Self-perceived health status:[3]			
Excellent	21	22	37
Very good	12	13	14
Good	40	39	31
Fair	24	22	12
Poor	3	3	6

[1]HHANES is the Hispanic Health and Nutrition Examination Survey.

[2]NHIS is the National Health Interview Survey.

[3]NHIS was significantly different from the HHANES examination and interview samples $p<.05$.

[4]Reported weight in kilograms divided by height in meters squared.

Table 13. Interview response rates by level of the predictor screener variables for Puerto Ricans in the Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Rate[2]
Total	3,525	89
Age:[3]		
6 months–11 years	997	92
12–19 years	764	92
20–44 years	970	86
45–74 years	794	87
Season:		
Spring	990	89
Summer	1,422	89
Fall	1,113	90
Sex:		
Male	1,575	88
Female	1,950	90
Family size:[3]		
1–2	703	83
3–4	1,577	90
5 or more	1,245	91
Language of screener interview:[3]		
English	1,805	86
Spanish	1,720	92
Geographic location:[3]		
43 North Bergen, NJ	299	95
45 Bridgeport, CT	312	96
47 Long Island, NY	269	85
49 Queens Co., NY	301	79
50 Brooklyn, NY	580	92
51 Brooklyn, NY	264	90
53 New York, NY	510	86
54 Bronx, NY	501	89
55 Bronx, NY	489	89
Interviewer:[3]		
1	310	92
2	305	94
3	285	94
4	261	94
5	236	91
6	201	89
7	150	95
8	148	89
9	118	87
10	115	94
11	113	67
12	108	96
13	99	92
14	86	94
All others	990	83
Telephone present in household:		
Yes	2,544	91
No	646	93
Unknown	335	62

[1]*n* is sample size.

[2]As a proportion of the unweighted total sample.

[3]Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p<.05$.

Table 14. Examination response rates for Puerto Rican children 6 months–11 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]
Total	914	87
Air-conditioning present:[3]		
Yes	181	81
No	718	90
Unknown	15	53
		1–2
Poverty index ratio:[3]		
Above poverty	322	84
Below poverty	523	92
Unknown	69	78
Language of screener interview:[3]		
English	473	84
Spanish	441	92
Health insurance:[3]		
Yes	278	84
No	623	91
Unknown	13	23
Received food stamps:[3]		
Yes	553	91
No	352	84
Unknown	9	21
Size of place:[3]		
Largest	650	89
2d largest	137	91
3d largest	127	80
Family size:[3]		
1–2	53	84
3–4	451	85
5 or more	410	91
Ever had anemia:[3]		
Yes	166	94
No	739	86
Unknown	9	100
Age:[3]		
6 months–5 years	451	85
6–11 years	463	90
SMSA:[3]		
Yes, central city	805	89
Yes, not central city	109	81

[1] n is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p < .05$.

Table 15. Examination response rates for Puerto Rican adolescents 12–19 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]
Total	704	87
Received food stamps:[3]		
Yes	341	92
No	350	85
Unknown	13	52
Poverty index ratio:[3]		
Above poverty	259	87
Below poverty	377	90
Unknown	68	76

[1] n is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level adjusted by Bonferroni multiplier of $p < .05$.

Table 16. Examination response rates for Puerto Rican adults 20–74 years—variables with the largest differences, as identified by the CHAID procedure: Hispanic Health and Nutrition Examination Survey, 1982–84

Variable	n[1]	Weighted rate[2]
Total	1,519	80
Received food stamps:[3]		
Yes	554	88
No	940	78
Unknown	25	20
Generation in United States:[3]		
1st generation	1,161	82
2d generation	280	79
3d generation	27	74
Unknown	51	53
Poverty index ratio:[3]		
Above poverty	805	79
Below poverty	606	85
Unknown	108	67
Major activity during previous 12 months:[3]		
Working	712	77
Keeping house	603	86
Going to school	50	89
Something else	120	74
Unknown	34	63
Family size:[3]		
1–2	488	75
3–4	652	79
5 or more	379	87
Sex:[3]		
Male	580	75
Female	939	83
Self-perceived health status:[3]		
Excellent	175	76
Very good	201	72
Good	422	82
Fair	543	84
Poor	177	78
Unknown	1	100
Education of head of household:[3]		
None	20	80
Grade school	579	79
High school	665	84
College	209	76
Unknown	46	48
Ever had trouble hearing:[3]		
Yes	212	87
No	1,307	79
Have health insurance:[3]		
Yes	603	79
No	880	83
Unknown	36	34

[1] *n* is sample size.

[2] As a proportion of the weighted interview sample.

[3] Predictor having Chi-square significance level (adjusted by Bonferroni multiplier) of $p<.05$.

Table 17. Weighted percent distribution of selected variables for Puerto Ricans 20–74 years of age for 1982–84 NHIS and 1982–84 HHANES data

Variables	HHANES[1] Examination (n=1,220)	HHANES[1] Interview (n=1,519)	NHIS[2] (n=780)
		Percent	
Age:			
20–34 years	46	47	48
35–44 years	25	24	21
45–54 years	15	15	18
55–64 years	9	9	9
65–74 years	4	5	4
Female	63	62	58
Family income:			
Less than $20,000	69	68	70
$20,000 or more	29	29	28
Unknown	2	3	2
Education of head of household:[3]			
Less than 12 years	58	58	55
12 years	23	22	29
More than 12 years	17	17	15
Unknown	2	3	1
Body mass index:[3,4]			
Less than 20	10	10	8
20–27	63	64	71
28–30	10	9	9
More than 30	13	13	12
Unknown	3	3	1
Self-perceived health status:[3]			
Excellent	13	14	20
Very good	14	16	23
Good	32	31	29
Fair	32	31	19
Poor	8	9	8

[1]HHANES is the Hispanic Health and Nutrition Examination Survey.

[2]NHIS is the National Health Interview Survey.

[3]NHIS was significantly different from the HHANES examination and interview samples ($p<.05$).

[4]Reported weight in kilograms divided by height in meters squared.

Table 18. Potential bias in estimated percent prevalence of overweight in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination Sample size	Examination Response rate	Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
Total	3,251	69.6	34.79	34.82	–0.03	–3
Female						
20–44 years	1,095	78.3	33.59	33.51	0.08	5
45–54 years	361	69.6	52.57	53.43	–0.86	–27
55–64 years	223	66.2	55.90	56.13	–0.23	–6
65–74 years	118	70.7	49.57	51.34	–1.77	–31
Male						
20–44 years	908	66.6	28.61	28.91	–0.30	–16
45–54 years	270	61.2	36.98	36.45	0.53	15
55–64 years	194	62.0	37.13	37.59	–0.46	–11
65–74 years	82	63.1	30.17	28.33	1.84	30

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 19. Potential bias in estimated percent prevalence of elevated cholesterol in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	3,199	67.6	15.84	15.81	0.03	4
Female						
20–44 years	1,119	76.4	10.40	10.43	–0.03	–3
45–54 years	343	66.1	23.94	24.04	–0.10	–4
55–64 years	219	65.0	37.64	36.73	0.91	23
65–74 years	114	68.3	43.38	45.08	–1.70	–30
Male						
20–44 years	871	63.9	13.13	13.28	–0.15	–11
45–54 years	263	59.6	30.09	30.66	–0.57	–16
55–64 years	191	61.0	24.25	23.17	1.08	28
65–74 years	79	60.8	23.42	24.32	–0.90	–15

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 20. Potential bias in estimated percent prevalence of impaired Fe status using MCV model in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	4,379	65.9	5.45	5.27	0.18	43
Female						
11–14 years	337	72.0	6.16	5.27	0.89	55
15–19 years	356	67.8	7.51	7.24	0.27	16
20–44 years	1,016	72.6	10.23	10.16	0.07	6
45–64 years	538	62.9	7.41	6.55	0.86	62
65–74 years	111	66.5	6.48	5.24	1.24	43
Male						
11–14 years	376	75.1	4.06	3.97	0.09	7
15–19 years	301	61.9	1.31	1.06	0.25	31
20–44 years	839	61.5	0.91	1.00	–0.09	–22
45–64 years	432	57.3	0.90	0.78	0.12	22
65–74 years	73	56.2	1.42	1.64	–0.22	–13

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 21. Potential bias in estimated percent prevalence of self-reported anemia in the examined sample due to differential reporting of anemia and poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	4,378	65.8	14.03	13.56	0.47	73
Female						
11–14 years	337	72.0	5.09	6.18	–1.09	–74
15–19 years	356	67.8	9.68	10.17	–0.49	–26
20–44 years	1,015	72.6	31.41	30.65	0.76	43
45–64 years	538	62.9	24.52	24.31	0.21	9
65–74 years	111	66.5	12.47	15.81	–3.34	–87
Male						
11–14 years	376	75.1	3.44	3.18	0.26	23
15–19 years	301	61.9	2.68	2.74	–0.06	–5
20–44 years	839	61.5	2.74	2.09	0.65	94
45–64 years	432	57.3	2.46	3.82	–1.36	–149
65–74 years	73	56.2	4.36	3.45	0.91	31

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 22. Potential bias in estimated percent prevalence of hypertension in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	3,243	68.5	14.65	14.52	0.13	17
Female						
20–44 years	1,129	77.1	4.66	4.95	–0.29	–38
45–54 years	350	67.4	24.38	25.99	–1.61	–57
55–64 years	219	65.0	45.31	46.11	–0.80	–19
65–74 years	119	71.3	66.50	67.00	–0.50	–9
Male						
20–44 years	884	64.8	10.00	9.44	0.56	45
45–54 years	268	60.8	28.89	29.25	–0.36	–11
55–64 years	191	61.0	48.93	47.71	1.22	28
65–74 years	83	63.9	59.09	60.68	–1.59	–24

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 23. Potential bias in estimated percent prevalence of self-reported hypertension in the examined sample due to differential reporting of hypertension and poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	3,240	68.4	19.05	18.16	0.89	105
Female						
20–44 years	1,128	77.1	15.91	14.55	1.36	102
45–54 years	350	67.4	34.88	37.10	–2.22	–71
55–64 years	219	65.0	39.92	42.08	–2.16	–53
65–74 years	119	71.3	56.69	58.16	–1.47	–26
Male						
20–44 years	883	64.7	11.25	10.90	0.35	27
45–54 years	268	60.8	22.53	24.65	–2.12	–68
55–64 years	191	61.0	37.87	32.29	5.58	130
65–74 years	82	63.1	34.64	32.75	1.89	29

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 24. Potential bias in estimated percent prevalence of gallstone disease in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,388	58.8	12.73	12.81	–0.08	–7
Female						
20–39 years	416	69.5	13.95	14.11	–0.16	–8
40–59 years	259	58.7	26.98	27.37	–0.39	–12
60–74 years	79	51.3	44.82	45.60	–0.78	–11
Male						
20–39 years	360	56.2	2.47	2.67	–0.20	–20
40–59 years	202	51.3	8.20	7.94	0.26	11
60–74 years	72	55.0	14.09	14.72	–0.63	–13

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 25. Potential bias in estimated percent prevalence of self-reported gallstones in the examined sample due to differential reporting of gallstone disease and poverty status in the interviewed-but-not-examined sample for Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,387	58.8	7.22	7.08	0.14	16
Female						
20–39 years	415	69.3	6.97	6.80	0.17	11
40–59 years	259	58.7	17.72	21.84	–4.12	–142
60–74 years	79	51.3	22.37	17.90	4.47	78
Male						
20–39 years	360	56.2	1.15	0.69	0.46	67
40–59 years	202	51.3	3.61	4.55	–0.94	–58
60–74 years	72	55.0	17.57	15.28	2.29	42

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 26. Potential bias in estimated percent prevalence of overweight in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	860	58.2	31.95	32.59	–0.64	–40
Female						
20–44 years	204	60.0	26.22	27.02	–0.80	–26
45–54 years	119	61.7	37.31	37.71	–0.40	–9
55–64 years	97	59.5	51.45	52.90	–1.45	–29
65–74 years	64	53.8	40.05	45.20	–5.15	–84
Male						
20–44 years	143	53.6	25.01	24.93	0.08	2
45–54 years	114	60.6	34.75	34.19	0.56	13
55–64 years	78	56.9	32.00	30.80	1.20	23
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 27. Potential bias in estimated percent prevalence of elevated cholesterol in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	826	55.8	18.20	18.17	0.03	2
Female						
20–44 years	192	56.0	4.95	5.17	–0.22	–14
45–54 years	116	60.1	21.62	21.86	–0.24	–6
55–64 years	95	58.3	43.81	44.54	–0.73	–14
65–74 years	57	47.9	41.59	44.95	–3.36	–51
Male						
20–44 years	134	50.2	11.43	11.10	0.33	12
45–54 years	112	59.6	22.56	22.18	0.38	10
55–64 years	79	57.7	21.58	22.12	–0.54	–12
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 28. Potential bias in estimated percent prevalence of impaired Fe status using MCV model in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,014	55.9	3.64	3.62	0.02	3
Female						
11–14 years	42	*	*	*	*	*
15–19 years	47	58.0	9.95	11.53	–1.58	–36
20–44 years	187	55.0	8.56	8.95	–0.39	–19
45–64 years	208	58.4	2.65	2.40	0.25	22
65–74 years	56	47.1	5.70	2.58	3.12	101
Male						
11–14 years	51	62.2	1.70	1.71	–0.01	–1
15–19 years	60	61.2	3.96	4.55	–0.59	–23
20–44 years	136	50.9	0.69	0.72	–0.03	–4
45–64 years	186	57.2	0.00	0.00	0.00	0
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 29. Potential bias in estimated percent prevalence of self-reported anemia in the examined sample due to differential reporting of anemia and poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,013	55.9	20.34	17.36	2.98	236
Female						
11–14 years	42	*	*	*	*	*
15–19 years	47	58.0	30.85	23.79	7.06	105
20–44 years	187	55.0	41.33	36.35	4.98	138
45–64 years	208	58.4	27.41	22.32	5.09	165
65–74 years	56	47.1	23.79	17.61	6.18	109
Male						
11–14 years	51	62.2	1.70	5.43	–3.73	–206
15–19 years	60	61.2	9.48	8.73	0.75	20
20–44 years	135	50.6	8.66	6.96	1.70	70
45–64 years	186	57.2	5.46	5.37	0.09	5
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 30. Potential bias in estimated percent prevalence of hypertension in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	850	57.4	19.34	19.43	–0.09	–7
Female						
20–44 years	203	59.2	2.89	3.26	–0.37	–31
45–54 years	116	60.1	15.22	15.75	–0.53	–16
55–64 years	97	59.5	35.49	35.11	0.38	8
65–74 years	64	53.8	49.98	51.06	–1.08	–17
Male						
20–44 years	141	52.8	7.14	7.55	–0.41	–19
45–54 years	114	60.6	37.11	35.16	1.95	43
55–64 years	74	54.0	40.91	42.53	–1.62	–28
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 31. Potential bias in estimated percent prevalence of self-reported hypertension in the examined sample due to differential reporting of hypertension and and poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	850	57.4	28.19	27.79	0.40	26
Female						
20–44 years	203	59.2	19.72	21.79	–2.07	–74
45–54 years	116	60.1	31.46	32.17	–0.71	–16
55–64 years	97	59.5	47.49	44.79	2.70	53
65–74 years	64	53.8	54.95	58.56	–3.61	–58
Male						
20–44 years	141	52.8	11.92	13.85	–1.93	–71
45–54 years	114	60.6	39.22	33.60	5.62	123
55–64 years	74	54.0	36.66	41.04	–4.38	–78
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 32. Potential bias in estimated percent prevalence of gallstone disease in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	323	43.6	12.08	11.16	0.92	51
Female						
20–39 years	52	35.9	11.22	8.90	2.32	53
40–59 years	94	49.7	19.60	19.65	–0.05	–1
60–74 years	43	*	*	*	*	*
Male						
20–39 years	39	37.5	0.00	0.00	0.00	0
40–59 years	73	51.1	5.41	3.75	1.66	63
60–74 years	22	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 33. Potential bias in estimated percent prevalence of self-reported gallstones in the examined sample due to differential reporting of gallstone disease and poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	323	43.6	14.09	10.30	3.79	224
Female						
20–39 years	52	35.9	7.67	3.06	4.61	125
40–59 years	94	49.7	15.80	11.06	4.74	126
60–74 years	43	*	*	*	*	*
Male						
20–39 years	39	37.5	2.39	0.92	1.47	60
40–59 years	73	51.1	5.78	4.98	0.80	29
60–74 years	22	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 34. Potential bias in estimated percent prevalence of overweight in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,201	68.7	33.25	33.32	–0.07	–4
Female						
20–44 years	431	74.7	32.42	32.35	0.07	3
45–54 years	177	72.8	51.09	51.77	–0.68	–15
55–64 years	97	66.0	51.09	50.75	0.34	5
65–74 years	53	58.2	60.78	61.97	–1.19	–14
Male						
20–44 years	234	61.9	22.39	22.53	–0.14	–4
45–54 years	103	67.3	32.98	34.87	–1.89	–33
55–64 years	81	71.1	27.71	27.32	0.39	6
65–74 years	25	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 35. Potential bias in estimated percent prevalence of elevated cholesterol in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey: 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,138	64.5	16.69	16.33	0.36	27
Female						
20–44 years	407	68.8	11.29	10.72	0.57	30
45–54 years	165	67.9	23.77	22.72	1.05	26
55–64 years	95	64.6	37.98	39.72	–1.74	–29
65–74 years	49	53.9	51.91	52.07	–0.16	–2
Male						
20–44 years	226	59.8	10.02	9.75	0.27	11
45–54 years	97	63.4	35.97	36.34	–0.37	–6
55–64 years	76	66.7	25.45	26.65	–1.20	–20
65–74 years	23	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 36. Potential bias in estimated percent prevalence of impaired Fe status using MCV model in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,663	64.4	4.52	4.35	0.17	27
Female						
11–14 years	125	65.8	5.12	5.44	–0.32	–13
15–19 years	153	66.2	7.61	8.23	–0.62	–24
20–44 years	379	65.7	6.95	6.48	0.47	29
45–64 years	253	64.9	9.04	8.66	0.38	17
65–74 years	49	53.9	2.06	2.36	–0.30	–12
Male						
11–14 years	121	68.0	1.54	1.65	–0.11	–8
15–19 years	168	71.5	1.92	1.48	0.44	34
20–44 years	221	58.5	0.45	0.49	–0.04	–7
45–64 years	172	64.4	0.57	0.60	–0.03	–4
65–74 years	22	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 37. Potential bias in estimated percent prevalence of self-reported anemia in the examined sample due to differential reporting of anemia and poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,662	64.3	19.87	20.08	–0.21	–18
Female						
11–14 years	125	65.8	7.22	7.84	–0.62	–22
15–19 years	153	66.2	19.76	24.08	–4.32	–110
20–44 years	379	65.7	37.76	36.56	1.20	39
45–64 years	253	64.9	28.62	31.64	–3.02	–87
65–74 years	49	53.9	20.65	16.55	4.10	58
Male						
11–14 years	121	68.0	5.30	4.08	1.22	49
15–19 years	167	71.1	9.55	8.55	1.00	36
20–44 years	221	58.5	3.43	4.82	–1.39	–93
45–64 years	172	64.4	10.29	7.29	3.00	106
65–74 years	22	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 38. Potential bias in estimated percent prevalence of hypertension in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,200	68.0	13.85	13.74	0.11	9
Female						
20–44 years	440	74.3	3.82	4.05	–0.23	–21
45–54 years	174	71.6	26.49	24.88	1.61	39
55–64 years	97	66.0	46.35	49.30	–2.95	–48
65–74 years	53	58.2	53.68	52.93	0.75	9
Male						
20–44 years	233	61.6	7.42	7.18	0.24	11
45–54 years	102	66.7	26.13	25.76	0.37	7
55–64 years	78	68.4	49.10	49.32	–0.22	–3
65–74 years	23	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 39. Potential bias in estimated percent prevalence of self-reported hypertension in the examined sample due to differential reporting of hypertension and poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	1,199	68.0	27.21	27.50	–0.29	–18
Female						
20–44 years	439	74.2	19.46	19.33	0.13	6
45–54 years	174	71.6	45.82	45.28	0.54	12
55–64 years	97	66.0	61.79	58.22	3.57	59
65–74 years	53	58.2	59.78	67.16	–7.38	–89
Male						
20–44 years	233	61.6	19.62	19.32	0.30	9
45–54 years	102	66.7	31.76	35.81	–4.05	–72
55–64 years	78	68.4	48.25	43.28	4.97	72
65–74 years	23	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 40. Potential bias in estimated percent prevalence of gallstone disease in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	582	66.1	10.29	9.99	0.30	19
Female						
20–39 years	184	72.2	8.86	8.49	0.37	14
40–59 years	157	70.4	23.07	22.04	1.03	25
60–74 years	41	*	*	*	*	*
Male						
20–39 years	95	59.8	2.00	2.00	0.00	0
40–59 years	81	60.5	3.66	3.90	–0.24	–9
60–74 years	24	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

Table 41. Potential bias in estimated percent prevalence of self-reported gallstones in the examined sample due to differential reporting of gallstone disease and poverty status in the interviewed-but-not-examined sample for Puerto Ricans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	581	66.0	6.20	6.39	–0.19	–16
Female						
20–39 years	183	71.8	5.97	6.77	–0.80	–37
40–59 years	157	70.4	12.38	12.33	0.05	2
60–74 years	41	*	*	*	*	*
Male						
20–39 years	95	59.8	1.03	0.64	0.39	31
40–59 years	81	60.5	4.28	4.27	0.01	0
60–74 years	24	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).

[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

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Survey design

The sample design of the Hispanic Health and Nutrition Examination Survey (HHANES) was similar to that of the previous National Health and Nutrition Examination Surveys. These studies have used complex, multistage, stratified, probability cluster samples of civilian noninstitutionalized persons residing in households in the United States. In hierarchical order, the stages of selection were as follows: Primary sampling unit (PSU), which is a county or a small group of contiguous counties; census enumeration district (ED); segment (a cluster of households); household; and sample person.

The major difference between HHANES and the previous national surveys is that HHANES was a survey of three special subgroups of the population in selected areas of the United States rather than a national probability sample. Even though HHANES was not designed as a survey representative of all Hispanic persons residing in the United States and national estimates cannot be made, the three HHANES universes included approximately 76 percent of the 1980 Hispanic-origin population in the United States.

The three subgroups and three areas covered by HHANES were as follows:

- Mexican American, selected counties in five Southwest States (Arizona, California, Colorado, New Mexico, and Texas).
- Cuban, Dade County, Florida (Miami).
- Puerto Rican, New York City area (New York, New Jersey, and Connecticut).

There were 229 counties with a 1980 Hispanic population of at least 1,000 that were identified and grouped into 210 PSU's, each representing a single county or a small group of counties.

The HHANES Mexican-origin universe for the Southwest consisted of 193 PSU's; for Puerto Rican-origin, 16 PSU's; and for Cuban-origin, 1 PSU.

The 1980 census information for the Mexican-origin population in the Southwest PSU's was unavailable prior to stratification; therefore, information based on Hispanics of all origins was used for the stratification process. The characteristics of the PSU's in the Southwest area that were used as stratification variables were:

- Number of Hispanics
- Percent Hispanic
- Ratio of the 1980 to the 1970 Hispanic population
- Median income
- Percent urban

For the New York City area component of HHANES, the corresponding stratification variables were in terms of the number of Puerto Ricans. Stratification was not required for the Miami area component of HHANES because only one PSU, Dade County, was sampled.

A critical sample design requirement for HHANES was that each stratum in the Southwest area consist of approximately equal Hispanic population size, and that each stratum in the New York City area consist of approximately equal Puerto Rican population size. Equal-size strata generally minimize sampling variances and, at the same time, permit roughly the same number of sample interviews and examinations at each survey location. This requirement was satisfied by forming equal-size strata (clusters), and then applying the same sampling fraction to each stratum.

As mentioned previously, for the Miami area, Dade County was the only PSU selected. For the New York City area, one PSU per stratum was selected with probability proportional to size (PPS). The Southwest area and the New York City area universes of PSU's were stratified according to the five demographic characteristics presented earlier.

Moreover, it was deemed desirable to maximize the probability that the proportion of sample PSU's in each of the five Southwest States would correspond to the proportion of the eligible population in each State. Therefore, during PSU selection for the Southwest area, a slightly modified version of a procedure introduced by Goodman and Kish (37)—and summarized in Kish (38)—was employed to obtain a balanced sample with respect to State while retaining a true probability sample design. A detailed description of this controlled selection process and its application to health examination surveys is given in other NCHS reports (39,40).

The selection of the households within a PSU was based on the probability selection. The first stage of sampling the in-scope population consisted of all households and residents of group quarters (noninstitutional) containing one or more eligible Hispanic persons. Other

living quarters such as military installations and Indian reservations were considered out of scope. The minimum numbers of eligible Hispanic persons per block group (BG) or enumeration district (ED) were as follows: 50–100 persons in the Southwest area; 6–100 persons in the New York City area; and about 100 persons in the Miami area.

Table I. Within-household sampling rates, by survey area and age: Hispanic Health and Nutrition Examination Survey, 1962–84

Survey area and age	*Sampling rate*
Southwest and New York City areas	
6 months–19 years	3/4
20–44 years	1/2
45–74 years	1
Miami (Dade County)	
6 months–19 years	1
20–44 years	2/3
45–74 years	1

The main purpose of selecting the households was to identify eligible Hispanic families and to select sample persons from these families to be interviewed and examined. If the family was eligible for the survey, all members of that family were eligible to be selected. To ensure a sufficient sample size in the desired estimation cells, sample persons were selected according to the sampling rates shown in table I.

The HHANES sample size and response data by age and sex are shown in tables II-IV. These tables exclude persons who were non-Hispanic or of an origin that did not meet the eligibility criteria. Of the 9,455 Mexican-American persons included in HHANES in the Southwest area sample, 8,222 (87 percent) were interviewed and 7,197 (76 percent) were interviewed and examined (table II). Of the 2,125 Cuban Americans included in HHANES in the Dade County area sample, 1,677 (79 percent) were interviewed and 1,291 (61 percent) were interviewed and examined (table III). Among the 3,525 Puerto Rican persons sampled in the New York City area, 3,137 (89 percent) were interviewed and examined (table IV).

Table II. Sample size and response rates for Mexican Americans, by sex and age: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	*Sample size*	*Interviewed*		*Examined*	
		Number	*Percent*	*Number*	*Percent*
Both sexes					
Total	9,455	8,222	87.0	7,197	76.1
6 months–4 years	1,232	1,136	92.2	1,025	83.2
5–9 years	1,288	1,182	91.8	1,100	85.4
10–11 years	480	443	92.3	412	85.8
12–19 years	1,720	1,526	88.7	1,334	77.6
20–24 years	708	600	84.7	499	70.5
25–34 years	1,323	1,154	87.2	979	74.0
35–44 years	797	683	85.7	593	74.4
45–54 years	960	745	77.6	631	65.7
55–64 years	650	506	77.8	422	64.9
65–74 years	297	247	83.2	202	68.0
Male					
Total	4,589	3,929	85.5	3,385	73.8
6 months–4 years	620	577	93.1	523	84.4
5–9 years	637	584	91.7	544	85.4
10–11 years	237	219	92.4	203	85.7
12–19 years	847	749	88.4	654	77.2
20–24 years	343	285	83.1	221	64.4
25–34 years	642	550	85.7	438	68.2
35–44 years	379	303	79.9	252	66.5
45–54 years	441	323	73.2	270	61.2
55–64 years	313	233	74.4	197	62.9
65–74 years	130	103	79.2	83	63.8
Female					
Total	4,866	4,296	88.3	3,812	78.3
6 months–4 years	612	559	91.3	502	82.0
5–9 years	651	598	91.9	556	85.4
10–11 years	243	224	92.2	209	86.0
12–19 years	873	777	89.0	680	77.9
20–24 years	365	315	86.3	278	76.2
25–34 years	681	604	88.7	541	79.4
35–44 years	418	380	90.9	341	81.6
45–54 years	519	422	81.3	361	69.5
55–64 years	337	273	81.0	225	66.8
65–74 years	167	144	86.2	119	71.3

NOTE: Data are for Mexican Americans residing in the Southwest area (selected counties in Arizona, California, Colorado, New Mexico, and Texas).

Table III. Sample size and response rates for Cubans, by sex and age: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Sample size	Interviewed		Examined	
		Number	Percent	Number	Percent
Both sexes					
Total	2,125	1,677	78.9	1,291	60.8
6 months–4 years	144	122	84.7	85	59.0
5–9 years	134	115	85.8	93	69.4
10–11 years	65	54	83.1	43	66.2
12–19 years	301	252	83.7	205	68.1
20–24 years	131	91	69.5	65	49.6
25–34 years	239	181	75.7	139	58.2
35–44 years	240	197	82.1	147	61.3
45–54 years	381	286	75.1	233	61.2
55–64 years	300	240	80.0	176	58.7
65–74 years	190	139	73.2	105	55.3
Male					
Total	999	786	78.7	608	60.9
6 months–4 years	72	62	86.1	51	70.8
5–9 years	67	54	80.6	40	59.7
10–11 years	34	30	88.2	26	76.5
12–19 years	163	136	83.4	114	69.9
20–24 years	56	37	66.1	27	48.2
25–34 years	111	83	74.7	64	57.7
35–44 years	100	82	82.0	52	52.0
45–54 years	188	140	74.5	114	60.6
55–64 years	137	106	77.4	79	57.7
65–74 years	71	56	78.9	41	57.7
Female					
Total	1,126	891	79.1	683	60.7
6 months–4 years	72	60	83.3	34	47.2
5–9 years	67	61	91.0	53	79.1
10–11 years	31	24	77.4	17	54.8
12–19 years	138	116	84.1	91	65.9
20–24 years	75	54	72.0	38	50.7
25–34 years	128	98	76.6	75	58.6
35–44 years	140	115	82.1	95	67.9
45–54 years	193	146	75.6	119	61.7
55–64 years	163	134	82.2	97	59.5
65–74 years	119	83	69.7	64	53.8

NOTE: Data are for Cubans residing in the Miami area (Dade County, Florida).

For each Hispanic subgroup, the numbers of examined males and females and the estimated populations they represent are given in table V for children and table VI for adults. For a complete description of the sample survey design, see NCHS (5).

Estimation procedures

Because the design of HHANES is a complex multistage probability sample, the estimates are derived through a multistage estimation procedure. The procedure consisted of four components:

1. Inflation of sample person observations by the product of the reciprocals of the probabilities of selection at each stage of the design (PSU, segment, household, and sample person).
2. Adjustment for nonresponse within homogeneous sociodemographic cells to reduce the potential bias attributable to nonresponse, under the assumption that within cells the characteristics of the respondents are similar to those of the nonrespondents.
3. Adjustment for noncoverage within the PSU to reduce the potential bias due to the exclusion of BG's and ED's with few Hispanic residents.
4. Poststratified ratio adjustment by age and sex to make the final estimates of the population correspond to U.S. Bureau of the Census estimates of the civilian noninstitutionalized target population (used only for Mexican Americans). The percent distributions of the nonresponse adjustment factors for interviewed and examined Mexican-American, Cuban, and Puerto Rican persons are shown in tables VII–IX.

Table IV. Sample size and response rates for Puerto Ricans, by sex and age: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Sample size	Interviewed		Examined	
		Number	Percent	Number	Percent
Both sexes					
Total	3,525	3,137	89.0	2,645	75.0
6 months–4 years	424	388	91.5	335	79.0
5–9 years	411	374	91.0	338	82.2
10–11 years	162	152	93.8	136	84.0
12–19 years	764	704	92.1	616	80.6
20–24 years	260	219	84.2	173	66.5
25–34 years	389	336	86.4	279	71.7
35–44 years	321	277	86.3	229	81.3
45–54 years	396	346	87.4	281	71.0
55–64 years	261	224	85.8	179	68.6
65–74 years	137	117	85.4	79	57.7
Male					
Total	1,575	1,385	87.9	1,155	73.3
6 months–4 years	221	207	93.7	175	79.2
5–9 years	208	186	89.4	169	81.3
10–11 years	80	73	91.3	65	81.3
12–19 years	375	339	90.4	301	80.3
20–24 years	97	79	81.4	55	56.7
25–34 years	163	135	82.8	107	65.6
35–44 years	118	97	82.2	73	61.9
45–54 years	153	133	86.9	104	68.0
55–64 years	114	97	85.1	81	71.1
65–74 years	46	39	84.8	25	54.3
Female					
Total	1,950	1,752	89.8	1,490	76.4
6 months–4 years	203	181	89.2	160	78.8
5–9 years	203	188	92.6	169	83.3
10–11 years	82	79	96.3	71	86.6
12–19 years	389	365	93.8	315	81.0
20–24 years	163	140	85.9	118	72.4
25–34 years	226	201	88.9	172	76.1
35–44 years	203	180	88.7	156	76.8
45–54 years	243	213	87.7	177	72.8
55–64 years	147	127	86.4	98	66.7
65–74 years	91	78	85.7	54	59.3

NOTE: Data are for Puerto Ricans residing in the New York City area (New York, New Jersey, and Connecticut).

Table V. Number of examined persons 6 months–19 years of age and estimated population, by specified Hispanic origin, sex, and age of examinee: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Mexican American		Cuban		Puerto Rican	
	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands
Male						
6 months–19 years	1,924	1,979	231	65	710	269
6–11 months	57	60	4	1	17	6
1 year	106	108	15	4	39	14
2 years	111	108	8	2	37	15
3 years	131	127	11	3	39	15
4 years	118	117	13	4	43	16
5 years	116	107	1	–	24	9
6 years	110	102	11	3	37	14
7 years	110	101	11	3	39	15
8 years	102	93	9	3	42	15
9 years	106	95	8	2	27	10
10 years	88	81	14	4	38	14
11 years	115	105	12	3	27	10
12 years	115	111	16	4	37	14
13 years	98	91	12	3	39	15
14 years	97	123	20	6	40	15
15 years	69	93	10	3	38	15
16 years	76	98	14	4	44	18
17 years	71	93	14	4	43	16
18 years	64	80	12	3	35	14
19 years	64	85	16	5	25	9
Female						
6 months–19 years	1,947	1,925	195	59	715	267
6–11 months	63	60	3	1	21	7
1 year	123	121	10	3	37	14
2 years	121	114	6	2	28	11
3 years	99	97	9	3	40	15
4 years	96	91	6	2	34	13
5 years	109	97	9	3	30	11
6 years	118	109	9	3	35	13
7 years	96	86	11	4	39	14
8 years	108	96	12	4	31	12
9 years	125	110	12	4	34	12
10 years	94	95	5	2	37	14
11 years	115	113	12	3	34	13
12 years	103	105	16	6	35	13
13 years	90	90	14	4	46	16
14 years	75	83	10	3	35	13
15 years	85	97	6	2	46	18
16 years	99	109	11	3	43	16
17 years	75	86	16	4	38	15
18 years	78	84	8	2	37	13
19 years	75	81	10	3	35	14

NOTES: See appendix III for the definition of Hispanic origin. Figures include unknowns.

Table VI. Number of examined persons 18–74 years of age and estimated population, by specified Hispanic origin, sex, and age of examinee: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Mexican American		Cuban		Puerto Rican	
	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands	Number of examined persons	Estimated population in thousands
Male						
18–74 years	1,589	2,748	405	155	505	260
20–74 years	1,461	2,583	377	147	445	237
18–24 years	349	701	55	22	115	58
20–24 years	221	536	27	14	55	35
25–34 years	438	881	64	32	107	75
35–44 years	252	502	52	27	73	53
45–54 years	270	316	114	36	104	38
55–64 years	197	221	79	24	81	28
65–74 years	83	126	41	13	25	9
Female						
18–74 years	2,018	2,714	506	187	847	424
20–74 years	1,865	2,549	488	182	775	397
18–24 years	431	640	56	22	190	103
20–24 years	278	475	38	17	118	76
25–34 years	541	817	75	35	172	108
35–44 years	341	495	95	43	156	104
45–54 years	361	359	119	38	177	60
55–64 years	225	253	97	29	98	31
65–74 years	119	149	64	19	54	18

NOTES: See appendix III for the definition of Hispanic origin. Figures include unknowns.

Table VII. Percent distribution of nonresponse adjustment factors for interviewed and examined persons in the Southwest area: Hispanic Health and Nutrition Examination Survey, 1982–84

Size of factor	Interviewed	Examined
	Percent distribution	
Total	100.0	100.0
1.00–1.24	82.5	87.1
1.25–1.49	14.0	11.1
1.50–1.74	2.2	1.2
1.75–1.99	1.1	0.3
2.00–2.50	0.2	0.2

Table VIII. Percent distribution of nonresponse adjustment factors for interviewed and examined persons in the Miami area: Hispanic Health and Nutrition Examination Survey, 1982–84

Size of factor	Interviewed	Examined
	Percent distribution	
Total	100.0	100.0
1.00–1.24	20.3	38.0
1.25–1.49	77.6	57.6
1.50–1.60	2.1	4.4

Table IX. Percent distribution of nonresponse adjustment factors for interviewed and examined persons in the New York City area: Hispanic Health and Nutrition Examination Survey, 1982–84

Survey status and size of factor	Percent distribution
Interviewed	
Total	100.0
<1.10	57.5
1.10–1.19	24.2
≥ 1.20	18.2
Examined	
Total	100.0
<1.20	62.6
1.20–1.49	35.4
≥ 1.50	2.1

Appendix II
National origin recode

In the Hispanic Health and Nutrition Examination Survey (HHANES), if any family member was identified as being an eligible Hispanic person (as defined below), all members of that person's family, regardless of origin, were eligible to be selected as sample persons (5). Thus, it was possible to include sample persons in the total sample who were either non-Hispanic or Hispanic, but not of the appropriate origin for inclusion in the analysis of a specified subgroup in a given portion of the survey. The national origin recode specifies whether a sample person was considered to be "Hispanic" (recode 1), "non-eligible Hispanic" (recode 2), or "non-Hispanic" (recode 2) for purposes of analysis. "Hispanic" is defined as

Mexican American, residing in the Southwest area;
Cuban, residing in Dade County, Florida; or
Puerto Rican, residing in the New York City area.

The recode was assigned as follows (see table X for original codes):

Southwest area

If the original national origin or ancestry response code (from the Household Screener Questionnaire) was 1, 2, 3, 8, 10, or 11, then *National origin recode* = 1.

If the original national origin or ancestry response code was 4,5,6,7,9, or 0 but the person specified Mexican/Mexicano, Chicano, or Mexican American on the adult sample person questionnaire, or if the person was the biological child of a household member with *recode* equal to 1 (as determined by questions A1-A11 on the family questionnaire), then *National origin recode* = 1.

In all other cases, *National origin recode* = 2.

Dade County, Florida, area

If the original national origin or ancestry code was 6 or 7, then *National origin recode* = 1.

In all other cases, *National origin recode* = 2.

New York City area

If the original national origin or ancestry code was 4 or 5, then *National origin recode* = 1.

If national origin or ancestry was 1, 2, 3, 6, 7, 8, 9, or 0 but the person specified Boricuan or Puerto Rican on the adult sample person questionnaire (question M10), or if the person was the biological child of a household member with *recode* equal to 1 (as determined by questions A1-A11 on the family questionnaire), then *National origin recode* = 1.

In all other cases, *National origin recode* = 2.

Table X. Number of sample persons in specified Hispanic group, by response codes obtained from self-identification of national origin or ancestry during household questionnaire: Hispanic Health and Nutrition Examination Survey, 1982–84

Response code	Mexican American	Cuban	Puerto Rican
0 Other—specify	276	30	114
1 Mexican/Mexicano	1,641	1	1
2 Mexican American	5,202	–	–
3 Chicano	102	–	–
4 Puerto Rican	7	3	2,596
5 Boricuan	–	–	36
6 Cuban	4	1,069	20
7 Cuban American	–	222	–
8 Hispaño—specify	150	14	26
9 Other Latin American or other Spanish	37	18	41
10 Spanish American	22	–	–
11 Spanish (Spain)	21	–	–

Use of recode

The national origin recode may be used in analysis in one of two ways. First, selecting on *recode* = 1 (as has been done for this report) will restrict analysis to "Hispanics" only. In this case, in the Southwest area of the survey, the weighted estimates by age and sex will approximately equal U.S. Bureau of the Census population estimates of the number of Mexican Americans and a small proportion of other Hispanics assumed to be Hispaño in the Southwest area (selected counties in Arizona, California, Colorado, New Mexico, and Texas) at the midpoint of the Mexican American portion of HHANES—March 1983. The weighted estimates for Cubans represent an independent estimate of the number of Cubans in Dade County at the midpoint—February 1984. The weighted estimates of Puerto Ricans represent an independent estimate of the number of Puerto Ricans in the sample counties in New York, New Jersey, and Connecticut at the midpoint of the Puerto Rican portion—September 1984.

Second, using *recode* greater than 0, that is, all sample persons, will include "Hispanic" and "non-Hispanic" per-

sons; and the Southwest weighted estimates by age and sex will overestimate the U.S. Bureau of the Census population estimates of Mexican Americans and other Hispanics by about 4.5 percent. In Dade County, using *recode* greater than 0 will increase the weighted estimates by about 5.3 percent over that for Cuban Americans only; and using *recode* greater than 0 for the New York City area will increase the weighted estimates by about 9.2 percent over that for Puerto Ricans only.

Appendix III
Definitions of demographic and socioeconomic terms

Age—Age was defined as age at last birthday at the time of the household interview.

Sex—Sex was recorded by the interviewers and examiners.

Annual family income—The respondent was given a card listing income categories and was instructed to select the one that represented his or her total combined family income for the last 12 months. Respondents were asked to include income from all sources such as wages, salaries, social security or retirement benefits, help from relatives, rent from property, unemployment payments, and so forth.

Season—The four seasons were defined as follows:

Winter	December 22–March 20
Spring	March 21–June 20
Summer	June 21–September 21
Fall	September 22–December 21

Education level of head of household—For each sample person interviewed, questions were asked pertaining to the head of the household. One such item was the highest grade or years of regular school that the head of the household attended. A further question was asked to determine whether that grade was completed. For the nonresponse analyses, four levels of educational status of the household head were defined. These categories are none, grade school (1–8 years), high school (9–12 years), and college (13 or more years).

Population concentration (size of place)—A place is a concentration of population. Most places are incorporated as cities, towns, villages, or boroughs, but others are defined by the Bureau of the Census around definite residential nuclei with dense, city-type street patterns, with, ideally, at least 1,000 persons per square mile. The categories used in nonresponse analyses were largest (500,000 or more), second largest (100,000–499,999), third largest (200–9,999), and fourth largest (not in a place).

Standard metropolitan statistical area (SMSA)—An SMSA is a large population nucleus and nearby communities that have a high degree of economic and social integration with that nucleus. Generally, an SMSA includes one or more central cities, all urbanized areas around the city or cities, and the remainder of the county or counties in which the urbanized areas are located. The categories used in nonresponse analyses were category 1 (in SMSA, in central city), category 2 (in SMSA, not in central city), and category 3 (not in SMSA).

Poverty status—Poverty status is based on the poverty index. The poverty index is a ratio of two components. The numerator is the midpoint of the income bracket reported for each family in the family questionnaire. Respondents were asked to report total combined family income during the 12 months preceding the interview. The denominator is a poverty threshold which varied with the number of persons in the family, the adult-child composition of the family, the age of the reference person, and the month and the year in which the family was interviewed. Members of families with incomes equal to or greater than poverty thresholds have poverty indexes equal to or greater than 1.0 and can be described as "at or above poverty"; those with incomes less than the poverty threshold have indexes less than 1.0 and can be described as "below poverty."

Food stamps—Respondents were asked in the family questionnaire whether any member of the family received any Government food stamps in any of the previous 12 months.

Health insurance—In the Health Insurance section of the family questionnaire, up to three separate health insurance plans could be reported for a family. Each sample person could have been covered by any combination of the three or by none at all. In order to simplify the health insurance coverage data, the information on all reported plans was combined to a single variable for each sample person, that is, whether or not the person is covered by any plan.

Mexican-American acculturation score—An eight-item Mexican-American acculturation score has been computed for those persons with national origin recode = 1 (see appendix II). The Mexican-American acculturation score is the arithmetic mean of the scores for eight variables that were derived from questions on the adult sample person questionnaire and the family questionnaire. The eight variables are:

1. What language do you speak?
2. What language do you prefer?
3. What language do you read better?
4. What language do you write better?
5. What ethnic identification do you use?
6. What ethnic identification does/did your mother use?
7. What ethnic identification does/did your father use?
8. Where were you born? Your mother? Your father?

These eight variables represent a subset of the 20-item Cuellar scale for Mexican Americans that served as a prototype for the HHANES questions (41). The score is scaled from 1.0 to 4.9, where the minimum value (1.0) indicates the strongest Spanish language-Mexican orientation and the maximum value (4.9) indicates the strongest English language-United States orientation. The categories used in the nonresponse analyses are strong Spanish (1.00–1.74), intermediate (1.75–3.20), and strong English (3.25–4.90).

Appendix IV
Items on the child sample person questionnaire used in nonresponse analysis

Form PHS 6208
9/82

OMB No. 0937-0078
Approval Expires 2/85

Department of Health and Human Services
Public Health Service
Office of Health Research, Statistics, and Technology
National Center for Health Statistics

NOTICE — Information contained on this form which would permit identification of any individual or establishment has been collected with a guarantee that it will be held in strict confidence, will be used only for purposes stated for this study, and will not be disclosed or released to others without the consent of the individual or the establishment in accordance with section 308(d) of the Public Health Service Act (42 USC 242m).

CHILD SAMPLE PERSON QUESTIONNAIRE (522)
(Ages 6 Mos.-11 Years)

HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEY

LANGUAGE OF INTERVIEW (106)
1 ☒ English
2 ☐ Spanish

(110) SEX
1 ☐ Male
2 ☐ Female

(111) AGE

BIRTH

A15. Was —— ever breastfed? (143) 1 ☐ Y 2 ☐ N(A18)

HEALTH SERVICES

B1. Would you say ——'s health in general is excellent, very good, good, fair, or poor? (150)
1 ☐ excellent
2 ☐ very good
3 ☐ good
4 ☐ fair
5 ☐ poor

DENTAL AND ANEMIA

C3. On the average, about how many times a year does —— see someone for dental care?	(216)	1 ☐ less than once a year 2 ☐ once 3 ☐ twice 4 ☐ 3 or more times 5 ☐ no regular schedule 9 ☐ DK
C9. Has —— ever had anemia, sometimes called "tired blood" or "low blood"?	(222)	1 ☐ Y 2 ☐ N(D1) 9 ☐ DK(D1)

VISION AND HEARING

D1. Has —— ever had trouble seeing with one or both eyes when not wearing glasses or contact lenses?	(226)	1 ☐ Y 2 ☐ N(D10)
D14. Did —— ever have an ear infection or an earache?	(244)	1 ☐ Y 2 ☐ N(D18) 9 ☐ DK(D18)
D21. Did —— ever see a doctor because of this condition?	(251)	1 ☐ Y 2 ☐ N 9 ☐ DK
D22. Has —— ever had trouble hearing with one or both ears? Do not include any problems which lasted just a short period of time such as during a cold.	(252)	1 ☐ Y 2 ☐ N(D27)

TB/WEIGHT/IMMUNIZATION/PESTICIDES

E5. For —— height, would you say —— is underweight, about the right weight, or overweight?	(270)	1 ☐ underweight 2 ☐ about the right weight (E9) 3 ☐ overweight

CONDITION LIST	
G1. Did a doctor ever say that —— had - IF "YES" ASK G2 - G4 BEFORE GOING TO NEXT CONDITION.	
a. Asthma?	(304) 1 ☐ Y(G2) 2 ☐ N

SCHOOL ATTENDANCE AND LANGUAGE USE	
H13. What language does —— mainly speak at home now?	(383) 1 ☐ Spanish 2 ☐ English 3 ☐ both equally 4 ☐ other language 5 _____ specify
H14. What language do (——'s parents/you) mainly speak at home now?	(384) 1 ☐ Spanish 2 ☐ English 3 ☐ both equally 4 ☐ other language 5 _____ specify
H20. What language does —— mainly speak at home now?	(393) 1 ☐ Spanish 2 ☐ English 3 ☐ both equally 4 ☐ other language — 5 _____ specify
H21. What language do (——'s parents/you) mainly speak at home now?	(394) 1 ☐ Spanish 2 ☐ English 3 ☐ both equally 4 ☐ other language — 5 _____ specify

Appendix V
Items on the adult sample person questionnaire used in nonresponse analysis

Form PHS 6206
9/82

OMB No. 0937-0078
Approval Expires 2/85

Department of Health and Human Services
Public Health Service
Office of Health Research, Statistics, and Technology
National Center for Health Statistics

ADULT SAMPLE PERSON QUESTIONNAIRE (521) (Ages 12-74 Years)

HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEY

NOTICE – Information contained on this form which would permit identification of any individual or establishment has been collected with a guarantee that it will be held in strict confidence, will be used only for purposes stated for this study, and will not be disclosed or released to others without the consent of the individual or the establishment in accordance with section 308(d) of the Public Health Service Act (42 USC 242m).

LANGUAGE OF INTERVIEW (106)
1 ☒ English
2 ☐ Spanish

(110) SEX
1 ☐ Male
2 ☐ Female

(111) AGE

HEALTH SERVICES

A1. Would you say your health in general is excellent, very good, good, fair, or poor? (118)
1 ☐ excellent
2 ☐ very good
3 ☐ good
4 ☐ fair
5 ☐ poor

A4. In your job or housework, how much of the time do you have to use lots of arm, leg, or back muscles, as in lifting, pulling, carrying, digging, and so on? Would you say: most of the time, some of the time or hardly ever or never? (121)

Most of the time	Some of the time	Hardly ever or never
1 ☐	2 ☐	3 ☐

A5. Outside of your job or work around the house, how often do you take part in activities which require a lot of body movement or energy, like ball games, cycling, dancing, and so on? Would you say: frequently, sometimes, or hardly ever or never? (122)

Freq.	Sometimes	Hardly ever or never
1 ☐	2 ☐	3 ☐

A33. About how long has it been since you had a routine physical examination; that is, not for a particular illness, but for a general checkup? (178)
1 ☐ less than 1 year ago
2 ☐ 1 yr., less than 2 yrs.ago
3 ☐ 2 yrs., less than 5 yrs.ago
4 ☐ 5 or more yrs. ago
5 ☐ never
9 ☐ DK

SELECTED CONDITIONS

B3. Have you ever had anemia, sometimes called "tired blood" or "low blood"?

(183) 1 ☐ Y 2 ☐ N(B7) 9 ☐ DK(B7)

B7. About how tall are you without shoes?

(187) (188) _____ / _____ feet inches

B8. About how much do you weigh without shoes?

IF NOW PREGNANT, RECORD CURRENT WEIGHT. THEN ASK:

About how much did you weigh just before you became pregnant?

(189) current weight: _____ number pounds

(190) weight before pregnant: _____ number pounds

B9. Do you now consider yourself to be overweight, underweight, or about right?

(191)
1 ☐ overweight
2 ☐ underweight
3 ☐ about right
9 ☐ DK

B13. How would you describe the condition of your teeth: excellent, very good, good, fair or poor?

(195)
1 ☐ excellent
2 ☐ very good
3 ☐ good
4 ☐ fair
5 ☐ poor
6 ☐ has no teeth

B15. About how long has it been since you last saw a dentist or dental hygienist for dental care?

(197)
1 ☐ 6 months ago or less
2 ☐ over 6 months to 12 months
3 ☐ over 12 months to 2 years
4 ☐ over 2 years to 5 years
5 ☐ more than 5 years
6 ☐ never (B20)
9 ☐ DK

DIABETES

C1. Do you have diabetes or sugar diabetes?

(203) 1 ☐ Y 2 ☐ N(C6)

VISION AND HEARING

D1. Have you ever had trouble seeing with one or both eyes when not wearing glasses or contact lenses?	(236)	1 ☐ Y 2 ☐ N(D10)
D11. Have you ever had trouble hearing with one or both ears? Do not include any problems which lasted just a short period of time such as during a cold.	(251)	1 ☐ Y 2 ☐ N (E1)

HYPERTENSION

E7. Have you ever been told by a doctor that you had high blood pressure?	(264)	1 ☐ Y(E10) 2 ☐ N
E8. Another name for high blood pressure is hypertension. Have you ever been told by a doctor that you had hypertension?	(265)	1 ☐ Y(E10) 2 ☐ N
E23. Are you now taking any medicine prescribed by a doctor for your (high blood pressure/hypertension)?	(294)	1 ☐ Y 2 ☐ N(E25)

DIGESTIVE DISEASE

F2. Has a doctor ever told you that you had gallstones?	(309)	1 ☐ Y 2 ☐ N

CARDIOVASCULAR CONDITIONS

G1. Have you ever had any pain or discomfort in your chest?	(366)	1 ☐ Y(G3) 2 ☐ N

SMOKING

H1. Have you smoked at least 100 cigarettes in your entire life?	(396) 1 ☐ Y 2 ☐ N(H13)
H3. Do you smoke cigarettes now?	(398) 1 ☐ Y(H6) 2 ☐ N

FUNCTIONAL IMPAIRMENT

J1. CHECK ITEM.	(423) 1 ☐ Age under 18 (J28) 2 ☐ Age 71 or older (J25) 3 ☐ Age 18-70 (J2)
J2. What was your major activity during most of the past 12 months; working at a job or business, keeping house, going to school, or something else?	(424) 1 ☐ working (J3) 2 ☐ keeping house (J5) 3 ☐ going to school (J12) 4 ☐ something else (J12)

CONDITION LIST

K1. Has a doctor ever told you that you had: (IF "YES" ASK K2 & K3 BEFORE GOING TO NEXT CONDITION).

Chronic bronchitis?	(469)	1 ☐ Y(K2)	2 ☐ N
Heart failure?	(481)	1 ☐ Y(K2)	2 ☐ N
Heart attack?	(484)	1 ☐ Y(K3)	2 ☐ N
Kidney problems?	(486)	1 ☐ Y(K2)	2 ☐ N
Stroke?	(498)	1 ☐ Y (K3)	2 ☐ N
An eye injury?	(509)	1 ☐ Y(K2)	2 ☐ N

PESTICIDE EXPOSURE

L1. Have you <u>ever</u> done farm work, either paid or unpaid? Some examples of farm work are working with crops or animals and supervising other workers on farms or orchards.	(518) 1 ☐ Y 2 ☐ N(L27)

ACCULTURATION

M1. Do you speak any Spanish?	(587) 1 ☐ Y 2 ☐ N(M4)
M2. Would you say that you speak mostly Spanish, or mostly English, or do you speak Spanish and English about the same?	(589) 1 ☐ mostly Spanish 2 ☐ mostly English 3 ☐ both about the same
M3. What language do you prefer: Spanish only, mostly Spanish, mostly English, English only, or Spanish and English about equally?	(590) 1 ☐ Spanish only 2 ☐ mostly Spanish 3 ☐ mostly English 4 ☐ English only 5 ☐ both equally
M4. Can you read Spanish?	(591) 1 ☐ Y 2 ☐ N
M5. Can you read English?	(592) 1 ☐ Y 2 ☐ N
IF "YES" TO BOTH M4 AND M5, ASK: **M6.** Which do you read better?	(593) 1 ☐ Spanish 2 ☐ English 3 ☐ both the same
M7. Can you write in Spanish?	(594) 1 ☐ Y 2 ☐ N
M8. Can you write in English?	(595) 1 ☐ Y 2 ☐ N
IF "YES" TO BOTH M7 AND M8, ASK: **M9.** In which language do you write better?	(596) 1 ☐ Spanish 2 ☐ English 3 ☐ both the same

HAND CARD ASP 4

M10. Which of those groups best describes your ethnic identification?

(597)
- 01 ☐ Boricuan
- 02 ☐ Puerto Rican
- 03 ☐ Cuban
- 04 ☐ Cuban-American
- 05 ☐ Mexican/Mexicano
- 06 ☐ Chicano
- 07 ☐ Mexican-American

- 08 ☐ Hispano
- 09 ☐ Latin American
- 10 ☐ Other Spanish or other Hispanic
- 11 ☐ American
- 12 ☐ Anglo-American
- 13 ☐ other group 14 _____ specify

IF ANY BOX BELOW THE LINE IN M10 IS CHECKED, ASK:

M11. What is your country of origin?

(598) 1 _____ specify

M12. Which of those groups best describes your mother's ethnic identification?

(599)
- 01 ☐ Boricuan
- 02 ☐ Puerto Rican
- 03 ☐ Cuban
- 04 ☐ Cuban-American
- 05 ☐ Mexican/Mexicano
- 06 ☐ Chicano
- 07 ☐ Mexican-American
- 08 ☐ Hispano
- 09 ☐ Latin American

10 _____ specify country

- 11 ☐ other Spanish or other Hispanic

12 _____ specify country

- 13 ☐ American
- 14 ☐ Anglo-American
- 15 ☐ other group 16 _____ specify

M13. Which of those groups best describes your father's ethnic identification?

(600)
- 01 ☐ Boricuan
- 02 ☐ Puerto Rican
- 03 ☐ Cuban
- 04 ☐ Cuban-American
- 05 ☐ Mexican/Mexicano
- 06 ☐ Chicano
- 07 ☐ Mexican-American
- 08 ☐ Hispano
- 09 ☐ Latin American

10 _____ specify country

- 11 ☐ other Spanish or other Hispanic

12 _____ specify country

- 13 ☐ American
- 14 ☐ Anglo-American
- 15 ☐ other group 16 _____ specify

M14. In what country or State was your father born?	(601) 1 ☐ U.S., except Puerto Rico 2 ☐ Puerto Rico 3 ☐ Cuba 4 ☐ Mexico 5 ☐ other 6 _____ specify
M15. In what country or State was your mother born?	(602) 1 ☐ U.S., except Puerto Rico 2 ☐ Puerto Rico 3 ☐ Cuba 4 ☐ Mexico 5 ☐ other 6 _____ specify

Appendix VI
HHANES-NHIS comparison

The National Health Interview Survey (NHIS) is an important source of data on the reported health status of Hispanics(42–44), and it can provide a point of comparison with similarly collected data from the HHANES examined group. Similarities and dissimilarities between the two surveys that should be considered when interpreting these results are discussed here. Detailed information on the plan and operation of the NHIS has been documented (45).

The two surveys have important design and operational features in common including the following:

1. Both are large-scale surveys utilizing stratified, multistage probability designs involving the selection of geographically defined areas (primary sampling units).

2. The two surveys share some of the same primary sampling units in the areas of the country in which the HHANES was conducted.

3. Similar demographic and medical history data were collected during household interviews, although relative positioning of specific questionnaire items in the interviews were different.

Limitations on the comparability of the two surveys include the following:

1. SMSA non-SMSA—Self-representing standard metropolitan statistical areas from Texas, California, Miami, and New York included in the NHIS were chosen for the comparison study. This may have led to an "urban" bias in the NHIS data.

2. Proxy status—For the NHIS, all persons 19 years or over or any age if ever married were eligible to respond for himself or herself and for any other related household member not present. For the HHANES, proxy response was allowed only for demographic and family information (including age, sex, income, and education); but medical history data were required to be self-reported.

3. Language—Both the NHIS and HHANES were based on interviews. The NHIS interviews were conducted by Bureau of the Census employees. For those interviewers who were not Spanish-speaking, household members, neighbors, or friends of the sample person were allowed to interpret. While there was no Spanish translation of the NHIS core questionnaire, Spanish-language flashcards were used. For the HHANES, bilingual interviewers were employed and a Spanish-language interpretation of the questionnaire was available.

4. Differing primary sampling units (PSU's)—The two surveys shared PSU's in Los Angeles and San Diego, California; Houston, Texas; Miami, Florida; and New York, New York. In the Mexican American sample, approximately 40 percent of the HHANES sample and 70 percent of the NHIS comparison sample were drawn from these areas.

5. Nonresponse—In past surveys, nonresponse to the NHIS has generally been smaller than nonresponse to the medical history interview component of the National Health Examination Surveys (NHES). This is due primarily to the NHIS practice of allowing proxy response to medical history questions while the NHES has required self-response among adults.

If there is close agreement between the two surveys, it adds to the sense of comparability and credibility of these two large-scale surveys. The comparison consists of the display of the weighted proportion of various conditions or attributes for each sample. The composition of the HHANES weights has already been described. The NHIS weights were the reciprocal of the probability of selection with adjustments for nonresponse and with poststratification to the population distribution as estimated by the Bureau of the Census.

One of the strengths of the NHIS is the ability to combine data over multiple years (43). To increase the stability of the estimates, years of data were combined. To maximize comparability with the HHANES, this comparison was limited to the combined 1982, 1983, and 1984 NHIS weighted samples. Reanalysis limited to just those SMSA's included in both surveys did not alter the conclusions of the study.

The comparison of the NHIS and the HHANES should be interpreted in light of the limitations mentioned—the use of proxy respondents in the NHIS and the availability of a Spanish-language-translated questionnaire in the HHANES but not in the NHIS. First, the use of proxy response allowed the NHIS to collect information on those who would have been nonrespondents in the HHANES. The HHANES approach was to assume that nonrespondents were similar to respondents within nonresponse weighting adjustment categories. When this assumption was not true, estimates from the two surveys would diverge. Second, it is not certain what effect the lack of a Spanish-language questionnaire in the NHIS may have

had on NHIS estimates. Although the opportunity for conducting the interview in Spanish as well as English was available in both surveys, the uniformity of translations was less exact in the NHIS than in the HHANES. This is clearly a subject for further research.

Lacking more direct and complete information on the socioeconomic and health status of the HHANES noninterviewed group, the HHANES versus NHIS comparison suggests the nature and direction of possible nonresponse bias.

Appendix VII
CHAID procedure

The Chi-Square Automatic Interaction Detection (CHAID) technique was used to summarize the data. CHAID is a descriptive procedure that provides the researcher with information about the relationships between the dependent variable (the interview status) and the predictor variables (other classification or descriptive variables) by calculating the chi-square measure of association between the dependent and each independent variable. (Note, "unknown" or "missing" category data were treated as "floating" response categories and were allowed to combine with other response categories.) The predictor variable that has the most significant chi-square, after a Bonferroni adjustment for the number of variable categories, is used to split the sample into groups. This process is repeated for each of the new groups until there are too few observations for further splitting. The result is a tree-like structure that suggests which predictor variables may be important and need future investigation. The computer software SI-CHAID (SI-CHAID^R is a registered trademark of Statistical Innovations Inc., Belmont, Massachusetts) was used to perform the analysis.

Background

The CHAID technique was originally developed by Kass (27) as a procedure for predicting the outcome of a categorical dependent variable on the basis of a set of independent categorical variables. But this type of "tree analysis" has its origin in the Sonquist and Morgan Automatic Interaction Detection (AID) program developed at the University of Michigan's Institute for Social Research in 1964 (12,44).

Advantages and limitations

CHAID was found to be particularly suitable to the present analyses for two reasons:

First, a large number of variables were to be screened as potential predictors of response status. CHAID is a multivariable procedure but not a multivariate one. All of the variables are not considered simultaneously, but rather are considered sequentially. Thus, the sample size problems endemic to multivariate approaches (multiple regression or logistic regression) are avoided.

Second, there was no reason to assume that the relationships between response and the dependent variables were linear. CHAID is a model-free approach depending on the structure of the data rather than the a priori structure assumed by a model.

A limitation of the CHAID approach is that it requires a large sample size. However, the sample sizes in the HHANES were sufficient for this type of analysis. Thus, in an exploratory-data-analysis approach, such as the present one, CHAID was the method of choice.

An empirical example

The illustrative analysis chosen here is the interview response analysis for Cubans 6 months–74 years in the HHANES. In this analysis, the goal was to identify screener variables that were predictors of interview response.

Data for the analysis were drawn from the responses of a sample of 2,125 persons who were chosen into the Cuban portion of the HHANES. The criterion variable for the analysis is completion of at least one examination component. The criterion is scored on a 1–2 basis.

The independent variables and their associated response categories for the analysis are summarized in figure I. In addition, figure I indicates whether the variable was treated as nominal (free) or monotonic (mono) in the analysis and gives the frequency distribution for each variable.

The results of the CHAID analysis are summarized in figures II and III. Figure II shows an analysis summary for the total sample providing for each variable the significance level, a measure of correlation analogous to the usual r-squared, and a summary describing how the categories were merged. Figure III shows the results of the sequential analysis. Initially, the interviewer variable (INV) was chosen as the "best" predictor (or independent) variable. The predictor with the smallest chi-square significance is considered "best." Having selected a best predictor, SI-CHAID carried out the same analysis for each population or "segment" (group of interviewers) described by the categories of the selected predictor. The completed analysis is depicted with a tree diagram in figure III. As shown, age, stand, and family size are identified as significant predictors at the second level of analysis.

HHANES Interview Response Rates for SPs: Cuban Americans

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375 Concord Avenue, Belmont, MA 02178

Run Mode
Automatic

Technical Parameters...
Analysis Depth Limit: 30
Significance Levels...
Predictor: 0.050
Category: 0.050
Mininum Segment Sizes...
Before Split: 200
After Split: 100
Bonferroni Adjustment? yes
Frequency Variable: *none*
Weight Variable: *none*

Detailed Tables Requested ...
no detailed tables

Default Summary Table: Row %

Missing values are included.

Dependent Variable	Levels	Category #	Label	Frequency Counts
RESPONSE	2	1	yes	1677
		2	no	448

Predictor	Levels	Combine..... Type	Sig	Category #	Sym	Label	Frequency Counts
AGE	4	Mono	0.050	1	1	lt 12 yrs	343
				2	1	12-19 yrs	301
				3	2	20-44 yrs	610
				4	4	45-74 yrs	871
SEX	2	Free	0.050	1	m	male	999
				2	f	female	1126
SEASON	2	Free	0.050	1	W	Winter	1610
				2	S	Spring	515
SIZE	3	Mono	0.050	1	1	1-2	576
				2	3	3-4	1002
				3	5	5 or more	547
LANGUAGE	2	Free	0.050	1	1	1	788
				2	2	2	1337
STAND	4	Free	0.050	1	1	35	541
				2	2	37	530
				3	3	39	539
				4	4	41	515
INV	15	Free	0.050	1	1	241	133
				2	2	242	128
				3	3	243	122
				4	4	247	115
				5	5	248	113
				6	6	249	108
				7	7	251	106
				8	8	253	103
				9	9	254	102
				10	A	255	97
				11	B	257	93
				12	C	259	81
				13	D	260	81
				14	E	885	70
				15	F	other	673

Figure I. SI-CHAID program output: summary frequency distributions for dependent and independent variables

The CHAID procedure culminating in the tree shown in figure III relies on a sequential, semihierarchical search procedure to partition response groups on the basis of the (combined) response levels for a set of predictor variables. The search procedure is directed by Bonferroni adjusted chi-square values.

HHANES Interview Response Rates for SPs: Cuban Americans

Analysis of total group.

	Predictor	p-value	r-sq	groups
7	INV	0.15e-8	0.033	3 158D 237EF 469ABC
1	AGE	0.00017	0.008	2 11 24
6	STAND	0.0011	0.007	2 1 234
5	LANGUAGE	0.0031	0.004	2 1 2
4	SIZE	0.0091	0.004	2 13 5
2	SEX	1.00	0.000	1 mf
3	SEASON	1.00	0.000	1 WS

Figure II. SI-CHAID program output: analysis summary

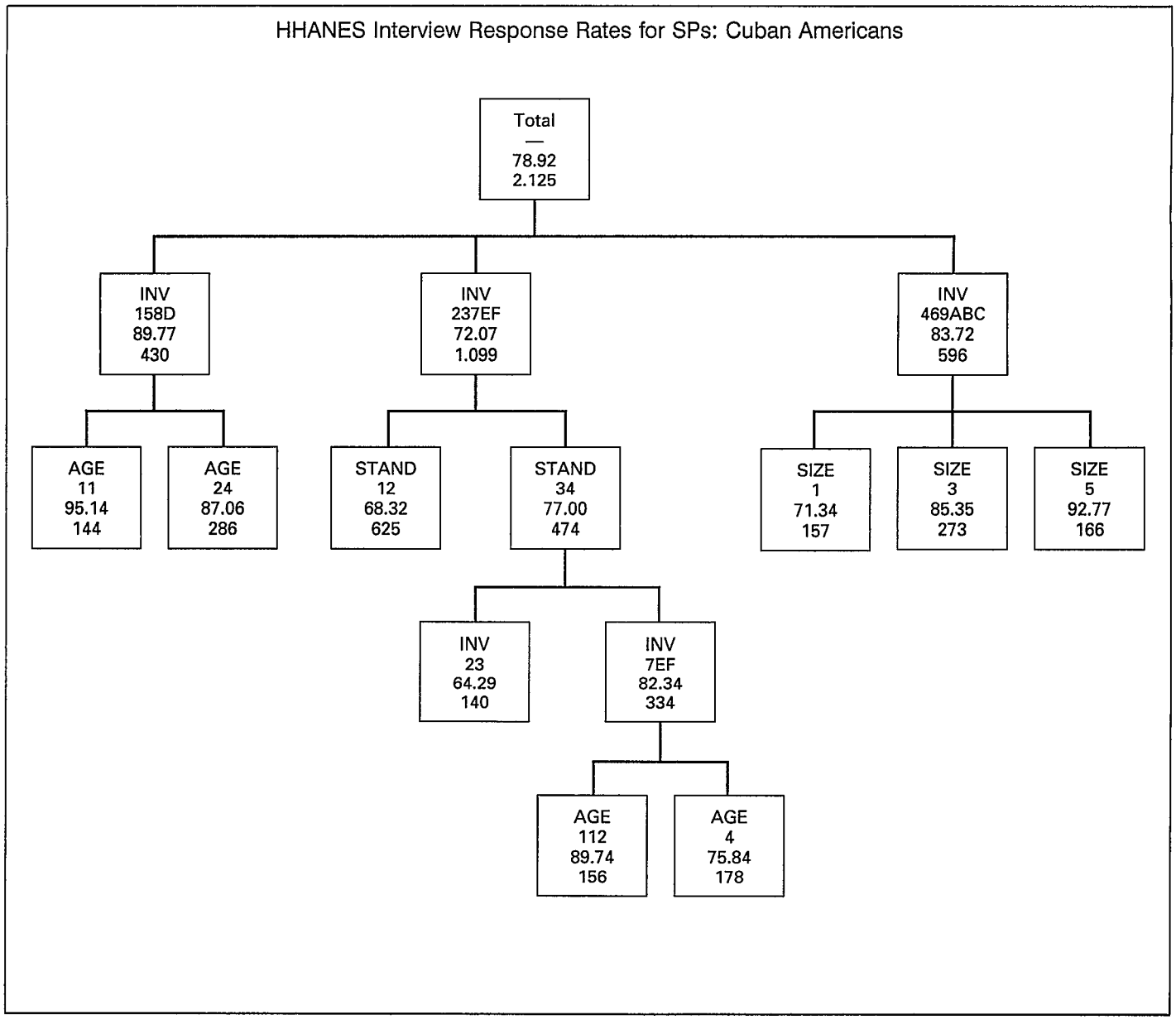

Figure III. SI-CHAID program output: tree diagram

Appendix VIII
Adjusting for possible nonresponse bias

The approach used in this report to adjust for nonresponse bias has been used previously at NCHS (6,23,33–35). The development of the following approach makes clear the potential effect that the magnitude of nonresponse to the examination may have on prevalence estimates. A model is also developed to estimate the "true" prevalence when there is evidence that respondents may differ from nonrespondents. This model incorporates a variable to modify the sample estimates of the population parameters. This variable is related to both the response status and the variable for which the parameter is being estimated. An analysis of the sensitivity of estimates based on this model to differing assumptions also follows.

Magnitude of nonresponse

The validity of prevalence estimates based on the HHANES examination sample rests on an assumption that the prevalence of sample persons participating in the examination did not differ from that of sample persons not participating. The importance of this assumption is illustrated in table XI. This table models the dependence of the results of the survey on the response rate and the prevalence of the attribute being estimated in respondents and nonrespondents. This model is based on the following equation:

$$P(C) = P(C_R) \bullet P(R) + P(C_{NR}) \bullet P(NR) \quad (1)$$

where $P(C)$ = true prevalence for a condition C
$P(R)$ = proportion of sample responding
$P(NR)$ = proportion of sample not responding
$P(C_R)$ = prevalence rate estimated based on respondents
$P(C_{NR})$ = prevalence rate in nonrespondents

This equation shows that true prevalence is the sum of prevalences in respondents and nonrespondents weighted by the proportions of respondents and nonrespondents, respectively. If B is the ratio of prevalence in nonrespondents to prevalence in respondents ($P(C_{NR})/P(C_R)$), then

$$\begin{aligned} P(C) &= P(R) \bullet P(C_R) + [1-P(R)] \bullet B \bullet P(C_R) \\ &= P(C_R) \bullet [P(R) + B - B \bullet P(R)] \end{aligned} \quad (2)$$

and the percent bias is

$$\begin{aligned} 100[P(C_R)-P(C)]/P(C) &= [100(1-P(R)-B+B \bullet P(R))] \\ &\quad /[P(R)+B-B \bullet P(R)] \end{aligned} \quad (3)$$

The numbers in table XI were obtained by substituting values for P(R) and B in the above equation. The table shows that bias is related to both response rate and a difference in prevalence rates. There is no bias when the prevalences are equal for respondents and nonrespondents. When the prevalences differ, the percent bias is higher at lower response rates. With only 60 percent response, if the prevalence in nonrespondents were 25 percent lower or higher, than in respondents, the survey estimate would be 11 percent overestimated, or 9 percent underestimated.

Estimating the "true" prevalence

Looking again at equation (1), we know P(R) (the proportion of the sample responding to the examination), $P(C_R)$ (for example, the prevalence of overweight estimated based on respondents), and 1-P(R). Assumptions can be made about the nature of $P(C_{NR})$ given what is known about the relationship between the condition of interest (overweight) and a variable that has been found

Table XI. Percent bias for selected respondent-nonrespondent prevalence ratios and selected response rates: Hispanic Health and Nutrition Examination Survey, 1982–84

Ratio of prevalence rate for nonrespondents to prevalence rate for respondents	Percent of population responding									
	30	40	50	55	60	65	70	75	80	85
0.50	54	43	33	29	25	21	18	14	11	8
0.75	21	18	14	13	11	10	8	7	5	4
0.90	8	6	5	5	4	4	3	3	2	2
1.00	0	0	0	0	0	0	0	0	0	0
1.10	–7	–6	–5	–4	–4	–3	–3	–2	–2	–1
1.25	–15	–13	–11	–10	–9	–8	–7	–6	–5	–4
1.50	–26	–23	–20	–18	–17	–15	–13	–11	–9	–7

Table XII. Potential bias in estimated percent prevalence of overweight in the examined sample due to differential reporting of poverty status in the interviewed-but-not-examined sample for Cubans: Hispanic Health and Nutrition Examination Survey, 1982–84

Sex and age	Examination		Survey estimate[1]	Adjusted estimate[1]	Difference	Relative bias[2] (percent)
	Sample size	Response rate				
Total	860	58.2	31.95	32.59	–0.64	–40
Female						
20–44 years	204	60.0	26.22	27.02	–0.80	–26
45–54 years	119	61.7	37.31	37.71	–0.40	–9
55–64 years	97	59.5	51.45	52.90	–1.45	–29
65–74 years	64	53.8	40.05	45.20	–5.15	–84
Male						
20–44 years	143	53.6	25.01	24.93	0.08	2
45–54 years	114	60.6	34.75	34.19	0.56	13
55–64 years	78	56.9	32.00	30.80	1.20	23
65–74 years	41	*	*	*	*	*

[1]Computed using basic weights (reciprocal of probability of selection).
[2]Relative bias = 100 (survey estimate-adjusted estimate)/(standard error of survey estimate).

to be related both to this condition and to response status (for example, poverty status). Thus, the "true" prevalence of overweight can be reexpressed in terms of these variables and the relationship with poverty status.

The model is shown as follows:

$$\begin{aligned} P(C) &= [P(C_R)] \bullet P(R) + [P(C_{NR})] \bullet P(NR) \\ &= [P(C|V_{1R}) \bullet P(V_{1R}) \\ &\quad + P(C|V_{2R}) \bullet P(V_{2R})] \bullet P(R) \\ &\quad + [P(C|V_{1NR}) \bullet P(V_{1NR}) \\ &\quad + P(C|V_{2NR}) \bullet P(V_{2NR})] \bullet P(NR) \end{aligned} \quad (4)$$

The terms in the brackets are $P(C_R)$ and $P(C_{NR})$, respectively; and

$P(C)$	is the true prevalence of overweight
$P(R)$	is the proportion responding to the examination
$P(V_{1R})$	is the proportion of the respondents living below poverty
$P(V_{2R})$	is the proportion of the respondents living at or above poverty
$P(C\|V_{1R})$	is the conditional probability of being overweight given that the person lives below poverty and was examined
$P(C\|V_{2R})$	is the conditional probability of being overweight given that the sample person lives at or above poverty and was examined
$P(NR)$	is the proportion not responding to the examination
$P(V_{1NR})$	is the proportion of the nonrespondents living below poverty
$P(V_{2NR})$	is the proportion of the nonrespondents living at or above poverty
$P(C\|V_{1NR})$	is the conditional probability of being overweight given that the sample person lives below poverty and was not examined
$P(C\|V_{2NR})$	is the conditional probability of being overweight given that the sample person lives at or above poverty and was not examined

The components of $P(C_R)$ are known (that is, can be computed from what is known for the examined sample).

The components of $P(C_{NR})$ must be estimated based on two assumptions. First assumption: It is assumed that the relation between the prevalence of the condition C (overweight) and the variable V (poverty status) is the same for respondents and nonrespondents ($P(C|V_R) = P(C|V_{NR})$). The examination data provides an estimate of this relation. Second assumption: The distribution of the adjustment variable ($P(V_{NR})$, the distribution of poverty status among nonrespondents) is known for the nonexamined sampled persons who were interviewed, but is not known for the noninterviewed-nonexamined sample. Thus, it is assumed that poverty status is distributed the same among all nonexamined persons as it is among the interviewed-nonexamined group.

Given these assumptions, all the pieces of this equation are known, and it is possible to obtain an adjusted estimate of the prevalence of C.

Values for the terms in equation (4) were estimated from the Cuban HHANES data using the basic weights (reciprocal of the probability of selection before adjustment for nonresponse). The adjusted estimates are compared with the unadjusted estimates in table XII. The adjusted estimate for total prevalence was 1.97 percent higher than the survey estimate. But the difference for age–sex specific cells varied from a 14.31 percent (5.2 percentage points) underestimate in males 65–74 years to an 11.40 percent (3.8 percentage points) overestimate in females 65–74 years.

Sensitivity of bias-adjusted estimate to assumptions of analysis

As previously mentioned, it is necessary in adjusting for nonresponse bias to make two assumptions about the similarity of respondents and nonrespondents. Although these assumptions cannot be verified, if they were incorrect, an error in either direction could have been introduced in the final bias-adjusted estimate. To evaluate the potential impact of differential response, a sensitivity analysis was done.

The first assumption is evaluated in table XIII. Values for the ratio of $P(C|V_{1R})$ to $P(C|V_{1NR})$ and $P(C|V_{2R})$ to

Table XIII. Sensitivity of estimated prevalences of overweight to response selection bias in Cubans 20–74 years living above or below poverty level: Hispanic Health and Nutrition Examination Survey, 1982–84

Ratio of prevalence for respondents to prevalence for nonrespondents living below poverty level	*Ratio of prevalence for respondents to prevalence for nonrespondents living at or above poverty level*				
	0.75	*0.90*	*1.00*	*1.10*	*1.25*
	Percent who are overweight				
0.75	27.87	30.18	31.72	33.26	35.57
0.90	28.39	30.70	32.24	33.78	36.10
1.00	28.74	31.05	32.59	34.13	36.45
1.10	29.09	31.40	32.94	34.48	36.80
1.25	29.61	31.92	33.47	35.01	37.32

$P(C|V_{2NR})$ were assigned as shown in the row and column labels, respectively. The cells show the resulting values for P(C). The stronger effect on the estimates would be caused by error in estimating the prevalence of overweight in the group living at or above poverty level because this is the larger group (about 81 percent of the population). Overestimating or underestimating the prevalence of overweight in these nonrespondents by 25 percent would cause about a 14 percent error in the survey estimates.

The second assumption is evaluated in table XIV. The ratios of the prevalence of poverty in the nonrespondents to the prevalence of poverty in the respondents are shown in the row labels. The cells show the resulting values for P(C). Based on this table, a deviation from a ratio of 1.00 by plus or minus 50 percent would result in less than 1 percentage point change in the adjusted estimate.

It is clear that the first assumption about the nonrespondents was the more critical assumption.

Table XIV. Sensitivity of estimated prevalences of overweight to assumptions about distribution of poverty status in nonrespondents for Cubans 20–74 years: Hispanic Health and Nutrition Examination Survey, 1982–84

Ratio of prevalence of poverty in nonrespondents to prevalence of poverty in respondents	*Bias-adjusted prevalence estimate of overweight*
	Percent who are overweight
0.50	32.66
0.75	32.58
0.90	32.53
1.00	32.49
1.10	32.46
1.25	32.41
1.50	32.33

Summary

The answer to the question, "To what extent does nonresponse affect the estimated prevalence of overweight in Cuban adults 20–74 years of age?" has been made using varying assumptions about the nonrespondent group. Assuming a deviation of no more than 25 percent in these assumption parameters, the population prevalence would differ no more than 14 percent (or less than 5 percentage points) from the estimate based on the examined sample alone. This analysis has also shown that potential bias for individual age-sex groups could be considerably greater than for the total group. The magnitude and direction of bias differed for males and females and was greatest in the oldest age group within each gender, the groups with the smallest sample size.

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