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Cycle 1 of the Health Examination Survey: Sample and Response

United States - 1960-1962

The first of a series of publications of the results of the "first cycle" of the Health Examination Survey, describing the sampling procedures and estimating techniques employed, the similarity between the sample and the universe it represents, and the impact of nonresponse.

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COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Health Survey, the Bureau of the Census, under a contractual agreement, participated in the design and selection of the sample, and carried out the first stage of the field interviewing and certain parts of the statistical processing.

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CYCLE I OF THE HEALTH EXAMINATION SURVEY

SAMPLE AND RESPONSE

INTRODUCTION

The National Health Survey uses three methods for obtaining information about the health of the U.S. population. The first is a household interview in which persons are asked to give information related to their health or to the health of other household members. The second method is the utilization of available health records. The third method is direct examination, which the Health Examination Survey administers by drawing samples of the civilian, noninstitutional population of the United States and, by means of medical and dental examinations and various tests and measurements, undertakes to characterize the population under study.

The overall plan of the Health Examination Survey (HES) is to conduct successive, separate cycles of examinations in specific segments of the national population. The plan and initial program of the HES have been described in another report.[1] Data are collected by actual examinations of, and tests upon, the individuals selected in the sample. Such examinations and tests can yield morbidity information unobtainable through other programs of the National Health Survey (NHS). They can provide information about diagnosed conditions including those which persons may fail to report or may be incapable of reporting in a survey based upon individual interviews. They can also reveal previously undiagnosed, unattended, and nonmanifested chronic diseases. In addition to serving this primary purpose of determining prevalence of specified diseases, the examinations are intended to obtain baseline data on certain physical and physiological measurements. Such measurement data on a defined population are needed for understanding departures from normal, as well as for assisting in planning certain specific programs dependent upon human engineering information.

Another key characteristic of the Health Examination Survey—one which is shared with other National Health Survey programs—is the use of a nationwide probability sample of the population. This makes it possible to obtain the desired statistics efficiently and in such a manner that the statistical reliability of results is determinable. These factors, together with the fact that the measurement processes are highly standardized and closely controlled, are essential ingredients of any survey that sets out to describe the entire population of the United States on the basis of a relatively small sample.

Furthermore, in the process of defining the sample group, information about all sample persons and their households is obtained prior to examination, by means of a household interview.

The first cycle of the Health Examination Survey was the examination of a sample of adults. It was directed toward the collection of statistics on the medically defined prevalence of certain chronic diseases and of a particular set of dental findings and physical and physiological measure-

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ments. The probability sample consisted of 7,710 of all noninstitutional, civilian adults in the age range 18-79 years in the United States. Altogether, 6,672 persons were examined during the period of the Survey which began in October 1959 and was completed in December 1962.

This report is the first of a series describing and evaluating the plan, execution, and findings of the first Health Examination Survey. While a number of previous publications have dealt with specific methodological investigations undertaken as part of the survey, this series will describe the results of the survey.

Although this initial report does not deal with the survey findings as such, it does consider the frame against which the findings are to be presented, describes the sampling procedures, the sample drawn and the group examined, and indicates how the survey data will be converted into estimates for the general population. The report includes a few comparisons with the population from which the sample was drawn. Thus it demonstrates the similarity of the sample and the population it represents with respect to a number of characteristics not specifically controlled in the sample design and explores the impact of nonresponse on the survey findings.

Obviously, the success of a program as large and complex as this one was possible because of the efforts of many staff members as well as the cooperation of a large number of outside individuals and organizations, State and local medical, dental, and osteopathic societies and health officers, and the staff of the Bureau of the Census.

THE TARGET POPULATION

The target population of the first cycle of the Health Examination Survey consisted of all noninstitutional, civilian adults in the age range 18-79 years in the United States. A more complete specification of this target should include several qualifications.

1. Alaska and Hawaii are not included.
2. The survey period is centered on October 1961, but should be considered as the interval 1960-62.
3. "Noninstitutional" is defined by excluding residents of several types of places. In particular, among persons out-of-scope are inmates of correctional institutions, resident hospitals, nursing homes, and homes for the aged. Resident staff of these places and persons in local jails are, however, included in the population surveyed.
4. Members of the crews of vessels are excluded from coverage.
5. Civilian personnel residing at a military base and Indians on reservations are included in the target.
6. Aliens are included if they have a place of residence in the United States; U.S. citizens residing overseas are excluded.

There are other categories of persons who are included in at least a conceptual target, but who because of the nature of the survey can scarcely be considered to be effectively represented by the group of persons finally examined. Worthy of mention in this category are two groups: (1) persons who die or otherwise move out-of-scope between the date of first contact at their place of residence and the time at which they were to have been examined (this was a very small group), and (2) persons who are manifestly unable to be examined, such as those gravely ill in short-stay hospitals or elsewhere, or persons with severe physical disabilities or impairments whose conditions prevented their being transported to the place of examination.

SELECTION OF THE SAMPLE

The size of the sample was keyed to the numbers necessary to yield reliable data on the conditions to be studied. Actually, the determinations of the size of sample and of the conditions to be studied are interrelated and interdependent, and a factor in these determinations was the number of examinations which could be accomplished within 3 years. Also determining the sample size were the budget and the statistical design and structure of the examining process.

The selection process provided that the sample be stratified with respect to broad geographic locations and the size of place of residence. For purposes of the Health Examination Survey, the 1,900 primary sampling units (PSU's) which account for the 48 contiguous States and which were

originally designed for use in the Health Interview Survey were grouped into 42 strata.[2] These strata were formed so that they were as equal as possible with respect to population size, each with approximately 3.5 million persons aged 18-79 years in 1950, and so that there were an approximately equal number of strata in each of the five population-density classes in each of the three geographic locations (table A).

Using a modified Goodman-Kish controlled-selection technique one PSU was drawn from each of the 42 strata. The sampling within PSU's was carried out in several steps beginning with a random selection of geographically clustered segments containing approximately six households. A systematic selection was made usually of four of these households. Within each selected household a roster was made of eligible adults (civilian, noninstitutional persons aged 18-79 years). Every alternate eligible adult within an interviewed household was a sample person. The alternation began with the first person in an ordered sequence in one subsegment and with the second person in the next subsegment. This alternation prevents bias in relation to the head of the household who was usually listed first. The number of segments selected varied somewhat from stand to stand, as they were chosen to yield an expected 150-160 persons. The design was essentially self-weighting, although operating efficiencies required some variation in sampling rates among PSU's, and occasionally among segments within a PSU.

The overall sampling process yielded an initial listing of 9,035 households from 2,174 segments. Of these households, 1,221 were vacant, belonging to persons having a usual residence elsewhere or to members of the Armed Forces on regular active duty. Another 163 households consisted of units which were demolished, outside segment boundaries, never intended for residential use, nonexistent, unoccupied and unfit for human habitation, converted to business or storage, or merged with another unit. Thus there were 7,651 households which formed the sample and which contained persons eligible for interview. No interview was obtained for 125 or 1.6 percent of the sample households because of refusal, because no one was home despite repeated

Table A. Distribution of strata by geographic location and population density: Health Examination Survey, United States, 1960-62

Population density	U.S. total	Geographic location		
		North-east	South	West
All strata	42	14	14	14
Giant metropolitan areas	9	6	-	3
Other very large metropolitan areas	6	2	2	2
Other standard metropolitan statistical areas	9	3	3	3
Other urban areas	8	2	4	2
Rural	10	1	5	4

NOTE: The States included in the Northeast are Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, Ohio, and Michigan. The States included in the South are Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. The States included in the West are Washington, Oregon, California, Idaho, Nevada, Montana, Utah, Arizona, Wyoming, Colorado, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, and Indiana. This division of the United States was especially made for the design of the HES sample.

calls, or because the sample person was absent during the period of the survey. From the 7,526 households in which an interview was obtained, 15,038 eligible persons were identified from which 7,710 were selected as sample persons. (In three stands the within-household sampling rate exceeded 1 in 2.)

It will be shown that the distribution of persons in the sample closely parallels the distribution for the United States for a number of demographic characteristics. No major feature of the U.S. population can be said to be seriously distorted.

Obviously, this is not true for minor features. In an area sample, such as was used for the Health Examination Survey, a geographically clustered population group (or in more abstract terms, a localized health characteristic) might be either completely missed or oversampled. Since the population is probably closer to a conglomerate than to a uniform mixture, this limitation in minor detail—a limitation which the Health Examination Survey shares with all similar surveys—is by no means trivial. Even where the sample includes exactly the expected number of persons from some specified subgroup, if this group is numerically small it is quite out of the question to describe any of its health characteristics with assurance. A group of 100,000 would have an expected representation of 6 examined persons in the Health Examination Survey, and even for larger groups, such as American Indians or persons 75-79 years of age, the sample size is so small that statements of findings for the groups must be limited both in number and in confidence.

SAMPLE RESPONSE

Of the 15,038 eligible persons in sample households, 7,710 sample persons were identified and 6,672 were examined. The examination or response rate based on these figures is 86.5 percent. Since the sample was based on households, however, another type of rate should also be considered. This rate, which might be termed the "net" examination or response rate, as contrasted to a gross rate, provides an adjustment for presumed eligible sample persons in the 125 noninterviewed households. The adjustment assumes that the ratio of sample persons in these households is the same as for the interviewed households. Using this adjustment the number of sample persons would increase by 128 to a total of 7,838. The "net" examination or response rate would be 85.1 percent (table 8).

Whichever one of these percentages is considered, 86.5 or 85.1, the fact is that nonresponse in this cycle of the Health Examination Survey program was remarkably low. At the outset of the planning for this program it was feared that perhaps as much as one-third of the sample selected might end up as "unexamined." Like other programs of the National Health Survey, this is based on legislation which specifies that the required information will be secured "on a noncompulsory basis." A number of voluntary surveys involving health examinations had been made in local areas in the United States, [3, 4, 5] and despite intensive persuasion, only about two-thirds of the sample had been examined in each of them. The fact that the first cycle program has only about one-half the percentage of nonrespondents of the earlier surveys greatly minimizes the possibility of bias in the survey results due to nonresponse.

The following describes briefly the measures adopted to ensure maximum cooperation. Prior to the beginning of the survey proper, methodological studies into the motivations and attitudes involving willingness to participate in a health examination survey were made. [6, 7] The survey design incorporated some techniques from these studies, some from earlier surveys, and some from the pilot tests made of the Health Examination Survey plans. Thus, the request to consent to the health examination was made only directly of the sample person. An attempt was made to identify the possible "noncooperator" early and to handle his case in an individualized way. An effort was made to minimize personal inconvenience to the examinee in loss of time, amount of travel, and the nature of the examination. The findings of the examination were made available to the examinee's physician (or in the case of dental findings to his dentist) when the examinee wanted this done. An attempt was made to allay the fears and doubts that might stem from lack of knowledge about just

what was involved by providing information through various means—pamphlets, newspaper stories, etc. Above all, a resourceful, skilled, and highly motivated staff persisted in their efforts to explain the program to all who were in anyway involved, doing this out of the conviction that, for the most part, persons who really understood the program would be favorably inclined toward it.

THE SAMPLE DESIGN AND ESTIMATING TECHNIQUE

The essence of probability sampling can be expressed rather simply. Suppose there exists a population of N individuals in which x_i is the value of a specified measurement for the i^{th} individual. The average of these measurements for all persons in the population might be defined as $\bar{x}$. A probability survey design in this universe might be described as a process in which:

1. A sample or subset of n of the N individuals is drawn in such a fashion that every individual in the population has a known nonzero probability of inclusion in the sample.
2. For each i^{th} individual included in the sample, the measurement x_i is obtained.
3. An estimating equation is adopted which converts the measurement x_i into an estimate $\bar{x}'$ of the population $\bar{x}$.

Probability designs have many features of which two are of special interest in the present context. The first of these is that a good design will be technically unbiased or nearly so; therefore, over repeated trials of the survey the average value of the estimate $\bar{x}'$ would be equal to the true value of $\bar{x}$.

The second attribute is that procedures exist whereby the variance of the estimate $\bar{x}'$ can be calculated. The variance permits the calculation of an interval around the estimated mean within which the true mean $\bar{x}$ lies with a given probability. It is the yardstick for determining the precision of the estimate $\bar{x}'$.

The HES sampling method is an unbiased one. The variance of a statistic depends not only on the design, but on the statistic itself; the variance is higher for measurements which are highly variable from one individual to another, and lower for measurements which are less variable in the population. HES publications will include estimates of variance for principal statistics which are presented.

Weighting and Estimation

In this survey the selection of an individual sample person is the outcome of four sampling procedures. In order to convert data from a sample person into estimates of population parameters, therefore, weights relating to the selection of a sample person by each of the four procedures must be applied. Briefly these weights are the reciprocals of the probability of selection of:

1. The PSU from the stratum from which it was drawn.
2. The segments from chosen PSU's.
3. The households in a segment from the total number of households within that segment.
4. The sample person from the eligible adults in the household.

The master design is essentially self-weighting with respect to persons; that is, each person has about the same probability of falling into the sample. In addition, the HES employs three techniques which enhance the representativeness of the survey. Of these, two are technical adjustments which leave the process still unbiased, but which increase precision by bringing survey results into closer alignment with the target population with respect to geography, population-density, age, and sex.

One is called a first-stage ratio adjustment. Computationally, using population controls from the 1960 census, this adjustment multiplies every observation by such a factor as would make the 42 first-stage primary sampling units reflect exactly the total 1960 population, if the PSU's had been enumerated completely, for each of eight geographic sectors of the Nation. The required multiplication factors are shown in table B.

The second of these two adjustments is a poststratification by age and sex. In it, a multiplier for each observation is utilized which has the effect of (a) obtaining most of the advantage

Table B. First-stage ratio adjustment factors: Health Examination Survey, United States, 1960-62

Geographic location	Self-representing areas[1]	Nonself-representing areas	
		Standard metropolitan statistical areas	Other areas
Northeast	1.00	0.97	0.98
South	-	1.09	0.88
West	1.00	0.88	1.04

[1]New York, Chicago, Los Angeles, Philadelphia, Detroit, and Boston sample areas represented only themselves.

Table C. Second-stage age-sex adjustment factors: Health Examination Survey, United States, 1960-62

Age	Multiplier factor	
	Male	Female
18-24 years	1.15	1.05
25-34 years	0.97	0.96
35-44 years	1.00	0.97
45-54 years	1.16	0.95
55-64 years	1.08	1.11
65-79 years	1.14	1.25

which would have been attained if the original sample had been drawn from a population stratified by age and sex; and (b) making the final sample estimate of population agree precisely with independent population controls prepared by the Bureau of the Census for October 1, 1961, in each of 12 age-sex classes. These second-stage adjustment factors are shown in table C.

The third adjustment is entirely different. Its function is to minimize the impact of nonresponse on final estimates. Unlike the other two adjustments, it can have a biasing effect, although the intention was to reduce bias that might have been introduced because 13.5 percent of the sample persons were not examined.

It must be recognized that when data for a specified person are missing there is no technique which can completely remove the consequent difficulty. All techniques which have been or might be used involve either explicit or implicit imputation for the missing data. From the experience of previous surveys involving health examinations, it had been feared that the nonresponse rate in the HES might be as great as 35 percent. Much energy was expended in cutting nonresponse to 13.5 percent of the designated sample persons. Residual nonresponse was treated by imputing to nonrespondents the characteristics of "similar" respondents. The "similar" respondents were those in the same cell. The choice of cell boundaries was guided by three principles:

1. The nonresponse rates should be different for different cells.
2. Key substantive statistics might vary from cell to cell.
3. The cells should be large enough to prevent the frequent occurrence of cells with very few respondents.

These principles resulted in the choice of boundaries for seven age-sex groups within each stand, yielding 294 separate cells with average membership of about 25 sample persons each. The adjustment resulted in substituting for the nonrespondent the characteristics of respondents of a similar age and sex in the same general community. The mechanism of the adjustment was to multiply data of respondents by factors which made total persons in the cells equal to the designed number. Multipliers in the cells were distributed as shown in table D.

Table D. Nonresponse adjustment factors: Health Examination Survey, United States, 1960-62

Size of multiplying factor	Number of cells in which factor was used
All cells	294
1.00-1.10	127
1.11-1.20	63
1.21-1.40	66
1.41-1.50	12
1.51-2.00	23
2.01-2.10	3

THE SAMPLE DRAWN AND THE TARGET POPULATION

From the structural point of view, bypassing questions relating to the validity of the measurement itself, the degree of confidence which one can place in a particular survey statistic from a probability design is most simply measured by its standard error. Standard errors will be published in future reports for the principal substantive findings of the Health Examination Survey.

It cannot be safely assumed that any sample design will be infallible in design or execution. There are certain to be some mistakes made in carrying out a large-scale survey. In addition, any given probability sample can be counted on to differ from expected values, slightly for large or controlled sectors of the population and more for small segments or for characteristics not controlled in selection. Because of these facts it is useful, in assuring that the total survey plan work well, to look at some comparisons between the population that actually was involved and that which might have been "expected" from the design.

These comparisons bear on two issues. The first is the execution of the sampling process. A close correspondence between the HES sample and other sources makes it likely that the sampling scheme was faithfully executed. These comparisons also bear on questions of exposition. While it is always possible (for known characteristics) either to control the estimating process or to present the data in sufficient analytic detail to compensate for recognized deviations from the universe, it is sometimes awkward to do so. Obviously, exposition of the data becomes much simpler, and is also more trustworthy, if the sample is essentially the same as the universe for known characteristics.

One important warning is worth repeating. Comparisons of the kind just described in this section cannot be used to determine whether the design is sound or what its precision may be. If the comparisons are close in one or in a dozen respects, it is not proof that the sample is efficient. Nor is it proof that the sample is inefficient if in some respects the comparisons reflect large differences. On the other hand, the procedure would be suspect if there were little semblance between the observed and expected results. It is suggested that the evidence presented in this report encourages confidence in the survey results since the sample does exhibit demographic characteristics quite similar to those of the total U.S. population.

To this, obviously, must be added the warning that a sample faithful for demographic representation may not provide a faithful representation of the prevalence of chronic disease or of the physical and physiological attributes that were the object of this cycle of the Health Examination Survey. However, future reports of findings will include comparisons with findings from other population surveys, as well as giving the sampling errors for the published statistics.

The PSU Sample

As mentioned previously, the 1,900 primary sampling units constituting the United States were grouped into 42 strata with further control by three geographic locations and five population-density classes. One primary sampling unit was then selected from each stratum with a probability proportionate to its 1950 population.

If each primary sampling unit is weighted by the reciprocal of its probability of selection from a stratum and adjusted by the first-stage adjustment, then the sum of the 42 units becomes an estimate of the total 1960 population of the United States. If the selection of the PSU's is not faulty, then such weighted and adjusted distributions of various demographic characteristics of the PSU's should approximate those of the United States, with some allowance for sampling variability.

A brief comparison between the weighted distributions of the PSU's and the United States with respect to several selected demographic characteristics follows. While there are many characteristics that might be used for comparative purposes, these are considered most important in judging the success of this first stage in the sampling and estimating procedure.

The sources of the statistics used for this comparison were the final reports of 1960 Census of Population (primarily the Population Census—B, C, and D series). Data for the New England stands of Boston and Providence where the PSU's were made up of minor civil divisions were obtained from tract reports of the U.S. Censuses of Population and Housing. The data include the institutional population and members of the Armed Forces.

The race distribution presented in table 1 shows that the sample of PSU's would yield a population which was 87.5 percent white; the Census figure was 89.9 percent. A part of this difference may be attributed to the selection of several rural areas in the South with unusually heavy Negro populations and an area in the West with a high proportion of American Indians. Regarding age, the estimates obtained from the weighted PSU's differ slightly from those of the Census, with 57.1 percent of the population in the 18-44 year age group as compared with 55.4 percent in the Census. Comparison of the distributions of four social characteristics—marital status, years of school completed, type of occupation, and family income—did not reveal any differences of consequence.

All in all, according to these characteristics, the population of the PSU's did not differ significantly from that of the total U.S. population.

Sample vs. Nonsample Persons

As previously mentioned, 15,038 adults were identified as eligible for inclusion in the Health Examination Survey panel. Except in three stands (Philadelphia, Pa., Valdosta, Ga., and Winslow, Ariz., where in some or all of the segments every eligible adult was sampled), every alternate eligible person became a potential sample person.

Table 2 provides comparative distributions of various demographic characteristics of sample and nonsample persons from the stands where alternate selection was used. The most notable difference occurred in the sex distribution; slightly more sample females (and consequently less sample males) were selected than had been expected. If the expected number of females is the product of the proportion of females in the eligible adult population times the number of sample persons, then there were approximately 100 more females selected through this sampling procedure than had been expected. No other differences which might indicate the introduction of bias through this step in the sampling process were observed.

Sample Estimates and the Population

Tables 3, 4, 5, and 6 present comparisons of several sample estimates with the target population. These estimates will not appear in future reports, but are a special set compiled from data for all sample persons, whether examined or not. They are intended to reflect what a particular estimating procedure would have yielded from the sample cases if there had been no nonresponse. The distribution of the sample estimates by age and sex in table 3 is derived by applying to the sample persons the four sample selection weights and the first-stage ratio adjustment previously described. The estimating procedure used for tables 4-6 includes all sampling weights, the first-stage ratio adjustment, and a poststratification to control on age and sex.

There is a minor difference between the estimated population and the target population in the proportion of white persons, 88.0 percent as

compared with 89.6 percent (table 3). A similar difference has been noted previously in a comparison of race differences between the weighted PSU's and the United States. In both instances, this difference is due to the chance selection of several PSU's atypical with respect to race from the strata from which they were drawn. One PSU is responsible for the fact that the estimated proportion of the "other" race in the sample population is almost three times as great as that of the target.

The age-sex distributions of the two populations differed very little. The largest observed difference occurred in the 65-79 year age group where the estimated percent in the sample population was 11.1 compared with 12.6 percent in the target. While even this difference is trivial, the second-stage poststratification adjustment will compensate for it and like differences.

Similar distributions of marital status, years of school completed, and occupation of employed presented in tables 4, 5, and 6, respectively, revealed only slight differences between the estimated and target populations. These may be attributed to the age groups upon which the distributions of the target population were based. The Census distributions for marital status and years of school completed were based on a population 18 years of age and over and the distribution of occupation based on an age group 14 years of age and over. The HES sample did not include any persons under 18 or over 79 years of age.

RESPONDENTS VS. NONRESPONDENTS

In any health examination survey, after the sample is identified and the sample persons are requested to participate in the examination, the survey meets one of its more severe problems. Usually, a sizable number of sample persons will not participate in the examination. If the nonparticipants are essentially identical with those who do participate, the loss in numbers is trivial in consequence, except as it reduces the effective sample size. If participants and nonparticipants differ, however, the problems resulting from nonresponse may be quite serious.

Reasons for Nonresponse

When examinations were completed at a given location, the field representatives of the Health Examination Survey responsible for contacting sample persons attempted to determine the reason each nonrespondent failed to come in for examination. For most of the 1,038 persons not examined, "no special reason" was designated. There were 94 cases in which medical reasons were adduced, including hospitalization, disability, and 3 deaths. While examinations were being conducted, 61 persons were out of the area during all or part of the period, and 38 were either very difficult to contact or inaccessible for religious or other reasons. There were examinations of six persons which were so grossly incomplete that these persons were considered nonexamined. Most of the persons not examined were simply unwilling to be examined or to make the personal arrangements necessary to come in.

Altogether, 13.5 percent of the identified sample were not examined. This response loss carries two serious risks. It may distort the demographic frame against which the examination findings are referred. Such a distortion would arise only if the response level varied according to the demographic class, and the effect of such differential response tends to be minimized by specificity in analysis. More serious and more difficult to evaluate is the possible distortion of the actual examination findings; that is, the possible difference between examined and nonexamined persons with respect to the characteristics under examination. It is difficult to remedy defects of this kind. Both aspects of nonresponse will be discussed: its possible effect on the frame and on the findings. (If the larger part of the discussion is concerned with the frame rather than the findings, it is not because it is the more important subject but because more and better information is available on the demographic than on the morbidity characteristics of the nonrespondent group.)

Comparison of the examined and nonexamined persons is made possible by the fact that, with few exceptions, all sample persons were included in a regular household interview survey. The interview procedure and the forms used were es-

sentially those of the Health Interview Survey of the National Health Survey. In fact, the method used for selecting the sample persons for examination included the conducting of a household interview at each residence falling in the sample area. As already noted, the household interview produced not only a large amount of demographic information about each sample person but also morbidity information of various kinds. It should be realized that since the informant was not necessarily the sample person, information could be collected even for nonexamined persons absent from the household during the examining period.

However, a uniform household interview is not assurance that all sample persons are equally willing or able to supply the desired information. It is possible that the household interview information for nonexamined persons is, in some respects, not so good as for the examined. This seems likely on *a priori* grounds, since unwillingness to cooperate ought to manifest itself during the household interview, just as it did when the person was asked to make an appointment for examination.

But we need not rely on presumption. For most items of the household interview, the proportion of missing or recognizably defective replies was greater for nonexamined than examined persons. For some items, the difference was trivial; for others it was not (table 7). The following are illustrative of items where the percentage of missing information is substantially greater for nonexamined than examined persons:

	Examined	Nonexamined
Class of worker--	2.8	5.4
Education--------	2.2	5.4
Family income---	9.0	17.1

The poorer quality of information for nonexamined persons is not to any marked degree due to the particular person supplying the information. More specifically, the respondent to the household interview was equally likely to be the sample person himself whether or not the person was subsequently examined. It is true that the likelihood of having the sample person as informant differs greatly by sex and, for men especially, varies with age, but even if the comparison is made on an age-sex-specific basis, there is little difference between the examined and the nonexamined groups in the percentage self-respondent to the interview.

The essential difference between examined and nonexamined persons appears to be simply a willingness to cooperate. Of the reasons adduced for nonresponse by field representatives of the Health Examination Survey, "refusal, unqualified" accounted for 81 percent of all nonrespondents. As had been expected, uncooperativeness was manifested, in those persons who subsequently joined the nonexamined group, as the interview progressed toward an actual request for examination.

At the end of the household interview each respondent was requested by the interviewer to sign an authorization permitting access to his medical records. In the households of nonexamined persons, one out of four of the respondents refused to sign. The refusal rate for the examined group was only 5 percent. Failure to sign the requested authorization was, in fact, one of the best indicators of ultimate nonresponse, even more dependable than failure to make an examination appointment at the time of the initial interview.

Selected Demographic Characteristics

Place.—The largest variability in response level was that associated with place. The percent examined at the various stands ranged from 65.5 at Philadelphia, Pa., to 97.8 at Eufala, Ala. Philadelphia was the first area surveyed and it is possible that better results would have been attained at this stand if it had been scheduled later, when the staff had acquired more experience in obtaining cooperation. On the other hand, Philadelphia is one of the places where cooperation tended to be below average. To a large extent, response differentials fell into patterns by population size and location. The larger the place the poorer the response, ranging down from 92.0 percent in rural areas to 77.7 in giant metropolitan areas (table E). This was anticipated from the results of an earlier methodological study.[6] The Northeast, with a heavier concentration of large

Table E. Number of places and percent of sample examined by population density: Health Examination Survey, United States, 1960-62

Population density	Number of places	Percent examined
All strata-------	42	86.5
Giant metropolitan areas----------	9	77.7
Other very large metropolitan areas-	6	85.8
Small metropolitan areas----------	9	87.5
Other urban areas---	8	90.7
Rural areas---------	10	92.0

places than the South and West, had an overall poorer response rate—81.8 compared with 89.8 and 88.2 percent for the South and West—but for places of the same size there was, in general, little difference in response from one location to another (fig. 1, table F).

The source of this differential response by place, as distinguished from its possible consequences, can only be guessed at from the data collected in this survey, but it is possible that it reflects chiefly some cultural attribute of the local populations. It definitely does not arise from special distributions of other demographic variables defined by the survey, such as age, race, or sex, and for this reason the response level of places has been made an analytical variable in some of the later discussion. The 42 stands have

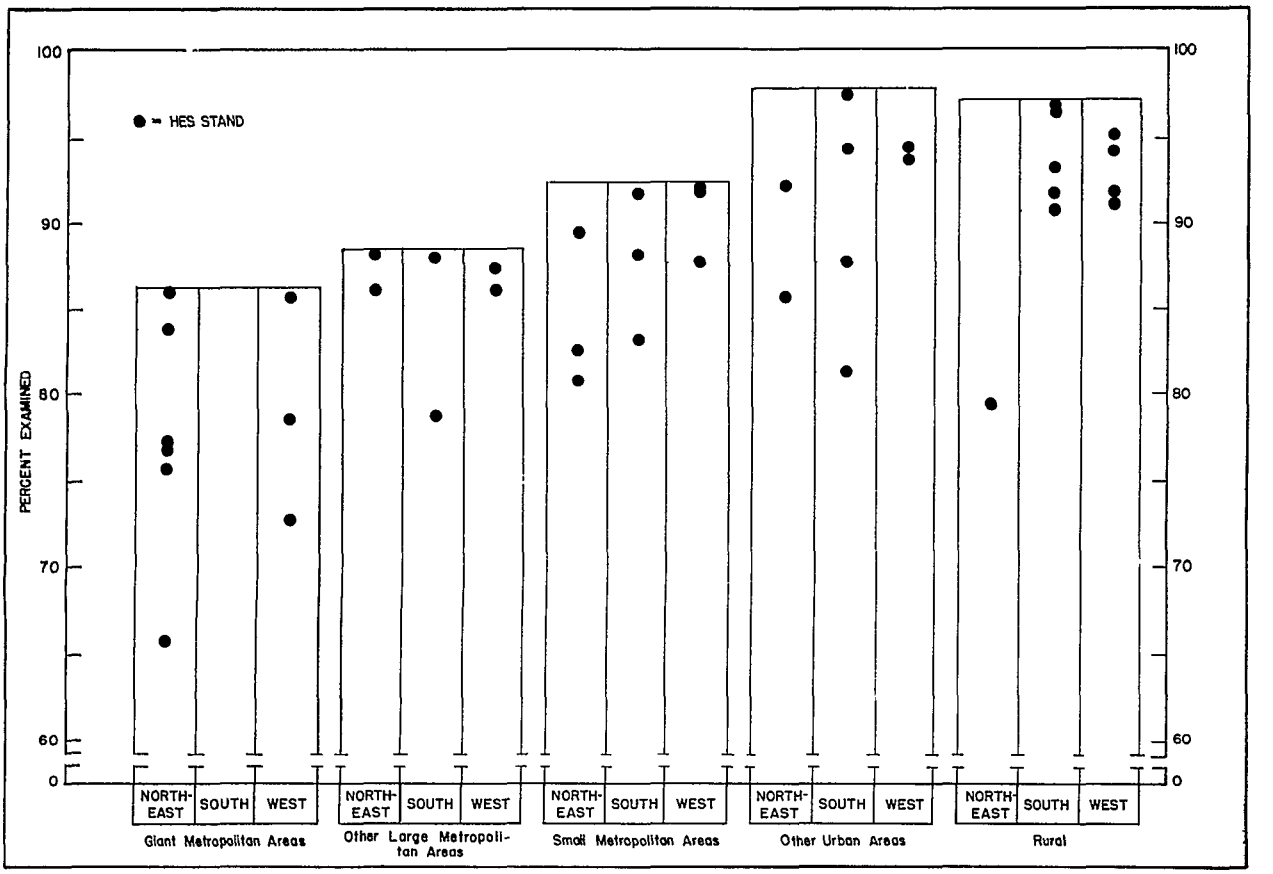

Figure 1. Percent examined by stand according to geographic location and size of place.

Table F. Percent of sample examined by geographic location and population density: Health Examination Survey, United States, 1960-62

Population density	Geographic location		
	Northeast	South	West
All strata----	81.8	89.8	88.2
Giant metropolitan areas----------	77.5	-	78.9
Other very large metropolitan areas----------	87.4	83.5	86.8
Small metropolitan areas----------	84.2	87.6	90.6
Other urban areas---	88.8	90.3	94.0
Rural places--------	79.4	93.8	93.0

been divided into five response groups defined as follows:

Response group	Number of stands	Percent examined
1	8	94-98
2	12	89-93
3	10	84-88
4	6	79-83
5	6	66-78

While there is a strong correlation between the population size of a place and its response level, so that all places in group 1 are either rural or "other urban" places, and all places in group 5 are giant metropolitan areas, the correlation is by no means complete. Therefore it is preferable to consider response level and population size as different analytical axes.

Up to this point, the 42 stands have been considered as demographic entities. In some respects, of course, they are not. For example, persons living in a standard metropolitan statistical area may reside within the central city or

Table G. Percent of sample examined by age and sex: Health Examination Survey, United States, 1960-62

Age	Total	Male	Female
Total, 18-79 years-------	86.5	88.3	85.0
18-24 years--------	90.2	91.7	89.0
25-34 years--------	89.5	92.0	87.5
35-44 years--------	88.7	90.6	87.0
45-54 years--------	86.7	87.2	86.3
55-64 years--------	81.1	81.5	80.7
65-74 years--------	80.5	85.2	76.7
75-79 years--------	74.3	80.0	69.3

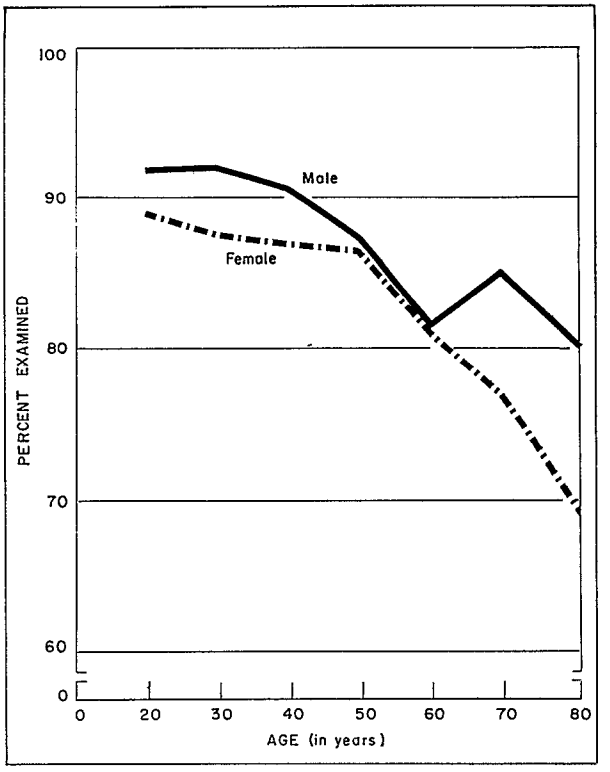

Figure 2. Percent examined by age and sex.

in the suburbs, and the socioeconomic differences between these two groups are often quite considerable. However, their response rates were quite similar, with 82.7 percent for persons in the central cities and 83.7 percent for persons outside the central city. Obviously, with an overall rate of 91.6 percent, places not located in the standard metropolitan areas have noticeably higher response levels.

Similarly, there are substantial socioeconomic differences between persons living on farms and rural residents not living on farms. Here the response rates differed somewhat, with 93.7 percent for rural farm and 89.0 percent for rural nonfarm. The response rate for urban places averaged 84.6 percent, though it is worth noting that for the smallest urban places (2,500-9,999 population) it was decidedly higher—92.0 percent.

Age and sex.—The examination rate was 88.3 percent for men and 85.0 percent for women. It was higher for men in every age group, but at ages under 65 years the sex differential was trivial. After 65 years of age, women were substantially less willing than men to come in for examination (table G, fig. 2). By age, the response rate was highest for the youngest persons and diminished with increasing age. In the age group 18-24 years, 90.2 percent were examined. In the age group 75-79 years, the examination rate was only 74.3 percent, or 80.0 percent for men and 69.3 for women.

Race.—The response rate was higher in the nonwhite population than in the white (table H, fig. 3). Overall, it was 85.8 percent for the white population and 91.4 percent for the Negro. The difference was not due to a confounding of place with race; there was no special concentration of Negroes in places of high response. In fact, response was higher for the Negro population in most age groups and at most places. There was little difference in response rates between Negro and other nonwhite races (chiefly Indian).

Other demographic variables.—For a number of other demographic variables, there was some slight variation noted in the percent examined. The response rate varied slightly with marital status, from 81.3 percent for widowed persons to 87.2 percent for married and 88.3 percent for separated persons (table I). It varied slightly

Table H. Percent of sample examined of the white and Negro populations, by age and sex: Health Examination Survey, United States, 1960-62

Age	White		Negro	
	Male	Female	Male	Female
Total, 18-79 years-----	87.8	84.1	91.8	90.7
18-24 years--	91.2	87.8	96.2	94.0
25-34 years--	91.5	86.5	93.4	92.9
35-44 years--	91.2	86.5	86.6	91.0
45-54 years--	86.2	85.7	94.1	89.9
55-64 years--	79.5	80.2	94.7	85.5
65-74 years--	85.0	75.6	90.0	85.7
75-79 years--	80.2	66.3	77.8	90.0

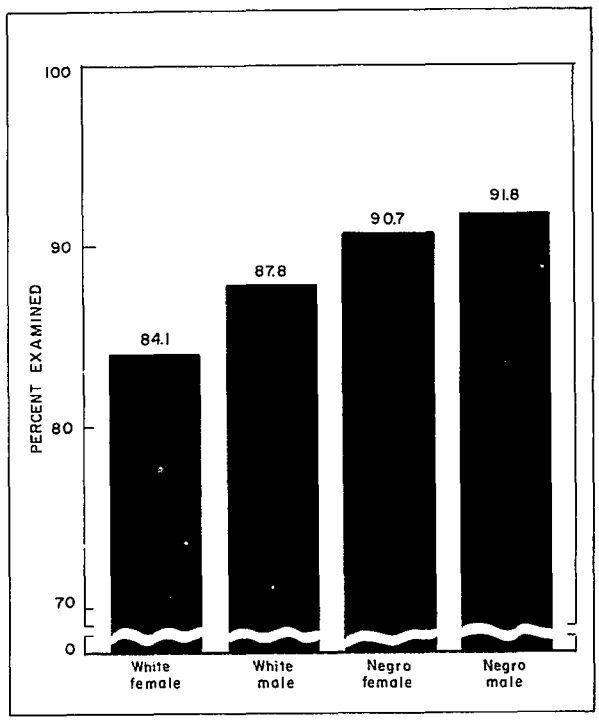

Figure 3. Percent examined by race and sex.

Table I. Percent of sample examined by marital status and sex: Health Examination Survey, United States, 1960-62

Marital status	Total	Male	Female
Single	85.3	85.6	84.9
Married[1]	87.2	89.2	85.5
Separated	88.3	87.0	89.4
Widowed	81.3	84.4	80.8
Divorced	86.6	84.4	87.9

[1]Exclusive of separated.

Table J. Percent of sample examined by years of school completed and sex: Health Examination Survey, United States, 1960-62

Years of school completed	Total	Male	Female
Under 5 years	89.2	90.5	88.0
5-8 years	85.2	87.9	82.8
9-12 years	86.6	89.1	84:8
13+ years	89.5	89.4	89.7
Unknown	72.1	71.7	72.8

Table K. Percent of sample examined by family income and sex: Health Examination Survey, United States, 1960-62

Family income	Total	Male	Female
Under $2,000	89.3	90.6	88.3
$2,000-3,999	86.6	87.7	85.8
$4,000-6,999	88.6	90.1	87.1
$7,000+	86.2	88.5	84.1
Unknown	77.2	79.6	75.5

Table L. Percent of sample examined by usual activity status and sex: Health Examination Survey, United States, 1960-62

Usual activity status	Total	Male	Female
Usually working	88.3	89.2	86.4
Keeping house	84.8	...	84.8
Retired	81.8	84.3	61.5
Other	86.1	86.6	85.1

Table M. Percent of sample examined by occupation and sex: Health Examination Survey, United States, 1960-62

Occupation	Total	Male	Female
Professional, technical, and kindred workers	89.6	89.1	90.2
Farmers and farm managers	92.4	92.6	90.0
Managers, clerical, and sales workers	86.5	88.0	84.9
Craftsmen, foremen, and kindred workers	89.5	89.7	82.4
Operatives and kindred workers	88.8	90.3	85.7
Private household and service workers	90.5	91.3	90.1
Laborers (except mine)	93.3	92.9	95.1
Occupation not reported	83.2	81.6	83.6

NOTE: Omits stands 01 and 02.

with the number of years of school completed, from 85.2 to 89.5 percent (table J), and with income, from 86.2 to 89.3 percent (table K). In neither case was there any definite pattern. In terms of usual (economic) activity, the response rate ranged from 81.8 percent for retired persons to 88.3 percent for usually working persons (table L). Similarly, there was a slight variation in response rates by occupation (table M).

Crude response rates, however, are insufficient for describing which of these differentials are meaningful and which are not. It is well known that most demographic features, such as education, income, and occupation, vary with age and sex. Since variation in response is generally more marked by age and sex than by these other demographic characteristics and since age and sex are well defined for the entire sample, it is appropriate to consider response rates for these variables after controlling by age and sex.

To do this, the following procedure is used. The number of examined persons with some specified characteristic, such as the number of married persons, is counted. This number is compared with the number of examined persons expected to have this characteristic. The expected number for an age-sex group will be considered to be $p_i x_i$, where p_i is the proportion of the sample in the i^{th} age-sex group that was examined and x_i is the number of sample persons in that age-sex group having the specified characteristic. The expected number for several age groups is the sum of the expected numbers for these groups. The sampling characteristics of this statistic are discussed in Appendix I. Those cases in which the person had not been adequately characterized for a specific variable are omitted from the total, so that totals differ from one characteristic to another. As already noted, the percentage of such cases is higher in the nonexamined than in the examined group for all demographic variables, and there is little point in rediscovering that fact by an additional route. On the other hand, the following discussion may be incorrect if the persons for whom there is no information on the specific variable differ from those persons who are well characterized on that variable.

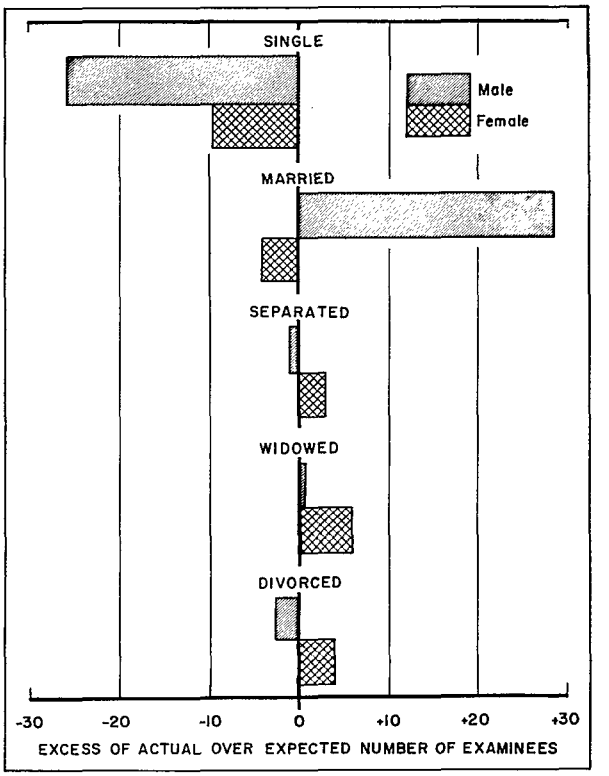

Figure 4. Excess of actual over expected number of examinees by marital status and sex.

When this approach is used, it is seen that response did vary somewhat by marital status and by education (figs. 4 and 5) and this variation is statistically significant. There were slightly more examined than had been expected in the married group and slightly less in the never-married group. In other words, married persons were more cooperative than single persons; whereas response differed little from expectation for widowed, divorced, or separated persons. It should be noted that the differential response that was observed for widowed persons when crude response rates were calculated has disappeared for age-adjustment, and, in fact, the difference in crude rates arose from the greater likelihood of being widowed at older than at younger ages. Persons with no education or who had completed no more than the first four grades of elementary

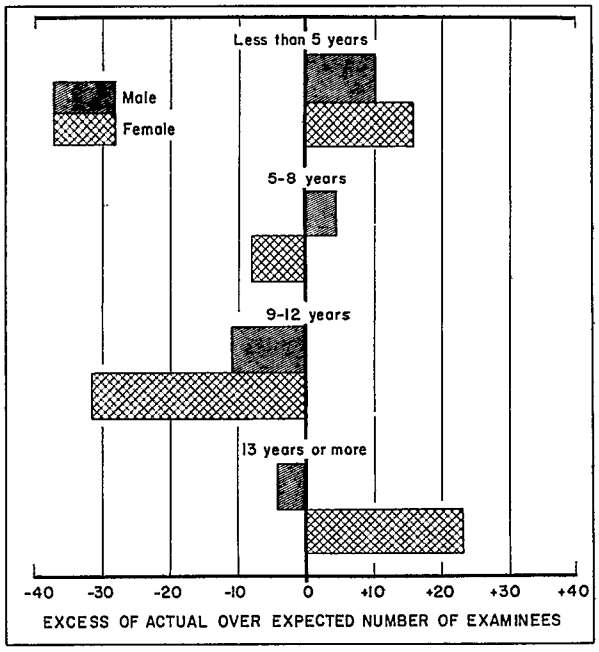

Figure 5. Excess of actual over expected number of examinees by years of school completed and sex.

school were more likely to come in for examination than expected, whereas persons who had gone to high school but not to college were less likely to do so.

Variation in response by income, while statistically significant, followed no clear pattern. Response was greater than had been expected for persons from families with incomes less than $2,000 per year and less than had been expected for persons from families with annual incomes of $7,000 or more. Variation in response by kind of usual (economic) activity, by (economic) activity in the 2 weeks preceding the interview, and by occupation, was within the range of chance fluctuation.

Similar calculations were performed for several characteristics for each of the five response groups of places. For family income and medical authorization, response varied from expected values more than chance when all 42 stands were considered together. However, no consistent pattern for family income carried over from one group of stands to another (fig. 6). Of all the variables investigated for each of the five response

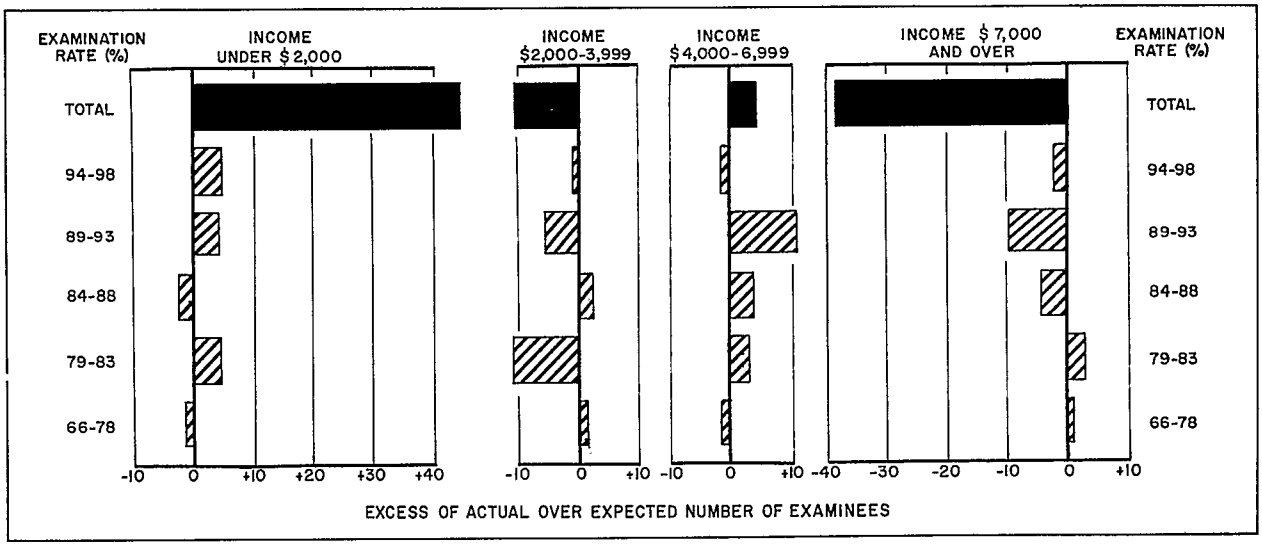

Figure 6. Excess of actual over expected number of examinees by family income for places grouped according to their examination rate.

groups, only the signing of a medical authorization was consistently associated with differential response in areas of high and low response alike.

It may be more meaningful to consider, instead of the response rates, the comparison of the demographic configuration of the examined group with that of the total sample. If these comparisons are made one characteristic at a time, it becomes evident that nonresponse produces some differences in the distributions by age, race and sex, population size of place, and location; but it is also apparent that characteristics such as family income, occupation, usual (economic) activity, education, and marital status appear to have the same lineaments in the examined groups as in the total sample. This was to be expected, of course. For these variables the differences between the examined and nonexamined groups were not large; also the examined group constituted more than 85 percent of the total sample. Beyond this, the estimation process used for the Health Examination Survey includes adjustments for differential response by age, sex, and place of examination. These adjustments tend to compensate for distortions arising from differential nonresponse. Differential nonresponse is not unimportant, but its effects on the demographic picture are apparently not serious.

The demographic differences may be looked at from another point of view. Data from the first Health Examination Survey will ordinarily be presented either in an age-sex-specific form or with adjustments for the known distribution of age and sex in the population. Thus, the question is how noticeably the demographic characteristics of each age-sex group are altered by nonresponse. A few examples may serve to illustrate how small the effect is (table N). The median family income, while consistently lower among examined women than in the entire group of sam-

Table N. Selected demographic characteristics of total sample and examined persons, by sex and age: Health Examination Survey, United States, 1960-62

Sex and age	Median income		Median education		Percent working		Percent married	
	Sample		Sample		Sample		Sample	
	Total	Examined	Total	Examined	Total	Examined	Total	Examined
Male								
18-24 years	$3,778	$3,695	10.7	11.7	67.4	67.6	35.9	37.2
25-34 years	$4,207	$4,212	10.9	11.0	93.0	93.0	79.0	81.0
35-44 years	$4,548	$4,573	10.2	10.2	95.4	96.3	88.8	89.6
45-54 years	$4,521	$4,473	9.6	9.4	93.6	93.4	87.9	88.5
55-64 years	$3,653	$3,550	8.0	7.9	80.3	80.9	82.1	81.8
65-74 years	$1,674	$1,614	7.2	7.2	33.2	32.8	75.6	75.8
75-79 years	$ 879	$ 886	6.4	6.4	7.8	5.6	70.0	70.8
Female								
18-24 years	$3,429	$3,343	10.6	10.6	33.9	33.3	57.0	56.0
25-34 years	$4,192	$4,173	10.5	10.5	30.5	29.4	83.5	83.9
35-44 years	$4,468	$4,463	10.3	10.3	32.2	32.2	86.2	87.1
45-54 years	$3,812	$3,712	9.5	9.5	42.6	43.8	76.4	76.3
55-64 years	$2,887	$2,812	8.8	8.9	32.8	34.8	66.8	65.9
65-74 years	$1,510	$1,395	7.4	7.4	9.8	9.7	47.7	45.8
75-79 years	$ 982	$ 925	7.6	7.6	5.9	5.7	35.6	37.1

ple women, is only slightly lower. For men, there is no consistent difference. The median number of school years completed for the examined group is indistinguishable in the various age-sex groups from the median for the entire sample, although this agreement may well conceal some slight compensating differences in distribution. Similarly, the percentage working was about the same in each age-sex group and in the percentage married there was little noticeable difference between the total sample and the examined group. This relatively unruffled reflection of the sample group in the examined group is, as already noted, only to be expected on the basis of the facts already adduced.

MEDICAL CONDITIONS REPORTED ON INTERVIEW

Reliance on household interview reports of illness for comparing examined and nonexamined persons is limited by two factors. The first is that the reporting of chronic diseases in the household interview is selective and incomplete for cases involving minor amounts of medical care. This was an important reason for the establishment of the Health Examination Survey. The second limiting factor is that persons unwilling to be examined may be assumed to be less willing to supply health information than persons who agree to a medical examination. The household interview information which nonexamined persons gave tended to be less complete and satisfactory in a number of respects than the information given by examined persons. Nonetheless, the health information from the interview is highly pertinent and ought to be considered.

Table O presents for selected conditions a comparison between the number of conditions reported on the household interview for nonexamined persons and the number that would have been expected if reports for nonexamined persons were the same as reports for the sample group as a whole. Figure 7 presents similar data for places grouped according to their examination rate. It will be noted that for those chronic disease categories of special interest to the first Health Examination Survey—diabetes, the cardiovascular conditions, and arthritis and rheumatism—the reported prevalence for nonexamined persons was less than expected. For diabetes the difference was trivial, but for both the cardiovascular diseases and for arthritis and rheumatism the reported deficit was about 25 percent (table O). The deficit in the number of hearing defects reported was even larger, and there was also a sizable deficit of reports of visual defects in the nonexamined group. On the other hand, nonexamined persons reporting cerebrovascular accidents or paralysis were more numerous than expected and there was a slight excess in the number of women reporting deliveries, etc. However,

Table O. Actual and expected prevalence of selected conditions reported on the household interview for nonexamined persons: Health Examination Survey, United States, 1960-62

Selected conditions	Number of conditions	
	Actual	Expected[1]
Diabetes	19	21.2
Cerebrovascular accidents	15	8.7
Cardiovascular diseases other than cerebrovascular accidents	100	130.4
Heart disease	45	54.2
Hypertension	66	85.9
Arthritis and rheumatism	109	144.8
Visual defects	49	58.4
Hearing defects	52	74.2
Paralysis	13	11.4
Deliveries, disorders of pregnancy, etc	42	36.8

NOTE: Conditions are not mutually exclusive.

[1] If p_i is the proportion not examined in a specific age-sex group and t_i is the number of sample persons in the age group reporting the condition, then $p_i t_i$ is the expected value. For deliveries, etc., only women 18-44 years of age were considered in computing the expected value.

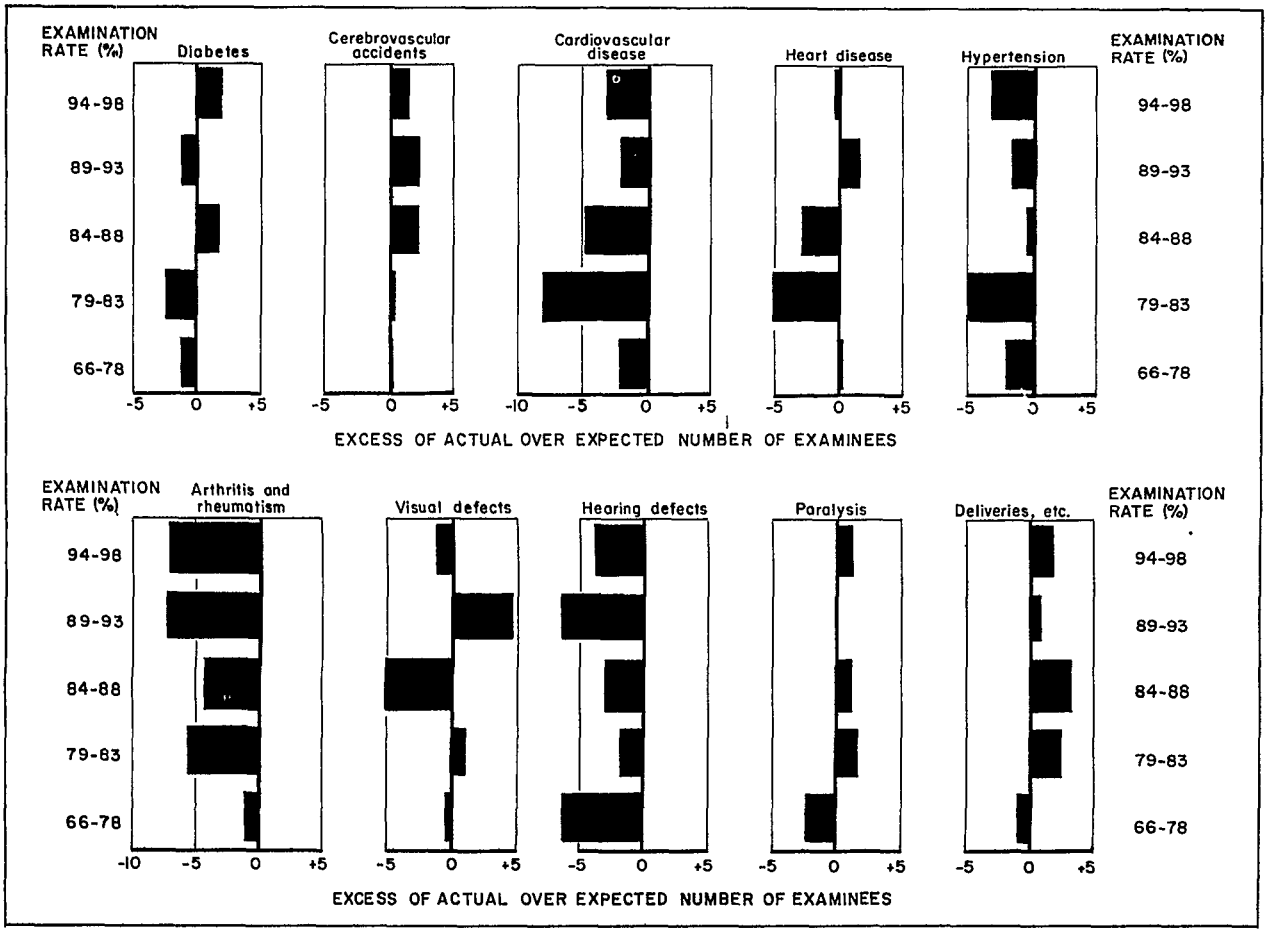

Figure 7. Excess of actual over expected number not examined by condition reported on household interview for places grouped according to their examination rate.

these latter differences probably resulted from sampling fluctuation and in any event are numerically too small to produce any noticeable bias in the survey.

There was a slight deficit in the number of nonexamined persons hospitalized during the preceding year (112 rather than the expected 122) and in the number of episodes that were surgically treated. Again, according to the interview reports, there was less evidence of serious illness in the nonexamined group than in the examined. It appears likely that the reported deficits of serious illness in the nonexamined group reflect, in considerable measure, an unwillingness to reveal the presence of serious illness. Their unwillingness to be examined may be merely another manifestation of the same attitude. Even if the reported deficits were accurate estimates of the difference in disease prevalence between examined and nonexamined persons, the biasing effect would be quite small. Thus, assuming a prevalence 25 percent lower in the nonexamined than in the examined group, an estimate which imputed to nonexamined persons the same prevalence as found for examined persons would overstate the true figure by only 4 percent.

INQUIRY OF PHYSICIANS

When a substantial part of the sample is not examined, it is most important that the persons not examined be similar in terms of the characteristics under study to the persons examined. If all of the 13.5 percent of the sample not examined during the first Health Examination Survey had heart disease, for example, the prevalence figures for heart disease derived from the examined group would represent a serious understatement of these statistics. Even less extreme differentials could lead to considerable bias in survey results. In general, a lower prevalence in the nonexamined than in the examined group is a matter of less concern, since the magnitude of possible bias from a lower prevalence is usually more limited.

In the absence of concrete evidence, it is impossible to say whether the nonresponse bias for any specific characteristic is large or small, positive or negative, or, indeed, whether it exists at all. One source of information available to us is the household interview. This is supplemented by a program which was developed to obtain auxiliary information from the person's own physician. During the household interview each sample person was asked to give the name and address of his personal physician and to indicate how long it had been since he had last seen him. In each household the respondent was asked to sign a form authorizing his physician to release medical information to the National Health Survey. If a nonexamined person signed such a medical release and gave the name of a personal physician whom he had seen in the preceding 2 years, an inquiry was sent his physician. If the person did not sign a release, the inquiry form was sent to him with a request that he forward it to his physician for completion. A similar inquiry form was sent to an examined person from the same place who was of the same sex and, as nearly as possible, the same age. This program was undertaken too late to include examined persons from the first two stands, since their physicians had already received reports of findings from the Health Examination Survey and the evaluation was to be based only on the expressed judgments of the personal physician.

The inquiry form is shown in figure 8. The request for information is brief, simple, and categorical. No criteria were offered to, or requested from, the physician for any diagnosis. Replies were tabulated as received, with no followup to clarify obscure entries or to complete those forms that were incomplete.

If the person said he had not seen a physician within the last 2 years, no inquiry was sent. About 15 percent of the nonexamined persons fell into this category. While there are a large number of reasons for not seeing a physician, including suspected ill health, it seems reasonable to assume that this group had a smaller than average proportion of persons with serious health problems. Another 33 percent either gave no verifiable physician's name or did not sign a release. As already indicated, these persons were sent a copy of the inquiry with a request to forward it to their physicians. In the remaining cases the inquiry was sent directly to the physician. If no reply to an inquiry was received, one followup letter was sent; at this point the investigation was terminated. In short, the program was conducted under very low pressure.

Returns were received from 419 nonexamined persons, or 45 percent of the nonexamined persons from the 40 stands included. Some of the returns indicated that the physician either did not know the person or had relatively little of the information requested. There were 312 returns complete enough to be used: 272 from the 475 inquiries sent directly to the physician and 40 from the 310 inquiries sent to the sample person to be forwarded to his physician.

Total returns	419
Patient	
Reply usable	312
Reply unusable	60
Not a patient	47

In other words, inquiries made of personal physicians yielded usable medical information for only 34 percent of the nonexamined population.

Returns for the examined persons included in the inquiry were greater. The chief reason for

Confidentiality has been assured the individual as set forth in 22 FR 1687

PHS-3504
8-60

PHYSICIAN INQUIRY

HES-211

Form Approved Bureau of the Budget No. 68-R620-S4
Expires 6-30-63

SERIAL NUMBER

PATIENT'S NAME, ADDRESS, AGE, AND SEX

1. When did you last see this patient? _____

2. What did you treat him for at that time? _____

3. In general, would you describe the patient's health at that time as:

☐ Excellent ☐ Good ☐ Fair ☐ Poor

4. Did the patient have any of the following conditions? (Please check the appropriate block)

CONDITION	Yes, definite	Yes, possible or tentative	No	Don't know (Have no information bearing on this condition)
a. Hypertension				
b. Peripheral vascular disease				
c. Coronary heart disease				
d. Hypertensive heart disease				
e. Rheumatic heart disease				
f. Other heart disease (Please specify) _____				
g. Diabetes				
h. Arthritis or rheumatism				

5. If in your record, please specify the following measurements and the date latest measurement was taken:

a. Blood pressure _____ _____ (Date)

b. Height _____ _____ (Date)

c. Weight _____ _____ (Date)

_____ (Signature of physician) _____ (Date)

Note: Please use other side for additional information or comments

Figure 8. Physician inquiry form.

this, of course, was the fact that all examined persons, excluding a few accidental omissions, signed a medical release and, in any case, examined persons were included in the inquiry only if they had given a verifiable physician's name and reported having seen a physician within the last 2 years. Among those inquiries sent directly to the personal physician the percentage of returns was nearly as high for nonexamined as for examined persons. The returns on inquiries sent directly to the personal physician are given in the following table:

	Examined	Nonexamined
Inquiries sent-------	767	475
Inquiries returned---	656	373
Patient----------	563	326
Reply usable----	489	272
Reply unusable---	74	54
Not a patient------	93	47

For both examined and nonexamined persons, where the inquiry was sent directly to the person's physician and he acknowledged that the person was his patient, 86 percent of the returns were complete enough to be used. Undoubtedly, there were instances in which the physician consulted with the patient before completing the inquiry. It seems likely, however, that response or nonresponse ordinarily reflected the cooperativeness of the physician rather than that of his patient. Coincidentally, the rate of return of forms sent to the physician and the examination rate for the survey were quite similar.

Examination of the returns indicated that in 190 cases there was a usable return for both a nonexamined person and his specific match in the examined group. This left 122 unmatched usable returns for the nonexamined group and 299 for the examined group. Since there was nothing to distinguish matched from unmatched returns either in the distribution of subjects by age and sex or in the medical conditions reported, it was decided to combine the two groups and compare all usable returns for nonexamined persons with those for examined persons.

So far as can be judged from these data the prevalence of the cardiovascular diseases, arthritis and rheumatism, and diabetes was the same in the examined as in the nonexamined group (table P). Furthermore, the two groups were indistinguishable in average height, weight, and blood pressure (table Q). The general health of persons in either group, in the judgment of their personal physicians, was similar (table R).

Needless to say, neither the physician in-

Table P. Prevalence of conditions reported by personal physicians for examined and nonexamined persons: Health Examination Survey, United States, 1960-62

Condition	Number of conditions		Rate per 100 persons	
	Examined persons	Nonexamined persons	Examined	Nonexamined
Hypertension----------	99	66	20.4	21.3
Peripheral vascular disease----------	59	33	12.2	10.6
Coronary heart disease----------	40	32	8.3	10.3
Hypertensive heart disease----------	54	34	11.3	11.0
Rheumatic heart disease----------	15	4	3.1	1.3
Other heart disease----------	12	9	2.5	2.9
Diabetes----------	27	15	5.8	5.0
Arthritis or rheumatism----------	76	43	15.8	14.2

NOTE: There were 489 examined and 312 nonexamined returns that were entirely, or almost entirely, complete. For a specific category the total may be slightly less. Conditions are not exclusive.

Table Q. Mean blood pressure, height, and weight reported by personal physicians for examined and nonexamined persons: Health Examination Survey, United States, 1960-62

Measurement	Number	Mean
Blood pressure (in mm/hg)		
Examined persons	439	134/80
Nonexamined persons	269	135/81
Height (in cms)		
Examined persons	196	165.4
Nonexamined persons	116	167.5
Weight (in pounds)		
Examined persons	313	149.1
Nonexamined persons	193	148.6

NOTE: There were 489 examined and 312 nonexamined returns that were entirely, or almost entirely, complete. For a specific category the total may be slightly less.

quiry, nor the morbidity information reported on the household interview, rules out the possibility that examined and nonexamined persons do differ with respect to some of the characteristics evaluated by the first Health Examination Survey. Obviously, the information available for nonexamined persons is less complete and reliable than that for examined persons; this is manifested in the household interview and, to a larger extent, in the physician inquiry. What does seem improbable at this point, however, is that the examined and nonexamined groups differ greatly; that is, it seems unlikely that the nonresponse has introduced a really serious bias in the findings of the Health Examination Survey. This assurance, imprecise as it is, adds greatly to the usability of the data.

SOME ASPECTS OF THE EXAMINATION PROCESS

It must be stressed that the sampling aspects of a survey are not restricted to choosing the sample persons and persuading them to report for examination. The conducting of the survey itself, and of the examination, has numerous sampling features, some of which are now mentioned, chiefly in a cautionary vein.

In the course of the first Health Examination Survey, 42 different places were visited. Examinations were performed by 62 different physicians and 5 dentists. There were 20 different techni-

Table R. Percent distribution of general health status reported by personal physicians for examined and nonexamined persons: Health Examination Survey, United States, 1960-62

General health status	Number of persons		Percent distribution	
	Examined	Nonexamined	Examined persons	Nonexamined persons
Total	466	293	100.0	100.0
Excellent	120	73	25.8	24.9
Good	237	145	50.9	49.5
Fair	94	58	20.2	19.8
Poor	15	17	3.2	5.8

NOTE: There were 489 examined and 312 nonexamined returns that were entirely, or almost entirely, complete. For a specific category the total may be slightly less.

cian-observers responsible for the anthropometric and audiometric examinations.

Ideally, each of the 6,672 examinees should have been assigned to examination on a random basis—random, that is, with respect to time, place, and examiner. Obviously, this was impossible. Sample persons were examined in their usual area of residence. All examinations at a given place were completed within the time span of 3 or 4 weeks. They were performed by a specific examining team, which ordinarily included only 2 of the 62 physicians, 2 of the 20 technicians, and 1 of the 5 dentists. If there were any difficulties in the equipment or the environment at that location, if there were any peculiarities in the conducting of the examination by any one of the examining physicians, if there were any wavering in the laboratory standards at that time, or in the interpretative standards used in X-ray or electrocardiographic reading, this would be likely to be reflected in the examination findings and would appear as a place peculiarity. For these reasons, apparent place differences in health found by the first Health Examination Survey must be examined critically, taking into consideration other factors which may possibly have produced differences.

This has more ramifications than first appear. Places vary with respect to a large number of demographic characteristics, so that to some extent examination differences from place to place tend to produce some effect on other demographic comparisons. Most of these are probably negligible. The one possible exception is race, since 40.5 percent of all Negroes examined came from 5 of the 42 stands and 1 stand accounted for 73.0 percent of the other nonwhite examinees.

Place differences are confounded not only with possible examination differences but also with seasonal differences. The scheduling of stands was deliberately arranged so that the North would be avoided in winter and the South in summer (fig. 9). To the extent that any characteristic under study varies with the season, regional comparisons for that characteristic will be difficult to interpret. For example, if people in all parts of the country weigh more in winter than in summer, the survey would tend to understate the weight of northerners and overstate the weight

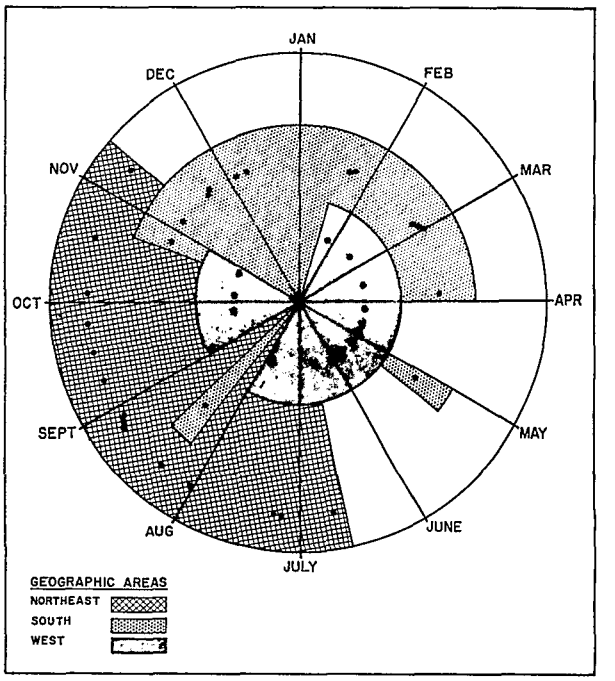

Figure 9. Health Examination Survey stands by geographic location and date of examination.

of southerners. Bias may also be introduced into racial comparisons of such characteristics unless these are made specific by place.

Finally, the association of age and sex with the time of day at which the person was examined should be discussed (fig. 10). The time of examination was fitted to the convenience of the examinee; this was related to such factors as employment, and so to sex and age. Women were more likely than men to come in during the morning or afternoon and less likely to come in during the evening. Young people were less likely than old to appear for examination in the morning. The sex differentials, while consistent for the various age groups, were not large. Some of the age differentials, however, were quite marked. More than 40 percent of the men under 55 years of age came in for examination after 5 p.m., while relatively few persons over 65 years old were examined in the evening. Only one-fourth of the examinees aged 18-24 years came in before noon,

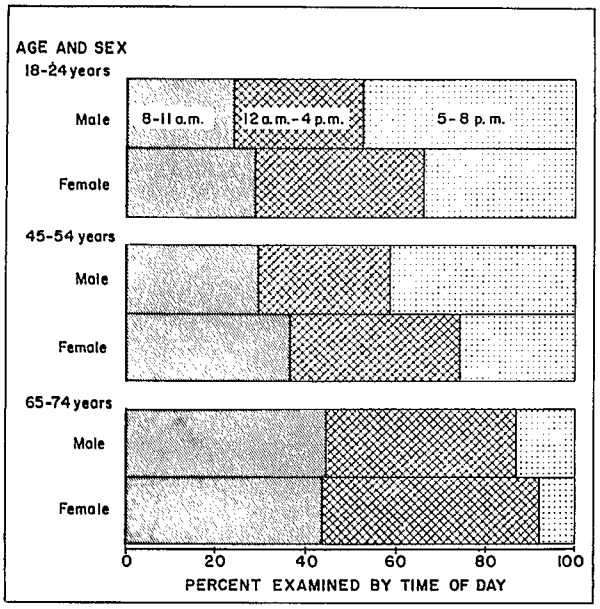

Figure 10. Percent distribution of examinations by time of day according to selected age groups and sex.

as compared with half of those aged 75-79 years. Hence, if any variable under examination has a marked diurnal variation this can easily appear as an age differential in the findings for that variable, even though no real age differential exists. Small diurnal variation—with a range, for example, of less than 10 percent—can probably be ignored in analysis. Larger variation probably cannot be ignored.

Aside from these factors, there exists in most examination measurements a degree of variability, which is often termed "measurement variance" to distinguish it from bias. Various measures and much effort were devoted to problems of standardization of observations, validation of measurement processes, and other aspects of quality control. Some of the measures used to assure standardization during the examining process involved developing a sound protocol and carefully selecting, training, and retraining an examining staff. Also worth mentioning is the periodic use of consultants to observe and comment on specific aspects of the examination. Certain blood chemistry tests and measurements were made at outside laboratories—serologic tests for syphilis, serum bentonite flocculation tests, and blood glucose and serum cholesterol measurements. In addition to the quality controls of the testing laboratories, replicate measurements of blood glucose and serum cholesterol were taken for a sample of cases. Electrocardiograms, chest X-rays, and X-rays of the hands and feet also were evaluated outside the clinic. Each of these was evaluated in replicate determinations.

The factors discussed in this section constitute possible sources of bias in the survey findings. They are pointed out not because they are unusual, but because they may not be so obvious to the reader as they are to the survey staff. Preliminary analyses of Health Examination Survey findings generally indicate that these factors are not a matter for serious concern, but obviously they should be considered in the analysis of specific data.

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DETAILED TABLES

Table 1. Percent distribution according to sex, by selected demographic characteristics reported in the Census and as estimated from the primary sampling units: United States, 1960

Characteristic	Both sexes		Male		Female	
	Census	Estimate	Census	Estimate	Census	Estimate
AGE						
All races	Percent distribution					
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
18-24 years	13.8	14.2	13.9	14.2	13.7	14.1
25-34 years	20.2	21.1	20.4	21.3	20.1	20.9
35-44 years	21.4	21.8	21.5	21.9	21.3	21.6
45-54 years	18.2	18.0	18.5	18.3	18.0	17.7
55-64 years	13.8	13.3	13.8	13.3	13.9	13.3
65-74 years	9.8	9.1	9.4	8.7	10.2	9.6
75-79 years	2.7	2.5	2.5	2.3	2.9	2.8
Median age	42.5	41.7	42.3	41.6	42.6	41.9
White						
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
18-24 years	13.5	13.7	13.7	13.8	13.4	13.7
25-34 years	19.9	20.8	20.2	21.2	19.7	20.5
35-44 years	21.3	21.8	21.5	22.0	21.2	21.6
45-54 years	18.3	18.1	18.6	18.4	18.1	17.9
55-64 years	14.1	13.6	14.0	13.5	14.1	13.6
65-74 years	10.0	9.4	9.6	8.8	10.5	9.9
75-79 years	2.8	2.6	2.6	2.4	3.0	2.9
Median age	42.8	42.1	42.5	41.8	43.0	42.3
Nonwhite						
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
18-24 years	16.6	17.3	16.6	17.3	16.6	17.3
25-34 years	23.0	22.9	22.4	22.2	23.5	23.5
35-44 years	21.7	21.5	21.5	21.3	21.8	21.6
45-54 years	17.3	17.2	17.7	17.6	17.0	16.8
55-64 years	12.1	11.9	12.4	12.3	11.7	11.5
65-74 years	7.5	7.4	7.5	7.4	7.5	7.3
75-79 years	1.9	1.9	1.9	1.9	1.9	1.9
Median age	39.8	39.6	40.1	39.9	39.5	39.3
RACE						
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
White	89.9	87.5	90.1	87.7	89.7	87.3
Nonwhite	10.1	12.5	9.9	12.3	10.3	12.7
MARITAL STATUS						
Total-14+ years	100.0	100.0	100.0	100.0	100.0	100.0
Single	22.0	22.0	25.1	25.1	19.1	19.1
Married	67.5	67.6	69.2	69.3	65.8	66.1
Separated	1.8	1.8	1.5	1.6	2.0	2.1
Widowed	8.1	7.8	3.6	3.5	12.3	11.9
Divorced	2.5	2.6	2.1	2.2	2.8	2.9

Table 1. Percent distribution according to sex, by selected demographic characteristics reported in the Census and as estimated from the primary sampling units: United States, 1960—Con.

Characteristic	Both sexes		Male		Female	
	Census	Estimate	Census	Estimate	Census	Estimate
YEARS OF SCHOOL COMPLETED	Percent distribution					
All persons-25+ years	100.0	100.0	100.0	100.0	100.0	100.0
None	2.3	2.8	2.4	2.9	2.1	2.7
Elementary						
1-4 years	6.0	6.4	7.0	7.3	5.2	5.6
5 and 6 years	7.5	7.5	7.9	7.8	7.1	7.3
7 years	6.4	6.2	6.8	6.5	6.0	5.9
8 years	17.6	16.8	17.8	16.9	17.4	16.8
High school						
1-3 years	19.2	19.0	18.7	18.5	19.7	19.5
4 years	24.5	24.1	21.2	20.8	27.7	27.2
College						
1-3 years	8.8	8.9	8.6	8.8	9.0	9.0
4+ years	7.7	8.2	9.7	10.5	5.8	6.1
Median years completed	10.6	10.6	10.3	10.4	10.9	10.8
OCCUPATION OF EMPLOYED PERSONS						
All occupations	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical, and kindred workers	11.2	11.8	10.3	11.1	13.0	13.1
Farmers and farm managers	3.9	3.6	5.5	5.0	0.6	0.6
Managers, officials, and proprietors, excluding farm	8.4	8.5	10.6	10.9	3.7	3.6
Clerical and kindred workers	14.4	14.8	6.9	7.1	29.7	30.6
Sales workers	7.2	7.1	6.9	6.8	7.8	7.6
Craftsmen, foremen, and kindred workers	13.5	13.5	19.5	19.6	1.2	1.2
Operatives and kindred workers	18.4	17.6	19.9	19.4	15.4	14.1
Private household workers	2.7	2.8	0.1	0.1	7.9	8.2
Service workers, excluding private household	8.4	8.4	6.0	6.0	13.4	13.3
Farm laborers and farm foremen	2.2	2.2	2.8	2.5	1.1	1.4
Laborers, except farm and mine	4.8	4.8	6.9	6.9	0.5	0.6
Occupation not reported	4.9	5.0	4.6	4.6	5.7	5.7
FAMILY INCOME						
All incomes	100.0	100.0				
Under $1,000	5.6	6.0				
$1,000-1,999	7.5	7.5				
$2,000-2,999	8.3	8.0				
$3,000-3,999	9.5	9.0				
$4,000-4,999	11.0	10.6				
$5,000-5,999	12.3	12.0				
$6,000-6,999	10.7	10.7				
$7,000-9,999	20.1	20.5				
$10,000 and over	15.0	15.7				
Median income	$5,657	$5,734				

Table 2. Number and percent distribution according to sample and nonsample eligible persons, by selected demographic characteristics: United States, 1960-62

(Excludes data from 3 stands)

Characteristic	Total eligible persons	Sample persons	Non-sample persons	Percent distribution		
				Total	Sample	Non-sample
AGE						
Both sexes						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
18-24 years	1,971	960	1,011	13.8	13.5	14.2
25-34 years	2,845	1,453	1,392	19.9	20.4	19.5
35-44 years	3,145	1,553	1,592	22.0	21.8	22.3
45-54 years	2,623	1,343	1,280	18.4	18.8	17.9
55-64 years	2,005	997	1,008	14.0	14.0	14.1
65-74 years	1,298	649	649	9.1	9.1	9.1
75-79 years	386	177	209	2.7	2.5	2.9
Median age	42.4	42.4	42.3	...	...	...
Male						
Total-18-79 years	6,672	3,234	3,438	100.0	100.0	100.0
18-24 years	885	410	475	13.3	12.7	13.8
25-34 years	1,305	665	640	19.6	20.6	18.6
35-44 years	1,505	726	779	22.6	22.4	22.7
45-54 years	1,253	583	670	18.8	18.0	19.5
55-64 years	985	478	507	14.8	14.8	14.7
65-74 years	560	287	273	8.4	8.9	7.9
75-79 years	179	85	94	2.7	2.6	2.7
Median age	42.6	42.5	42.8	...	...	...
Female						
Total-18-79 years	7,601	3,898	3,703	100.0	100.0	100.0
18-24 years	1,086	550	536	14.3	14.1	14.5
25-34 years	1,540	788	752	20.3	20.2	20.3
35-44 years	1,640	827	813	21.6	21.2	22.0
45-54 years	1,370	760	610	18.0	19.5	16.5
55-64 years	1,020	519	501	13.4	13.3	13.5
65-74 years	738	362	376	9.7	9.3	10.2
75-79 years	207	92	115	2.7	2.4	3.1
Median age	42.2	42.4	42.0	...	...	...
RACE						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
White	12,481	6,248	6,233	87.4	87.6	87.3
Nonwhite	1,792	884	908	12.6	12.4	12.7
SEX						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
Male	6,672	3,234	3,438	46.7	45.3	48.1
Female	7,601	3,898	3,703	53.3	54.7	51.9
MARITAL STATUS						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
Single	1,873	913	960	13.1	12.8	13.4
Married	10,930	5,480	5,450	76.6	76.8	76.3
Separated	299	148	151	2.1	2.1	2.1
Widowed	1,061	513	548	7.4	7.2	7.7
Divorced	407	224	183	2.9	3.1	2.6
Unknown	2	2	-	0.0	0.0	

Table 2. Number and percent distribution according to sample and nonsample eligible persons, by selected demographic characteristics: United States, 1960-62—Con.

(Excludes data from 3 stands)

Characteristic	Total eligible persons	Sample persons	Non-sample persons	Percent distribution		
				Total	Sample	Non-sample
YEARS OF SCHOOL COMPLETED						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
None	195	87	108	1.4	1.2	1.5
Elementary						
1-4 years	755	382	373	5.3	5.4	5.2
5-8 years	3,653	1,828	1,825	25.6	25.6	25.6
High school						
1-4 years	6,862	3,440	3,422	48.1	48.2	47.9
College						
1-4 years	1,957	1,013	944	13.7	14.2	13.2
5+ years	442	195	247	3,1	2.7	3.5
Unknown or unreported	409	187	222	2.9	2.6	3.1
Median years completed	10.4	10.4	10.4	...	...	...
FAMILY INCOME						
Total-18-79 years	14,273	7,132	7,141	100.0	100.0	100.0
Under $1,000	993	496	497	7.0	7.0	7.0
$1,000-1,999	1,225	616	609	8.6	8.6	8.5
$2,000-2,999	1,157	572	585	8.1	8.0	8.2
$3,000-3,999	1,425	725	700	10.0	10.2	9.8
$4,000-4,999	1,520	755	765	10.6	10.6	10.7
$5,000-6,999	2,648	1,335	1,313	18.6	18.7	18.4
$7,000-9,999	2,167	1,083	1,084	15.2	15.2	15.2
$10,000 and over	1,683	829	854	11.8	11.6	12.0
Unknown or unreported	1,455	721	734	10.2	10.1	10.3
Median income	$5,067	$5,063	$5,073	...	...	...

Table 3. Percent distribution by age and race, according to sex: Census and weighted HES sample

Age and race	Total		Male		Female	
	Census[1]	HES	Census[1]	HES	Census[1]	HES
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
18-24 years	14.0	13.3	13.5	12.7	14.4	13.9
25-34 years	19.4	21.0	19.5	21.5	19.4	20.6
35-44 years	21.3	22.3	21.6	22.9	21.1	22.0
45-54 years	18.5	18.8	19.0	18.0	18.1	19.5
55-64 years	14.1	13.5	14.3	14.3	13.9	12.7
65-79 years	12.6	11.1	12.1	10.6	13.1	11.3
Total-18-79 years	100.0	100.0	100.0	100.0	100.0	100.0
White	89.6	88.0	89.8	88.3	89.5	87.7
Negro	9.8	10.3	9.6	9.8	9.9	10.7
Other	0.6	1.7	0.6	1.9	0.6	1.6

[1]These distributions represent estimates for October 1, 1961, based on unpublished figures from the Bureau of the Census.

Table 4. Percent distribution by marital status, according to sex: Census and weighted HES sample

Marital status	Total		Male		Female	
	Census[1]	HES	Census[1]	HES	Census[1]	HES
Total	100.0	100.0	100.0	100.0	100.0	100.0
Single	14.2	13.0	16.9	15.5	11.8	10.7
Married	74.1	76.0	77.0	79.0	71.5	73.3
Separated	2.1	2.0	1.8	2.0	2.3	2.1
Widowed	9.0	7.7	3.8	2.5	13.8	12.2
Divorced	2.6	3.4	2.3	3.0	2.9	3.7

[1]Civilian population, 18 years and over as of March 1962. Source: Current Population Reports: Series P-20, No. 122.

Table 5. Percent distribution by years of school completed, according to sex: Census and weighted HES sample

Years of school completed	Total		Male		Female	
	Census[1]	HES	Census[1]	HES	Census[1]	HES
Total	100.0	100.0	100.0	100.0	100.0	100.0
No school	1.9	1.7	2.0	1.5	1.8	1.8
Elementary						
1-4 years	5.0	4.9	5.9	5.2	4.3	4.6
5-8 years	25.6	25.6	26.2	26.4	24.9	25.0
High school						
1-4 years	49.0	49.7	45.0	45.9	52.6	53.0
College						
1-4 years	15.8	15.3	16.7	17.0	15.0	13.8
5+ years	2.8	2.8	4.2	3.9	1.4	1.8

[1]Civilian population, 18 years and over as of March 1962. Source: Current Population Reports: Series P-20, No. 121.

Table 6. Percent distribution by occupation group, according to sex: Census and weighted HES sample

Occupation group	Total		Male		Female	
	Census[1]	HES	Census[1]	HES	Census[1]	HES
Total employed	100.0	100.0	100.0	100.0	100.0	100.0
Professional, technical, and kindred workers	11.3	12.0	10.9	11.3	12.1	13.4
Farmers and farm managers	4.0	4.0	5.7	5.6	0.6	0.9
Managers, officials, and proprietors, excluding farm	10.5	10.9	13.4	13.1	4.9	6.7
Clerical and kindred workers	14.5	13.8	7.0	6.6	29.2	27.9
Sales workers	6.4	5.9	5.9	5.4	7.2	7.0
Craftsmen, foremen, and kindred workers	13.0	14.6	19.1	21.6	1.0	1.2
Operatives and kindred workers	17.9	19.1	19.3	20.1	15.2	17.1
Private household workers	3.3	3.0	0.2	0.1	9.4	8.6
Service workers, excluding private household	9.5	9.4	6.6	6.9	15.1	14.4
Farm laborers and farm foremen	4.3	2.4	4.0	2.5	4.9	2.3
Laborers, except farm and mine	5.3	4.7	7.9	7.0	0.4	0.4

[1]Civilian, noninstitutional population of the United States, 14 years of age and over as of October 1961. Source: Special Labor Force Report, No. 23, U.S. Dept. of Labor, Bureau of Labor Statistics.

Table 7. Percent of information unknown or incomplete for selected items for examined and nonexamined sample persons: United States, 1960-62

Selected item	Sample persons	
	Examined	Nonexamined
Family income	9.0	17.1
Education	2.2	5.4
Marital status	0.0	0.2
Occupation of employed	1.2	2.4
Industry of employed	1.1	2.8
Usual activity	0.3	1.3
Activity in last 2 weeks	0.3	1.2
Veteran status[1]	0.7	2.2
Class of worker	2.8	5.4

[1]Males only.

Table 8. Selected sample data

Geographic location, population density, and stand	Segments	Households					Sample persons	Examined	Examination rate	
		Total	Non-interviewed	Vacant	Listed in error	Interviewed			Gross	Net
Total, United States-	2,174	9,035	125	1,221	163	7,526	7,710	6,672	86.5	85.1
Northeast----------	683	2,825	54	298	36	2,437	2,635	2,155	83.5	80.0
Giant metropolitan areas-	295	1,155	35	86	8	1,026	1,172	904	77.5	74.6
Boston, Mass----------	51	207	4	20	5	178	193	162	83.9	82.1
Detroit, Mich----------	44	181	1	15	-	165	175	151	86.3	85.7
Philadelphia, Pa----------	43	120	10	7	-	103	221	145	65.6	59.8
New York, N. Y. (3)----------	157	647	20	44	3	580	583	446	76.5	74.0
Other very large SMSA's--	96	389	4	26	11	348	364	318	87.4	86.4
Columbus, Ohio----------	48	192	4	4	6	178	180	155	86.1	84.2
Pittsburgh, Pa----------	48	197	-	22	5	170	184	163	88.6	88.6
Other SMSA's----------	144	607	9	46	6	546	564	475	84.2	82.9
Akron, Ohio----------	48	195	2	18	1	174	189	169	89.4	88.4
Providence, R. I----------	53	219	1	19	2	197	194	160	82.5	82.1
York, Pa----------	43	193	6	9	3	175	181	146	80.7	78.0
Other urban----------	102	467	5	107	10	345	355	315	88.8	87.5
Biddeford, Me----------	51	243	1	71	7	164	180	154	85.6	85.0
Muskegon, Mich----------	51	224	4	36	3	181	175	161	92.0	90.0
Rural----------	46	207	1	33	1	172	180	143	79.4	79.0
Auburn, N. Y----------	46	207	1	33	1	172	180	143	79.4	79.0
South----------	735	3,001	14	450	81	2,456	2,504	2,249	89.8	89.3
Other very large SMSA's--	108	441	3	33	20	385	386	322	83.5	82.8
Baltimore, Md----------	54	224	1	18	9	196	194	153	78.9	78.5
Louisville, Ky----------	54	217	2	15	11	189	192	169	88.0	87.1
Other SMSA's----------	159	652	2	66	17	567	549	481	87.6	87.3
Nashville, Tenn----------	49	209	1	16	4	188	183	152	83.1	82.6
San Antonio, Tex----------	50	194	1	15	1	177	176	155	88.1	87.6
Savannah, Ga----------	60	249	-	35	12	202	190	174	91.6	91.6
Other urban----------	208	798	7	105	18	668	711	641	90.3	89.2
Eufaula, Ala----------	54	216	4	31	1	180	178	174	97.8	95.6
Midland, Tex----------	52	215	2	31	7	175	174	164	94.3	93.2
Newport News, Va----------	48	195	-	15	9	171	172	151	87.8	87.8
Valdosta, Ga----------	54	172	1	28	1	142	187	152	81.3	80.1
Rural----------	260	1,110	2	246	26	836	858	805	93.8	93.6
Conway, S. C----------	71	296	-	116	10	170	173	161	93.1	93.1
Clinton, La----------	45	198	1	31	8	158	173	167	96.5	95.9
Newport, Ark----------	48	205	-	35	2	168	174	169	97.1	97.1
Oxford, Miss----------	50	208	1	33	2	172	171	155	90.6	90.1
Rocky Mount, N. C----------	46	203	-	31	4	168	167	153	91.6	91.6

Table 8. Selected sample date—Con.

Geographic location, population density, and stand	Segments	Households					Sample persons	Examined	Examination rate	
		Total	Non-interviewed	Vacant	Listed in error	Interviewed			Gross	Net
West	756	3,209	57	473	46	2,633	2,571	2,268	88.7	86.3
Giant metropolitan areas-	156	688	30	39	3	616	633	499	78.9	75.2
Chicago, Ill. (2)	104	454	26	19	2	407	431	326	75.6	71.1
Los Angeles, Calif	52	234	4	20	1	209	202	173	85.6	84.0
Other very large SMSA's--	112	462	11	34	4	413	387	336	86.8	84.6
Minneapolis, Minn	54	229	4	22	1	202	180	155	86.1	84.4
San Francisco, Calif	58	233	7	12	3	211	207	181	87.4	84.6
Other SMSA's	145	602	7	34	14	547	538	488	90.6	89.6
Fort Wayne, Ind	43	188	2	11	2	173	171	150	87.7	86.7
Topeka, Kans	55	217	2	12	12	191	182	168	92.3	91.4
San Jose, Calif	47	197	3	11	-	183	185	170	91.9	91.9
Other Urban	109	419	-	51	13	355	347	326	94.0	93.9
Carbondale, Ill	56	218	-	31	7	180	173	162	93.6	93.6
Kennett, Mo	53	201	-	20	6	175	174	164	94.3	94.3
Rural	234	1,038	9	315	12	702	666	619	93.0	91.8
Butler, Mo	60	243	3	48	1	191	178	163	91.6	90.2
Grand Coulee, Wash	57	220	1	38	3	178	163	155	95.1	94.6
Washburn, Wis	62	321	2	153	2	164	155	141	91.0	89.9
Winslow, Ariz	55	254	3	76	6	169	170	160	94.1	92.5

APPENDIX I

COMPARISONS OF EXAMINED AND NONEXAMINED SAMPLE PERSONS

All comparisons between examined and nonexamined sample persons in this text are undertaken with unweighted data. This is probably the most appropriate way of looking at data on nonresponse, but it does differ from the usual way in which data from the Health Examination Survey will be used.

The evaluative techniques described in the text are based on analysis according to the model described below. This model is the work of Mantel and Haenszel.[8] It assumes that the 7,710 sample persons constitute the universe of study and that the nonrespondents are a simple random sample from that universe. This model does not take into account the actual design of the survey, in which the sample persons were selected in clusters from a much larger stratified universe. Empirical tests indicate that for most items the actual survey variance is larger than that utilized in the model. Consequently, when the tests indicate a difference is within sampling error at a 1 percent level (the level at which these tests were applied) the statement can be relied on; whereas a difference that is apparently statistically significant at that level may be significant only at a higher level, 5 or 10 percent, for example.

The model may be described in these terms: Let S_i, S_{ij}, N_i, N_{ij} be respectively (for age group i) the number of sample persons, the number of sample persons with characteristic j, the number of examined persons, and the number of examined persons with characteristic j.

Let $\sum_i \frac{N_i S_{ij}}{S_i}$ = the expected number of examined persons with characteristic j.

Then the variance of $D_j = \sum_i N_{ij} - \sum_i \frac{N_i S_{ij}}{S_i}$

is $V_j = \sum_i \frac{N_i (S_i - N_i) S_{ij} (S_i - S_{ij})}{S_i^2 (S_i - 1)}$

and $(D_j - 0.5)^2 = V_j$ is distributed

X^2 (1 d.f.)

Let $j = 1,2,3,\ldots, n$. In the event that $n = 2$—for example, if a person either has or does not have diabetes—then the application of this statistic is entirely straightforward. In the event that $n = 3$ an exact test is available on the basis of the following chi-square (2 d.f.).

X^2 (summary) = $X_1^2 + X_2^2$ (adjusted),

where

$$X_2^2 \text{ (adjusted)} = \left[D_2 - \frac{(V_3 - V_1 - V_2) D_1}{2 V_1} \right]^2 \Bigg/ \left[V_2 - \frac{(V_3 - V_1 - V_2)^2}{4 V_1} \right]$$

If n is 4 or more, the X^2 for the set of D has $n-1$ d.f. and is no less than the largest of the X_j^2 and no greater than $\sum_j X_j^2$. If a decision cannot be made on this basis the number of classes is collapsed to 3 and the exact test is computed.

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