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DATA FROM THE NATIONAL HEALTH SURVEY

Hypertension and Hypertensive Heart Disease in Adults

United States - 1960 - 1962

A discussion of the criteria used for the diagnosis of hypertension and hypertensive heart disease, with data on the prevalence of hypertension and hypertensive heart disease by age, sex, and race, and an analysis of differentials by place, family income, education, marital status, usual activity, occupation, and industry.

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IN THIS REPORT findings are presented on the prevalence of hypertension and hypertensive heart disease (HHD) obtained from Cycle I of the Health Examination Survey (HES). Cycle I consisted of examinations of a nationwide probability sample of persons 18-79 years of age selected from the U.S. civilian, noninstitutional population.

This report describes the steps taken in diagnosing hypertension and HHD, presents the data collected, and compares the information obtained in this Survey with that obtained in other surveys. The relationship of the prevalence of hypertension and HHD to the demographic variables of age, race, sex, family income, education, residence, marital status, usual activity status, occupation, and industry are examined.

Definite hypertension and definite HHD were more prevalent in men than in women. The rates for the Negro population were substantially greater than those for the white population in both sexes and in every age group. The prevalence of hypertension and HHD also varied by residence and occupation. There was no strong pattern of prevalence associated with income or education, but there was an apparent trend toward a lower prevalence with greater education, particularly for white women.

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HYPERTENSION AND HYPERTENSIVE HEART DISEASE IN ADULTS

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INTRODUCTION

The Health Examination Survey (HES) found an estimated 17.0 million adults in the United States to have definite hypertension and 10.5 million adults to have definite hypertensive heart disease (HHD), in addition to those persons with borderline or suspect forms of these diseases. Thus 15.3 percent of U.S. adults had definite hypertension and 9.5 percent had definite hypertensive heart disease.

The high prevalence of these diseases lends considerable importance to any evidence of variations in prevalence. This report discusses the prevalence of hypertension and hypertensive heart disease by age, race, sex, and certain other demographic factors. It also compares the findings of this Survey with that of other surveys.

This is one of a series of reports describing and evaluating the plan, conduct, and findings of the first cycle of the Health Examination Survey. The Survey was organized in order to obtain health information on the population of the United States by use of direct examination. Between October 1959 and December 1962 a series of examinations were conducted by the Survey using a probability sample of noninstitutionalized U.S. adults aged 18-79 years. The purpose of this cycle of the examinations was to obtain information on the prevalence of cardiovascular diseases and certain other chronic diseases, dental health, and the distribution of a number of anthropometric and sensory characteristics. Altogether, 6,672 of a sample of 7,710 persons were examined. These sample persons were given a standard examination, which lasted about 2 hours, by medical and other staff members of the Survey in specially designed mobile clinics.

The descriptions of the general plan and of the sample population and response have been published.[1,2] These provide the general background for all the reports of findings. Two reports on blood pressure findings have been published.[3,4] In these, the technique and context for blood pressure measurement are described and some information on the reliability of the blood pressure measurement is provided. In addition, an introductory report on heart disease findings has been published,[5] which includes detailed information on the cardiovascular examination and an extended account of the method of evaluating the findings related to heart disease and of the procedures used in arriving at heart disease diagnoses. In this report, a briefer account is given of those parts of the examination specifically directed toward the diagnosis of hypertension and hypertensive heart disease.

The Medical History

The cardiovascular examination began with a self-administered medical history which the examinee was asked to complete. The receptionist was available to provide the examinee with any necessary assistance. Questions regarding cardiovascular symptoms and disease were included and are shown in Appendix I. After the self-administered history had been completed, the receptionist asked several additional questions concerning physical handicaps, major health prob-

lems, and operations. These questions were designed to elicit relevant medical information which had not appeared in response to the more specific questions on the history. The receptionist, at the same time, reviewed the history both for completeness and for consistency and queried the examinee further where any deficiencies were evident.

The examining physician reviewed the medical history before beginning the physical examination. He attempted to correct any incompleteness or inconsistency remaining in the record and to arrive at a definite "yes" or "no" answer, by further questioning when the examinee had been uncertain in his answer. In some cases this was not possible. For most of the cardiovascular questions the physician was instructed to ask a series of standard probe questions to obtain more information if an answer of "yes" or "?" had been checked or if the examinee indicated that he did not know the answer. When these probes were completed, the physician was free to question the examinee further until he was satisfied that he had all the relevant information that could be obtained in a single session. Among the cardiovascular questions, one was of especial importance for the diagnosis of hypertensive heart disease--question 66 (Appendix I). This dealt with high blood pressure.

Blood Pressure Measurement

Three blood pressure measurements were made: the first just after the physician met the examinee; the second midway in the examination, after completing the auscultation of the heart in the sitting position; and the third at the end of the examination. Blood pressures were taken while the examinee was sitting on the examining table. The nurse placed the middle of the cuff over the bulge in the upper left arm. The cuff was left on the arm between the first and second measurements, removed after the second, and returned for the third. The physician held the arm at the level of the atrium, with the nurse holding the Baumanometer at the physician's eye level. Using the bell of his stethoscope, the physician noted the pressure when the sound was first heard, when it first became muffled, and when it disappeared. All three measurements were recorded. The point at which Korotkoff's sounds disappeared was taken as the diastolic pressure. If the sounds did not disappear, the point of muffling, if distinctly heard, was used. Since the Baumanometer is scaled in intervals of 2 mm., measurements were so recorded. Some results from this examination have already been reported. [3 4]

X-ray and Electrocardiogram

The chest X-ray was a posterior-anterior view taken at a distance of 6 feet and recorded on a 14 by 17 inch film. The exposure was taken in inspiration but was not timed for a fixed phase of the heart cycle. The electrocardiogram (ECG) was obtained by a Twin Viso machine (model 60-1300). Twelve leads were recorded: I, II, III, AVR, AVL, AVF, V_1-V_6

HYPERTENSION AND HHD DIAGNOSIS

The progression from the blood pressure findings of the examination to a diagnosis concerning hypertension involved an averaging of the three blood pressures and a fixing of criteria to be used for classification of these average pressures as regards hypertension. Several additional steps were involved in progressing from examination findings to a hypertensive heart disease diagnosis. The first step was interpreting the chest X-ray film and the electrocardiographic tracing. The second was constructing a set of diagnostic criteria. The third was developing a procedure for translating the findings from the examination and the interpretation of the X-ray and electrocardiogram into specific diagnoses. How these steps were taken for the Health Examination Survey is discussed in the following sections.

Averaging Blood Pressures

Blood pressure may vary considerably over a short period of time, even under relatively standard conditions. Because of this fluctuation, it seemed reasonable to average the three blood pressure measurements obtained for each individual and to use this average as the best measure

of his blood pressure. This procedure also tended to reduce the effect of reading preference for certain end digits in measurements, discussed in a previous report.[3]

Interpretation of the X-ray and Electrocardiogram

Both the electrocardiogram and the chest X-ray were interpreted independently by several specialists. These interpretations were made without any other information about the examinee.

The electrocardiogram was read independently by three cardiologists according to criteria agreed upon in advance. These criteria are specified in Appendix II, which also contains a reproduction of the precoded form on which the findings were entered. For all major findings, it was possible to designate an electrocardiographic abnormality as "outside criteria" if the reader observed an "abnormality" which the criteria did not adequately describe. After the forms were completed, the three independent determinations were compared. Where they all agreed, the unanimous decision was used for subsequent diagnosis. When there was any disagreement, the three readers met with Dr. Michael A. Corrado, Georgetown University School of Medicine, who served as coordinator for this work, and together they came to a final decision. This final decision was the one used in these cases.

The evaluation of the chest X-ray was a somewhat more complicated undertaking. Initially, arrangements were made to have the X-ray films interpreted by radiologists specializing in pulmonary disease. In addition to noting evidence of pulmonary disease, the "pulmonary readers" were requested to record evidence of distinct cardiovascular abnormality. As had been anticipated, this led to an estimate of the prevalence of cardiovascular abnormalities which was much lower than is ordinarily found in cardiovascular surveys. Another group of radiologists was therefore employed to reexamine the films for evidence of cardiovascular abnormality. These "cardiovascular readers" were chosen on the basis of standards set by Dr. Lloyd E. Hawes, radiologist for the Framingham Heart Study. A set of films from the Health Examination Survey were first read by Dr. Hawes and then by a number of different radiologists. Three were found to employ about the same standards as Dr. Hawes and were chosen to read the Health Examination Survey films for cardiovascular abnormalities. Each was given a random third of the films to read. The forms used in recording the radiological findings both for the pulmonary readers and the cardiovascular readers are reproduced in Appendix III.

The reading procedure was designed as follows. A finding of general cardiac enlargement or left ventricular hypertrophy (LVH), definite or possible, was considered "positive." All films were read by two pulmonary readers and one cardiovascular reader. The determination of the two pulmonary readers provided a preliminary evaluation and if both considered the film positive a decision of enlargement was made whatever the findings of the cardiovascular reader. If they disagreed and the cardiovascular reader considered the film positive, the decision was that enlargement was present; otherwise, a second cardiovascular reader interpreted the film and his decision was binding. If the two pulmonary readers considered the film "negative," and the cardiovascular reader agreed with them, the decision was that no enlargement was present; otherwise, a second cardiovascular reader examined the film and his decision was binding. All decisions were made independently of each other and no reconciliation of differences was undertaken.

The rationale for this procedure is too complicated to be discussed at this point. It is partly explained in Appendix III. The effect was to produce reading results which conformed well, both in the level of abnormalities found and in attributions to specific individuals, with the standards of the Framingham Heart Study.

Classification and Criteria

After extensive consultation, the Health Examination Survey arrived at the following diagnostic categories and criteria for hypertension and hypertensive heart disease. Ultimately, these categories and criteria were derived from definitions of the New York Heart Association[6] but were modified to fit the circumstances of population surveys in general[7-9] and of the Health Examination Survey in particular.

Hypertension

Hypertension.—160 mm. Hg. or over systolic, or 95 mm. Hg. or over diastolic

Borderline hypertension.—Below 160 mm. Hg. systolic and below 95 mm. Hg. diastolic, but not simultaneously below both 140 and 90 mm. Hg.

Normotension.—Below both 140 mm. Hg. systolic and 90 mm. Hg. diastolic.

(When aortic insufficiency was present or the heart rate was under 60, hypertension or borderline hypertension was defined by the diastolic pressure.)

Hypertensive Heart Disease

Definite.—One of the following:

1. Hypertension plus left bundle branch block or left ventricular hypertrophy by ECG. (By voltage criteria when 35 years of age or over. If under 35 years left ventricular or subendocardial ischemia must be present in addition to LVH by voltage criteria. No person under 35 had hypertension or borderline hypertension with this combination of ECG findings.)

2. Hypertension plus LVH or general cardiac enlargement (GCE) by X-ray.

3. A history of hypertension, currently on medication for hypertension, and LVH or GCE by X-ray and/or LVH by ECG.

Suspect.—One of the following:

1. Borderline hypertension plus LVH by ECG.

2. Borderline hypertension plus LVH or GCE by X-ray.

It will be noted that no allowance for treatment was made in the diagnosis of hypertension, but the criteria for HHD did admit cases without currently hypertensive blood pressures provided that they gave a history of hypertension under treatment. The criteria were invariant for age, race, and sex except for LVH by ECG.

Diagnosis

After all the findings were available, the final step was to arrive at a diagnosis. Even under favorable circumstances this is a difficult process to standardize. In the Health Examination Survey, it was more difficult than usual. There were 62 different physicians and to rely on their consistent use of the same diagnostic standards and criteria was impossible. Moreover, they did not have the specialists' judgments on the electrocardiographic tracing or the chest X-ray. Thus, although the examining physician was requested to enter his diagnostic impressions, these were used only as indicators; the final diagnosis was made by the permanent staff of the Survey, with consultant help in difficult cases.

The first step in this procedure was to supply a set of rules suitable for diagnosis by computer, which would convert the coded information from the medical record and from the interpretation of the X-ray film and the electrocardiogram into a diagnostic decision. An example of the computer output is given in Appendix IV. Some of these decisions were then subject to review. Included in this review were:

1. Cases where the diagnosis depended on a history of hypertension.
2. Cases where a significant murmur was noted.
3. Cases diagnosed as having heart disease by the examining physician but not by the computer.

This omitted from review those cases with a clear and definite diagnosis of heart disease on the available evidence and those cases where there was no possibility of diagnosing heart disease from the available evidence.

In most cases where the computer diagnosis was reviewed, the diagnostic decision made by the computer was unaltered. In a few instances, however, there was a diagnostic change on the basis of review. Where a review decision seemed to require a specialist's judgment the case was referred to Dr. Abraham Kagan of the Framingham Heart Program for a final decision.

Comparison With Clinical Examination

There is a distinct difference between the purpose of the standardized single-visit examination used by the Health Examination Survey

and a clinical examination, and this leads to differences in diagnostic findings. A study by Dr. Jeremiah Stamler[10] found that for hypertensive heart disease the two main causes of diagnostic disagreement between a standardized examination and a clinical examination lay in the differences in blood pressure found at separate examinations and in the reading and interpretation of the electrocardiogram. Interpretation of the X-ray was seen as a minor factor in accounting for observed disagreements on HHD. He did find, however, that the overall results on hypertension diagnoses were about the same for both types of examinations and that somewhat fewer HHD diagnoses were found by the standardized examination.

The Health Examination Survey, however, used somewhat different and less conservative criteria than those used in this methodological study. Available evidence for a sample of examinees indicates that their personal physician would be somewhat less likely to make a finding of hypertension than would the HES. The chief difference was in the category of borderline hypertension; this category was used less frequently by the personal physician than by the HES. Since the average blood pressure reported by the personal physician is similar to that found by the HES, the diagnostic difference must arise from differences in definition. It could arise, for example, if the personal physician required a persistent elevation of blood pressure, perhaps sustained on repeated examinations, to declare hypertension to be present.

With HHD, differences between the HES and the personal physician may well be due in part to a difference in the examination (since a chest X-ray and ECG are not a routine part of medical care whereas they were standard for the HES). In any case, the personal physician used the category of suspect HHD as commonly as the HES but used the category of definite HHD substantially less often.

HYPERTENSION

Hypertension was the most commonly encountered specific form of chronic disease found by the HES. Some 17.0 million (a rate of 15.3 per 100 persons aged 18-79 years) were estimated to have definite hypertension, another 16.2 million (a rate of 14.6 per 100 persons aged 18-79 years) were estimated to have borderline hypertension (table 1).

In the following sections the findings for definite hypertension are presented by age, race, and sex. The discussions on prevalence by other demographic variables will also be limited to definite hypertension only.

Age and Sex

With increasing age the prevalence of definite hypertension rises (table 1, fig. 1). At 18-24 years, less than 2 percent of all persons had definite hypertension while nearly 40 percent of all persons aged 75-79 years had this disease. Men are more likely to have definite hypertension than are women in age groups under 50 years, whereas at older ages the relationship is reversed. This corresponds to the crossover point in mean blood pressures. (Appendix V, Table II)

Race

The preponderance of hypertension in the Negro population of the United States is well documented. At every age covered by the HES, the prevalence of definite hypertension was roughly twice as great for the Negro population as for the white (table 2, fig. 1). Were the prevalence of hypertension as high in the population as a whole as among Negroes, 29 million American adults would have definite hypertension. The prevalence of definite and borderline hypertension in the white and Negro populations was as follows:

	White	Negro
	Number in thousands	
Definite	13,801	3,043
Borderline	14,559	1,470
	Percent	
Definite	14.1	26.7
Borderline	14.9	12.9

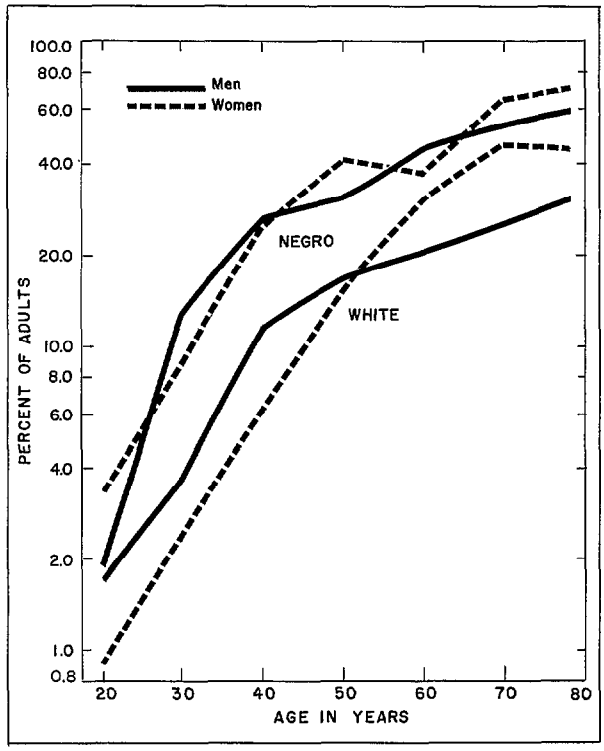

Figure 1. Percent of adults with definite hypertension, by age, race, and sex.

This racial difference in the prevalence of hypertension is associated with a difference in mean blood pressures but is larger than would be suggested on the basis of mean differences alone. In other words, not only are blood pressure distributions for Negroes displaced to the right relative to distributions for white persons, but they exhibit greater skewing to the right, toward higher values.

HYPERTENSIVE HEART DISEASE

Hypertensive heart disease was the most commonly encountered specific form of heart disease in American adults. Some 10.5 million (a rate of 9.5 per 100 persons aged 18-79 years) had definite HHD. Another 4.8 million (or 4.3 per 100) were estimated to have suspect HHD (table 3). In the remaining discussion attention is restricted to definite diagnoses of HHD.

Nearly 9 out of 10 adults diagnosed as having definite HHD had definitely hypertensive blood pressures on examination; the remaining cases did not, but they did give a history of hypertension and were under medication for it.

The more frequently encountered evidence of heart disease was a finding of enlargement on X-ray: 86 cases in a hundred of definite HHD were so characterized. Nearly 36 cases had ECG findings of LVH. Thus, about one case out of four with X-ray evidence also had ECG evidence while nearly two cases out of three with ECG evidence had concurrent X-ray evidence. This subject is treated more extensively in Appendix V.

Age

As with hypertension, the prevalence of HHD rose sharply with age (table 3, fig. 2). At ages 18-24 years 0.3 per 100 persons had definite HHD. At ages 75-79 years the rate was 31.8 per 100.

The rate of increase with age was steeper for definite HHD than for definite hypertension, indicating that the likelihood that a person with hypertension would also have heart disease increased with age. Restricting attention to those persons who had definitely hypertensive blood pressures on examination, about 2 out of 10 had HHD at ages 18-24 years, 4 out of 10 had HHD at ages 45-54 years, while 7 out of 10 had HHD at ages 75-79 years. The likelihood that the evidence of heart disease would include an ECG finding of LVH also rose with age, as did the likelihood that in any given case of HHD both X-ray and electrocardiographic evidence of disease would be found.

Sex

Women had a higher prevalence of definite HHD than did men at ages over 55 years. At younger ages, however, the prevalence was higher for men (table 3). The likelihood that persons with a definitely hypertensive blood pressure on examination would also have HHD was about the same in both sexes under age 55 but was greater for women than men over age 55. Men, however, were more likely than women to have an ECG finding of LVH associated with the diagnosis. The likelihood that a case would manifest both X-ray and ECG evidence of HHD was about the same for both sexes.

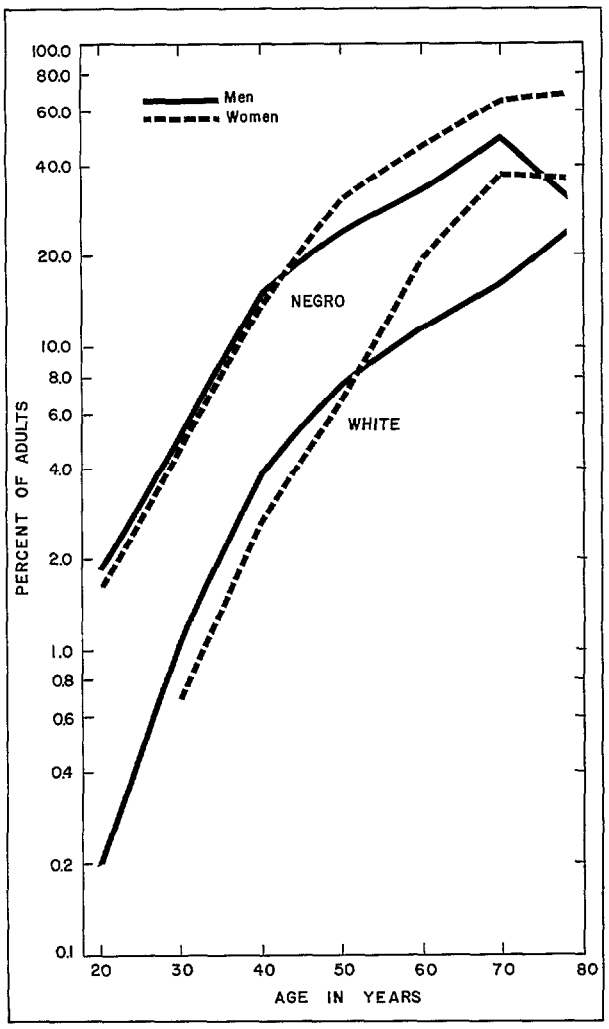

Figure 2. Percent of adults with hypertensive heart disease, by age, race, and sex.

Race

In every age group of either sex the prevalence of definite HHD was greater for Negro adults than white (table 4, fig. 2). The rate was about three times as great for Negro men as white men and more than twice as great for Negro women as for white women.

These race differentials were greater than those for definite hypertension. As this implies, the likelihood of finding HHD associated with definite hypertension was greater in Negro than in white persons. What is more, the likelihood in these cases that ECG findings of LVH would be encountered was substantially greater for Negro men than white men and greater for Negro women than white women. There was also a greater likelihood in the Negro population that a diagnosis of HHD would be supported by concurrent ECG and X-ray findings. The prevalence of HHD in the white and Negro populations was as follows:

	White	Negro
	Number in thousands	
Definite	8,057	2,372
Borderline	4,019	689
	Percent	
Definite	8.2	20.8
Borderline	4.1	6.0

OTHER DEMOGRAPHIC VARIABLES

In the discussions that follow, the population is classified in a variety of ways; by family income, education, etc.; and the prevalence of definite hypertension or definite HHD in different groups is compared. If the population is classified by income, for example, the prevalence of definite hypertension in different income groups is examined to determine whether prevalence varies from one group to another. These data are summarized in tables 5-8.

In evaluating these findings allowance must be made for the fact that there are differences from one group to another in the distribution of people by age, race, and sex, and that the prevalence of definite hypertension or definite HHD varies by age, race, and sex. Because the sampling variability of age-race-sex-specific values for each group is usually very large, a summary comparison was thought preferable to the presentation of prevalence rates specific by age. For this reason, the actual prevalence rate for each race-sex group is compared with an expected rate. The expected value is obtained by weighting age-specific rates for the total United States by the age distribution for the race-sex group. The obvious meaning can be attached to differences

between actual and expected rates, with the understanding that differences may arise by chance. A positive difference, for example, indicates that the prevalence rate for the group is higher than expected. In general, where there is no statistically significant difference between the actual and expected values for a group, differences for individual age-race-sex groups exhibit only random fluctuations.

Definite hypertension is considered in this part of the discussion but the observations generally carry over to definite hypertensive heart disease. Disagreements between differentials for these two disease categories are sufficiently uncommon to be attributable to random variation, although, of course, this may not always be true. In general, differentials are weaker for definite HHD than for definite hypertension.

Residence

Regional differences in hypertension rates (table 9) are both large and consistent for the white population. For all age groups the rates for white men and white women are higher than expected in the Northeast and lower than expected in the West. The Negro population, however, presents a different picture, as the rates for Negro adults are apparently lower than expected in the Northeast. This is the only significant regional pattern in the Negro rates. The effect is a greatly narrowed gap between white and Negro prevalence in the Northeast.

In terms of residence classifications, on the basis of population density (tables 10-12), there are only small differentials evident for the white population. These seem generally to be indistinguishable from random variation. However for white men but not for women there is a suggestive variation by population-size group, rates apparently increasing with population size.

There are a number of residence differentials evident for Negro men. In rural areas they have higher than expected rates. This is more marked in rural-nonfarm areas than farm areas but is evident in both. In urban areas and especially in standard metropolitan statistical areas, on the other hand, the rates for Negro men are lower than expected (fig. 3).

Income and Education

In the white population there is no clear pattern of prevalence associated with family income (table 13). There does appear to be a trend toward a lower prevalence of hypertension with greater education, however, which is especially evident for white women (table 14).

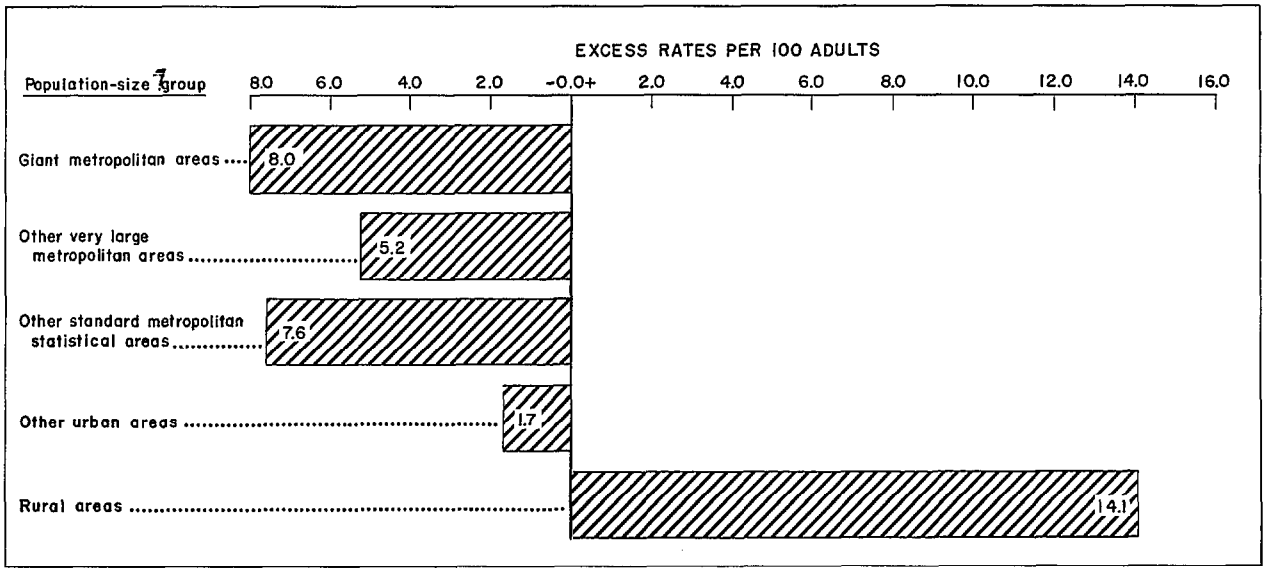

Figure 3. Excess of actual over expected prevalence of definite hypertension in Negro men, by population-size group.

In the Negro population family incomes above $7,000 and educational attainment beyond high school are relatively uncommon. Below these levels there appear to be clear differentials, with higher than expected prevalences both for men and women with family incomes of less than $2,000 or with less than 5 years of schooling. To some degree, these findings must be related to the regional differentials noted for Negroes, but the HES sample size is really too small to disentangle the various factors.

Marital Status

In the white population, divorced men and divorced women have apparently lower than expected rates of hypertension. Otherwise the actual prevalence rates by marital status are essentially the same as the expected rates (table 15). It cannot be said that no other marital status differences exist, but those that do exist are either small or occur in those categories which exhibit too great a variance for the difference to be deemed statistically significant.

Usual Activity Status

The actual prevalence rates by usual activity status are essentially the same as the expected rates (table 16). Only for working Negro males is there an apparent difference between the actual and expected rate, the actual rate being less than expected. Whatever other usual activity differences exist are either small or occur in categories exhibiting too great a variance to be deemed statistically significant.

Occupation and Industry

White farmers and farm managers, or, in terms of industry, white men employed in agriculture have a lower than expected prevalence of hypertension, while white laborers have a higher than expected prevalence (tables 17 and 18). Negro clerical and sales workers have a lower prevalence than expected, though this is statistically significant only for Negro women, and Negro farmers and farm managers also have lower than expected prevalence rates. Paradoxically, Negro men in agricultural industries, as a whole, have a higher than expected prevalence. Professional persons generally have a lower than expected prevalence regardless of race or sex.

There are a number of other differentials suggested by the data but they are of less reliability.

DISCUSSION

Despite the large number of published studies on hypertension, usable data on demographic variables other than age, race, and sex are surprisingly sparse. There is considerable information from mortality statistics, but it would be hazardous to compare HES findings (which refer largely to mild manifestations of hypertension and hypertensive heart disease) with mortality data. Age, race, and sex differentials in blood pressure have been discussed in previous reports.[3 4]

Two studies are of special interest because of the evidence they give that blood pressures in Negroes have been modified by changes in milieu. A. G. Shaper has reported that Samburu warriors serving in the army in Kenya had higher blood pressures than their tribal counterparts and that this elevation increased with length of service.[11] He attributes the change in blood pressure to a change in diet. In a study by Miall et al., urban Jamaicans were found to have lower blood pressures than rural Jamaicans.[12] These indications are in accord with the HES findings that the prevalence of hypertension among U.S. Negroes varies from one group to another.

In the Framingham Study, T. R. Dawber and his associates have noted that in the age group 50-59 years blood pressures were lower for persons with more education than in the remainder of this age group.[11] This is in accord with the HES findings. In a study of men 40-59 years employed by a Chicago Utility Company, J. Stamler found that the prevalence of hypertension varied with occupation, with the highest prevalence in semiskilled, unskilled, and service workers, and the lowest in professionals, executives, managers, and supervisors.[11] HES data are not inconsistent with these two findings. A study made of men working for the General Electric Company in Birmingham, England, found lower blood pressures among men engaged in sedentary work than in moderate to heavy work.[13] This was also noted

in the Chicago study. On the other hand, the Framingham Study found no relationship between the level of physical activity and blood pressure level.[11] The HES findings in that respect are ambivalent: white farmers had a lower than expected hypertension prevalence while the prevalence for white laborers was higher than expected.

In the reports of the blood pressure findings of the HES, data were presented which indicated that the blood pressures for the American population were comparable with those reported for a variety of other populations. This was true not only of the general level of prevalence but also for age and sex differentials. It was also noted that other studies have found Negroes to have higher blood pressures than white persons, and that the HES findings indicate that the racial differential in the prevalence of high blood pressures is greater than would be expected from racial differences in mean blood pressures.

The present report adds the information that Negro-white differentials appeared to vary in different milieus. For example, the prevalence of definite hypertension in the two races was much closer in the Northeast than in the South or West. It was closer in giant metropolitan areas than rural areas, and closer at incomes over $2,000 than at incomes less than $2,000. These are not, of course, entirely independent variables and the sample-size of the HES is too small to separate them statistically, but there are clear indicators in the data that hypertension in Negroes (and especially for Negro men) is related to environment.

Among persons living in giant metropolitan areas with family incomes of $2,000 or more, the following race differentials are evident in the prevalence of definite hypertension:

	White	*Negro*
Men	11.6	13.7
Women	8.3	21.8

(These rates for white persons are adjusted to the age distribution of the parallel Negro group.) In this population there is only a trivial difference in the prevalence of definite hypertension for white and Negro men but the race differential for women is, if anything, greater than that found in the population as a whole. In a contrasting population group, composed of the rural Southern population with incomes less than $2,000, comparable figures are:

	White	*Negro*
Men	15.4	31.5
Women	19.5	36.7

The nature of this relationship is another question, however. The Northeast and the big cities, for example, have been the terminals of heavy migration from rural areas and from the South. Are persons with hypertension less likely to migrate than persons without hypertension? If so, would the selective factor be weaker for white persons than for Negroes? A similar question might be asked with respect to occupation or industry groups: what are the selective factors involved and how do they differ by race? Because of the relatively benign character of hypertension found in a general population it might be assumed that selection would play a relatively minor role, but this is not known at present.

Similar considerations apply to the other demographic differentials noted. At this point these must be treated as indicative, both as to the facts and their interpretation.

SUMMARY

Hypertension was the most commonly encountered specific form of chronic disease found by the HES. Some 17.0 million persons were estimated to have definite hypertension.

Men were more likely to have definite hypertension than women in age groups under 50 years, whereas at older ages the relationship was reversed (table 19). This corresponds to the crossover point in mean blood pressures.

At every age covered by the HES the prevalence of definite hypertension was roughly twice as great in the Negro population as the white. This racial difference in the prevalence of hypertension was associated with a difference in mean blood pressures but was larger than would be suggested on the basis of mean differences alone.

Hypertensive heart disease was the most commonly encountered specific form of heart disease in American adults. Some 10.5 million persons had definite HHD.

As with hypertension the prevalence of HHD rose sharply with age. The rate of rise with age was steeper for definite HHD than for definite hypertension, thus indicating that as age increased the likelihood that a person with hypertension would have heart disease also increased.

The sex crossover point was slightly higher at age 55 (table 20) and the race differentials greater for definite HHD than for definite hypertension. The likelihood of finding HHD associated with definite hypertension was greater for women than for men and for Negro than for white persons.

Various other demographic variations were noted. In general, these differentials were similar but somewhat weaker for definite HHD than for definite hypertension.

Rates for hypertension and HHD were higher than expected in the Northeast and lower than expected in the West for white adults. For Negro adults they were lower than expected in the Northeast. Residential differentials were especially evident for Negro men. In rural areas they had higher than expected rates, and in urban areas, especially in standard metropolitan statistical areas, the rates for Negro men were lower than expected.

There was no clear pattern of prevalence associated with family income, but there was an apparent trend to a lower prevalence with greater education, particularly for white women. Also Negro men and women with family incomes of less than $2,000 or with less than 5 years of schooling exhibited higher than expected prevalence.

Divorced white men and women had apparently lower than expected prevalence.

Negro males who were working also had apparently lower than expected rates.

White farmers and farm managers had lower than expected prevalence, while white laborers had higher than expected prevalence. Negro clerical and sales workers and farmers and farm managers had lower than expected prevalence. Professional persons generally had a lower than expected prevalence regardless of race or sex.

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DETAILED TABLES

Table 1. Prevalence of definite and borderline hypertension in men and women, by age: United States, 1960-62

Age	Hypertension					
	Definite			Borderline		
	Both sexes	Men	Women	Both sexes	Men	Women
	Number of adults in specified group in thousands					
Total, 18-79 years	17,008	7,462	9,547	16,182	9,076	7,106
18-24 years	219	121	98	894	779	116
25-34 years	840	489	352	1,592	1,228	364
35-44 years	2,578	1,535	1,044	2,720	1,615	1,106
45-54 years	3,754	1,833	1,921	3,393	1,777	1,616
55-64 years	4,207	1,674	2,532	4,054	2,064	1,990
65-74 years	4,297	1,347	2,949	2,739	1,233	1,507
75-79 years	1,114	463	651	789	381	408
	Percent of specified group					
Total, 18-79 years	15.3	14.1	16.4	14.6	17.2	12.2
18-24 years	1.4	1.7	1.2	5.7	10.9	1.4
25-34 years	3.9	4.8	3.1	7.4	11.9	3.2
35-44 years	10.9	13.5	8.5	11.5	14.2	9.0
45-54 years	18.2	18.3	18.2	16.5	17.7	15.3
55-64 years	26.9	22.3	31.2	25.9	27.5	24.5
65-74 years	38.5	27.1	47.6	24.5	24.8	24.3
75-79 years	38.8	32.4	45.1	27.5	26.7	28.3

Table 2. Prevalence rates of definite and borderline hypertension for white and Negro adults, by age and sex: United States, 1960-62

Hypertension and age	Men		Women	
	White	Negro	White	Negro
	Percent of specified group			
Definite				
Total, 18-79 years	12.8	26.7	15.3	26.6
18-24 years	1.7	1.9	0.9	3.4
25-34 years	3.6	12.5	2.3	8.6
35-44 years	11.8	26.5	6.2	25.7
45-54 years	16.5	30.9	15.5	41.3
55-64 years	20.2	44.6	30.6	37.9
65-74 years	25.0	52.7	46.6	64.1
75-79 years	30.3	59.8	44.1	69.5
Borderline				
Total, 18-79 years	17.7	14.9	12.3	11.2
18-24 years	11.6	7.3	1.6	-
25-34 years	11.7	15.4	3.4	1.6
35-44 years	14.9	10.4	8.3	12.3
45-54 years	17.3	23.1	15.4	14.6
55-64 years	28.4	21.7	24.4	27.1
65-74 years	26.6	2.6	24.8	20.8
75-79 years	27.1	21.4	27.3	30.5

Table 3. Prevalence of definite and suspect hypertensive heart disease in men and women, by age: United States, 1960-62

Age	Hypertensive heart disease					
	Definite			Suspect		
	Both sexes	Men	Women	Both sexes	Men	Women
	Number of adults in specified group in thousands					
Total, 18-79 years	10,499	4,050	6,449	4,759	2,716	2,043
18-24 years	44	28	15	106	106	-
25-34 years	280	147	134	247	175	72
35-44 years	1,103	587	516	617	481	136
45-54 years	1,969	971	998	906	502	405
55-64 years	2,805	1,025	1,780	1,319	589	730
65-74 years	3,384	941	2,443	1,160	635	525
75-79 years	913	351	562	405	230	175
	Percent of specified group					
Total, 18-79 years	9.5	7.7	11.1	4.3	5.1	3.5
18-24 years	0.3	0.4	0.2	0.7	1.5	-
25-34 years	1.3	1.4	1.2	1.1	1.7	0.6
35-44 years	4.7	5.2	4.2	2.6	4.2	1.1
45-54 years	9.6	9.7	9.5	4.4	5.0	3.8
55-64 years	17.9	13.6	21.9	8.4	7.8	9.0
65-74 years	30.3	18.9	39.5	10.4	12.8	8.5
75-79 years	31.8	24.6	39.0	14.1	16.1	12.1

Table 4. Prevalence rates of definite and suspect hypertensive heart disease for white and Negro adults, by age and sex: United States, 1960-62

Hypertensive heart disease and age	Men		Women	
	White	Negro	White	Negro
	Percent of specified group			
Definite				
Total, 18-79 years	6.5	19.1	9.8	22.2
18-24 years	0.2	1.9	-	1.6
25-34 years	1.1	5.2	0.7	4.7
35-44 years	4.0	15.2	2.7	14.0
45-54 years	7.7	24.4	6.8	31.5
55-64 years	11.7	33.1	19.5	46.4
65-74 years	16.3	50.2	37.5	66.4
75-79 years	24.0	32.3	37.1	69.5
Suspect				
Total, 18-79 years	5.0	7.6	3.3	4.7
18-24 years	1.5	1.5	-	-
25-34 years	1.2	7.3	0.7	-
35-44 years	4.0	6.2	0.8	3.6
45-54 years	4.3	10.5	3.4	5.9
55-64 years	7.3	13.8	8.5	15.0
65-74 years	13.8	-	8.4	10.3
75-79 years	15.7	21.4	10.7	14.2

Table 5. Prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by specified residence categories and sex: United States, 1960-62

Residence categories	Definite hypertension			Definite hypertensive heart disease		
	Both sexes	Men	Women	Both sexes	Men	Women
	Percent of specified group					
Region						
Northeast	17.1	15.8	18.2	10.0	8.0	11.8
South	16.0	15.7	16.3	10.8	8.7	12.5
West	12.9	11.4	14.4	7.8	6.7	9.0
Population-size group						
Giant metropolitan areas	15.8	14.4	17.1	9.6	6.9	12.0
Other very large metropolitan areas	15.5	13.9	16.8	8.7	6.8	10.2
Other standard metropolitan statistical areas	14.1	12.4	15.6	8.8	6.5	10.9
Other urban areas	13.4	13.3	13.5	8.4	7.6	9.2
Rural areas	17.7	16.8	18.6	11.6	10.7	12.5
Place description						
SMSA—in central city	15.6	14.0	16.9	10.4	7.9	12.4
SMSA—outside central city	15.0	13.2	16.6	8.0	5.9	10.1
Urban, not SMSA	13.4	14.0	12.9	8.2	7.9	8.4
Rural, farm	16.7	15.5	18.3	12.1	11.9	12.4
Rural, nonfarm	16.8	16.0	17.5	10.6	9.0	12.2
Place						
Urban	15.4	14.3	16.3	9.5	7.8	11.0
Rural	15.2	13.9	16.5	9.3	7.5	11.2

NOTE: See tables 9-12 for effect of age and racial differences among these various groups.

Table 6. Prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by family income, education, and sex: United States, 1960-62

Income and education	Definite hypertension			Definite hypertensive heart disease		
	Both sexes	Men	Women	Both sexes	Men	Women
	Percent of specified group					
Income						
Under $2,000	26.2	20.5	30.4	19.7	14.5	23.5
$2,000-$3,999	16.4	15.4	17.3	9.8	7.7	11.4
$4,000-$6,999	11.8	12.8	10.7	6.7	6.6	6.8
$7,000-$9,999	11.2	10.4	12.0	4.3	3.2	5.4
$10,000+	11.8	11.8	11.8	7.9	7.9	8.0
Unknown	18.7	17.9	19.4	11.9	9.4	13.8
Education						
Under 5 years	32.7	29.6	35.7	25.3	20.7	29.6
5-8 years	22.5	17.8	27.1	14.5	10.2	18.8
9-12 years	11.1	11.3	10.9	6.0	5.3	6.5
13+ years	9.6	9.5	9.6	5.4	4.7	6.1

NOTE: See tables 13 and 14 for effect of age and racial differences among these various groups.

Table 7. Prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by marital status and sex: United States, 1960-62

Marital status	Definite hypertension			Definite hypertensive heart disease		
	Both sexes	Men	Women	Both sexes	Men	Women
	Percent of specified group					
Married	14.2	14.2	14.1	8.2	7.5	8.9
Widowed	35.7	30.7	36.7	27.9	19.7	29.4
Divorced	14.6	16.3	13.5	10.7	13.2	9.1
Separated	22.4	27.5	18.4	11.3	7.7	14.3
Never married	8.7	8.6	8.9	5.1	5.4	4.8

NOTE: See table 15 for effect of age and racial differences among these various groups.

Table 8. Prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by usual activity status, occupation, industry, and sex: United States, 1960-62

Usual activity status, occupation, and industry	Definite hypertension			Definite hypertensive heart disease		
	Both sexes	Men	Women	Both sexes	Men	Women
	Percent of specified group					
Usual activity status						
Usually working	12.9	13.0	12.8	6.7	6.6	7.1
Keeping house	18.4	*	18.4	13.3	*	13.2
Retired	27.3	25.8	*	18.5	17.1	*
Other or unknown	10.8	12.3	8.2	6.2	7.1	4.5
Occupation						
Professional, technical, and managerial	9.8	10.1	9.3	5.5	6.0	4.3
Farmers and farm managers	12.3	12.8	*	7.9	8.1	*
Clerical and sales workers	11.6	14.7	9.6	4.3	4.4	4.2
Craftsmen, foremen, and kindred workers	10.7	10.5	*	4.8	5.0	*
Operative and kindred workers	12.4	12.6	11.9	5.5	5.8	5.0
Private household and service workers	18.6	19.2	18.3	13.9	13.8	13.9
Farm and other laborers (except mine)	19.4	19.9	*	11.2	11.0	*
Industry						
Agriculture, forestry, and fisheries	15.7	15.0	19.2	11.0	10.0	15.9
Mining and construction	16.8	17.0	*	8.9	9.3	*
Manufacturing	11.1	11.2	10.9	5.1	5.7	3.4
Transportation, communication, and other public utilities	11.4	11.3	*	5.1	5.6	*
Wholesale and retail trade	12.6	13.1	12.0	5.9	5.8	6.0
Finance, insurance, and real estate	14.0	11.9	16.8	5.1	2.9	7.9
Service and miscellaneous	12.9	13.7	12.4	8.4	7.8	8.8
Government	9.8	10.9	*	5.0	4.9	*

NOTE: See tables 16-18 for effect of age and racial differences among the various groups.

Table 9. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, geographic region, and sex: United States, 1960-62

Race and region	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Northeast	15.5	12.7	2.8	18.0	15.6	2.4
South	12.7	12.2	0.5	12.9	14.1	-1.3
West	10.1	13.2	-3.1	14.3	16.0	-1.7
Negro						
Northeast	21.1	26.0	-4.9	21.6	25.3	-3.7
South	27.4	27.2	0.2	30.3	28.1	2.2
West	30.8	26.4	4.5	22.5	23.8	-1.3
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Northeast	7.7	6.4	1.3	11.6	10.2	1.4
South	5.5	6.0	-0.5	9.1	8.8	0.3
West	5.9	6.9	-1.0	8.5	10.2	-1.7
Negro						
Northeast	13.8	18.4	-4.6	14.8	20.1	-5.3
South	21.1	19.6	1.5	26.6	24.0	2.6
West	19.6	18.6	1.0	19.2	19.6	-0.4

Table 10. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, population-size group, and sex: United States, 1960-62

Race and population-size group	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Giant metropolitan areas	14.4	13.3	1.1	16.6	16.2	0.4
Other very large metropolitan areas	13.4	12.7	0.8	16.2	15.0	1.2
Other standard metropolitan statistical areas	11.7	12.1	-0.4	14.3	14.7	-0.3
Other urban areas	11.4	12.2	-0.8	12.0	13.9	-1.9
Rural areas	12.8	13.5	-0.7	17.5	16.8	0.7
Negro						
Giant metropolitan areas	15.7	23.7	-8.0	23.0	23.9	-0.9
Other very large metropolitan areas	18.4	23.7	-5.2	23.1	26.7	-3.7
Other standard metropolitan statistical areas	21.5	29.1	-7.6	32.9	28.8	4.1
Other urban areas	26.7	28.4	-1.7	24.0	26.2	-2.2
Rural areas	41.6	27.5	14.1	30.9	28.4	2.5
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Giant metropolitan areas	7.0	6.9	0.1	11.4	10.5	0.9
Other very large metropolitan areas	5.9	6.4	-0.5	9.4	9.4	0.0
Other standard metropolitan statistical areas	5.9	6.0	-0.1	9.4	9.3	0.1
Other urban areas	5.4	6.1	-0.7	7.1	8.7	-1.6
Rural areas	8.2	7.1	1.1	11.2	11.0	0.2
Negro						
Giant metropolitan areas	7.3	16.1	-8.8	17.4	18.0	-0.6
Other very large metropolitan areas	15.9	17.0	-1.1	17.4	22.1	-4.7
Other standard metropolitan statistical areas	16.6	20.4	-3.8	31.2	25.5	5.7
Other urban areas	22.5	20.6	1.9	23.2	22.0	1.2
Rural areas	28.1	20.1	8.0	23.3	24.6	-1.3

Table 11. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, place description, and sex: United States, 1960-62

Race and place description	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
SMSA—in central city	13.2	13.3	-0.2	15.5	16.5	-1.0
SMSA—outside central city	13.2	12.2	1.0	16.2	14.3	1.9
Urban, not SMSA	12.0	11.8	0.2	11.8	14.3	-2.5
Rural, farm	13.4	15.4	-2.0	18.8	16.6	2.2
Rural, nonfarm	11.6	13.1	-1.5	15.7	15.9	-0.2
Negro						
SMSA—in central city	18.9	26.1	-7.3	24.7	26.1	-1.4
SMSA—outside central city	13.6	22.2	-8.6	32.6	25.8	6.7
Urban, not SMSA	34.6	30.1	4.6	23.0	25.6	-2.7
Rural, farm	31.4	25.2	6.2	22.7	23.8	-1.1
Rural, nonfarm	41.3	28.5	12.7	34.9	31.1	3.8
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
SMSA—in central city	7.1	7.1	0.0	10.9	10.8	0.1
SMSA—outside central city	5.7	5.9	-0.2	9.5	9.0	0.5
Urban, not SMSA	6.3	5.7	0.6	6.7	8.9	-2.2
Rural, farm	10.6	8.3	2.3	13.3	10.4	2.9
Rural, nonfarm	5.8	6.9	-1.1	10.4	10.5	-0.1
Negro						
SMSA—in central city	13.0	18.4	-5.4	21.2	21.5	-0.3
SMSA—outside central city	10.7	14.4	-3.7	27.2	18.7	8.5
Urban, not SMSA	25.2	22.2	3.0	22.6	22.5	0.1
Rural, farm	24.5	17.5	7.0	13.5	19.7	-6.2
Rural, nonfarm	28.8	21.4	7.4	27.0	27.2	-0.2

Table 12. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, residence, and sex: United States, 1960-62

Race and residence	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Urban	13.5	12.8	0.7	15.3	15.7	-0.4
Rural	11.4	12.8	-1.4	15.3	14.5	0.8
Negro						
Urban	21.1	26.4	-5.3	24.8	26.1	-1.2
Rural	37.4	27.2	10.2	31.1	28.0	3.1
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Urban	7.0	6.5	0.5	9.7	10.1	-0.4
Rural	5.6	6.5	-0.9	10.1	9.1	1.0
Negro						
Urban	15.3	18.6	-3.3	22.1	21.5	0.6
Rural	26.3	19.9	6.4	22.5	23.9	-1.4

Table 13. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, family income, and sex: United States, 1960-62

Race and family income	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Under $2,000	16.7	18.3	-1.6	30.3	25.5	4.9
$2,000-$3,999	13.9	13.5	0.4	16.3	17.0	-0.7
$4,000-$6,999	12.2	11.2	1.0	10.3	11.5	-1.2
$7,000-$9,999	10.6	11.1	-0.5	11.5	12.1	-0.7
$10,000+	11.6	13.2	-1.6	11.9	13.5	-1.6
Unknown	14.6	13.2	1.4	20.1	18.4	1.7
Negro						
Under $2,000	37.1	29.8	7.3	34.8	30.5	4.3
$2,000-$3,999	21.6	26.9	-5.4	24.7	22.9	1.9
$4,000-$6,999	20.3	23.7	-3.4	19.1	25.0	-6.0
$7,000-$9,999	5.4	19.2	-13.8	22.1	22.5	-0.4
$10,000+	26.6	20.0	6.5	-	5.6	-5.6
Unknown	35.3	28.3	7.0	16.6	28.0	-11.4
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Under $2,000	10.9	11.4	-0.5	22.5	18.7	3.8
$2,000-$3,999	6.7	7.5	-0.8	10.7	11.0	-0.3
$4,000-$6,999	6.0	5.3	0.7	6.0	6.7	-0.7
$7,000-$9,999	3.2	5.0	-1.8	5.1	7.2	-2.1
$10,000+	7.7	6.3	1.4	8.1	8.0	0.1
Unknown	7.4	6.9	0.5	13.0	12.0	1.0
Negro						
Under $2,000	30.1	21.9	8.2	29.7	27.0	2.7
$2,000-$3,999	12.4	19.0	-6.6	15.6	16.8	-1.2
$4,000-$6,999	13.8	16.0	-2.2	20.5	19.7	0.8
$7,000-$9,999	5.4	12.3	-6.9	10.8	17.2	-6.4
$10,000+	26.6	14.7	11.9	-	2.9	-2.9
Unknown	22.5	21.6	0.9	20.5	24.8	-4.3

Table 14. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, education, and sex: United States, 1960-62

Race* and education	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Under 5 years	26.9	19.6	7.3	36.5	28.2	8.3
5-8 years	16.1	16.9	-0.7	26.4	23.0	3.4
9-12 years	10.7	10.5	0.1	10.3	11.4	-1.1
13+ years	9.3	10.3	-0.9	9.5	12.7	-3.3
Negro						
Under 5 years	42.9	37.7	5.2	46.3	41.4	4.9
5-8 years	27.8	29.9	-2.1	33.3	34.3	-1.0
9-12 years	18.3	18.4	-0.1	17.1	17.1	0.0
13+ years	15.5	22.5	-7.0	14.9	20.2	-5.3
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Under 5 years	16.3	11.9	4.4	25.7	20.7	5.0
5-8 years	8.7	9.5	-0.8	17.5	15.8	1.7
9-12 years	4.9	4.8	0.1	6.1	6.8	-0.7
13+ years	4.7	4.8	-0.1	6.4	7.7	-1.3
Negro						
Under 5 years	36.2	29.0	7.2	49.8	38.7	11.1
5-8 years	20.3	21.5	-1.2	26.8	29.1	-2.3
9-12 years	10.2	12.1	-1.9	11.5	11.5	0.0
13+ years	8.7	15.9	-7.2	3.2	14.3	-11.1

Table 15. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, marital status, and sex: United States, 1960-62

Race and marital status	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Married	13.0	13.4	-0.4	13.0	13.1	-0.1
Widowed	25.4	24.2	1.2	35.8	35.9	-0.1
Divorced	10.6	15.0	-4.3	12.1	17.2	-5.1
Separated	22.6	13.1	9.5	19.0	12.4	6.7
Never married	9.1	6.9	2.2	8.9	7.5	1.4
Negro						
Married	28.1	29.2	-1.2	27.5	25.5	2.1
Widowed	63.6	44.5	19.2	46.4	47.5	-1.2
Divorced	40.2	31.2	9.0	18.3	27.5	-9.2
Separated	31.7	30.6	1.1	17.3	19.5	-2.3
Never married	7.1	10.5	-3.3	10.7	12.5	-1.7
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Married	6.4	6.7	-0.3	7.7	7.8	-0.1
Widowed	12.6	16.1	-3.5	26.9	26.9	0.0
Divorced	6.6	8.2	-1.6	9.5	10.5	-1.0
Separated	6.1	6.7	-0.6	12.6	6.8	5.8
Never married	5.9	3.1	2.8	4.8	4.4	0.4
Negro						
Married	20.6	21.0	-0.4	21.4	20.4	1.0
Widowed	63.6	31.2	32.4	50.1	47.1	3.0
Divorced	40.2	22.3	17.9	8.9	19.2	-10.3
Separated	9.6	22.1	-12.5	17.1	13.8	3.3
Never married	3.1	7.0	-3.9	5.6	9.5	-3.9

Table 16. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, usual activity status, and sex: United States, 1960-62

Race and usual activity status	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Usually working	12.0	11.7	0.4	11.4	13.1	-1.8
Keeping house	*	*	*	17.4	16.6	0.7
Retired	23.2	25.4	-2.2	*	*	*
Other or unknown	7.2	8.2	-1.0	8.3	6.7	1.6
Negro						
Usually working	21.6	25.4	-3.8	22.5	24.3	-1.9
Keeping house	*	*	*	30.2	28.7	1.6
Retired	59.8	51.9	7.9	*	*	*
Other or unknown	37.7	22.2	15.5	11.6	12.6	-1.0
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Usually working	5.8	5.4	0.4	5.9	7.4	-1.5
Keeping house	*	*	*	11.8	11.0	0.8
Retired	14.7	17.4	-2.7	*	*	*
Other or unknown	3.5	4.2	-0.7	4.7	4.3	0.4
Negro						
Usually working	14.9	17.4	-2.5	14.5	18.3	-3.8
Keeping house	*	*	*	28.0	25.2	2.8
Retired	49.2	42.6	6.6	*	*	*
Other or unknown	26.7	17.0	9.7	4.4	10.5	-6.1

Table 17. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, occupation, and sex: United States, 1960-62

Race and occupation	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Professional, technical, and managerial	10.1	12.1	-2.0	8.6	11.3	-2.7
Farmers and farm managers	10.9	16.8	-5.9	*	*	*
Clerical and sales workers	14.8	11.4	3.5	9.8	8.8	1.0
Craftsmen, foremen, and kindred workers	10.0	11.7	-1.7	*	*	*
Operatives and kindred workers	10.3	9.4	0.9	11.7	11.4	0.2
Private household and service workers	17.6	12.3	5.3	16.1	14.8	1.2
Farm and other laborers (except mine)	14.4	10.0	4.4	*	*	*
Negro						
Professional, technical, and managerial	14.2	30.1	-15.9	17.8	19.2	-1.4
Farmers and farm managers	27.0	31.2	-4.2	*	*	*
Clerical and sales workers	4.4	10.7	-6.3	5.8	17.4	-11.7
Craftsmen, foremen, and kindred workers	16.4	24.0	-7.7	*	*	*
Operatives and kindred workers	27.1	23.7	3.4	15.9	18.6	-2.7
Private household and service workers	27.4	25.7	1.7	23.9	22.5	1.4
Farm and other laborers (except mine)	30.1	27.2	2.9	*	*	*
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Professional, technical, and managerial	6.2	5.8	0.4	4.4	5.6	-1.2
Farmers and farm managers	6.3	8.8	-2.5	*	*	*
Clerical and sales workers	4.4	5.3	-0.9	4.3	4.3	-
Craftsmen, foremen, and kindred workers	4.8	5.7	-0.9	*	*	*
Operatives and kindred workers	3.7	4.1	-0.4	4.5	5.6	-1.1
Private household and service workers	11.1	6.3	4.8	11.0	7.8	3.2
Farm and other laborers (except mine)	6.9	5.0	1.9	*	*	*
Negro						
Professional, technical, and managerial	-	20.8	-20.8	3.1	10.3	-7.2
Farmers and farm managers	19.5	24.2	-4.7	*	*	*
Clerical and sales workers	4.4	5.9	-1.5	-	10.3	-10.3
Craftsmen, foremen, and kindred workers	8.7	15.6	-6.9	*	*	*
Operatives and kindred workers	20.8	15.7	5.1	10.4	8.8	1.6
Private household and service workers	27.4	19.2	8.2	20.5	18.1	2.4
Farm and other laborers (except mine)	18.7	19.7	-1.0	*	*	*

Table 18. Actual and expected prevalence rates of definite hypertension and definite hypertensive heart disease in adults, by race, industry, and sex: United States, 1960-62

Race and industry	Men			Women		
	Actual	Expected	Difference	Actual	Expected	Difference
DEFINITE HYPERTENSION						
White	Percent of specified group					
Agriculture, forestry, and fisheries	9.9	14.5	-4.6	15.7	10.8	4.8
Mining and construction	14.6	11.7	2.9	*	*	*
Manufacturing	9.7	10.9	-1.3	11.0	9.8	1.2
Transportation, communication, and other public utilities	10.6	11.0	-0.5	*	*	*
Wholesale and retail trade	13.4	11.4	2.1	10.5	10.9	-0.4
Finance, insurance, and real estate	12.3	12.0	0.3	15.8	9.8	6.0
Service and miscellaneous	11.9	11.9	0.0	10.5	12.6	-2.1
Government	12.0	10.8	1.2	*	*	*
Negro						
Agriculture, forestry, and fisheries	35.9	26.5	9.4	23.3	20.3	3.1
Mining and construction	31.6	28.6	3.1	*	*	*
Manufacturing	26.8	25.4	1.4	11.3	20.7	-9.4
Transportation, communication, and other public utilities	19.8	25.1	-5.3	*	*	*
Wholesale and retail trade	8.1	20.5	-12.4	32.0	19.5	12.5
Finance, insurance, and real estate	-	9.3	-9.3	100.0	33.1	66.9
Service and miscellaneous	31.0	25.8	5.1	19.8	21.7	-1.9
Government	-	24.2	-24.2	*	*	*
DEFINITE HYPERTENSIVE HEART DISEASE						
White						
Agriculture, forestry, and fisheries	5.9	7.5	-1.6	13.4	5.6	7.8
Mining and construction	8.8	5.7	3.1	*	*	*
Manufacturing	4.2	5.1	-0.9	3.4	4.7	-1.3
Transportation, communication, and other public utilities	5.9	5.2	0.7	*	*	*
Wholesale and retail trade	5.7	5.6	0.1	4.7	5.6	-0.9
Finance, insurance, and real estate	3.0	5.8	-2.8	6.7	4.8	1.9
Service and miscellaneous	6.0	5.9	0.1	7.2	6.4	0.8
Government	5.4	4.8	0.6	*	*	*
Negro						
Agriculture, forestry, and fisheries	27.6	19.8	7.8	18.9	17.3	1.6
Mining and construction	14.4	20.1	-5.7	*	*	*
Manufacturing	22.6	17.2	5.4	4.4	10.1	-5.7
Transportation, communication, and other public utilities	3.3	18.5	-15.2	*	*	*
Wholesale and retail trade	8.1	13.5	-5.4	23.2	13.3	9.9
Finance, insurance, and real estate	-	4.1	-4.1	100.0	27.7	72.3
Service and miscellaneous	25.0	18.8	6.2	15.1	16.6	-1.5
Government	-	15.8	-15.8	*	*	*

Table 19. Definite hypertension in adults, by sex and 5-year age groups: United States, 1960-62

Age	Men	Women
	Percent of specified group	
18-24 years	1.7	1.2
25-29 years	1.9	1.7
30-34 years	7.0	4.6
35-39 years	14.2	6.7
40-44 years	12.8	10.5
45-49 years	18.4	16.6
50-54 years	18.1	20.2
55-59 years	19.0	27.4
60-64 years	25.9	35.9
65-69 years	21.6	42.4
70-74 years	34.4	54.7
75-79 years	32.4	45.1

Table 20. Definite hypertensive heart disease in adults, by sex and 5-year age groups: United States, 1960-62

Age	Men	Women
	Percent of specified group	
18-24 years	0.4	0.2
25-29 years	-	0.5
30-34 years	2.5	1.9
35-39 years	4.6	2.5
40-44 years	5.7	6.1
45-49 years	8.1	8.9
50-54 years	11.5	10.2
55-59 years	8.7	16.5
60-64 years	19.2	28.6
65-69 years	16.6	36.7
70-74 years	22.1	43.2
75-79 years	24.6	39.0

APPENDIX I

MEDICAL HISTORY QUESTIONS RELATED TO CARDIOVASCULAR DISEASE

(Excerpts From HES-204, Medical History-Self Administered)

1. a. In the past few years have you had any headaches? YES NO ?
   If YES b. How often? Every few days Less often
   c. Do they bother you quite a bit just a little
   Probes A,B

2. a. In the past few years have you had any nosebleeds? YES NO ?
   If YES b. How often? Every few days Less often
   c. Do they bother you quite a bit just a little
   Probe A

3. a. At any time over the past few years, have you ever noticed ringing in your ears or have you been bothered by other funny noises in your ears? YES NO ?
   If YES b. How often? Every few days Less often
   c. Do they bother you quite a bit just a little
   Probes A,B

4. a. Have you ever had spells of dizziness? YES NO ?
   If YES b. How often? Every few days Less often
   c. Do they bother you quite a bit just a little
   Probe A

5. Have you ever fainted or blacked out? YES NO ?

6. a. Have you ever had a stroke? YES NO ?
   If YES b. Have you had a stroke in the past 12 months? YES NO ?
   c. Have you ever seen a doctor about it? YES NO ?

7. Has any part of your body ever been paralyzed? YES NO ?

9. Was there anytime in your life when you had a lot of bad sore throats? YES NO ?

16. a. Have you ever been bothered by shortness of breath when climbing stairs? YES NO ?
   If YES b. How often? Almost everytime Less often
   c. Does it bother you quite a bit just a little
   Probes A,D

17. a. Have you ever been bothered by shortness of breath when doing physical work or exercising? [YES] [NO] [?]

If YES b. How often? [Almost everytime] [Less often]

c. Does it bother you [quite a bit] [just a little]

18. a. Have you ever been bothered by shortness of breath when you were not doing physical work or exercising? [YES] [NO] [?]

Probe A

If YES b. How often? [Every few days] [Less often]

c. Does it bother you [quite a bit] [just a little]

19. a. Have you ever been bothered by shortness of breath when you are excited or upset about something? [YES] [NO] [?]

If YES b. How often? [Almost everytime] [Less often]

c. Does it bother you [quite a bit] [just a little]

20. a. Have you ever waked up at night because you were short of breath? [YES] [NO] [?]

Probe A

If YES b. How often? [Every few nights] [Less often]

c. Does it bother you [quite a bit] [just a little]

21. a. In the past few years, have you ever had any pain, discomfort, or tightness in your chest? [YES] [NO] [?]

Probes A,B

IF YES, please answer questions b through j below.

b. How often? [Every few days] [Less often]

c. Does it bother you [quite a bit] [just a little]

---

d. Where does it bother you? (Check every place it bothers you.)

[Front] [Back] [Right side] [Middle] [Left side]

[Somewhere else] State where _____

e. Does it usually [stay in one place] [move around] [?]

f. How long does the pain usually last?

[Just a few minutes] [Few minutes to an hour] [More than an hour]

---

g. Does it usually come [When you take a lot of exercise] or [when you are quiet] or [is there no difference]

h. Does it usually come [when you are upset] or [doesn't this make any difference]

---

j. Do you take any pills or medicine for it? [YES] [NO] [?]

22. a. In the past few years, have you ever had any pain, discomfort, or trouble in or around your heart? YES NO ?

IF YES, please answer questions b through j below.

b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

d. Where does it bother you? (Check every place it bothers you.)

Front Back Right side Middle Left side Probes A,B

Somewhere else State where _____

e. Does it usually stay in one place move around ?

f. How long does the pain usually last?

Just a few minutes Few minutes to an hour More than an hour

g. Does it usually come When you take a lot of exercise or when you are quiet or is there no difference

h. Does it usually come when you are upset or doesn't this make any difference

j. Do you take any pills or medicine for it? YES NO ?

23. a. Sometimes, our hearts "act funny" (odd) like missing a beat, or beating real fast, or seem to turn over. Have you ever noticed your heart do anything like that? YES NO ? Probes A,B

If YES b. How often? Every few days Less often

c. Does it bother you quite a bit just a little

24. a. Have you ever been bothered by your heart beating hard? YES NO ?

If YES b. How often? Every few days Less often Probes A,B

c. Does this bother you quite a bit just a little

25. a. Are your ankles ever swollen at bedtime? YES NO ? Probe A

If YES b. Is the swelling gone by morning? YES NO ?

26. a. When you walk, do you have pains or cramps in your legs? YES NO ?

If YES b. How often? Every few days Less often Probe A

c. Does it bother you quite a bit just a little

62. a. Has a doctor ever said you had rheumatic fever (inflammatory rheumatism) YES NO

If YES b. Have you had it in the past 12 months? YES NO ?

c. Are you taking any pills or medicine for it? YES NO

If YES d. What is it? _____

63. Has a doctor ever said you had chorea or St. Vitus' Dance? YES NO

Probe C

65. a. Has a doctor ever told you that you have hardening of the arteries? YES NO

If YES b. Have you had this condition in the past 12 months? YES NO ?

66. a. Have you ever had any reason to think you may have high blood pressure? YES NO ?

If YES or ? b. Did a doctor tell you it was high blood pressure? YES NO

Probe C

c. How long ago did you first start having it?

1 year | 1-5 years | over 5 years

d. Have you had it in the past 12 months? YES NO ?

e. Do you take any pills or medicine for it? YES NO ?

If YES f. Give name of the medicine_____

67. a. Have you ever had any reason to think you may have heart trouble? YES NO ?

If YES or ? b. Did a doctor tell you that you had heart trouble? YES NO

Probe C

If YES, what did he call it?_____

c. How long ago did you first start having it?

1 year | 1-5 years | over 5 years

d. Have you had it in the past 12 months? YES NO ?

e. Do you take any pills or medicine for it? YES NO ?

If YES f. Give name of the medicine_____

Probes: A. Do you have any idea what causes your_____?

B. Tell me how it feels.

C. In what way does it bother or affect you?

D. How many flights?

These questions were used, where indicated, if the examinee answered either "yes" or "?"

——— ooo ———

APPENDIX II

ELECTROCARDIOGRAPHIC READINGS

Criteria and Classification

The following are the criteria and classifications used in electrocardiographic (ECG) reading by the Health Examination Survey relevant to the diagnosis of hypertensive heart disease. They were developed by the cardiologists who read the ECG's. The draft version of these criteria was submitted to cardiologists experienced in reading electrocardiograms for survey purposes, and their criticisms and suggestions were taken into account in this working version. A complete listing of all ECG criteria was included in the introductory report on heart disease.[5]

The general ECG reading procedure is described in the main body of this report.

Two exceptions to this procedure were accepted. (1) When a case was reviewed the full documentation was considered. If the ECG was found to have an abnormality which had been overlooked in the routine reading, this abnormality was taken into account in the diagnosis; similarly ECG readings that failed to meet the criteria were discounted on review. This led to very few changes. (2) The voltage criteria used in the finding of LVH (S in V_1 or V_2 plus R in V_5 or V_6, whichever was greater) made it possible to obtain this finding by having clerks measure the ECG's. S in V_1 and R in V_5 were measured on all ECG's. It was found on the basis of a sample of electrocardiograms that the S wave was almost always greater in lead V_1 than lead V_2 and the R wave was almost always greater in lead V_5 than lead V_6, so measurements were confined to leads V_1 and V_5. If their sum was 35 mm. or more and the person was 35 years or older, this was considered evidence of LVH for purposes of diagnosing hypertensive heart disease. A review of a sample of these cases indicated that the measurement was sometimes in error but it was assumed that other ECG's were undermeasured and hence that there was a counterbalancing error. The measurement added a fairly large number of cases. Of persons 35 years of age or older having definite or borderline hypertension, 111 had LVH by measurement but not by the readings of the cardiologists. All of these cases were automatically diagnosed as having hypertensive heart disease. Actually in 70 cases the ECG finding simply constituted supplementary evidence of hypertensive heart disease since there was also evidence of heart enlargement on the X-ray, and in only 7 of these cases was the diagnosis changed from suspect to definite hypertensive heart disease as a consequence of the ECG measurement. In the re-

Category	*Leads*	*Impressions*
1. Ventricular preponderance (hypertrophy)		
S (+) R=35 mm. or more NOTE: Record associated ST- or T-wave abnormalities separately	"S" in V_1 or V_2, and "R" in V_5 or V_6	Left ventricular hypertrophy
2. T wave		
T= -1 to -5 mm. when R = (+) 5 mm. or more when QRS mainly upright	I, II, AVL, V_2-V_6 (any) AVL AVF	Left ventricular ischemia
3. Ventricular conduction		
QRS duration 0.12 second or more and R peak duration 0.06 second or more (in absence of infarct criteria, category 1, above)	I, II, III (any) I, AVL, V_5, V_6 (any)	Left bundle branch block

NOTE: In each category the ECG readers were allowed to designate abnormalities outside of criteria. For some categories such findings were fairly common.

maining 41 cases, however, a new diagnosis of hypertensive heart disease resulted—in 23 cases definite, and in 18 suspect. The net effect of the ECG measurement was to raise the prevalence of hypertensive heart disease by approximately 9 percent.

The distributions of LVH findings by the readers for persons 35 years and over against the combined sum of the S in V_1 and the R in V_5 were as follows:

Voltage S (V_1) + R (V_5)	Number of electrocardiograms		
	Total	LVH finding	No LVH finding
Under 35 mm-----	3,903	45	3,858
35 mm-----------	62	8	54
36 mm-----------	53	11	42
37 mm-----------	37	11	26
38 mm-----------	35	13	22
39 mm-----------	33	16	17
40 mm-----------	22	10	12
41 mm-----------	22	13	9
42 mm-----------	27	22	5
43 mm-----------	18	15	3
44 mm-----------	14	13	1
45+ mm----------	80	75	5

This table includes all sample persons, whatever their blood pressure.

If a person had normal blood pressure, no account was taken in this report of discrepancies between the electrocardiographic readings and the measurements for LVH. Had this been done, the number of persons considered to have had significant but nondiagnostic cardiac findings would have been increased by about 10 percent.

The level of agreement between readers in designating major electrocardiographic findings was generally very high. Some examples are given below. Needless to say, agreement is no assurance of validity, LVH being a case in point. For most findings, however, it seems reasonable to assume that relatively few cases were missed in the ECG reading.

Final determination	Number of readers agreeing with final determination on their original reading			
	Total	3	2	1
Left ventricular hypertrophy----------	397	342	29	26
Left ventricular ischemia, inside or outside criteria----------	83	67	5	11

There were instances where one or more of the readers reported a finding which was not agreed to in the final review. The number of such cases of "false positives" was as follows:

Left ventricular hypertrophy ----------	33
Left ventricular ischemia ----------	28

APPENDIX III

INTERPRETATION OF CHEST X-RAY

Form Used in Pulmonary Reading

PHS-3739
4-61

NATIONAL HEALTH SURVEY CHEST X-RAY INTERPRETATION

X-RAY NUMBER	READER	DATE	CHECK HERE IF FILM IS UNSATISFACTORY ☐

PULMONARY PATHOLOGY

NONE	EXISTENCE OF LESION *(Check one)*	IF LESION EXISTS, STATE MOST LIKELY ETIOLOGY
☐	☐ Definite ☐ Indefinite	

CARDIOVASCULAR PATHOLOGY

NONE	HEART ENLARGEMENT *(Check one)*	OTHER CVD *(Check one)*
☐	☐ Definite ☐ Borderline	☐ Definite ☐ Borderline

IF OTHER CVD, PLEASE SPECIFY

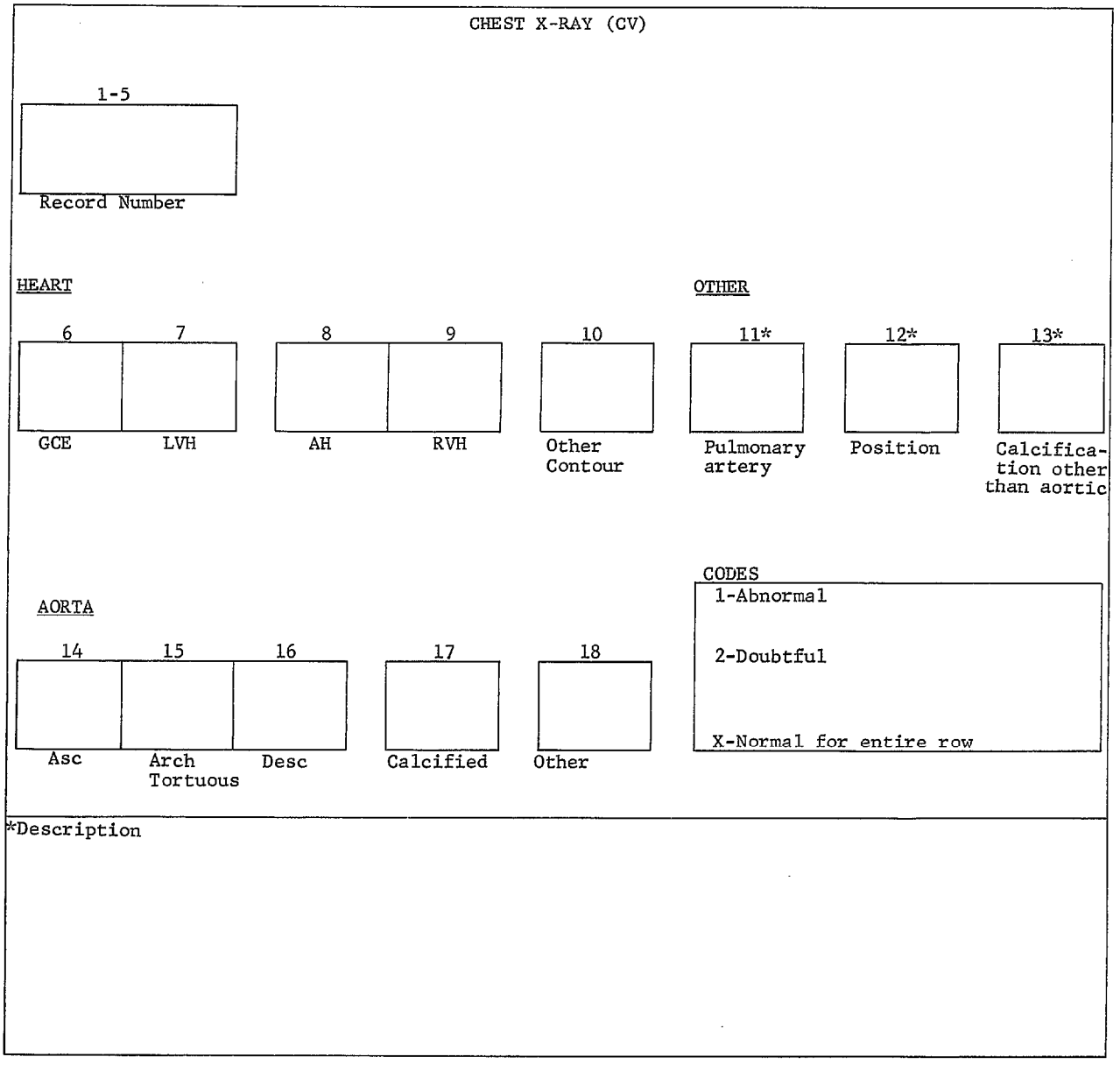
PLEASE SPECIFY BELOW ANY OTHER SIGNIFICANT PATHOLOGY

Instructions for interpreting cardiovascular pathology

Heart enlargement: Borderline enlargement is defined as 10 to 20 percent larger than normal. If enlargement was not generalized specify the hypertrophied chamber.

Other cardiovascular pathology is to be specified as follows: Calcification of the ascending aorta, calcification of the aortic knob, calcification of other portions of the aorta, abnormality of shape of aorta (specify), increased pulmonary vascularity.

Form Used in Cardiovascular Reading



Pulmonary Readers

Initially, the X-ray films were interpreted by three radiologists with a special interest in pulmonary disease. While their primary concern was with evidence of pulmonary pathology, abnormalities of the heart or vessels were also noted. So far as the diagnosis of heart disease was concerned, the two findings of special concern were those of generalized cardiac enlargement (GCE) and those of chamber enlargement, especially left ventricular hypertrophy (LVH). Borderline GCE was defined as present if the heart was 10 to 20 percent larger than normal; larger hearts were considered to have definite GCE. No criteria were given for LVH.

In the following discussion a reading is considered positive if a finding of GCE or LVH, definite or borderline, was made. In order to determine how frequently a film with evidence of GCE was missed by the pulmonary readers, a series of 190 films were measured by the method of Hilbish and Morgan,[14] and the heart size as measured was compared with the findings of the pulmonary readers.

Heart size (in percent of normal)	Number of films	Reader 1	Reader 2	Reader 3
		Number of positive readings		
Total------	190	56	42	22
Under 105------	134	17	10	1
105-109--------	20	10	9	3
110-114--------	9	6	3	1
115-119--------	6	5	5	2
120+----------	14	13	13	11
Could not measure-------	7	5	2	4

There were 29 films found to be 10 percent or more enlarged on measurement. Reader 1 read 24 of these as positive, reader 2 read 21 as positive, and reader 3 read 14 as positive. The findings of readers 1 and 2 were consistent with the criteria for GCE. Reader 3 seemed to be following a different rule, generally recording enlargement when it was 20 percent or greater but seldom if it was 10-19 percent. The positive findings reported for the smaller hearts are not inconsistent with the rules, since the films may have exhibited abnormalities of shape indicative of cardiac hypertrophy.

Next, it was determined in what way, if any, the cardiovascular readings of the pulmonary readers differed from readings by radiologists who specialize in cardiovascular reading. To answer this it was necessary to obtain a set of cardiovascular reading standards, or, in more concrete terms, to have a set of films read by a standard radiologist. Dr. Lloyd E. Hawes, radiologist for the Framingham Heart Program, was chosen. In other words, Framingham practice in X-ray reading was the standard chosen.

Dr. Hawes was given a set of 192 Survey films which had been selected to include a high proportion of positives. He found 96 of these "positive"; the number of positive readings by the three pulmonary readers were 56, 42, and 22, respectively. Thus, even the two highest counts were substantially below the level of readings by Dr. Hawes.

Cardiovascular Readers

It was evident that to make the cardiovascular findings of the Survey comparable with those of the Framingham Heart Program another group of readers would have to be used to read the X-ray films for cardiovascular abnormalities. It was felt that training radiologists to conform to standards was beyond the resources of the Survey; it was decided, instead, to choose radiologists who conformed naturally and without instruction to Dr. Hawes' standards.

A series of radiologists were asked to read the standard set of films. The four who conformed most closely to Dr. Hawes' readings compared with him as follows:

Reading by		Reader			
Hawes	Other reader	A	B	C	D
		Number of films			
Total----------		185	192	192	183
Agreement					
positive	positive	68	84	73	54
negative	negative	64	56	80	86
Disagreement					
positive	negative	24	12	23	37
negative	positive	29	40	16	6

In terms of reading levels the four readers read the following percentage of films as positive.

Dr. Hawes----------	50.0
Reader A----------	52.4
Reader B----------	64.6
Reader C----------	46.4
Reader D----------	32.8

(Although it later turned out that reader D could not participate in the cardiovascular readings, his readings on the standard films are included in some of the subsequent analysis.)

The procedure used in the cardiovascular readings allowed for a distinction between generalized heart enlargement and left ventricular hypertrophy and for a designation of findings as abnormal or doubtful. These distinctions were ignored in the final determinations because the readers clearly had no common standards for such details. This is shown in the following tables.

Percent of positive findings designated doubtful:

Dr. Hawes	32.3
Reader A	18.6
Reader B	1.6
Reader C	44.7
Reader D	15.0

Percent of positive findings designated as generalized enlargement:

Dr. Hawes	41.7
Reader A	14.4
Reader B	38.7
Reader C	55.9
Reader D	6.7

Since the cardiovascular reading was to proceed without training the readers or reconciling their differences, it was felt advisable to assimilate all positive findings to one class. In the case of one reader (reader C), possible findings were actually assimilated to negative, since the threshold between possible and definite in his case seemed to correspond to the threshold between negative and possible for the other cardiovascular readers.

Final Evaluation

The procedure adopted for using both the pulmonary and the cardiovascular readings to arrive at a final evaluation of heart abnormalities on the X-ray was essentially *ad hoc* but can be justified by both the standardization experience and the Survey findings. The readings made during the standardization process were used only as an aid in selecting readers. The films were re-read routinely for their final evaluation.

The evaluation technique adopted has been described in the text. The combination of possible findings by the pulmonary and cardiovascular readers is summarized:

Final evaluation code	Pulmonary reader		Cardiovascular reader	
	1	2	1	2
0	Negative	Negative	Negative	...
1	Positive	Positive	Positive	...
2	Positive	Positive	Negative	...
3	Positive or negative	Negative or positive	Positive	...
4	Positive or negative	Negative or positive	Negative	Positive
5	Negative	Negative	Positive	Positive
6	Positive or negative	Negative or positive	Negative	Negative
7	Negative	Negative	Positive	Negative

NOTE: Codes 1-5 are considered positive, all others negative.

There were 183 films which were interpreted by Dr. Hawes and readers A, B, and D. The distribution of films according to the findings of these four readers and the final evaluation code is shown:

Final evaluation code	Number of films according to the number of positive initial readings					
	Total	0	1	2	3	4
Total	183	46	31	30	31	45
0	63	34	15	7	5	2
1	32	-	-	2	5	25
2	1	-	-	-	-	1
3	23	1	-	3	10	9
4	5	-	1	1	-	3
5	31	2	7	9	9	4
6	1	-	1	-	-	-
7	27	9	7	8	2	1

(Of the four only A and B subsequently engaged in routine reading for the Survey.) There were 92 films with positive codes 1-5. The average number of positive readings by the four readers (A, B, C, and D) was 91. Dr. Hawes found 91 films positive. All three counts were practically the same.

The preceding table can be summarized in terms of the percentage of the initial readings positive for each code.

Final evaluation code	Percent positive
Total	49.7
0	20.6
1	93.0
2	*
3	78.3
4	*
5	54.8
6	*
7	30.6

One final piece of evidence may be considered. It is well recognized that heart enlargement—whether generalized or confined to the left ventricle—is highly correlated with blood pressure. The following table shows the percentage of films coded to each of the specified codes which came from persons having hypertension.

Final evaluation code	Number of films	Percent with hypertension	
		Definite	Borderline
0	4,461	9.1	11.4
1	272	54.0	18.8
2	17	*	*
3	343	33.8	22.2
4	61	16.4	24.6
5	506	35.8	20.0
6	73	11.0	19.2
7	661	19.4	22.1
Missing	278	6.1	5.4

Since both heart enlargement and hypertension become more common with age these percentages exaggerate the correlation between the two findings. Nonetheless, they do generally tend to support the evaluation procedure used.

A comment is in order with respect to the "missing" films. Some 278 examinees had no X-ray or, in a few instances, had a film taken which was too poor to be interpreted. The large majority of these persons were women of childbearing age. It was the Survey policy not to X-ray a woman where there was evidence suggesting pregnancy. Persons with missing films were distributed by age and sex as follows:

	Number
Men	34
Women	244
18-24 years	102
25-34 years	80
35-44 years	41
45-79 years	21

The missing films were treated as negative in this report. Judging from the small number of persons with missing X-rays who had hypertension (15 definite, 17 borderline) this decision seems reasonable. It is unlikely that treating the missing X-rays as negative resulted in an appreciable understatement of heart disease prevalence. Some of these persons were diagnosed as having heart disease even without the evidence of the X-ray, but even if this were not the case there would seem to be no alternative to the procedure chosen.

Finally, some note should be made of the unusual nature of the X-ray evaluation procedure. The use of a screening procedure which picks up all suspicious findings initially and then, at a second stage of evaluation, applies more stringent rules to the cases selected is not uncommon. The Survey procedure was the reverse. The initial (pulmonary) screening was the more conservative, the final (cardiovascular) reading the less conservative. Actually the contrast between the two readings is greater than appears from the standard films. Since these films included an unusually large proportion of very large hearts, there would be more agreement on them than on a purely random sample of the population. The contrast for the Survey films as a whole was much greater, the cardiovascular readers finding 27.9 percent positive on their initial reading, the pulmonary 8.2 percent.

Why, then, were the pulmonary readings used? There were three reasons. First, they were already largely available at the time the cardiovascular standards were finally chosen. Second, they were relevant; clearly heart enlargement found on the pulmonary readings was meaningful in terms of the cardiovascular standards. Third, it was possible by using them to devise a more economical and secure cardiovascular reading system than would otherwise have been possible. While it is not suggested that the procedure used was the optimum one, it seems to have worked quite satisfactorily.

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APPENDIX IV

DIAGNOSTIC REVIEW

The procedure used in case review has been described in the text. Briefly, every case was first diagnosed by the computer. The key information was then printed out, and this machine record served as a convenient summary of the case record, as well as a place for entering decisions made in a subsequent review, if there were such a review.

```
        DIAGNOSTIC REVIEW FOR HEART DISEASE

CASE NO. 15010

AGE-RACE-SEX  73 MW

DIAGNOSIS  HHD /2
           CHD /2

MD IMPRESSION
           H. D.  DEFINITE
           A. P.  DEFINITE

AVERAGE BLOOD PRESSURE  186/109/102

EKG        NORMAL

CHEST X-RAY
           ENLARGEMENT YES
           AORTIC ANEURYSM NO

HISTORY    H. D. NO        HYP. YES       R. F. NO

PHYSICAL EXAM
           THRILL NO
           SIGNIFICANT MURMUR DIASTOLIC /0  SYSTOLIC /0
           HEART SOUND NORMAL
           VENOUS ENGORGEMENT  NO

LAB.       STS  NORMAL
```

APPENDIX V

EVIDENCE OF HYPERTENSION AND HYPERTENSIVE HEART DISEASE

Hypertension

Hypertension is defined by an elevation of either diastolic or systolic blood pressure. Thus, definite hypertension is diagnosed if the diastolic blood pressure is 95 mm. Hg. or more or the systolic is 160 mm. Hg. or more. With increasing age, the likelihood that a person diagnosed as having definite hypertension will have a diastolic blood pressure of at least 95 mm. Hg. (diastolic hypertension) decreases. The likelihood of diastolic hypertension is greater for hypertensive men than for hypertensive women. Table I gives estimates of the prevalence of diastolic and systolic hypertension in the U.S. population.

One implication of the figures in table I is that there is an alteration with age of mean blood pressures among persons having definite hypertension (table II). With increasing age, the mean systolic blood pressure of such persons rises continuously, with the possible exception of hypertensive women aged 75-79 years. The mean diastolic pressure of hypertensives first rises, then, at older ages, falls. The peak varies with sex and race but in all groups the mean diastolic pressure of hypertensives is less at ages 75-79 years than at ages 18-24 years. If nothing else, these data emphasize the fact that even though the definition of definite hypertension is invariant by age, sex, and race, exact blood pressures of this group are by no means equally invariant.

Hypertensive Heart Disease

Tables III, IV, and V show the evidence on which diagnoses of HHD were based. In table III the relation of hypertension status to X-ray and ECG findings is shown by race and sex in broad age groups. Both X-ray findings of heart enlargement or LVH and ECG findings of LVH or left bundle branch block (LBBB) are more common with definite hypertension. These heart findings are more common in older people than in younger. In a given age group with a given hypertension status, they are more common for Negro than white persons. Women with a given hypertension status have these findings less often than men in the age group 18-44 years and more often than men in the age group 45-79 years. X-ray evidence is generally more common than ECG evidence but this differential is less with definite hypertension than normotension. Put in other terms, the prevalence of ECG findings exhibits a stronger gradient on the hypertension scale than does the prevalence of X-ray evidence.

Table IV gives the evidence for the subgroup of cases (included in the counts of table III) designated as having HHD because of a history of hypertension under treatment with associated X-ray or ECG findings. This table does not include counts of persons with a similar history of hypertension who do not have these X-ray or ECG findings.

Table V combines all evidence used in the diagnosis of HHD, including the supplementary ECG evidence obtained by measurement of the S wave in lead V_1 and the R wave in lead V_5. It will be noted that in persons 45-79 years old diagnosed as having suspect HHD, supplementary ECG evidence yields a larger number of cases than the evidence obtained from the readings by the cardiologists. It is difficult to say what this means, but it is very curious.

Table VI gives the percentage of persons with definite hypertension who have HHD, that is, have either X-ray evidence of heart enlargement or LVH or ECG evidence of LVH or LBBB.

The probability that a person who has definite hypertension will also have heart disease increases with age. At ages 18-24 years the likelihood is about 2 out of 10; at ages 45-54 it is about 4 out of 10; while at ages 75-79 it is about 7 out of 10. This is reasonable if it is assumed that heart disease is a function not only of the blood pressure level but of the length of time the heart and the remainder of the cardiovascular system is exposed to that level.

The likelihood that a person aged 45-74 years will have heart disease is greater if he has diastolic hypertension than if he has systolic hypertension (table VII). However, the race and sex differentials in the risk of heart disease appear to be the same for systolic and diastolic hypertension. It is necessary to restrict this statement to the age group 45-74 years because in the

HES sample there are too few persons with systolic hypertension at ages under 45 and too few with diastolic hypertension at ages over 74 years.

Table VIII presents a comparison of physicians' diagnoses and those made by the Health Examination Survey for a sample of the HES examinees. The personal physicians of the examinees were less likely to diagnose hypertension that was the HES. The disparity was less for definite hypertension than for borderline. If the total of all hypertensive cases reported by the physician is used as a criterion, the cases diagnosed as definite hypertension by the HES provide a conservative estimate of hypertension by current clinical standards. A large part of the difference in assignments of individual cases may be assumed to be due to fluctuations in blood pressure level.

HHD was also reported less often by the personal physician than by the HES. While some of this difference arises from differences in diagnostic standards, some undoubtedly arises from the fact that the HES took a chest X-ray and an ECG for every examinee whereas this is not routine in ordinary clinical practice. In this light it may be reasonably concluded that the level of definite HHD as reported by the HES is fairly conservative by current clinical standards.

The amount of diagnostic disagreement on individual cases was about the same for HHD as for hypertension. This is surprising, since it might be guessed that the variation in HHD diagnosis would be more closely approximated by the sum of variation in hypertension diagnosis and variation in the diagnosis of heart disease. The apparent anomaly would be accounted for, in part, if there were a greater inclination by clinicians to report hypertension for persons with moderately elevated blood pressures if heart disease was found than if it were not.

Stroke and Urine Albumin

In addition to its effect on the heart, hypertension can influence the renal and cerebral vasculature. While the HES data in these areas are limited it may be useful to describe them briefly.

The examination for cerebrovascular accidents was quite limited. The self-administered history included a question about stroke (question 6) and a question about paralysis (question 7). Where either of these questions was answered positively, the record was reviewed. Out of the 6,672 persons examined 62 were considered to have had a stroke (in all but one case, physician-diagnosed) on the basis of the history they gave. Of these 25 had findings on physical examination indicative of paralytic residuals. These cases of stroke were distributed by hypertension status as follows:

	Men	
	Actual	*Expected*
Definite hypertension--------	11	6.7
Borderline hypertension------	4	6.7
Normotension-----------------	14	15.6

	Women	
	Actual	*Expected*
Definite hypertension--------	16	10.6
Borderline hypertension------	7	6.6
Normotension-----------------	10	15.8

As anticipated, there were more cases of stroke than expected among persons with definite hypertension. So far as can be judged from such small numbers the excess was equally great whether or not paralytic residuals were found to be associated with the history. (The expected number was computed for each sex as follows: If S_i is the number of persons in the ith age group with stroke, h_i the number with hypertension and n_i the total number, the expected number of cases is $\Sigma_i S_i h_i / n_i$).

Urine Albumin

The urine specimen of male examinees (but not female) was tested for the presence of albumin, using the Bumin Test (sulfosalicylic acid test) (Ames Company, Inc., Elkhart, Indiana). A trace or more of albumin was reported for 73 of the 3,009 men for whom a urine albumin determination was available. Of these, 38 had a trace only. The distribution by hypertension status of cases with a trace or more of urine albumin was as follows:

	Actual	*Expected*
Definite hypertension--------	30	13.2
Borderline hypertension------	10	14.6
Normotension-----------------	33	45.2

There were more findings of a trace or more of albumin than expected among men with definite hypertension. So far as can be judged from such small numbers the excess was equally great whether the urine showed only a trace or was definitely positive for albumin.

	Men				Women	
	Stroke		Urine albumin		Stroke	
	Actual	Expected	Actual	Expected	Actual	Expected
Definite hypertensive heart disease--------	10	4.2	19	8.3	13	8.2
Possible hypertensive heart disease--------	1	2.6	3	5.5	5	2.1
No hypertensive heart disease--------------	18	22.1	51	59.2	15	22.7

Stroke and urine albumin were both relatively uncommon findings in the Survey. It is therefore not surprising that only two men had both of these findings. Hypertensive heart disease is much more common and is found relatively frequently in association with stroke or urine albumin.

Part of the excess number of cases of definite HHD found in persons with stroke or urine albumin arose from the fact that stroke or urine albumin is more common in persons with definite hypertension. There is also the possibility that persons with definite hypertension are more likely to have heart disease if stroke or urine albumin is present than if it is not.

Among men with definite hypertension the figures were:

	Number with hypertensive heart disease	
	Actual	*Expected*
Stoke------------------------	8	6.0
Trace or more of urine albumin-	19	15.7

Among women with definite hypertension the figures were:

	Number with hypertensive heart disease	
	Actual	*Expected*
Stroke------------------------	10	9.8

These data suggest that men, but not women, who have both definite hypertension and stroke have more hypertensive heart disease than expected; and that men with both definite hypertension and a trace or more of urine albumin also have more hypertensive heart disease than expected. The number of cases is small, however, and no very firm conclusions can be drawn from these data alone.

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Table I. Prevalence of diastolic and systolic hypertension, by age and sex: United States, 1960-62

Age	Diastolic hypertension (diastolic blood pressure at 95 mm. Hg. or more)			Systolic hypertension (systolic blood pressure at 160 mm. Hg. or more with diastolic pressure less than 95[1])		
	Both sexes	Men	Women	Both sexes	Men	Women
	Number in thousands					
Total, 18-79 years	11,192	5,559	5,633	5,816	1,903	3,914
18-24 years	219	121	98	-	-	-
25-34 years	809	468	341	31	21	11
35-44 years	2,370	1,441	929	208	94	115
45-54 years	3,003	1,582	1,421	751	251	500
55-64 years	2,512	1,026	1,486	1,695	648	1,046
65-74 years	1,895	723	1,172	2,402	624	1,777
75-79 years	386	198	188	728	265	463
	Rate per 100 persons					
Total, 18-79 years	10.0	10.5	9.6	5.2	3.6	6.7
18-24 years	1.4	1.6	1.1	-	-	-
25-34 years	3.8	4.5	3.0	0.1	0.2	0.1
35-44 years	10.0	12.6	7.5	0.9	0.8	0.9
45-54 years	14.6	15.7	13.4	3.6	2.5	4.7
55-64 years	16.1	13.6	18.3	10.8	8.6	12.9
65-74 years	17.0	14.5	18.9	21.5	12.5	28.7
75-79 years	13.4	13.8	13.0	25.4	18.6	32.1

[1]Excluding persons with mitral insufficiency or heart rates of less than 60.

Table II. Mean blood pressure of definite hypertensive persons, by age, sex, and race: United States, 1960-62

Age	Men			Women		
	All races	White	Negro	All races	White	Negro
	Mean pressure in mm. Hg.					
Systolic						
Total, 18-79 years	164.2	164.0	167.1	173.8	173.7	175.0
18-24 years	146.0	146.9	139.0	140.1	139.4	141.4
25-34 years	148.8	147.2	153.1	152.2	149.7	158.8
35-44 years	156.1	153.1	168.8	159.1	154.9	166.8
45-54 years	158.5	157.7	163.8	170.8	168.6	177.5
55-64 years	167.0	166.7	168.6	176.0	175.3	182.3
65-74 years	179.3	180.1	174.8	181.9	181.6	185.2
75-79 years	180.8	181.3	177.7	177.9	179.1	170.7
Diastolic						
Total, 18-79 years	98.0	97.4	100.3	95.6	94.1	102.5
18-24 years	98.3	98.3	99.0	99.3	97.9	102.0
25-34 years	101.3	102.0	97.6	102.0	100.8	104.5
35-44 years	100.6	100.0	102.6	100.1	97.5	104.6
45-54 years	101.0	100.5	103.0	98.6	96.7	104.4
55-64 years	96.3	95.7	99.0	98.2	96.8	110.1
65-74 years	94.3	93.6	98.1	91.0	90.5	95.7
75-79 years	90.8	90.5	93.1	86.1	86.9	81.3

Table III. Specified X-ray and ECG evidence of hypertensive heart disease, by hypertension status, sex, and race in broad age groups: Health Examination Survey, 1960-62

Hypertension status and evidence	Men			Women		
	All races	White	Negro	All races	White	Negro
Definite hypertension	Number of persons 18-44 years					
Total	142	102	33	103	61	40
Evidence	49	28	20	41	19	21
X-ray[1]	35	22	12	37	17	19
ECG[2]	19	8	11	6	2	4
Both X-ray and ECG evidence	5	2	3	2	-	2
No evidence	93	74	13	62	42	19
Borderline hypertension						
Total	220	192	24	109	89	17
Evidence	45	33	11	14	9	4
X-ray[1]	35	25	9	12	9	2
ECG[2]	11	9	2	3	-	3
Both X-ray and ECG evidence	1	1	-	1	-	1
No evidence	175	159	13	95	80	13
Normotension						
Total	1,427	1,240	149	1,852	1,581	228
Evidence	122	94	23	82	53	26
X-ray[1]	98	78	16	77	49	25
ECG[2]	29	17	11	5	4	1
Both X-ray and ECG evidence	5	1	4	-	-	-
No evidence	1,305	1,146	126	1,770	1,528	202
Definite hypertension	Number of persons 45-79 years					
Total	309	244	63	462	372	89
Evidence	154	107	46	268	202	66
X-ray[1]	128	90	37	259	197	62
ECG[2]	58	29	29	47	26	21
Both X-ray and ECG evidence	32	12	20	38	21	17
No evidence	155	137	17	194	170	23
Borderline hypertension						
Total	295	266	28	303	269	32
Evidence	96	86	10	113	94	18
X-ray[1]	88	81	7	109	92	16
ECG[2]	13	9	4	13	7	6
Both X-ray and ECG evidence	5	4	1	9	5	4
No evidence	199	180	18	190	175	14
Normotension						
Total	698	625	61	752	678	63
Evidence	180	152	25	170	143	26
X-ray[1]	160	137	20	161	137	23
ECG[2]	35	27	8	15	9	6
Both X-ray and ECG evidence	15	12	3	6	3	3
No evidence	518	473	36	582	535	37

[1]Finding of general cardiac enlargement or left ventricular hypertrophy.
[2]Finding of LVH or left bundle branch block. Does not include cases determined on the basis of supplementary ECG measurements.

Table IV. Specified X-ray and ECG evidence for cases of definite hypertensive heart disease without currently hypertensive blood pressures, by hypertension status, sex, and race in broad age groups: Health Examination Survey, 1960-62

Hypertension status and evidence	Men			Women		
	All races	White	Negro	All races	White	Negro
Borderline hypertension	Number of persons 18-44 years					
Total	1	1	-	1	-	-
X-ray evidence[1]	-	-	-	1	-	-
ECG evidence[2]	1	1	-	-	-	-
Both X-ray and ECG evidence	-	-	-	-	-	-
Normotension						
Total	-	-	-	2	2	-
X-ray evidence[1]	-	-	-	2	2	-
ECG evidence[2]	-	-	-	-	-	-
Both X-ray and ECG evidence	-	-	-	-	-	-
Borderline hypertension	Number of persons 45-79 years					
Total	8	8	-	24	18	6
X-ray evidence[1]	8	8	-	23	17	6
ECG evidence[2]	1	1	-	5	4	1
Both X-ray and ECG evidence	1	1	-	4	3	1
Normotension						
Total	12	12	-	22	16	6
X-ray evidence[1]	11	11	-	19	14	5
ECG evidence[2]	3	3	-	4	2	2
Both X-ray and ECG evidence	2	2	-	1	-	1

[1]Finding of general cardiac enlargement or left ventricular hypertrophy.
[2]Finding of LVH or left bundle branch block. Does not include cases determined on the basis of supplementary ECG measurements.

Table V. Evidence in the diagnosis of hypertensive heart disease, by hypertension status, sex, and race in broad age groups: Health Examination Survey, 1960-62

Hypertension status and evidence	Men			Women		
	All races	White	Negro	All races	White	Negro
Definite HHD with definite hypertension	Number of persons 18-44 years					
Total	54	32	21	43	20	22
X-ray	35	22	12	37	16	19
ECG evidence (original)[1]	19	8	11	6	2	4
ECG evidence (supplementary)[2]	7	4	3	4	2	2
Both X-ray and ECG evidence[3]	7	2	5	4	1	3
Definite HHD without definite hypertension						
Total	1	1	-	3	2	-
X-ray	-	-	-	3	2	-
ECG evidence (original)[1]	1	1	-	-	-	-
ECG evidence (supplementary)[2]	-	-	-	-	-	-
Both X-ray and ECG evidence[3]	-	-	-	-	-	-
Suspect HHD						
Total	47	34	12	15	10	5
X-ray	35	25	9	11	9	2
ECG (original)[1]	10	8	2	3	-	3
ECG (supplementary)[2]	3	2	1	2	1	1
Both X-ray and ECG evidence[3]	1	1	-	1	-	1
Definite HHD with definite hypertension	Number of persons 45-79 years					
Total	169	118	50	280	208	71
X-ray	128	90	37	259	197	62
ECG evidence (original)[1]	58	29	29	47	26	21
ECG evidence (supplementary)[2]	25	19	6	42	22	19
Both X-ray and ECG evidence[3]	42	20	22	68	37	31
Definite HHD without definite hypertension						
Total	20	20	-	46	34	12
X-ray	19	19	-	42	31	11
ECG evidence (original)[1]	4	4	-	9	6	3
ECG evidence (supplementary)[2]	2	2	-	2	2	-
Both X-ray and ECG evidence[3]	5	5	-	7	5	2
Suspect HHD						
Total	103	90	13	99	82	15
X-ray	80	73	7	86	75	10
ECG (original)[1]	12	8	4	8	3	5
ECG (supplementary)[2]	29	25	4	13	9	3
Both X-ray and ECG evidence[3]	18	16	2	8	5	3

[1] Original reading.
[2] Voltage measurement.
[3] Either original or supplementary ECG evidence and X-ray evidence.

Table VI. Percent of persons with definite hypertension who have hypertensive heart disease, by age, sex, and race: Health Examination Survey, 1960-62

Age	Men		Women	
	White	Negro	White	Negro
	Percent of hypertensive persons with HHD			
Total, 18-79 years	43.4	74.0	52.7	72.1
18-24 years	*	*	*	*
25-34 years	29.2	40.0	26.7	*
35-44 years	33.3	72.7	38.1	57.1
45-54 years	41.7	75.0	38.2	67.4
55-64 years	43.8	79.2	56.7	89.5
65-74 years	59.3	93.3	66.9	90.0
75-79 years	61.9	*	69.2	*

Table VII. Percent of persons aged 45-74 years with diastolic or systolic hypertension who have hypertensive heart disease, by age, sex, and race: Health Examination Survey, 1960-62

Age	Men		Women	
	White	Negro	White	Negro
	Percent of diastolic hypertensive[1] persons with HHD			
Total, 45-74 years	49.0	83.7	57.9	79.4
45-54 years	43.5	73.7	38.2	67.6
55-64 years	51.0	88.9	67.2	88.9
65-74 years	58.6	91.7	75.0	100.0
	Percent of systolic hypertensive[1] persons with HHD			
Total, 45-74 years	43.4	70.0	51.0	73.7
45-54 years	33.3	*	38.5	*
55-64 years	32.3	*	43.4	*
65-74 years	60.0	*	61.1	*

[1]Diastolic hypertensives are those with diastolic pressures of 95 or more. Systolic hypertensives are all others diagnosed as definite hypertensive.

Table VIII. Number of persons reported as having hypertension or hypertensive heart disease, by the Health Examination Survey and by their personal physician: Physician Inquiry, Health Examination Survey, 1960-62

Condition reported by personal physician	Total	Condition reported by Health Examination Survey		
		Definite hypertension	Borderline hypertension	Normotension
Hypertension				
Total	488	84	80	324
Definite hypertension	65	38	14	13
Borderline hypertension	33	12	9	12
Normotension	390	34	57	299
		Definite HHD	Suspect HHD	No HHD
Hypertensive heart disease				
Total	488	65	21	402
Definite HHD	33	17	3	13
Borderline HHD	22	12	2	8
No HHD	433	36	16	381

NOTE: Inquiries were sent for a subsample of the HES examinees; 488 usable replies were received.

APPENDIX VI

DEMOGRAPHIC TERMS

Age.—The age recorded for each person is the age at last birthday. Age is recorded in single years.

Race.—Race is recorded as "White," "Negro," or "Other." "Other" includes American Indian, Chinese, Japanese, and so forth. Mexican persons are included with "White" unless definitely known to be Indian or of another nonwhite race.

Population size.—The five classes comprising this characteristic were derived from the design of the sample, which accomplished a stratification of the primary sampling units by population size in each of three broad geographic locations. Because the Survey was started in 1960, the primary sampling units within each of the five population-size classes were necessarily based on populations and definitions of the 1950 census. The name of each selected primary sampling unit within each population-size class and geographic location, along with other selected sample data, are presented in an earlier report.[2]

The definitions for each of the five population-size classes are as follows:

Giant metropolitan areas.—This class includes primary sampling units defined in the census as standard metropolitan statistical area's (SMSA's) having a population of 3,000,000 persons or more.

Other very large metropolitan areas.—Included in this class are standard metropolitan statistical areas with a population of 500,000 to 3,000,000 as defined by the 1950 census.

Other standard metropolitan statistical areas.—This class includes other SMSA's.

Other urban.—This includes primary sampling units which were highly urban in composition but were not defined as SMSA's.

Rural.—This includes primary sampling units which were primarily rural in composition according to census definitions.

Region.—For the purpose of classifying the population by geographic area, the United States was divided into three major regions. This division was especially made for the design of the HES sample. The regions and the States included are as follows:

Region	*States Included*
Northeast-----	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Ohio, and Michigan
South --------	Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas
West---------	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

Urban and rural.—For the first six primary sampling units at which examinations were conducted, the definition of urban and rural was the same as that used in the 1950 census. These locations were Philadelphia, Pa., Valdosta, Ga., Akron, Ohio, Muskegon, Mich., Chicago, Ill., and Butler, Mo. For the remainder of the sampling units the 1960 census definitions were used.

The change from 1950 to 1960 definitions is of small consequence in the Survey, since only six locations were affected, and the major difference is the designation in 1960 of urban towns in New England and of urban townships in New Jersey and Pennsylvania.

According to the 1960 definition, the urban population comprises all persons living in (a) places of 2,500 inhabitants or more incorporated as cities, boroughs, villages, and towns (except towns in New England, New York, and Wisconsin); (b) the densely settled urban fringe, whether incorporated or unincorporated, of urbanized areas; (c) towns in New England and townships in New Jersey and Pennsylvania which contain no incorporated municipalities as subdivisions and have either 25,000 inhabitants or more or a population of 2,500-25,000 and a density of 1,500 persons or more per square mile; (d) counties in States other than the New England States, New Jersey, and Pennsylvania that have no incorporated municipalities within their boundaries and have a density of 1,500 persons or more per square mile; and (e) unincorporated places of 2,500

inhabitants or more not included in any urban fringe. The remaining population is classified as rural.

Place description.—In this Survey the urban population is classified as living " in the central city" or "outside the central city" of an SMSA. The remaining urban population is classified as "not in SMSA."

The definitions and titles of standard metropolitan statistical areas are established by the U.S. Bureau of the Budget with the advice of the Federal Committee on Standard Metropolitan Statistical Areas.

The definition of an individual standard metropolitan statistical area involves two considerations: first, a city or cities of specified population to constitute the central city and to identify the county in which it is located as the central county; and, second, economic and social relationships with contiguous counties which are metropolitan in character so that the periphery of the specific metropolitan area may be determined.

Persons "in the central city" of an SMSA are therefore defined as those whose residency is in the city appearing in the stand and metropolitan statistical area title. Persons residing in an SMSA but not in the city appearing in the SMSA title are considered to reside "outside the central city."

The remaining population is allocated into rural-farm and rural-nonfarm groups. The farm population includes all persons living in rural territory on places of 10 acres or more from which sales of farm products amounted to $50 or more during the previous 12 months or on places of less than 10 acres from which sales of farm products amounted to $250 or more during the preceding 12 months. Other persons living in rural territory were classified as nonfarm. Persons were also classified as nonfarm if their household paid rent for the house but their rent did not include any land used for farming.

Employment status.—This term applies to the employment status of persons during the 2-week period prior to the week of interview. It is not intended that this term define the labor force or provide estimates of the employed or unemployed population at the time of the survey.

Persons who reported that they either worked at or had a job or business at any time during the 2-week period prior to the week of interview were considered employed. This includes paid work as an employee of someone else, self-employment in business, farming, or professional practice, and unpaid work in a family business or farm. Persons on layoff from a job and those who were absent from their job or business because of temporary illness, vacation, strike, or bad weather are considered employed if they expected to work as soon as the particular event causing their absence no longer existed. Freelance workers are considered currently employed if they had a definite arrangement with one or more employers to work for pay according to a weekly or monthly schedule either full time or part time. Excluded are such persons who have no definite employment schedule but work only when their services are needed. Also excluded are (1) persons receiving revenue from an enterprise in whose operation they do not participate, (2) persons doing housework or charity work for which they receive no pay, and (3) seasonal workers during the portion of the year when they were not working. (It should be noted that these data were not collected for Philadelphia.)

Occupation.—A person's occupation may be defined as his principal job or business. For the purposes of this Survey the principal job or business of a respondent is defined in one of the following ways. If the person worked during the 2-week-reference period of the interveiw or had a job or business, the question concerning his occupation (or what kind of work he was doing) applies to his job during that period. If the respondent held more than one job, the question is directed to the one at which he spent the most time. It refers to the one he considers most important when equal time is spent at each job. A person who has not begun work at a new job, is looking for work, or is on layoff from work is questioned about his last full-time civilian job. A full-time job is defined as one at which the person spent 35 hours or more per week and which lasted 2 consecutive weeks or more. A person who has a job to which he has not yet reported and has never had a previous job or business is classified as a "new worker."

The occupational groups are shown below with the appropriate census code categories.[a] (This information was not collected for Philadelphia and Valdosta.)

Occupational title	*Census code*
Professional, technical, and managerial	R,000-195, 250-285
Farmers and farm managers	N, 222
Clerical and sales workers	S, Y, Z, 301-395
Craftsmen, foremen, and kindred workers	Q, 401-545
Operatives and kindred workers	T, W, 601-721
Private household and service workers	P, 801-803,810-890
Farm and other laborers (except mine)	U, V, X, 901, 905, 960-973
Unknown (including new workers)	995 and all other codes

Industry.—The industry in which a person was reportedly working was classified by the major activity of the establishment in which he worked.

[a]U.S. Bureau of the Census: *1960 Census of Population, Classified Index of Occupations and Industries.* Washington. U.S. Government Printing Office, 1960.

Industry Title	*Census Code*	*SIC Code*
Agriculture, forestry, and fisheries	A, 017,018	01,02,07, exc. 0713,08,09
Mining and construction	C, 126-156	10-14, 15-17
Manufacturing	B, M, 206-459	19-39, 0713
Transportation, communication, and other public utilities	L, 507-579	40-49
Wholesale and retail trade	D, F, G, 606-696	50, 52-59
Finance, insurance, and real estate	706-736	60-67
Service and miscellaneous	E, H, K, 806-898	70,72,73,75,76,78,82, 84,86,88,89
Government	J, 906-936	91-94
Unknown (including new workers)	999	99

The only exceptions to the above are those few establishments classified according to the major activity of the parent organization, and they are as follows: laboratories, warehouses, repair shops, and places for storage.

The industry groupings are shown above. (Data on industry were not collected for Valdosta and Philadelphia.) The census code (the Classified Index of Occupation and Industries) and the Standard Industrial Classification (SIC) code components are also listed.

The industry title government differs somewhat from the usual industrial classification of government, since it is limited to the postal service and Federal, State, and local public administrations. This category includes only uniquely governmental functions and excludes those activities which may also be carried out by private enterprise. For example, teachers in public educational facilities and nurses engaged in medical services of governmental agencies are included with the "service and miscellaneous" group.

Usual activity status.— All persons are classified according to their usual activity status during the 12-month period prior to the week of interview. The "usual" activity status, in case more than one is reported, is the one at which the person spent the most time during the 12-month period.

The categories of usual activity status used are usually working, usually keeping house, retired, and other. For several reasons these categories are not comparable with somewhat similarly named categories in official Federal labor force statistics. First, the responses concerning usual activity status are accepted without detailed questioning, since the objective of the question is not to estimate the numbers of persons in labor force categories but to identify crudely certain population groups which may have differing health problems. Second, the figures represent the usual activity status over the period of an entire year, whereas official labor force statistics relate to a much shorter period, usually 1 week. Finally in the definitions of specific categories which follow, certain marginal groups are classified differently to simplify procedures.

Usually working includes persons who are paid employees; self-employed in their own business, profession, or in farming; or unpaid employees in a family business or farm. Work around the house or volunteer or unpaid work, such as for a church, is not counted as working.

Usually keeping house includes women whose major activity is described as "keeping house" and who cannot be classified as "working."

Retired includes persons 45 years of age and older who consider themselves retired. In case of doubt a person 45 years of age or older is counted as retired if he or she has either voluntarily or involuntarily stopped working, is not looking for work, and is not described as "keeping house." A retired person may or may not be unable to work.

Other in this report includes men not classified as "working" or "retired" and women not classified as "working," "keeping house," or "retired." Persons who are going to school are included in this group.

Education.—Each person is classified by education in terms of the highest grade of school completed. Only grades completed in "regular" schools, where persons are given a formal education, are included. A regular school is one which advances a person toward an elementary or high school diploma or a college, university, or professional school degree. Thus, education in vocational, trade, or business schools outside the regular school system is not counted in determining the highest grade of school completed.

Income of family or unrelated individuals.—Each member of a family is classified according to the total income of the family of which he is a member. Within the household all persons related to each other by blood, marriage, or adoption constitute a family. Un-

related individuals are classified according to their own income.

The income recorded is the total of all income received by members of the family in the 12-month period preceding the week of interview. Income from all sources is included, e.g., wages, salaries, rents from properties, pensions, help from relatives, and so forth.

Marital status.—The categories of marital status are *married, widowed, divorced, separated,* and *never married.* Persons with common-law marriages are considered married. *Separated* refers to married persons who have a legal separation, those living apart with intentions of obtaining a divorce, and other persons permanently or temporarily estranged from their spouse because of marital discord.

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APPENDIX VII

STATISTICAL NOTES

The Survey Design

The Health Examination Survey is designed as a highly stratified multistage sampling of the civilian, noninstitutional population, aged 18-79 years, of the conterminous United States. The first stage of the plan is a sample of the 42 primary sampling units (PSU's) from 1,900 geographic units into which the United States has been divided. A PSU is a county, two or three contiguous counties, or a standard metropolitan statistical area. Later stages result in the random selection of clusters of about four persons from a small neighborhood within the PSU. The total sample included 7,710 persons in the 42 PSU's in 29 different States. The detailed structure of the design and the conduct of the Survey have been described in previous reports.[1 2]

Reliability in Probability Surveys

The methodological strength of the Survey derives especially from its use of scientific probability sampling techniques and of highly standardized and closely controlled measurement processes. This does not imply that statistics from the Survey are exact or without error. Data presented are imperfect for three important reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement process itself is inexact even when standardized and controlled. The faithfulness with which the study design was carried out has been analyzed in a previous report.[2]

Of the total of 7,710 sample persons, 86 percent or 6,672 were examined. Analysis indicates that the examined persons are a highly representative sample of the adult civilian, noninstitutional population of the United States. Imputation for the nonrespondents was accomplished by attributing to nonexamined persons the characteristics of comparable examined persons. The specific procedure used[2] consisted of inflating the sampling weight for each examined person to compensate for nonexamined sample persons at the same stand (place of examination) and of the same age-sex group.

While it is impossible to be certain that the prevalences of hypertension and of hypertensive heart disease were the same in the examined and the nonexamined groups, the available evidence indicates that they did not differ greatly. One source of information on this question was a special inquiry sent to the physicians of nonexamined persons and to the physicians of a matching set of examined persons. The prevalences reported for the examined and for the nonexamined groups were in close agreement.

Sampling and Measurement Error

In this report and its appendixes, several references have been made to efforts to evaluate both bias and variability of the measurement techniques. The probability design of the Survey makes possible the calculation of sampling errors. Traditionally the role of the sampling error has been the determination of how imprecise the survey results may be because they come from a sample rather than from the measurement of all elements in the universe.

The task of presenting sampling errors for a study of the type of the Health Examination Survey is complicated by at least three factors: (1) Measurement error and "pure" sampling error are confounded in the data; it is not easy to find a procedure which will either completely include both or treat one or the other separately. (2) The survey design and estimation procedure are complex and accordingly require computationally involved techniques for calculation of variances. (3) Thousands of statistics come from the survey, many for subclasses of the population for which there are small numbers of sample cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error, which may be large when the number of cases in a cell is small, or even occasionally when the number of cases is substantial.

In the present report, estimates of approximate sampling variability for selected statistics are presented in tables IX and X. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered to be the range within one standard error of the tabulated statistic with 68 percent confidence or the range within two standard errors of the tabulated statistic with 95 percent confidence.

Table IX. Standard error in prevalence rates for definite hypertension and definite hypertensive heart disease in adults, by sex, age, and race: United States, 1960-62

Sex and age	Definite HHD			Definite hypertension		
	All races	White	Negro	All races	White	Negro
	Percent of specified population group					
Both sexes, 18-79 years	0.38	0.33	1.66	0.61	0.56	2.13
Men						
Total, 18-79 years	0.46	0.39	2.29	0.71	0.77	2.94
18-24 years	0.39	0.22	1.65	0.68	0.66	1.82
25-34 years	0.51	0.49	3.20	0.86	0.91	3.13
35-44 years	0.98	1.11	3.20	1.48	1.53	6.10
45-54 years	1.35	1.23	3.91	2.01	1.98	4.94
55-64 years	1.77	1.99	3.31	2.45	2.42	7.14
65-74 years	1.89	1.96	3.01	3.52	3.24	11.07
75-79 years	4.67	5.52	3.87	6.81	6.67	19.74
Women						
Total, 18-79 years	0.44	0.49	2.22	0.82	0.77	2.93
18-24 years	0.18	-	1.57	0.67	0.75	1.97
25-34 years	0.42	0.31	1.79	0.59	0.58	2.57
35-44 years	0.79	0.82	3.51	1.10	0.87	3.08
45-54 years	1.32	1.09	1.26	2.00	1.86	4.95
55-64 years	1.97	2.14	2.32	3.12	3.36	7.96
65-74 years	3.95	3.75	3.33	3.81	4.19	12.82
75-79 years	4.68	3.71	6.95	5.87	8.37	22.92

Table X. Standard errors in prevalence rates for definite hypertension and definite hyperten-

Characteristic	Definite hypertension				Definite HHD			
	White		Negro		White		Negro	
	Men	Women	Men	Women	Men	Women	Men	Women
	Standard errors per 100 adults							
Region								
Northeast	1.55	1.28	5.18	4.33	0.94	1.16	4.35	4.69
South	2.00	2.04	3.36	3.71	1.29	1.29	2.99	3.26
West	1.01	1.43	7.23	5.50	1.11	1.04	5.18	5.07
Population-size group								
Giant metropolitan areas	2.28	1.66	4.72	4.60	1.11	1.62	2.31	3.68
Other very large metropolitan areas	2.12	1.98	8.84	7.29	1.55	1.63	9.40	6.03
Other standard metropolitan statistical areas	2.61	2.27	6.81	7.35	1.37	1.33	5.76	8.55
Other urban areas	2.55	2.67	6.55	5.87	1.44	1.22	5.73	5.43
Rural areas	2.02	2.15	5.09	6.19	1.42	1.58	3.98	4.66
Place description								
SMSA-in central city	2.08	1.55	3.77	3.03	0.99	1.53	3.19	3.00
SMSA-outside central city	1.32	1.62	6.53	10.29	1.07	1.17	7.80	7.45
Urban, not SMSA	1.90	2.63	8.12	7.26	1.40	1.50	6.90	7.16
Rural, farm	3.00	3.25	9.94	7.19	3.01	3.76	6.71	7.96
Rural, nonfarm	2.59	2.48	5.84	6.53	1.53	1.48	4.99	5.40
Usual activity status								
Usually working	0.85	1.14	2.65	2.75	0.71	1.11	2.58	2.51
Keeping house	*	1.23	*	3.70	*	0.83	*	3.43
Retired	3.28	*	18.90	*	2.08	*	15.54	*
Other	1.87	1.85	8.43	13.63	1.05	1.60	7.32	5.18
Industry								
Agriculture, forestry, and fisheries	2.21	6.64	8.41	8.88	1.99	6.58	7.55	7.18
Mining and construction	3.27	*	10.00	*	2.32	*	8.52	*
Manufacturing	1.81	2.45	6.56	13.24	0.98	1.03	5.75	5.24
Transportation, communication, and other public utilities	2.36	*	10.75	*	2.00	*	3.74	*
Wholesale and retail trade	2.12	2.35	6.22	10.13	1.50	1.42	5.90	7.33
Finance, insurance, and real estate	5.24	2.50	-	6.33	2.52	4.13	-	51.90
Service and miscellaneous	2.67	2.34	9.79	4.20	1.60	1.60	6.83	3.69
Government	2.68	*	-	*	1.84	*	-	*

sive heart disease in adults, by race, sex, and selected characteristics: United States, 1960-62

Characteristic	Definite hypertension				Definite HHD			
	White		Negro		White		Negro	
	Men	Women	Men	Women	Men	Women	Men	Women
	Standard errors per 100 adults							
Residence								
Urban	0.81	0.92	3.58	2.73	0.70	0.97	2.30	3.09
Rural	1.34	1.21	4.48	3.89	0.92	1.11	3.75	3.27
Occupation								
Professional, technical, and managerial	2.26	1.93	9.73	9.67	0.97	1.33	-	3.53
Farmers and farm managers	2.44	*	8.54	*	1.95	*	7.42	*
Clerical and sales workers	3.32	2.19	5.15	6.78	1.32	1.15	5.22	-
Craftsmen, foremen, and kindred workers	2.23	*	7.84	*	1.27	*	6.30	*
Operatives and kindred workers	2.31	2.61	6.64	9.14	0.98	1.72	5.29	11.87
Private household and service workers	3.05	2.78	8.66	4.47	3.15	3.12	7.50	4.09
Farm and other laborers (except mine)	3.22	*	6.02	*	2.12	*	3.97	*
Education								
Under 5 years	3.80	4.46	8.02	10.35	3.81	3.64	7.23	9.95
5-8 years	1.61	1.86	4.81	4.08	1.38	1.75	4.05	3.29
9-12 years	1.07	1.03	3.88	2.70	0.77	0.60	2.97	2.44
13+ years	2.09	2.11	8.90	7.12	1.10	1.10	9.90	2.33
Family income								
Under $2,000	2.37	3.03	4.54	4.26	1.73	3.19	4.25	3.63
$2,000-$3,999	2.20	2.00	4.03	4.95	1.51	1.52	3.93	4.95
$4,000-$6,999	1.22	1.03	4.96	4.67	0.85	1.11	4.36	5.22
$7,000-$9,999	2.38	2.57	6.37	8.41	0.85	1.36	6.20	12.39
$10,000+	2.59	2.67	17.82	-	1.71	1.81	20.31	-
Unknown	3.26	2.84	11.15	5.85	2.29	2.06	7.12	6.47
Marital status								
Married	0.92	0.92	3.44	3.37	0.64	0.77	2.91	3.02
Widowed	5.95	3.58	40.24	10.36	6.16	3.29	33.06	10.02
Divorced	5.92	5.13	12.71	8.80	4.09	5.85	12.70	6.44
Separated	6.79	5.71	10.02	8.27	3.78	6.15	7.02	5.93
Never married	2.02	1.98	4.22	6.34	1.56	1.43	2.14	3.84

Expected Values

In tables 9-18 the actual prevalence rates for the various demographic variables are compared with the expected. The computation of expected rates was done as follows:

Suppose that in an area (say, the Northeast) the Health Examination Survey estimates that there are N_i persons in the i^{th} age-sex-race group ($i = 1, 2, \ldots, 42$; sum of $N_i = N$).

Suppose the Health Examination Survey estimates that the hypertension or HHD prevalence rate for the United States in the i^{th} age-sex-race group is X_i.

Then the expected rate of hypertension or HHD for the area is

$$\frac{I}{N} \sum_i N_i X_i$$

Comparison of an actual value for, say, a region with the expected value for that region is undertaken on the assumption that a meaningful statement can be made which holds, in some average way, for all persons in the region. This may or may not be true. The specified region may have higher values for young persons and lower values for old persons than are found in other regions. In that case an average comparison will obliterate one or both of these differentials. A similar remark may be made with respect to values computed for all races together, since relationships found in one race may not be found in another. Some instances will be noted in the detailed tables where the white and Negro differentials are not the same. In arriving at the general conclusions expressed in the text, an effort was made to consider all the specific data, including data not presented in this report; but it must be recognized that balancing such evidence is a qualitative rather than quantitative exercise. The standard error of the difference between an actual and expected value may be approximated by the standard error of the actual value (table X).

Small Numbers

In some tables magnitudes are shown for cells for which sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included to convey an impression of the overall story of the table.

Tests of Significance

Tests of significance for the demographic variables were performed in two ways. The first was to divide the difference between the actual and expected values by the standard error of the actual value. For example, for white men who were employed as farmers and farm managers the actual definite hypertension prevalence was 5.9 percent lower than expected, and the standard error was 1.7 percent. Since the difference was more than three times its standard error, it may be deemed statistically significant.

The second method was to examine the age-specific differences (not published) between the prevalence for the specified group and the prevalence for all persons. Thus, for white women living in the Northeast, the definite hypertension prevalence was less than the overall prevalence for all seven age groups. The probability of such an occurrence is 0.008, and the difference is considered statistically significant. In this instance the difference between the actual and expected values (which is really a weighted average of the age-specific differences) is 1.55 its standard error which (using tables of the normal distribution) has a probability of 0.12 and is not statistically significant.

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