NATIONAL CENTER For HEALTH STATISTICS | Series 11 Number 34

VITAL and HEALTH STATISTICS
DATA FROM THE NATIONAL HEALTH SURVEY

Blood Pressure

As it Relates to Physique, Blood Glucose, and Serum Cholesterol

United States-1960-1962

A tabular presentation of the data and a multiple regression analysis of blood pressure on five somatic measurements and their derivatives, and on blood glucose and serum cholesterol by age, sex, and race.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Health Services and Mental Health Administration

Washington, D.C. October 1969

Public Health Service Publication No. 1000-Series 11-No. 34

For sale by the Superintendent of Documents, U. S Government Printing Office
Washington, D.C., 20402 - Price 40 cents

NATIONAL CENTER FOR HEALTH STATISTICS

DIVISION OF HEALTH EXAMINATION STATISTICS

COOPERATION OF THE BUREAU OF THE CENSUS

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

Public Health Service Publication No. 1000-Series 11-No. 34

Library of Congress Catalog Card Number 79-601416

CONTENTS

Introduction 1

Methods 2

Results 2

Comment 4

References 7

Detailed Tables 10

Appendix I. Statistical Notes 27
Survey Design 27
Reliability in Probability Surveys 27
Sampling and Measurement Error 27

Appendix II. Regression Analysis 29

IN THIS REPORT findings are presented on the relationship between systolic and diastolic blood pressure and age, body measurements, blood glucose, and serum cholesterol for white and Negro persons of both sexes participating in Cycle I of the Health Examination Survey. Cycle I consisted of a nationwide probability sample of persons 18-79 years of age selected from the U.S. civilian, noninstitutional population. Mean values of blood pressure at different levels of blood glucose and serum cholesterol are given as estimates for the U.S. population while correlations and multiple regression analyses are presented for the unweighted sample of individual observations.

The mean values of systolic and diastolic blood pressure at different levels of glucose and cholesterol are given by age, sex, and race. In general there is a positive correlation between blood pressure and the blood constituents, but this correlation is not seen consistently for all age, sex, and race specific groups.

Simple correlations between all the variables considered show significant associations between blood pressure and age, body measurements (including triceps and infrascapular skinfold), glucose, and cholesterol. Stepwise multiple regression led to equations which included age, ponderal index (height/weight$^{1/3}$), and glucose as significant correlates of blood pressure, but indicated that cholesterol was not correlated with blood pressure when the above three variables were taken into account (except with the systolic pressure of white males).

SYMBOLS

Data not available------------------------	---
Category not applicable------------------	...
Quantity zero----------------------------	-
Quantity more than 0 but less than 0.05----	0.0
Figure does not meet standards of reliability or precision-----------------	*
No sample cases------------------------	**

BLOOD PRESSURE

AS IT RELATES TO PHYSIQUE, BLOOD GLUCOSE, AND SERUM CHOLESTEROL

Charles du V. Florey and Roy M. Acheson, *Yale University School of Medicine* [1]

INTRODUCTION

Among the many variables thought to be associated with an increased incidence of "degenerative" conditions of the cardiovascular system are age, certain physical attributes (especially overweight), elevated serum cholesterol, and elevated blood glucose. The interrelationship between these variables and blood pressure is certainly extremely complex. The purpose of this report is to present an analysis which examines the extent to which, on a sex-specific and race-specific basis, blood pressure can be judged from prevalence data alone to be dependent on age, physique, serum cholesterol, and blood glucose.

The plan and conduct of the U.S. National Health Survey have been described elsewhere[1] and will not be repeated in detail here. During the Cycle I study, 6,672 persons were examined out of a nationwide probability sample of 7,710 persons aged 18-79 years selected from the 111 million persons in that age range. The measurements used in the present analysis were made during a standard examination of about 2 hours, conducted in mobile clinics specially designed for this purpose. Data on the sample population, the response, and the effect of nonresponse on the findings have already been published.[2] Several reports from the survey relating to blood pressure,[3-5] height and weight,[6,7] blood glucose,[8] and serum cholesterol,[9] have already appeared. These reports have described the distribution of the variables in the general population and in various subgroups, and in all, the survey findings are reported in terms of estimates for the total U.S. population. These estimates are obtained by applying appropriate weights to the sample survey data to take into account the probability of selection and the effect of differential nonresponse.

This report presents some new data on the interrelationships between blood pressure (systolic and diastolic) and both blood glucose and serum cholesterol. In tables 1-16, appropriately weighted estimates of mean blood pressure for selected values of these variables are given for the total U.S. population by sex, race, and age.

In this analysis, however, the authors' aim has been to consider the relationship between blood pressure and various measures of obesity and body build as well as relationships with serum cholesterol and blood glucose. For most of the report, the analysis is based upon the use of unweighted, rather than weighted, data. In other words, reference is made only to the 6,672 examined persons in the survey sample, rather than to the 111 million persons from whom the sample persons were selected.

The use of unweighted data for the analysis is largely a matter of expediency. For some kinds of analyses, application of relevant theory to weighted data from this kind of sample survey is so very complicated that the operational mechanics for applying appropriate tests exist only in experimental terms and require extensive and impracticable calculations. However, the sample design is roughly self-weighting and many results from the use of unweighted data approximate results from weighted data. The reader must, nevertheless, be warned not to regard the data as descriptive of the total population of the United States when probability of selection is not taken into account.

[1] This report was prepared under a contract with NCHS.

METHODS

The measurements considered here are systolic and diastolic blood pressure, standing height, weight (partially dressed), right triceps and infrascapular skinfolds, arm girth, blood glucose, serum cholesterol, age, sex, and race. The methods of measurement and, in some cases, their reliability have already been described in detail.[3,6,8-11]

Briefly, the blood pressure was measured on the left arm with the survey respondent sitting on the examining table wearing the cuff over the bulge in the upper arm. Systolic pressure was taken as the reading at which sounds were first heard and diastolic, as the reading at which they disappeared. If the sounds did not disappear, the point at which the sounds became muffled was taken as the diastolic pressure. Readings were made to the nearest 2 mm. Hg. Three readings of each pressure were taken and the average of the three has been used in the present analyses.

Weight was recorded automatically with the respondent standing on a balance without support, stripped to the waist, pockets emptied, without shoes, but wearing a knee-length examining gown and paper slippers.

Height was measured with an anthropometer attached to a horizontal platform. The respondent stood erect with his back against a vertical 3-inch-wide measuring scale, looking straight ahead with his head in the Frankfort horizontal plane. When the horizontal measuring bar was brought down snugly on the top of the respondent's head, its position on the scale was photographed.

Blood glucose was determined for each examinee who was not clearly diabetic. The respondent was given 50 grams of glucose in 250 cc. of water, regardless of the content or time of the previous meal. A specimen of blood was collected 1 hour later and mixed with sodium fluoride. The blood glucose was estimated by the Somogyi-Nelson method.[12]

Determinations of total serum cholesterol concentration were made by a modified ferric chloride procedure.[13,14] The values were then converted to comparable Abell-Kendall values by a method described elsewhere.[9]

The skinfold thickness of the right upper arm was measured by a trained technician who grasped a skinfold parallel to the long axis of the right arm over triceps area (back of the arm, not side) and 1 centimeter above the midpoint mark. He then applied the calipers at the level of the mark. The infrascapular skinfold was taken 1 centimeter below the tip of the right scapula. The girth of the right arm was measured at the midpoint of the upper arm without deforming the contours of the arm.

The age at the birthday prior to the examination was also recorded for each respondent.

Only measurements for white and Negro adults were used in this analysis because the numbers in the various other racial groups were too small for separate analysis and too heterogeneous to permit pooling with either of the above. Thus, of the 6,672 respondents, the following analysis was made on 2,669 white and 358 Negro men and 3,050 white and 468 Negro women.

RESULTS

As a first step, the mean systolic and diastolic blood pressure values were calculated at various blood glucose or serum cholesterol levels by age, sex, and race. In tables 1-16, which refer to the U.S. adult population, both measures of blood pressure appear to be positively related to the two blood constituents when considered only on a sex-specific and race-specific basis (total rows). However, a search for the same relationships within each age group reveals that they appear to be either not present or are much weaker than in the total rows. This statement is based upon evaluation of the means in terms of the estimates of the standard errors as shown in appendix I. Only small age-specific relationships can be found between pressure and glucose for each sex-race combination while age-specific correlations between pressure and cholesterol appear only for white men.

As the next step in a more detailed investigation of such possible interrelationships, simple correlation coefficients were calculated between all variables under study from the unweighted sample data. These correlations are shown by sex and race in tables 17-20. In each table the coefficients which are underlined were derived from the persons in the sample who had glucose and cholesterol measurements; those which are not, were derived from the whole sample. The number of observations for each sample is given at the bottom of each table.

Height and weight are correlated, as would be expected,[7] although somewhat less for white women than for either Negro women or for men of either race. As has been previously shown,[3] height is correlated negatively with age. Weight is highly correlated positively with measures of subcutaneous fat and with arm girth, more particularly with the latter which gives coefficients of correlation (r) ranging from .85 to .90. Fat and arm girth measurements are highly correlated.

Both systolic and diastolic blood pressure are associated with weight, and this association, like those with the other somatic measurements, is much stronger in women; there is also a weak negative association with height. There are significant associations between blood pressure and both glucose and cholesterol, although the relationship tends to be stronger for glucose. Finally, there is of course a strong relationship with age, especially for systolic pressure, and considerable interdependence between the two measures of blood pressure.

Following these indications, the possible interrelationships between blood pressure and the other variables were further investigated by regression analysis. A brief description of the technique is given in appendix II.

Multiple linear regressions were calculated by a stepwise procedure for systolic and diastolic pressure on age, height, weight, arm girth, right triceps skinfold, infrascapular skinfold, and ponderal index (height divided by the cube root of weight—presently the most widely used of the height-weight indexes) to determine which combination of these body size measurements was, along with age, the most highly correlated with blood pressure.

Ponderal index was the most highly correlated for all but Negro women, in whom arm girth was better for systolic pressure and weight was better for diastolic pressure. However, the partial correlation coefficients of these independent variables on blood pressure, when age was taken into account, were larger than those of ponderal index by only a few thousandths—for all practical purposes the index was as good a correlate as either weight or arm girth. The subsequent analyses, which include age and the blood components, are therefore based on the single body measurement of ponderal index for all sex-race groups. Some of the statistics from the regressions of blood pressure on age, age squared, ponderal index, glucose, and cholesterol are shown in tables 21-28. The name of the variable entered at each step is given. The maximum number of steps possible in these analyses is five (for the five independent variables under consideration), however, only those variables which were found to make a significant reduction in the unexplained variance of blood pressure are included ($p < .05$). The multiple correlation coefficient (R) and its square are also shown. The age-squared term has been included because the relationship in cross-sectional data between blood pressure and age is frequently curvilinear (see fig. 2 in Series 11, No. 4). The final columns in each table give the components of the regression equation and the standard errors of the estimates.

Similarities exist between the equations of both sexes in each race. For white persons, the age-squared term appears in all equations, indicating that the curvilinear relationship already mentioned is statistically significant. Glucose is also a significant correlate of blood pressure in both sexes, but cholesterol is significant only in white men. Their contributions to the increase in R^2 are very small. The best, simple correlates for white adults are age-squared for systolic and ponderal index for diastolic pressures. Age-squared is better than age for estimating systolic pressure, but the reverse holds true for diastolic pressure.

For Negro adults, the age-squared term appears only in the diastolic equations, with a negative sign; this is present because the pressures are lower in old age than in middle age. Glucose appears in all equations except in that for diastolic pressure for Negro men, but cholesterol appears in none of the equations for Negroes. The significant independent variables, thus, are somewhat different between races but not between sexes of the same race. In contrast, a sex-specific difference is found in the proportion of the variance accounted for by the independent variables: R^2 for each sex at the final

Table A. Highest R^2 value obtained by race and sex

Race and sex	Systolic	Diastolic
White		
Men	0.257	0.194
Women	0.457	0.266
Negro		
Men	0.273	0.193
Women	0.430	0.270

tabulated step is essentially the same for both races, but it differs considerably between sexes (table A).

Six new independent variables were created from the crossproducts of age, ponderal index, blood glucose, and serum cholesterol. The regressions were rerun using these and the five original independent variables to determine whether they would increase the values of R^2 significantly over those that had already been obtained. Little or no improvement was found, so only the physiologically meaningful variables are presented, rather than the crossproducts which are difficult to interpret.

The effects in the regression of two other body-bulk indexes were investigated because it was recently suggested by Khosla and Lowe[15] that at least one of these may be more efficient than ponderal index in correcting weight for height in studies of bulkiness. These alternative indexes are weight divided by height (W/H), and weight divided by the square of height (W/H^2). The regressions were recalculated, replacing ponderal index by each of the new indexes in turn; neither of them was consistently better than ponderal index in reducing the unaccounted variance so only the statistics for ponderal index are given in tables 21-28.

Table B shows the distribution of the residuals by observed systolic pressure of white men for the equation summarized in the regression coefficient column of table 21. Each residual is equal to an individual observed blood pressure minus its expected value, as calculated from the regression equation. Similar plots for both systolic and diastolic pressure of each race-sex group gave essentially the same configuration. For low values of pressure the equation overpredicts blood pressure and for high values it underpredicts it. This "lack of fit" is due to the inadequacy of the independent variables as predictors of blood pressure.[a]

On the other hand, the equations appear to be adequate predictors of the age-specific mean pressure as indicated in table C. The predicted values were calculated from the equations in tables 21 and 22 using the age-specific means as the values for the independent variables. For other race-sex groups the "fit" was not quite so good, mainly at the extremes of age.

COMMENT

Multiple regression techniques have been used by several investigators to define the relationship between blood pressure and other variables, principally age and weight. The first attempt to describe the distribution of blood pressure with respect to age, age squared, and age cubed was made by Hamilton and others[16] using data from a sample of the population attending the outpatient department of a London hospital. They found that the cubic term was of little predictive value. Other equations of this type were used by Miall and Oldham[17] to describe the relationship of various powers of age to blood pressure in a random sample of the population of the Rhondda Fach in South Wales. In neither report, however, were the properties of the equations or the multiple correlation coefficients given.

More recently Holland and others[18] have published summary tables of stepwise regressions for the blood pressure of men aged 40-59, but of unstated race, employed by the Bell Telephone

[a]If the independent variables are no better at prediction than the mean blood pressure itself, the residuals will vary with blood pressure on a 1:1 basis, with zero residual only at the mean pressure value. On the other hand, if the dependent variable is exactly predictable, all the residuals will be zero and will plot horizontally in table B.

Table B. Frequency distribution of residuals for systolic blood pressure

Residual	Systolic blood pressure in mm. Hg. 80.0-89.9	90.0-99.9	100.0-109.9	110.0-119.9	120.0-129.9	130.0-139.9	140.0-149.9	150.0-159.9	160.0-169.9	170.0-179.9	180.0-189.9	190.0-199.9	200.0-209.9	210.0-219.9	220.0-229.9	230.0-239.9	240.0-249.9	250.0-259.9
Under-57.50	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-57.50 to -52.51	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-52.50 to -47.51	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-47.50 to -42.51	-	1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-
-42.50 to -37.51	1	1	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-37.50 to -32.51	-	6	6	5	4	-	-	-	-	-	-	-	-	-	-	-	-	-
-32.50 to -27.51	-	4	11	15	5	1	-	-	-	-	-	-	-	-	-	-	-	-
-27.50 to -22.51	-	6	37	25	20	3	-	-	-	-	-	-	-	-	-	-	-	-
-22.50 to -17.51	-	10	54	70	28	7	2	-	-	-	-	-	-	-	-	-	-	-
-17.50 to -12.51	-	2	55	98	58	24	4	-	-	-	-	-	-	-	-	-	-	-
-12.50 to -7.51	-	1	35	129	89	34	15	2	-	-	-	-	-	-	-	-	-	-
-7.50 to -2.51	-	-	3	116	152	62	17	2	1	-	-	-	-	-	-	-	-	-
-2.50 to +2.49	-	-	1	50	168	90	41	10	6	-	-	-	-	-	-	-	-	-
2.50 to 7.49	-	-	-	2	85	105	44	19	4	-	-	-	-	-	-	-	-	-
7.50 to 12.49	-	-	-	-	29	97	53	28	3	2	-	-	-	-	-	-	-	-
12.50 to 17.49	-	-	-	-	4	54	73	25	13	7	-	-	-	-	-	-	-	-
17.50 to 22.49	-	-	-	-	-	10	38	37	11	5	3	-	-	-	-	-	-	-
22.50 to 27.49	-	-	-	-	-	1	7	35	19	10	1	-	-	-	-	-	-	-
27.50 to 32.49	-	-	-	-	-	-	9	18	23	9	5	1	-	-	-	-	-	-
32.50 to 37.49	-	-	-	-	-	-	1	9	11	9	3	1	-	-	-	-	-	-
37.50 to 42.49	-	-	-	-	-	-	-	-	5	9	6	4	1	-	-	-	-	-
42.50 to 47.49	-	-	-	-	-	-	-	-	1	4	-	7	-	-	-	-	-	-
47.50 to 52.49	-	-	-	-	-	-	-	-	-	-	3	5	2	-	-	-	-	-
52.50 to 57.49	-	-	-	-	-	-	-	-	-	-	1	1	4	1	-	-	-	-
57.50 to 62.49	-	-	-	-	-	-	-	-	-	-	1	1	2	1	-	-	-	-
62.50 to 67.49	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	-	-	-
67.50 to 72.49	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-
72.50 to 77.49	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
77.50 to 82.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
82.50 to 87.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
87.50 to 92.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92.50 to 97.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
97.50 to 102.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
102.50 to 107.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107.50 to 112.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
112.50 to 117.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
117.50 to 122.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

NOTE: The pattern of residuals is for regression for systolic blood pressure of white men on age, age squared, ponderal index, blood glucose, and serum cholesterol (components of the equation are listed in the regression coefficient column of table 21). Each residual is equal to an individual observed blood pressure minus its expected value as calculated from the regression equation. The figures in the table give the number of residuals found at the various points.

Company. Although the multiple correlation coefficients were somewhat lower than those presented here, probably in part due to the smaller age span, the variables that were entered in the first two steps were the same both in nature and in order as those for white men in the present study (tables 21 and 22), that is, age, then weight (closely correlated with ponderal index) for systolic pressure, and weight, then age for diastolic pressure.

Regression analysis has also been used for the purpose of comparing the distributions of blood pressure by age of native Cape Verdean Islanders and Cape Verdeans living in the United States.[19] Again, both age and weight were found to be significant correlates of pressure. Multiple correlation coefficients for the Islanders were rather lower than found in the present analysis; for the U.S. Cape Verdeans the coefficients differed for systolic pressure (men higher and women lower), but were the same for diastolic pressure. Because of the known relationship between blood pressure and weight,[20-22] regressions were used to remove the effect of weight in comparisons of pressure made between the two populations.

In the present study, as in those cited above, both age and ponderal index (weight) have been found to be highly significant correlates of blood pressure. In addition, in all but one of the analyses, after the effects of age, physique, and race are removed, blood glucose is significantly correlated with both systolic and diastolic blood pressures. The association between diabetes mellitus, in which disease blood glucose reaches extreme levels, and vascular disease is well known.[23] The finding in this analysis that blood pressure is related to the level of blood glucose in a continuous fashion, is in accord with the findings of others,[23,24] i.e., that persons with hyperglycemic responses to glucose ingestion have higher prevalence rates of atherosclerotic disease and tend to have higher blood pressures[24] than those with normoglycemic responses. In

Table C. Comparison of observed mean blood pressure values with those predicted from a multiple regression equation for white men: United States, 1960-62

Age	Systolic blood pressure			Diastolic blood pressure		
	Observed value	Predicted value[1]	Standard error of predicted value	Observed value	Predicted value[1]	Standard error of predicted value
	Values in mm. Hg.%					
18-24 years-	121.7	121.5	0.76	70.9	70.8	0.49
25-34 years-	124.3	124.1	0.45	76.4	76.3	0.29
35-44 years-	127.9	128.5	0.45	80.5	80.8	0.29
45-54 years-	133.3	133.3	0.48	83.1	82.8	0.31
55-64 years-	140.4	140.2	0.50	83.3	83.1	0.32
65-74 years-	147.4	147.8	0.77	80.9	81.3	0.50
75-79 years-	154.6	155.8	1.25	79.5	79.3	0.80

[1]Predicted values obtained from the equations in tables 21 and 22, entering the age-specific means as values for the independent variables.

other words, there is an increasing chance, with increasing glucose levels, for pathological changes in the vasculature to occur and, with these, for blood pressure to be increased.

The relationship of cholesterol to blood pressure is also made clearer in this analysis. For many years it has been the consensus of writers that no such relationship exists, and the Framingham data[25] have been used to show that, because cholesterol and blood pressure are independent of each other, both provide independent and cumulative risks for coronary heart disease. In contrast, however, it would appear from the simple correlations in tables[17-19] that blood pressure and cholesterol are indeed dependent on each other and should therefore be expected to have interdependent effects on the cumulative risks of coronary heart disease. This conflict in interpretation is resolved, at least partially, by the results of the regression analysis because, when age and physique are taken into account first, cholesterol has a significant correlation only with blood pressure for white men, and even this is minimal. It must therefore be assumed that the simple correlation found between cholesterol and blood pressure must be indirect, and due to the correlation of each with physique—especially bulk—and age.

It is of interest that, although the values for R^2 given in table A differ, they show a clear consistency in pattern. Presumably the reason the R^2 values for diastolic pressure are so much lower than those for systolic is that the diastolic pressure is much more difficult to measure in a repeatable manner and therefore, a larger component of the total variance for diastolic pressure arises from observer error. This error component cannot, of course, be predicted by any of the variables taken into account in the present analysis. It is also worth noting that the final R^2 values are higher for blood pressure readings for women than men, and that the values for each sex are remarkably similar regardless of race, despite the differences in significant independent variables. These latter differences lie predominantly in the inclusion or exclusion of glucose and cholesterol, neither of which, when present, adds very much to the overall value of R^2. Thus, since the main contribution to regression for all sex-race combinations comes from age and physique, the factors predisposing an individual to high blood pressure must be much less related to these variables in men than in women; and therefore may differ between the sexes.

Finally, a word is in order about the prediction of blood pressure from longitudinal data. Miall and Lovell,[26] in a longitudinal study in South Wales, have found that the higher the blood pressure of an individual, the greater the rate of change in his pressure with time; those whose blood pressures were below average when first examined experienced a much smaller rise of pressure by the subsequent examination than those with above average pressures. It was also found that, although the rate of change was highly correlated with level of pressure, it was only weakly correlated with age and physique.[27] These findings indicate that the young person who has relatively high blood pressure for his age will become a real hypertensive, based on present clinical definitions, sooner than his coevals.

In contrast to the work of Miall and Lovell[26] in the present analysis age plays a very important role because the data are cross-sectional. The difference between the two studies can best be summarized in the following terms. If faced with the task of predicting the blood pressure of any individual in a population at a given time, then age and physique are the most useful pieces of information that can be obtained. If, on the other hand, the future blood pressure of an individual is to be estimated, Miall and others[26,27] have demonstrated that the level of present blood pressure is a far more powerful predictor than either age or physique.

[ED. NOTE: Since this monograph was written a report on change in blood pressure over 14 years of observation in Framingham[28] has been presented, the results of which ran counter to those of Miall and Lovell.]

REFERENCES

[1]National Center for Health Statistics: Plan and initial program of the Health Examination Survey. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 1-No. 4. Public Health Service. Washington. U.S. Government Printing Office, July 1965.

[2]National Center for Health Statistics: Cycle I of the Health Examination Survey, sample and response. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 1. Public Health Service. Washington. U.S. Government Printing Office, Apr. 1964.

[3]National Center for Health Statistics: Blood pressure of adults by age and sex. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 4. Public Health Service. Washington. U.S. Government Printing Office, June 1964.

[4]National Center for Health Statistics: Blood pressure of adults by race and area. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 5. Public Health Service. Washington. U.S. Government Printing Office, July 1964.

[5]National Center for Health Statistics: Hypertension and hypertensive heart disease in adults. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 13. Public Health Service. Washington. U.S. Government Printing Office, May 1966.

[6]National Center for Health Statistics: Weight, height, and selected body dimensions of adults. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 8. Public Health Service. Washington. U.S. Government Printing Office, June 1965.

[7]National Center for Health Statistics: Weight by height and age of adults. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 14. Public Health Service. Washington. U.S. Government Printing Office, May 1966.

[8]National Center for Health Statistics: Blood glucose levels in adults. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 18. Public Health Service. Washington. U.S. Government Printing Office, Sept. 1966.

[9]National Center for Health Statistics: Serum cholesterol levels of adults. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 22. Public Health Service. Washington. U.S. Government Printing Office, Mar. 1967.

[10]National Center for Health Statistics: Osteoarthritis and body measurements. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 29. Public Health Service. Washington. U.S. Government Printing Office, Apr. 1968.

[11]National Center for Health Statistics: Skinfold, body girths, biacromial breadth, and selected anthropometric indices of adults: United States, 1960-62. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 35. Public Health Service. Washington. U.S. Government Printing Office, in publication.

[12]Nelson, N. A.: Photometric adaptation of the Somogyi method for the determination of glucose. *J. Biol. Chem.* 153: 375, 1944.

[13]Boyd, E. M.: The extraction of blood lipids. *J. Biol. Chem.* 114:223, 1936.

[14]Zak, B.; Dickenman, R. C.; White, E. G.; Burnett. H.; and Cherney, P. J.: Rapid estimation of free and total cholesterol. *Am. J. Clin. Path.* 24:1307, 1954.

[15]Khosla, T., and Lowe, C. R.: Indices of obesity derived from body weight and height. *Brit. J. prev. soc. Med.* 21:122, 1967.

[16]Hamilton, M.; Pickering, G. W.; Fraser-Roberts, J. A.; and Sowry, G. S. C.: The aetiology of essential hypertension. 1. The arterial pressure in the general population. *Clin. Sci.* 13:11, 1954.

[17]Miall, W. E., and Oldham, P. D.: A study of arterial blood pressure and its inheritance in a sample of the general population. *Clin. Sci.* 14:459. 1955.

[18]Holland, W. W.; Raftery, E. B.; McPherson, P.; and Stone, R. W.: A cardiovascular survey of American east coast telephone workers. *Am. J. Epid.* 85:61, 1967.

[19]Florey, C. du V., and Cuadrado R. R.: Blood pressure in native Cape Verdeans and in Cape Verdean immigrants and their descendants living in New England. *Hum. Biol.* 40:189-211, May 1968.

[20]Kannel, W. B.; Brand, N.; Skinner, J. J., Jr.; Dawber, T. R.; and McNamara, P. M.: The relation of adiposity to blood pressure and development of hypertension. *Ann. Int. Med.* 67:48, 1967.

[21]Harlan, W. R.; Osborne, R. K.; and Graybiel, A.: A longitudinal study of blood pressure. *Circulation.* 26:530, 1962.

[22]Fletcher, A. P.: The effect of weight reduction upon the blood pressure of obese hypertensive women. *Quart. J. Med.* 23:331, 1954.

[23]Ostrander, L. D., Jr.; Francis, T., Jr.; Hayner, N. S.; Kjelsberg, M. O.; and Epstein, F. H.: The relationship of cardiovascular disease to hyperglycemia. *Ann. Int. Med.* 62: 1188, 1965.

[24]Epstein, F. H.; Ostrander, L. D., Jr.; Johnson, B. C.; Payne, M. W.; Hayner, N. S.; Keller, J. B.; and Francis, T., Jr.: Epidemiological studies of cardiovascular disease in a total community - Tecumseh, Michigan. *Ann. Int. Med.* 62: 1170, 1965.

[25]Kannel, W. B.; Dawber, T. R.; Kagan, A.; Revotskie, N.; and Stokes, J.: Factors of risk in the development of coronary heart disease—six-year follow-up experience. The Framingham study. *Ann. Int. Med.* 55:33, 1961.

[26]Miall, W. E., and Lovell, H. G.: Relation between change of blood pressure and age. *Brit. Med. J.* i:660, 1967.

[27]Miall, W. E.; Bell, R. A.; and Lovell, H. G.: Relation between change in blood pressure and weight. *Brit. J. prev. soc. Med.* 22:73, 1968.

[28]Feinleib, M., et. al.: Blood pressure and age. The Framingham Study. Paper presented at the 2d annual meeting of the Society for Epidemiological Research, Chapel Hill, North Carolina, May 3, 1969.

ooo

DETAILED TABLES

Page

Table 1. Mean systolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62---------- 12

2. Standard errors for mean systolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62---------- 12

3. Mean diastolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62---------- 13

4. Standard errors for mean diastolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62---------- 13

5. Mean systolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62---------- 14

6. Standard errors for mean systolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62---------- 15

7. Mean diastolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62---------- 16

8. Standard errors for mean diastolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62---------- 17

9. Mean systolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 18

10. Standard errors for mean systolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 18

11. Mean diastolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 19

12. Standard errors for mean diastolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 19

13. Mean systolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 20

14. Standard errors for mean systolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 20

15. Mean diastolic blood pressure in Negro adults, by cholestorol levels, sex, and age: United States, 1960-62---------- 21

16. Standard errors for mean diastolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62---------- 21

17. Simple correlation coefficients between nine variables, for white men: United States, 1960-62---------- 22

18. Simple correlation coefficients between nine variables, for white women: United States, 1960-62---------- 22

		Page
Table 19.	Simple correlation coefficients between nine variables for Negro men: United States, 1960-62	23
20.	Simple correlation coefficients between nine variables for Negro women: United States, 1960-62	23
21.	Selected regression statistics for systolic blood pressure and selected independent variables of white men: United States, 1960-62	24
22.	Selected regression statistics for diastolic blood pressure and selected independent variables of white men: United States, 1960-62	24
23.	Selected regression statistics for systolic blood pressure and selected independent variables of Negro men: United States, 1960-62	24
24.	Selected regression statistics for diastolic blood pressure and selected independent variables of Negro men: United States, 1960-62	25
25.	Selected regression statistics for systolic blood pressure and selected independent variables of white women: United States, 1960-62	25
26.	Selected regression statistics for diastolic blood pressure and selected independent variables of white women: United States, 1960-62	25
27.	Selected regression statistics for systolic blood pressure and selected independent variables of Negro women: United States, 1960-62	26
28.	Selected regression statistics for diastolic blood pressure and selected independent variables of Negro women: United States, 1960-62	26

Table 1. Mean systolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	Glucose levels in mg.%									
	All levels	Under 88	88-107	108-127	128-147	148-167	168-187	188-207	208-227	228 and over
	Mean systolic blood pressure in mm. Hg.%									
Both sexes										
All ages, 18-79 years	130	122	125	130	133	136	144	142	145	153
Men										
All ages, 18-79 years	132	126	128	132	135	138	144	142	143	153
18-24 years	122	122	121	124	123	121	*	*	*	*
25-34 years	125	121	126	124	129	127	132	125	*	*
35-44 years	128	123	127	129	129	130	134	126	151	*
45-54 years	133	134	132	132	134	134	136	139	133	117
55-64 years	140	139	130	136	145	141	152	143	159	156
65-74 years	147	145	139	151	141	152	155	160	*	156
75-79 years	154	*	130	158	153	157	*	*	148	*
Women										
All ages, 18-79 years	129	117	121	129	132	135	144	142	146	153
18-24 years	111	108	112	114	116	110	111	*	*	*
25-34 years	115	113	115	116	119	114	125	117	*	113
35-44 years	122	115	121	124	124	123	125	122	141	*
45-54 years	132	123	130	132	132	135	135	136	127	149
55-64 years	145	141	141	146	139	148	151	145	152	142
65-74 years	158	151	145	162	160	153	164	155	161	169
75-79 years	156	*	*	156	*	156	158	160	137	*

Table 2. Standard errors for mean systolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	Glucose levels in Hg.%									
	All levels	Under 88	88-107	108-127	128-147	148-167	168-187	188-207	208-227	228 and over
	Standard error in mm. Hg.%									
Both sexes										
All ages, 18-79 years	1	1	1	1	1	2	2	2	3	3
Men										
All ages, 18-79 years	1	1	1	1	1	2	2	3	4	4
18-24 years	1	1	2	3	3	6	**	46	33	**
25-34 years	1	2	1	1	1	2	5	9	47	40
35-44 years	1	1	1	1	2	3	2	2	11	48
45-54 years	1	2	1	1	3	2	4	6	5	8
55-64 years	2	4	3	2	4	5	10	7	9	6
65-74 years	2	6	4	7	4	6	5	8	69	6
75-79 years	3	**	9	7	7	11	64	58	18	61
Women										
All ages, 18-79 years	1	1	1	1	1	2	3	6	4	4
18-24 years	1	1	1	1	2	3	3	45	33	5
25-34 years	1	1	1	1	2	2	4	2	24	10
35-44 years	1	2	1	1	2	1	3	2	10	67
45-54 years	1	2	2	2	2	2	4	4	6	8
55-64 years	2	7	3	3	4	4	6	4	6	9
65-74 years	2	7	8	7	5	5	4	6	12	8
75-79 years	3	**	74	9	41	12	12	14	7	44

Table 3. Mean diastolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 88	88-107	108-127	128-147	148-167	168-187	188-207	208-227	228 and over
	Mean diastolic blood pressure in mm. Hg.%									
Both sexes										
All ages, 18-79 years-	78	75	77	79	80	80	83	81	82	82
Men										
All ages, 18-79 years-	79	76	78	81	80	82	84	80	81	84
18-24 years--------------	72	71	72	73	67	68	*	*	*	*
25-34 years--------------	76	74	78	77	76	79	76	78	*	*
35-44 years--------------	80	76	81	82	80	83	80	77	89	*
45-54 years--------------	83	82	81	84	84	83	84	82	79	72
55-64 years--------------	83	80	80	81	85	83	90	81	89	92
65-74 years--------------	81	77	80	83	78	81	84	85	*	85
75-79 years--------------	79	*	72	84	75	81	*	*	77	*
Women										
All ages, 18-79 years-	77	73	75	78	79	79	83	82	82	82
18-24 years--------------	69	67	69	71	73	68	70	*	*	*
25-34 years--------------	72	71	72	74	75	70	79	73	*	71
35-44 years--------------	77	74	77	77	78	78	79	79	84	*
45-54 years--------------	81	80	79	81	82	80	83	84	85	85
55-64 years--------------	84	84	81	84	83	88	87	83	82	82
65-74 years--------------	83	83	83	82	84	81	85	83	88	86
75-79 years--------------	79	*	*	83	*	81	84	81	66	*

Table 4. Standard errors for mean diastolic blood pressure in white adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 88	88-107	108-127	128-147	148-167	168-187	188-207	208-227	228 and over
	Standard error in mm. Hg.%									
Both sexes										
All ages, 18-79 years-	0.0	1	1	0.0	1	1	1	1	2	2
Men										
All ages, 18-79 years-	0.0	1	1	1	1	1	1	1	2	3
18-24 years--------------	1	1	2	3	3	4	**	53	42	**
25-34 years--------------	1	1	1	1	1	2	4	4	28	45
35-44 years--------------	1	1	1	1	1	2	2	2	7	30
45-54 years--------------	1	1	1	1	2	1	4	3	3	2
55-64 years--------------	1	2	2	1	2	3	2	4	4	6
65-74 years--------------	1	1	2	3	2	3	3	4	38	6
75-79 years--------------	2	**	4	3	3	5	32	29	9	25
Women										
All ages, 18-79 years-	0.0	1	1	0.0	1	1	1	1	2	2
18-24 years--------------	1	1	1	1	2	2	2	26	51	42
25-34 years--------------	0.0	1	1	1	1	2	2	3	45	8
35-44 years--------------	1	1	1	1	2	1	1	2	6	45
45-54 years--------------	1	1	1	1	1	2	2	3	4	4
55-64 years--------------	1	4	2	1	2	2	3	3	3	3
65-74 years--------------	1	3	4	2	3	1	2	2	6	5
75-79 years--------------	2	**	44	4	20	7	4	9	5	19

Table 5. Mean systolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	Glucose levels in mg.%						
	All levels	Under 88	88-107	108-127	128-147	148-167	168 and over
	Mean systolic blood pressure in mm. Hg.%						
Both sexes							
All ages, 18-79 years---------	136	121	128	135	144	146	158
Men							
All ages, 18-79 years---------	136	124	133	138	148	140	147
18-24 years------------------------	119	117	116	123	121	117	*
25-34 years------------------------	127	126	127	125	*	*	*
35-44 years------------------------	135	124	128	143	151	134	130
45-54 years------------------------	139	124	*	140	139	*	146
55-64 years------------------------	148	144	139	164	154	145	145
65-74 years------------------------	161	*	142	158	169	*	165
75-79 years------------------------	155	*	*	*	167	*	161
Women							
All ages, 18-79 years---------	136	118	124	133	140	149	167
18-24 years------------------------	114	115	112	118	103	115	*
25-34 years------------------------	119	114	118	116	127	131	*
35-44 years------------------------	132	120	123	129	138	142	153
45-54 years------------------------	147	*	136	139	154	157	166
55-64 years------------------------	158	*	139	159	*	*	174
65-74 years------------------------	176	*	160	*	*	*	185
75-79 years------------------------	166	*	*	*	158	160	170

Table 6. Standard errors for mean systolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	Glucose levels in mg.%						
	All levels	Under 88	88-107	108-127	128-147	148-167	168 and over
	Standard error in mm. Hg.%						
Both sexes							
All ages, 18-79 years	2	2	2	3	3	3	3
Men							
All ages, 18-79 years	2	3	3	4	6	3	4
18-24 years	2	3	4	5	11	5	**
25-34 years	2	3	4	3	35	64	53
35-44 years	3	6	3	14	13	7	9
45-54 years	3	10	37	9	5	39	12
55-64 years	3	10	6	9	14	7	6
65-74 years	8	**	16	17	11	59	10
75-79 years	16	**	67	**	32	**	20
Women							
All ages, 18-79 years	3	2	2	4	3	4	6
18-24 years	1	4	3	3	3	3	46
25-34 years	2	3	3	1	7	5	63
35-44 years	3	4	7	5	4	9	11
45-54 years	5	35	8	11	7	7	13
55-64 years	6	74	8	11	51	42	11
65-74 years	6	70	15	67	44	67	11
75-79 years	3	**	**	**	6	17	2

Table 7. Mean diastolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	Glucose levels in mg.%						
	All levels	Under 88	88-107	108-127	128-147	148-167	168 and over
	Mean diastolic blood pressure in mm. Hg.%						
Both sexes							
All ages, 18-79 years	83	77	80	84	87	87	91
Men							
All ages, 18-79 years	84	79	82	84	89	86	87
18-24 years	73	73	71	75	77	64	*
25-34 years	80	78	77	81	*	*	*
35-44 years	84	81	82	85	90	86	87
45-54 years	87	79	*	89	88	*	92
55-64 years	90	89	87	96	89	95	82
65-74 years	88	*	83	80	95	*	89
75-79 years	84	*	*	*	*	*	*
Women							
All ages, 18-79 years	83	76	77	83	85	88	94
18-24 years	71	70	71	71	60	76	*
25-34 years	76	73	75	77	80	81	*
35-44 years	85	82	78	85	87	91	91
45-54 years	90	*	86	89	90	93	96
55-64 years	92	*	82	93	*	*	98
65-74 years	91	*	*	*	*	*	95
75-79 years	83	*	*	*	92	*	92

Table 8. Standard errors for mean diastolic blood pressure in Negro adults, by glucose levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 88	88-107	108-127	128-147	148-167	168 and over
	Glucose levels in mg.%						
Both sexes	Standard error in mm. Hg.%						
All ages, 18-79 years	1	1	2	2	2	3	2
Men							
All ages, 18-79 years	1	2	2	2	3	4	2
18-24 years	2	3	5	4	9	9	**
25-34 years	1	2	3	2	22	45	31
35-44 years	2	4	3	6	5	5	5
45-54 years	2	6	23	3	5	26	7
55-64 years	2	9	4	6	5	4	4
65-74 years	5	**	8	8	9	29	7
75-79 years	8	**	44	**	45	**	44
Women							
All ages, 18-79 years	1	2	1	2	2	3	2
18-24 years	1	2	2	4	4	1	30
25-34 years	1	3	2	1	5	6	40
35-44 years	1	4	2	3	2	5	3
45-54 years	2	22	3	6	5	3	6
55-64 years	3	43	6	9	31	25	6
65-74 years	4	43	43	34	23	34	4
75-79 years	8	**	**	**	65	14	2

Table 9. Mean systolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 140	140-159	160-179	180-199	200-219	220-239	240-259	260-279	280-299	300-319	320-339	340-359	360 and over
	Cholesterol levels in mg.%													
	Mean systolic blood pressure in mm. Hg.%													
Both sexes														
All ages, 18-79-	130	126	119	122	126	128	133	135	137	140	145	146	144	145
Men														
All ages, 18-79-	132	124	124	126	131	130	135	136	136	139	136	140	138	141
18-24 years---------	122	119	122	120	125	124	123	125	129	*	*	131	*	115
25-34 years---------	124	119	120	122	124	123	126	127	128	133	135	129	131	113
35-44 years---------	128	122	125	126	129	126	128	128	132	129	133	130	127	*
45-54 years---------	133	*	127	127	134	129	134	133	136	137	138	134	131	*
55-64 years---------	139	122	150	136	133	143	143	142	135	143	129	145	141	176
65 years and over---	146	*	122	142	149	142	152	153	154	153	148	*	*	141
Women														
All ages, 18-79-	128	128	114	119	122	126	130	134	138	140	151	148	147	149
18-24 years---------	112	109	110	111	113	112	111	117	113	*	115	108	109	*
25-34 years---------	115	113	114	114	115	116	117	117	115	115	*	115	115	114
35-44 years---------	122	115	118	120	122	122	122	121	121	128	126	123	*	*
45-54 years---------	132	*	129	128	134	132	130	130	132	133	139	143	143	138
55-64 years---------	145	*	167	127	149	148	150	140	145	145	155	146	142	154
65 years and over---	155	*	*	168	152	154	151	158	160	167	161	164	152	158

Table 10. Standard errors for mean systolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 140	140-159	160-179	180-199	200-219	220-239	240-259	260-279	280-299	300-319	320-339	340-359	360 and over
	Cholesterol levels in mg.%													
	Standard error in mm. Hg.%													
Both sexes														
All ages, 18-79-	1	3	1	1	1	1	1	1	1	2	3	2	3	3
Men														
All ages, 18-79-	1	2	2	2	1	1	1	1	1	2	3	3	4	6
18-24 years---------	1	1	2	2	1	2	2	3	3	48	64	16	66	19
25-34 years---------	1	3	4	2	1	1	2	1	2	5	8	4	6	12
35-44 years---------	1	5	6	5	2	2	2	2	1	4	3	4	3	45
45-54 years---------	1	69	71	2	3	3	1	2	3	3	4	8	8	**
55-64 years---------	2	5	59	7	6	3	4	3	2	5	5	6	7	21
65 years and over---	1	34	12	6	5	3	5	3	8	7	9	46	70	70
Women														
All ages, 18-79-	1	3	2	1	1	2	1	2	1	3	4	2	3	3
18-24 years---------	1	2	3	1	1	1	2	2	3	38	5	4	5	**
25-34 years---------	1	3	3	2	1	1	2	3	2	7	43	1	2	1
35-44 years---------	1	4	4	2	2	2	1	2	2	5	7	7	59	33
45-54 years---------	1	54	54	3	5	4	3	2	2	4	7	5	8	22
55-64 years---------	2	**	**	38	6	6	6	4	3	5	6	3	6	10
65 years and over---	2	72	59	10	14	6	5	3	5	6	7	6	5	7

Table 11. Mean diastolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 140	140-159	160-179	180-199	200-219	220-239	240-259	260-279	280-299	300-319	320-339	340-359	360 and over
	Cholesterol levels in mg.%													
	Mean diastolic blood pressure in mm. Hg.%													
Both sexes														
All ages, 18-79	78	74	72	74	77	78	80	80	82	82	84	84	83	85
Men														
All ages, 18-79	79	72	74	76	79	78	80	81	83	82	83	82	81	80
18-24 years	72	66	71	71	74	73	70	69	81	*	*	85	*	*
25-34 years	76	69	74	74	76	76	77	79	76	81	88	80	81	*
35-44 years	80	73	77	82	80	78	80	80	84	84	81	82	79	*
45-54 years	83	*	80	80	84	80	83	83	86	80	86	81	80	*
55-64 years	82	84	81	78	79	84	84	83	82	86	80	89	86	105
65 years and over	77	*	68	75	81	78	83	81	82	83	83	*	*	*
Women														
All ages, 18-79	77	76	71	73	76	77	78	79	81	82	85	84	84	85
18-24 years	69	69	68	70	70	68	71	71	70	*	59	72	73	*
25-34 years	73	70	71	73	73	72	73	73	75	77	*	73	68	80
35-44 years	77	72	74	75	77	78	77	77	76	78	80	85	*	*
45-54 years	81	*	80	78	83	81	80	80	83	82	86	84	83	88
55-64 years	84	*	*	73	87	85	86	81	83	85	91	84	82	88
64 years and over	82	*	*	79	82	79	82	82	83	83	82	87	79	85

Table 12. Standard errors for mean diastolic blood pressure in white adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 140	140-159	160-179	180-199	200-219	220-239	240-259	260-279	280-299	300-319	320-339	340-359	360 and over
	Cholesterol levels in mg.%													
	Standard error in mm. Hg.%													
Both sexes														
All ages, 18-79	0.0	2	1	1	0.0	1	1	1	1	1	1	1	1	2
Men														
All ages, 18-79	1	2	1	1	1	1	1	1	1	1	1	2	2	4
18-24 years	1	2	1	1	2	1	2	4	12	57	59	14	69	49
25-34 years	1	2	1	2	2	1	1	2	1	4	6	2	2	54
35-44 years	1	4	3	1	1	2	2	1	2	2	3	3	4	29
45-54 years	1	43	2	2	1	1	1	2	1	3	3	2	2	**
55-64 years	1	10	3	3	2	2	1	1	2	3	1	3	3	15
65 years and over	1	20	5	2	2	2	2	2	4	3	6	22	36	36
Women														
All ages, 18-79	0.0	2	1	1	1	1	1	1	1	1	2	1	1	2
18-24 years	1	2	1	1	1	2	3	3	3	21	12	2	2	**
25-34 years	0.0	2	1	1	1	1	1	2	3	4	27	3	5	2
35-44 years	1	4	3	1	1	1	1	1	2	2	4	4	44	23
45-54 years	1	30	2	2	2	1	1	1	1	2	4	2	4	10
55-64 years	1	**	66	5	3	2	3	2	2	2	4	1	1	4
65 years and over	2	43	58	5	5	3	2	1	2	4	2	3	3	7

Table 13. Mean systolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	Cholesterol levels in mg.%								
	All levels	Under 160	160-179	180-199	200-219	220-239	240-259	260-299	300 and over
	Mean systolic blood pressure in mm. Hg.%								
Both sexes									
All ages, 18-79 years	136	129	135	128	135	142	141	155	161
Men									
All ages, 18-79 years	136	140	142	130	136	136	138	153	176
18-24 years	119	115	126	123	*	*	*	*	*
25-34 years	128	126	132	124	129	129	*	129	114
35-44 years	133	128	148	119	133	135	130	*	174
45-54 years	139	149	*	133	140	129	132	150	159
55-64 years	149	*	*	146	*	153	145	138	*
65 years and over	167	*	*	150	147	*	159	163	*
Women									
All ages, 18-79 years	136	117	130	127	134	148	144	157	157
18-24 years	115	113	114	118	114	117	*	*	*
25-34 years	120	114	119	123	118	128	*	119	*
35-44 years	132	*	140	132	129	132	142	133	*
45-54 years	147	*	159	130	150	153	147	140	190
55-64 years	158	*	*	*	160	182	141	165	*
65 years and over	174	*	*	*	189	174	164	176	*

Table 14. Standard errors for mean systolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	Cholesterol levels in mg.%								
	All levels	Under 160	160-179	180-199	200-219	220-239	240-259	260-299	300 and over
	Standard error in mm. Hg.%								
Both sexes									
All ages, 18-79 years	1	3	3	1	2	2	5	3	5
Men									
All ages, 18-79 years	1	4	3	2	4	3	6	5	8
18-24 years	2	4	4	5	43	53	**	**	**
25-34 years	2	5	5	2	4	5	47	8	16
35-44 years	2	8	15	5	2	8	6	55	30
45-54 years	3	6	37	5	13	7	20	8	12
55-64 years	3	56	62	6	40	4	12	9	48
65 years and over	7	77	66	14	24	59	16	9	78
Women									
All ages, 18-79 years	2	4	4	1	3	4	6	3	6
18-24 years	2	2	5	2	5	4	56	**	**
25-34 years	2	2	4	4	6	4	43	5	41
35-44 years	3	31	7	3	7	7	11	11	60
45-54 years	4	58	13	6	16	7	11	5	34
55-64 years	6	**	37	51	15	19	7	14	54
65 years and over	5	**	79	**	12	9	5	8	64

Table 15. Mean diastolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 160	160-179	180-199	200-219	220-239	240-259	260-299	300 and over
	Cholesterol levels in mg.%								
	Mean diastolic blood pressure in mm. Hg.%								
Both sexes									
All ages, 18-79 years	83	79	82	80	83	86	84	88	94
Men									
All ages, 18-79 years	83	85	87	79	84	84	85	87	98
18-24 years	72	70	77	74	*	*	*	*	*
25-34 years	80	79	83	79	83	79	*	77	*
35-44 years	83	86	92	76	83	84	81	*	104
45-54 years	87	95	*	84	88	76	85	94	*
55-64 years	90	*	*	89	*	95	87	86	*
65 years and over	90	91	*	78	87	*	91	85	*
Women									
All ages, 18-79 years	83	75	79	82	81	89	84	88	90
18-24 years	71	71	70	74	71	69	*	*	*
25-34 years	77	74	76	80	75	81	*	74	*
35-44 years	85	79	87	88	85	80	85	89	*
45-54 years	90	*	94	82	95	94	90	84	113
55-64 years	93	*	*	*	90	106	82	98	*
65 years and over	90	*	*	*	79	91	87	92	*

Table 16. Standard errors for mean diastolic blood pressure in Negro adults, by cholesterol levels, sex, and age: United States, 1960-62

Sex and age	All levels	Under 160	160-179	180-199	200-219	220-239	240-259	260-299	300 and over
	Cholesterol levels in mg.%								
	Standard error in mm. Hg.%								
Both sexes									
All ages, 18-79 years	1	2	1	1	2	1	3	2	4
Men									
All ages, 18-79 years	1	3	2	1	2	2	4	3	6
18-24 years	2	3	3	4	26	36	**	**	**
25-34 years	1	3	6	2	3	11	28	3	49
35-44 years	1	5	4	4	2	3	5	34	13
45-54 years	2	8	23	4	5	5	14	4	77
55-64 years	2	32	37	3	23	3	5	7	49
65 years and over	3	46	36	5	14	69	11	4	70
Women									
All ages, 18-79 years	1	2	2	1	1	1	3	2	4
18-24 years	1	1	3	2	5	4	33	**	**
25-34 years	1	1	3	3	5	8	29	4	27
35-44 years	2	21	5	2	4	3	4	7	41
45-54 years	2	33	5	3	7	3	4	4	20
55-64 years	3	**	21	31	5	10	9	10	28
65 years and over	3	**	39	**	10	4	5	4	34

Table 17. Simple correlation coefficients between nine variables for white men: United States, 1960-62

Variable	Height	Weight	Right triceps skinfold	Infra-scapular skinfold	Arm girth	Glu-cose	Choles-terol	Age	Systolic blood pressure
Height------------------	-								
Weight------------------	.39	-							
Right triceps skinfold-	.06	.58	-						
Infrascapular skinfold-	-.005	.71	.69	-					
Arm girth---------------	.14	.85	.58	.67	-				
Glucose-----------------	-.14	.008	.02	.08	-.02	-			
Cholesterol-------------	-.11	.14	.18	.22	.15	.20	-		
Age---------------------	-.27	-.04	-.02	.06	-.11	.37	.32	-	
Systolic blood pressure---------------	-.15	.15	.12	.21	.11	.27	.23	.43	-
Diastolic blood pressure---------------	-.06	.28	.20	.30	.25	.16	.23	.26	.64

NOTES: Number of observations for sample: N=2,669 and N=2,599.

Figures which are underlined were derived from persons in the sample for whom glucose and cholesterol measurements were available.

Table 18. Simple correlation coefficients between nine variables for white women: United States, 1960-62

Variable	Height	Weight	Right triceps skinfold	Infra-scapular skinfold	Arm girth	Glu-cose	Choles-terol	Age	Systolic blood pressure
Height------------------	-								
Weight------------------	.19	-							
Right triceps skinfold-	-.03	.66	-						
Infrascapular skinfold-	-.14	.73	.75	-					
Arm girth---------------	-.03	.89	.74	.77	-				
Glucose-----------------	-.13	.12	.12	.18	.15	-			
Cholesterol-------------	-.17	.17	.18	.24	.22	.29	-		
Age---------------------	-.28	.21	.21	.28	.29	.42	.53	-	
Systolic blood pressure---------------	-.22	.34	.27	.36	.38	.37	.36	.62	-
Diastolic blood pressure---------------	-.11	.38	.30	.38	.41	.23	.27	.40	.71

NOTES: Number of observations for sample: N=3,050 and N=2,931.

Figures which are underlined were derived from persons in the sample for whom glucose and cholesterol measurements were available.

Table 19. Simple correlation coefficients between nine variables for Negro men: United States, 1960-62

Variable	Height	Weight	Right triceps skinfold	Infra-scapular skinfold	Arm girth	Glu-cose	Choles-terol	Age	Systolic blood pressure
Height------------------	-								
Weight------------------	.34	-							
Right triceps skinfold--	-.04	.61	-						
Infrascapular skinfold--	-.05	.72	.72	-					
Arm girth---------------	.10	.89	.60	.70	-				
Glucose-----------------	-.20	-.05	.09	.10	-.03	-			
Cholesterol-------------	-.08	.15	.17	.20	.17	.12	-		
Age---------------------	-.23	-.09	-.05	.02	-.10	.37	.34	-	
Systolic blood pressure---------------	-.18	.11	.07	.12	.12	.29	.20	.47	-
Diastolic blood pressure---------------	-.09	.17	.08	.16	.18	.20	.17	.33	.79

NOTES: Number of observations for sample: N=358 and N=349.

Figures which are underlined were derived from persons in the sample for whom glucose and cholesterol measurements were available.

Table 20. Simple correlation coefficients between nine variables for Negro women: United States, 1960-62

Variable	Height	Weight	Right triceps skinfold	Infra-scapular skinfold	Arm girth	Glu-cose	Choles-terol	Age	Systolic blood pressure
Height------------------	-								
Weight------------------	.27	-							
Right triceps skinfold--	-.01	.73	-						
Infrascapular skinfold--	-.06	.75	.82	-					
Arm girth---------------	.02	.90	.80	.80	-				
Glucose-----------------	-.15	.05	.09	.13	.12	-			
Cholesterol-------------	-.15	.14	.22	.22	.22	.27	-		
Age---------------------	-.24	.17	.20	.22	.26	.33	.46	-	
Systolic blood pressure---------------	-.15	.30	.24	.27	.35	.41	.30	.59	-
Diastolic blood pressure---------------	-.04	.37	.30	.33	.39	.28	.22	.41	.79

NOTES: Number of observations for sample: N=468 and N=443.

Figures which are underlined were derived from persons in the sample for whom glucose and cholesterol measurements were available.

Table 21. Selected regression statistics for systolic blood pressure and selected independent variables of white men: United States, 1960-62

Dependent variable = systolic blood pressure						
Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1-------------------------------	Age squared----	.439	.193	.193	.0104	17.9551
2-------------------------------	Ponderal index-	.488	.238	.045	-6.1775	17.4471
3-------------------------------	Glucose--------	.499	.249	.011	.0500	17.3221
4-------------------------------	Cholesterol----	.503	.253	.004	.0351	17.2859
5-------------------------------	Age------------	.507	.257	.004	-.5136	17.2386

NOTE: Constant term = 194.997.

Table 22. Selected regression statistics for diastolic blood pressure and selected independent variables of white men: United States, 1960-62

Dependent variable = diastolic blood pressure						
Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1-------------------------------	Ponderal index-	.334	.111	.111	-4.9810	11.5995
2-------------------------------	Age------------	.398	.158	.047	.8820	11.2912
3-------------------------------	Age squared----	.434	.189	.031	-.00806	11.0876
4-------------------------------	Glucose--------	.438	.192	.003	.0156	11.0685
5-------------------------------	Cholesterol----	.441	.194	.002	.0145	11.0536

NOTE: Constant term = 114.968.

Table 23. Selected regression statistics for systolic blood pressure and selected independent variables of Negro men: United States, 1960-62

Dependent variable = systolic blood pressure						
Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1-------------------------------	Age------------	.474	.225	.225	.6685	21.9399
2-------------------------------	Ponderal index-	.509	.259	.034	-6.4515	21.4769
3-------------------------------	Glucose--------	.523	.273	.014	.0734	21.3048

NOTE: Constant term = 180.252.

Table 24. Selected regression statistics for diastolic blood pressure and selected independent variables of Negro men: United States, 1960-62

Dependent variable = diastolic blood pressure

Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1	Age	.328	.108	.108	1.3414	14.1997
2	Age squared	.408	.166	.058	-.0115	13.7425
3	Ponderal index	.439	.193	.027	-3.6428	13.5438

NOTE: Constant term = 95.797.

Table 25. Selected regression statistics for systolic blood pressure and selected independent variables of white women: United States, 1960-62

Dependent variable = systolic blood pressure

Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1	Age squared	.623	.388	.388	.00821	18.9317
2	Ponderal index	.667	.445	.057	-7.3925	18.0352
3	Glucose	.676	.457	.012	.0650	17.8445

NOTE: Constant term = 193.260.

Table 26. Selected regression statistics for diastolic blood pressure and selected independent variables of white women: United States, 1960-62

Dependent variable = diastolic blood pressure

Step	Variables entered	Multiple		Increase in R^2	Regression coefficient	Standard error of estimate
		R	R^2			
1	Ponderal index	.425	.181	.181	-4.5967	11.2148
2	Age	.496	.246	.065	.7665	10.7614
3	Age squared	.511	.261	.015	-.00629	10.6561
4	Glucose	.516	.266	.005	.0212	10.6231

NOTE: Constant term = 111.251

Table 27. Selected regression statistics for systolic blood pressure and selected independent variables of Negro women: United States, 1960-62

Dependent variable = systolic blood pressure

Step	Variables entered	Multiple R	Multiple R^2	Increase in R^2	Regression coefficient	Standard error of estimate
1	Age	.590	.348	.348	.9318	24.9930
2	Glucose	.634	.401	.053	.1388	23.9851
3	Ponderal index	.656	.430	.029	-6.0723	23.4223

NOTE: Constant term = 153.149.

Table 28. Selected regression statistics for diastolic blood pressure and selected independent variables of Negro women: United States, 1960-62

Dependent variable = diastolic blood pressure

Step	Variables entered	Multiple R	Multiple R^2	Increase in R^2	Regression coefficient	Standard error of estimate
1	Age	.404	.163	.163	1.3691	14.9017
2	Ponderal index	.468	.219	.056	-3.4320	14.4102
3	Age squared	.498	.248	.029	-.0120	14.1539
4	Glucose	.520	.270	.022	.0482	13.9620

NOTE: Constant term = 84.984.

APPENDIX I[b]

STATISTICAL NOTES

Survey Design

Cycle I of 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 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[2] used consisted of inflating the sampling weight for each examined person to compensate for nonexamined sample persons at the same stand, and in the same age-sex group.

The blood pressure, glucose, and cholesterol level data used in this report are based only on the Negro and white persons in the examined sample for whom measurements were available. The sample sizes for estimates by glucose and cholesterol levels, used in the calculations in tables 1-16, differ slightly due to missing information for some examinees (table I). The differing sample populations account for the slight discrepancies in mean blood pressure estimates by age group between the tables relating to glucose and those relating to cholesterol. Persons for whom no glucose levels are available are largely those examinees who had a definite history of diabetes under medical care as described in Series 11, No. 2.

Sampling and Measurement Error

The probability design of the survey makes possible the calculation of sampling errors for the weighted data presented in tables 1-16. Traditionally, the role of the sampling error has been the determination of how precise 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 such as 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

Table I. Number of persons in sample, by measurement group and race: United States, 1960-62

Race	Measurement group	
	Glucose	Cholesterol
Total	6,322	6,378
White	5,530	5,579
Negro	792	799

[b]This appendix was prepared by Mr. Robert Murphy of the Office of Statistical Methods, NCHS.

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. Approximate estimates of standard errors for the estimates presented in tables 1-8 are derived by a technique which yields overall variability through observation of variation among random subsamples of the total sample. The method reflects "pure" sampling variance and a part of measurement variance. Hence, the estimates of sampling errors presented in tables 1-8 are themselves subject to sampling error, which may be large when the number of cases in a cell is small or occasionally, even when the number of cases is substantial.

When the estimated standard error of a statistic is large in relation to the size of the estimate, the usefulness of the statistic is frequently compromised to some extent. This situation usually indicates that the sample size in the cell is small and/or the occurrence of measurements from the general population falling into this category is infrequent. Double asterisks in the standard error tables indicate that no sample cases are classified as having the specific characteristics defined by the cell.

In accordance with usual practice, a 68-percent-confidence interval may be considered that range within one standard error of the estimate and a 95-percent-confidence interval that range within two standard errors. An approximate standard error of a difference, $d = X - Y$, of two statistics X and Y is given by the formula:

$$s_d = [s_{x^2} + s_{y^2}]^{1/2}$$

where s_x and s_y are the standard errors shown in even numbered tables 2-16. For example, the mean blood pressures for men and women 18-24 years of age shown in table 1 are 122 and 111, respectively. From table 2, s_x and s_y are both 1. Hence, the estimated standard error of the difference is 1.4. Since the observed difference is more than seven times its sampling error, it can be concluded with near certainty that the evidence from this survey shows that the mean blood pressure for men 18-24 years is higher than that for women 18-24 years.

———ooo———

APPENDIX II

REGRESSION ANALYSIS

Regression analysis is a statistical method for determining the strength of the relationship between one particular variable (known as the dependent) and any number of other variables (independent), and for finding the best equation for estimating the value of the dependent from the independent variables. For example, systolic blood pressure is in part dependent on age—the older one is, the higher one's blood pressure is likely to be. From data gathered in this survey it is possible to calculate for the white male that his blood pressure in millimeters of mercury equals 0.5505 times his age, plus a constant factor of 107.7, or:

Systolic blood pressure (mm.Hg) = .5505 x age (years) + 107.7

The number .5505 is the value of the regression coefficient. From the equation, the expected value of the systolic pressure for men aged 40 would be 129.7 mm.Hg. Obviously not all men 40 years of age have this blood pressure; there will be considerable variation around this predicted mean value. Assuming that blood pressure is normally distributed, it can be calculated that 95 percent of the surveyed men at this age will have a blood pressure between 94.6 and 164.9 mm.Hg.[c]

There is thus considerable variation remaining in blood pressure which is not "explained" by the association between pressure and age. The explained variation can be expressed as a proportion of the total and this is known as R^2. It is conveniently calculated by squaring the correlation coefficient (R) whether it is simple (i.e., between only two variables) or multiple (between a dependent variable and two or more independent variables). For systolic pressure and age, table 9 shows that R is .43 and therefore R^2 is .185. In the rare instance when R^2 is equal to 1.0, that is, all the variation in the dependent variable can be accounted for by the variation in the independent variables, the equation can predict the value of the dependent variable exactly for all values of the independent variables. The smaller R^2 is, the less reliable the equation becomes as a predictor of the dependent value.

Now, the value of R^2 in this model may be increased by including a second independent variable. The model might become:

Pressure (mm.Hg) = constant $+ b_1$ age (years) $+ b_2$ height (inches)

The regression coefficients are indicated by b_1 and b_2. If age and height were completely uncorrelated, the proportion of the variance in blood pressure explained by the two of them together would be the sum of the squares of the two simple correlations with pressure (.207). However, age and weight are correlated (-.27) and, because of this, the proportion of variance in pressure that they explain is less than if they were independent of each other (.187). In other terms, the *partial* correlation between blood pressure and height, when the effect of age on pressure is removed, is smaller (-.03) than the simple correlation (-.15) in which no other factors are involved.

Because of this type of relationship between the independent variables, there is usually one "best" equation which explains more of the variance of the dependent variable than any other. If there are only a few variables, all possible equations can be calculated, but the number of permutations rises rapidly as the number of variables increase, so that the search for the best equation becomes not only uneconomical but overwhelming. Stepwise regression is an alternative method. In this, the variable most highly correlated with the dependent variable is entered into the equation first. The partial correlations between each of the remaining independent and the dependent variables are calculated (i.e., the correlations when the effect of the first entered variable has been taken into account) and the independent variable with the highest partial correlation is then entered. This procedure continues until all the variables are entered or the process is terminated at a predetermined point. The final equation is the best *under the conditions of choice just described* but it is always possible that some other equation might be better. However, the only way of being sure of obtaining the best equation is by calculating all possible regressions.

[c]In fact, this assumption is not quite correct; blood pressure is skewed to the right in most populations.[3] In the survey, the actual 95 percent limits of the pressures of white men aged 35-44 were 102 and 167 mm.Hg.

☆ U. S. GOVERNMENT PRINTING OFFICE – 1969 – 396-236 P. O. 91

OUTLINE OF REPORT SERIES FOR VITAL AND HEALTH STATISTICS

Public Health Service Publication No. 1000

Series 1. *Programs and collection procedures.*—Reports which describe the general programs of the National Center for Health Statistics and its offices and divisions, data collection methods used, definitions, and other material necessary for understanding the data.

Series 2. *Data evaluation and methods research.*—Studies of new statistical methodology including: experimental tests of new survey methods, studies of vital statistics collection methods, new analytical techniques, objective evaluations of reliability of collected data, contributions to statistical theory.

Series 3. *Analytical studies.*—Reports presenting analytical or interpretive studies based on vital and health statistics, carrying the analysis further than the expository types of reports in the other series.

Series 4. *Documents and committee reports.*—Final reports of major committees concerned with vital and health statistics, and documents such as recommended model vital registration laws and revised birth and death certificates.

Series 10. *Data from the Health Interview Survey.*—Statistics on illness, accidental injuries, disability, use of hospital, medical, dental, and other services, and other health-related topics, based on data collected in a continuing national household interview survey.

Series 11. *Data from the Health Examination Survey.*—Data from direct examination, testing, and measurement of national samples of the population provide the basis for two types of reports: (1) estimates of the medically defined prevalence of specific diseases in the United States and the distributions of the population with respect to physical, physiological, and psychological characteristics; and (2) analysis of relationships among the various measurements without reference to an explicit finite universe of persons.

Series 12. *Data from the Institutional Population Surveys.*—Statistics relating to the health characteristics of persons in institutions, and on medical, nursing, and personal care received, based on national samples of establishments providing these services and samples of the residents or patients.

Series 13. *Data from the Hospital Discharge Survey.*—Statistics relating to discharged patients in short-stay hospitals, based on a sample of patient records in a national sample of hospitals.

Series 14. *Data on health resources: manpower and facilities.*—Statistics on the numbers, geographic distribution, and characteristics of health resources including physicians, dentists, nurses, other health manpower occupations, hospitals, nursing homes, and outpatient and other inpatient facilities.

Series 20. *Data on mortality.*—Various statistics on mortality other than as included in annual or monthly reports—special analyses by cause of death, age, and other demographic variables, also geographic and time series analyses.

Series 21. *Data on natality, marriage, and divorce.*—Various statistics on natality, marriage, and divorce other than as included in annual or monthly reports—special analyses by demographic variables, also geographic and time series analyses, studies of fertility.

Series 22. *Data from the National Natality and Mortality Surveys.*—Statistics on characteristics of births and deaths not available from the vital records, based on sample surveys stemming from these records, including such topics as mortality by socioeconomic class, medical experience in the last year of life, characteristics of pregnancy, etc.

For a list of titles of reports published in these series, write to:

Office of Information
National Center for Health Statistics
U.S. Public Health Service
Washington, D.C. 20201

PUBLIC HEALTH SERVICE PUBLICATION NO. 1000 - SERIES 11 NO. 34