

# **Blood Pressure of Youths 12-17 Years**

## **United States**

Systolic and diastolic blood pressure measurements of youths 12-17 years of age in the United States from the Health Examination Survey of 1966-1970, by age, sex, race, geographic region, urban or rural area of residence, family income, and education of head of household.

DHEW Publication No. (HRA) 77-1645

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE  
Public Health Service  
Health Resources Administration  
National Center for Health Statistics  
Rockville, Md.                      March 1977



Library of Congress Cataloging in Publication Data

Roberts, Jean

Blood pressure of youths 12-17 years, United States.

(Vital and health statistics: Series 11, Data from the National Health Survey; no. 163)  
(DHEW publication; no. (HRA) 77-1645)

“Systolic and diastolic blood pressure measurements of youths 12-17 years of age in the United States from the health examination survey of 1966-1970, by age, race, geographic region, urban-rural, family income, and parent education.”

Includes bibliographical references.

1. Youth—Health and hygiene—United States—Statistics. 2. Blood pressure—United States—Statistics. 3. Health surveys—United States. I. Maurer, Kurt, joint author. II. Title. III. Series: United States. National Center for Health Statistics. Vital and health statistics: Series 11, Data from the National Health Survey, Data from the health examination survey; no. 163. IV. Series: United States. Dept. of Health, Education, and Welfare. DHEW publication; no. (HRA) 77-1645.

RA407.3.A347

no. 163

[RA564.5]

312'.0973s

[312'.6]

ISBN 0-8406-0074-7

76-17117

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### COOPERATION OF THE BUREAU OF THE CENSUS

In accordance with specifications established by the National Center for Health Statistics, 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.

**Vital and Health Statistics-Series 11-No.163**

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**DHEW Publication No. (HRA) 77-1645**

*Library of Congress Catalog Card Number 76-17117*

## FOREWORD

The National Center for Health Statistics collects and disseminates data on health through a number of specific programs focused on different aspects of health. All of these programs share a deep concern with the quality and reliability of the data. The Health Examination Statistics Division has from its inception been constantly concerned with the problems of sampling and non-sampling (or measurement) error. We have made great efforts to minimize, to measure, and to report to the reader the nature and extent of these problems.

The blood pressure data included in the present report present a special problem in this regard. Several years ago when these data were first tabulated for what was assumed would be presentation in this report series in the usual manner, it was apparent that the data did not fit the expected continuum. The expectation was based in part on general knowledge of the literature but more particularly on the data obtained in the first and second cycles (or programs) of our Health Examination Surveys. The data for the ages 12-17 years were at an unexpectedly high level producing discontinuities in the curve with a sharp increase between ages 11 and 12 years and a correspondingly sharp decrease after age 17.

The obvious suspicion was that some systematic measurement error had flawed the data for the 12-17 year old youths. As time permitted, these data were examined in many detailed ways in an attempt to better understand what might account for the observed picture. In an appendix to this report, the authors present some of these results. It appears from these results that the data had a very high degree of internal consistency. Separate subgroups by age, sex, race, or location, for example, showed a consistent picture. Such factors as positioning of the subject (i.e., sitting or recumbent), time of day of ex-

amination, possible systematic differences in measuring techniques by different examiners, or smoking habits could not have been responsible for the unexpectedly high general level of the readings.

Meanwhile data were becoming available from the first Health and Nutrition Examination Survey (HANES) in which a blood pressure measurement was included for the entire age range. This survey, however, had been addressed to the full age range of 1 through 74 years and had had nutrition and unmet health needs as special focuses. As a result, the data available from it with respect to youths' blood pressures are much less extensive. Only one measurement of blood pressure was made, contrasted with three in the 12-17 year old Health Examination Survey program. Even more important, the size of the population sample in these age groups was less than one-third as large as in the youth program. As a result, the HANES data on blood pressure cannot be looked at in detail with respect to such variables as single year of age, sex, race, region, and income and education of parent. The HANES data do, however, provide a comparison with respect to overall mean blood pressure values. These data, soon to appear in a separate report in this series, indicate that blood pressures in the 12-17 year age range are lower than those in the immediately succeeding years and lower than those recorded in the third cycle program of the Health Examination Survey.

The most likely explanation for the difference (i.e., between the levels of blood pressure recorded in the third cycle program and the lower levels expected from other evidence) seemed to be one associated with the process of measurement. In this connection, it should be noted that the measurements were made by relatively few examiners. In the first blood pressure report from the first Health Examination Survey (*Vital*

and Health Statistics, Series 11, No. 4), a discussion of examiner variability included the following statement: "For studies in which only a few observers measure the blood pressure, such risks" (examiner bias) "are obviously present." Unfortunately, the reduced level of resources available during the examination survey of 12-17 year old youths resulted in only two observers making almost all of the blood pressure measurements. Also unfortunately, failure to require recording of the size of the cuff used in the individual measurements precluded the possibility of our reconstructing from the data relationships between the percentage of total arm area covered and recorded pressure.

Thus, the special problem presented by these blood pressure data was the following dilemma. Publication of the observed measurements might mislead users of the data if the general level in the 12-17 population was actually substantially lower than found in this survey. On the other hand, failure to make the data available to users would deprive them of the opportunity to examine for themselves a large set of blood pressure measurements made in a standardized manner on a representative sample of the 12-17 year old segment of the U.S. population. It has been decided

to present the data included in the present report because it is believed they represent carefully and uniformly made recordings which can provide useful comparisons of internal relationships within the data themselves. The reader is cautioned against making any use of the absolute levels of blood pressure shown without careful regard to the above considerations and the cautions included in the report. It is well to remember the conclusion stated nearly 20 years ago by Bøe and his colleagues in reporting their study of blood pressures in Bergen, Norway that one shall not attach too much importance to absolute figures and that it may be dangerous to compare investigations.<sup>a</sup> It is believed that the data permit useful internal comparisons by age, race, sex, and other subgroups and that the value of and need for further study of the important area of hypertension outweigh the limitations we acknowledge.

Arthur J. McDowell  
Director, Division of Health  
Examination Statistics

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<sup>a</sup>Bøe, J., Humerfelt, S., and Wedervang, F.: The blood pressure in a population; blood pressure readings and height and weight determinations in the adult population of the City of Bergen. *Acta. med Scandinav.* Supplement 321. Bergen. 1957.

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# BLOOD PRESSURE OF YOUTHS 12-17 YEARS

Jean Roberts and Kurt Maurer, *Division of Health Examination Statistics*

## INTRODUCTION

This report contains data on blood pressure of youths 12-17 years of age in the noninstitutionalized population of the United States, as estimated from direct examination findings from the Health Examination Survey of 1966-70 among a national probability sample representative of the 22.7 million youths in that segment of the population. Findings are analyzed with respect to age, sex, race, geographic region, area of residence, annual family income, and educational level of the head of the household.

In using these national estimates of blood pressure levels for the ages 12-17 years, the reader should keep in mind that these data show a marked degree of internal consistency but are unexpectedly high in comparison with previous national survey findings and with those from the first Health and Nutrition Examination Survey of 1971-1974 (soon available in a separate report) for reasons apparently attributable primarily to ones associated with the examiners who used the 1951 American Heart Association criteria, as described in the findings and in appendix I.

The Health Examination Survey is one of the major programs of the National Center for Health Statistics which was authorized through the National Health Survey Act of 1956 by the 84th Congress as a continuing Public Health Service responsibility to determine the health status of the population.<sup>1</sup>

The principal health survey programs in the National Center for Health Statistics which carry out the intent of the National Health Survey Act are those of the Divisions of Health Examination

Statistics, Health Interview Statistics, Health Manpower and Facilities Statistics, and Health Resources Utilization Statistics. The Health Interview Survey, which collects health information from samples of people by household interview, primarily studies the impact of known illness and disability on the lives of people. The Health Manpower and Facilities program obtains information through surveys of hospitals, nursing homes, and other resident institutions and the entire range of personnel in the health occupations. The Health Resources Utilization surveys obtain information on the extent of health facility and service utilization. In the Health Examination Survey data are collected through direct physical examinations, tests, and measurements performed on carefully selected nationwide probability samples of the population. This latter system, in addition to providing the most efficient way of obtaining actual diagnostic data on the prevalence of specified medically defined illness, is the only one of the survey methods used to secure information on unrecognized or undiagnosed conditions as well as a variety of physical, physiological, and psychological measures within the population. Medical history, demographic, and socioeconomic data are also obtained on the sample population under study, making possible the interrelation of these data with the examination findings for those examined.

The Health Examination Survey is planned as a continuous series of separate programs called "cycles." Each cycle is limited to specific aspects of health within specified segments of the U.S. population. The first cycle, 1960-62, was designed primarily to provide data on the preva-



lence of certain chronic diseases and on the distribution of various physical and physiological measures in a defined adult population.<sup>2,3</sup>

For the second cycle, 1963-65, the target population was noninstitutionalized children 6-11 years of age. The examination and medical histories for this cycle were focused primarily on health factors related to growth and development.<sup>4,5</sup>

The findings on which this blood pressure report is based are from the third cycle, which was designed to obtain data on the health status of the youth population with particular emphasis on factors and conditions related to their growth and development. For this program a probability sample of the noninstitutionalized youths 12-17 years in the United States was selected and examined. The questionnaires, examination content, and procedures were similar to those in the children's program in order to obtain comparable information for the entire age range of childhood through and beyond adolescence, but the earlier survey methods were supplemented to obtain data specifically related to adolescent health. Included were a physical examination given by a pediatrician assisted by a nurse, an examination by a dentist, tests administered by a psychologist, and a variety of tests and measurements by laboratory, X-ray, and health technicians. The survey plan, sample design, examination content, and operation of this survey program have been described in a previous report.<sup>6</sup>

Field collection operations for the youths' cycle started in March 1966 and were completed in March 1970. There were 6,768 youths examined, 90 percent of the 7,514 youths selected in the national probability sample. This national sample is representative, and the examined group is closely representative, of the 22.7 million civilian noninstitutionalized youths 12-17 years in the United States with respect to age, sex, race, geographic region, population size of place of residence, and rate of change in size of place of residence from 1950 to 1960.

Examinations in the youths' cycle, as in the preceding program among children, were done consecutively in 40 different locations throughout the United States. During his single visit each youth was given a standardized examination by the medical team in the mobile units specially

designed for use in the survey. Prior to the examination, demographic and socioeconomic data on household members as well as medical history, behavioral, and related data on the youth to be examined were obtained from his parents. In addition, a Health Habits and History form was completed by the youth before he arrived for the examination and a Health Behavior form was completed by him while in the examination center. Ancillary data were requested from the school last attended by the youth including his grade placement, the teacher's rating of his behavior and adjustment, and health problems known to his teacher. A birth certificate was obtained for each youth to verify his age and provide information related to his condition at birth.

The reliability and limitation of the blood pressure measurements obtained in this survey of youths are assessed in appendix I. Statistical notes on the survey design, reliability of the data, and sampling error are in appendix II. Definitions of the demographic and socioeconomic terms are in appendix III.

## BLOOD PRESSURE MEASUREMENTS

Systolic and diastolic blood pressures were measured as part of the cardiovascular examination that, in addition to a medical history, included a routine auscultation of the heart by the survey pediatrician, an electrocardiogram, a chest X-ray, and an exercise tolerance test.

Three sets of blood pressure readings were taken by the nurse—the first two at the beginning and end of the physical examination given by the survey pediatrician with the youth in a supine or prone position and the third immediately after the second with the youth sitting on the edge of the examination table. The venipuncture was done between the first and second reading.

Blood pressure was measured indirectly with standard clinical mercury sphygmomanometers of the type usually used in physicians' offices and in most surveys obtaining blood pressures. The following guidelines, based on the American Heart Association's "Recommendations for Human Blood Pressure Determinations by Sphygmomanometers,"<sup>7</sup> were observed by the two nurses who took these measurements:

- The cuff at least 20 percent wider than the diameter of the examinee's arm or covering approximately two-thirds of the arm. (An adult 13 cm. cuff and a pediatric 9.5 cm. cuff were available.)
- The nurse at eye level with the manometer.
- The meniscus checked weekly for zero-level calibration.
- While measuring, the rate of fall in pressure maintained at 2-3 mm. Hg per heartbeat, which would be slow enough to detect the first and last sounds but sufficiently rapid to avoid intermittent trapping of blood between systolic and diastolic pressures.
- For diastolic pressure, the level recorded was at the point of complete cessation of Korotkoff's sounds or, if no cessation, at the point of muffling.
- Measurements were recorded to the nearest 2 mm. Hg on the measurement scale.

The middle of the cuff was placed over the bulge in the upper right arm. Using the bell of the stethoscope, the nurse noted and recorded the pressure when the sound was first heard (systolic) and the pressure when the sounds disappeared or, if no cessation, when the sound first became muffled (diastolic).

This method of measurement provides results comparable with clinical findings. However, these indirect blood pressure measurements may differ from the true values that would be obtained by direct (intra-arterial) measurement. The direct and indirect methods of measurement have been found to agree closely for systolic pressure if the cuff size is appropriate to the examinee's height and arm girth. For diastolic pressure, the agreement is not as good. Use of the American Heart Association criterion—the point of complete cessation of sound or, if no cessation, the point at which it first becomes muffled—has been found to underestimate intra-arterial diastolic blood pressure. However, using the point at which the sounds first become muffled produces a similar amount of bias in the opposite direction.<sup>8,9</sup>

Since blood pressure has been found to vary considerably over a short period of time even

under relatively standard conditions,<sup>10,11</sup> the basic findings for systolic and diastolic blood pressure among youths in this report are shown as the average of the three measurements taken, assuming as has been done in the published findings from the earlier Health Examination Surveys, that this is a better measure of the examinee's actual pressure than the individual readings would be. For comparison with the published findings among children from the 1963-65 Health Examination Survey, some data on the average of the two prone measurements for youths are also included.

## FINDINGS

### Age and Sex

Mean systolic blood pressure among youths 12-17 years of age in the United States consistently increases with age from 121.8 mm. Hg at 12 years to 132.9 mm. Hg at 17 years (table 1 and figure 1). As previously indicated, these national estimates are based on the average of the three blood pressure measurements obtained in the Health Examination Survey of 1966-70 among a national probability sample of examinees

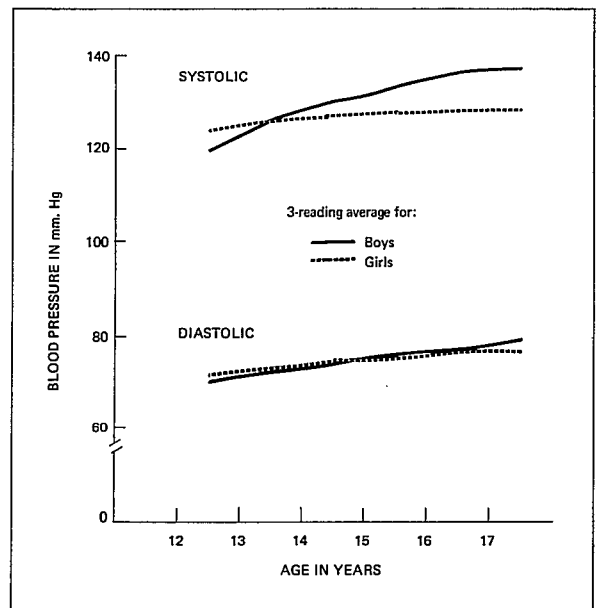


Figure 1. Mean systolic and diastolic blood pressure of youths by age and sex: United States, 1966-1970.

representative of the noninstitutionalized youth population at that time.

Boys age 12-17 years tend to have higher systolic pressure and the level increases more rapidly with age for them than for girls age 12-17 years. For the total youth age range the mean level for boys exceeds that for girls by 3.6 mm. Hg, a difference that is statistically significant (at the 5-percent probability level). The increase with age from 12 to 17 years is 17.8 mm. Hg for boys compared with only 4.3 mm. Hg for girls.

Only among the youngest youths, 12 years of age, is the mean systolic pressure of girls greater (significantly) than that of boys. From 14 years on, the mean systolic pressure of boys substantially exceeds that for girls by values that increase with age from 3.8 mm. Hg at 14 years to 9.2 mm. Hg at 17 years.

The variability in systolic pressure, as measured by the standard deviation, increases slightly with age from 11.3 mm. Hg at 12 years to 13.2 mm. Hg at 17 years. The variability is greater among boys (standard deviation of 13.6 mm. Hg) than girls (11.8 mm. Hg) and the increase in variability with age is also larger (1.9 mm. Hg for boys compared with 0.5 mm. Hg for girls over the 6-year range). However, the relative variability in relation to the mean is generally similar for boys and girls and shows no consistent age-related trend.

At each of the selected percentile points in the distributions of systolic blood pressure among youths, there is a consistent increase in this pressure with age from 12 to 17 years, the increase being more than four times as large for boys as for girls.

When tested for normality the distributions of systolic pressure at each year of age are significantly skewed to the right and/or leptokurtic (more peaked than in a normal distribution) among both boys and girls, the only exception being for 12-year-old girls, where the distribution is essentially normal (table 2). The distributions for both boys and girls become slightly more skewed to the right and more peaked with age.

The mean diastolic blood pressure (average of the three readings) among youths 12-17 years of age in the United States also increases with age from 71.1 mm. Hg at 12 years to 77.9 mm.

Hg at 17 years (table 1 and figure 1). While the mean diastolic pressures for boys and girls 12-17 years are nearly identical, the increase with age is more rapid among boys than among girls, an 8.9 mm. Hg increase from 12 to 17 years for boys compared with a 4.7 mm. Hg increase for girls. For younger boys (12-14 years) mean diastolic pressures are less than those for girls while among older youths the pattern reverses. Only at the extremes of the age range—12 and 17 years—are the mean differences large enough to be considered statistically significant.

Although the variability in systolic pressures increases with age, no such age-related trend was found for diastolic pressures. There was also no difference between boys (8.1 mm. Hg) and girls (7.9 mm. Hg) in the variability of diastolic pressure among the youth population, as measured by the standard deviation. At each percentile point in the distribution of diastolic pressure, there was a nearly constant increase with age from 12 to 17 years for both boys and girls.

Diastolic blood pressure tends to be more nearly normally distributed among youths at each year of age than systolic pressure (table 2). The distributions for diastolic pressure are significantly skewed (to the right) and/or leptokurtic (more peaked than normal) except at 12 and 14 years for boys and at 12, 13, and 15 years for girls.

## Race

Among white youths in the United States, mean systolic blood pressure consistently increases with age from 122.2 mm. Hg at 12 years to 133.2 mm. Hg at 17 years (table 3 and figure 2). Similar to youths of all races combined, white boys have higher mean systolic pressure and the level increases more rapidly with age than for white girls. At 12 years the mean level for white girls exceeds that for white boys while from 14-17 years the reverse is found and the sex difference increases with age. The mean increase from 12 to 17 years for white boys is 18.0 mm. Hg and for white girls 3.9 mm. Hg. Similarly the variability in systolic pressure is greater among white boys than among white girls and generally increases slightly with age.

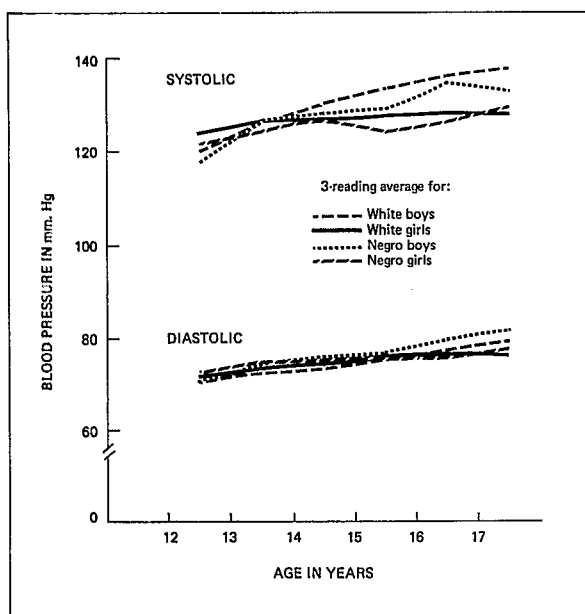


Figure 2. Mean systolic and diastolic blood pressure of white and Negro youths by age and sex: United States, 1966-1970.

Negro youths show patterns similar to those for white youths of increasing systolic pressure with age from 119.6 mm. Hg at 12 years to 131.6 mm. Hg at 17 years (table 4) and of higher mean levels among boys than among girls (128.0 mm. Hg compared with 125.4, respectively).

At each year of age the mean systolic blood pressure of white youths is greater than that of Negro youths, except among 13-year-old boys and 17-year-old girls. While this pattern of higher systolic pressure among white than Negro youths is fairly consistent, only at 15 years for boys and girls and 17 years for boys are the mean differences large enough to be statistically significant (or to probably reflect more than sampling variability).

The increase in systolic pressure with age from 12 to 17 years is slightly greater among white than Negro boys (18.0 mm. Hg compared with 16.0 mm. Hg), while the increase among white girls is only half that among Negro girls (3.9 mm. Hg compared with 7.9 mm. Hg).

The mean diastolic blood pressure of white youths also consistently increases with age from 71.0 mm. Hg at 12 years to 77.7 mm. Hg at 17 years. While the mean levels for white boys and

girls are identical (74.6 mm. Hg), the increase with age is twice as large among white boys (8.7 mm. Hg) as among white girls (4.7 mm. Hg). Among younger white youths mean levels for girls exceed those for boys, while at age 15 years and older the pattern is reversed. The variability in this measurement is similar among white boys and girls and shows no age-related trend.

Among Negro youths diastolic pressure also increases with age from mean values of 71.8 mm. Hg at 12 years to 79.5 mm. Hg at 17 years. The mean level among Negro boys slightly exceeds that among Negro girls and the increase with age for Negro boys (10.8 mm. Hg) is about twice that for Negro girls (4.6 mm. Hg).

In contrast to the racial differences found in systolic pressure, Negro youths have slightly higher mean diastolic blood pressure than have white youths across the age range in this study, with the one exception for 16-year-old girls. The mean diastolic pressure is 75.8 mm. Hg for Negro youths and 74.6 mm. Hg for white youths 12-17 years, with the racial difference being greater among boys (1.7 mm. Hg) than girls (0.8 mm. Hg).

Findings are not included separately for other racial groups since their proportion in the United States and hence in the sample for this survey is too small to provide reliable estimates for that segment of the population. However, the national estimates for all races combined do include those groups.

### Geographic Region

Although some regional differences in blood pressure are noted here, these differences do not follow a consistent pattern but appear to reflect the differences between the nurse observers described in appendix I.

Mean systolic blood pressure is higher among youths 12-17 years of age in the South and lower among those in the West than among youths living in either the Northeast or Midwest (table 5). Only the mean difference in levels between those in the South and West (1.7 mm. Hg) is large enough to be statistically significant (at the 5-percent level). Both boys and girls in the South had higher mean systolic pressures and those in the West

had systolic pressures as low as or lower than elsewhere, although the difference between the extremes for either group is not large enough to be statistically significant with the size and design of the sample used in this survey. The States included in each of the four broad geographic regions into which the United States was divided for the probability sample selection used in this survey are listed in appendix III.

In each region the mean systolic blood pressure for boys exceeds that for girls and the increase from 12 to 17 years is more rapid among boys than among girls.

Regional differences in the systolic blood pressure levels of white youths are similar to those for all youths—those in the South had the highest mean values and those in the West had the lowest (table 6). No such consistent pattern of regional differences in systolic pressure is evident among Negro youths, in part because of the substantially smaller proportion of this race in two of the regions. Negro youths in the South have slightly higher mean systolic pressure and those in the Midwest have lower levels than elsewhere (table 7); however, the mean differences are too small to be of significance and are found only among boys.

Youths in the Northeast have higher mean diastolic blood pressure and those in the West have lower levels than youths in the other two regions. Only the mean difference between those in the Northeast and West (1.3 mm. Hg) is statistically significant. This regional pattern in diastolic pressure levels—significantly higher mean levels among those in the Northeast than West—is present among both boys and girls.

Mean diastolic pressure in each of the regions is similar for boys and girls but increases substantially more rapidly with age for boys than girls.

Among white youths, the mean diastolic pressure of those in the Northeast is significantly higher than that of those in the West and South. The mean diastolic pressure of white boys was also significantly higher in the Northeast than in the West and South, while only the Northeast-West mean difference among white girls is significant.

The pattern of regional differences in diastolic pressure among Negro youths is less

consistent than that for white youths. The mean diastolic pressure of Negro youths in the Midwest is significantly higher (1.5 mm. Hg) than that in the South. However, no significant regional differences in mean diastolic levels are evident among either Negro boys or girls and what regional pattern appears to exist differs for the two groups.

### Urban or Rural Area of Residence

No significant differences in either systolic or diastolic pressures were found between youths living in urban or rural areas. The mean systolic pressure of urban youths (table 8) was 128.2 mm. Hg and the mean systolic pressure of rural youths was 129.1 mm. Hg, a difference of less than 1 mm. Hg. There was even less difference between the mean diastolic pressures of urban (74.8 mm. Hg) and rural youths (74.6 mm. Hg). A specific definition of urban and rural areas is found in appendix III.

### Family Income

No relationship is evident between income level of the family and either the systolic or diastolic blood pressures of youths. Mean pressure levels are similar (do not differ significantly) among youths in families with less than \$3,000, less than \$5,000, \$5,000-\$9,999, and \$10,000 or more annual family income for all youths and for white and Negro youths (tables 9-11 and appendix III). Within each income level, the mean systolic pressure is greater for boys than for girls, and for both blood pressures the mean increases more rapidly with age for boys than for girls.

### Education of Head of Household

Blood pressure levels of youths, either systolic or diastolic, show no relationship to the education level of the head of their household (their fathers, if present). As used here the education level is the highest grade of formal education completed by the head of the household (tables 12-14 and appendix III).

### Comparison With Previous Health Examination Survey Findings

*Background.*—Blood pressure measurements were obtained, as described, in the general cardio-

vascular part of the examination among adults 18-79 years in the Health Examination Survey of 1960-1962<sup>12,13</sup> and among children 6-11 years in the Health Examination Survey of 1963-1965,<sup>14</sup> as well as in the national survey among youths 12-17 years in 1966-1970, discussed in this report.

Throughout each of these surveys the methods were standardized and the quality of the data was carefully monitored. However, before proceeding with the comparison of findings from the three national surveys, particularly since the levels among youths are somewhat higher than expected, consideration needs to be given to the differences among the three surveys that might have influenced the test results.

The effects of the major identifiable factors present in the examinations of children and youths but not of adults and in the examinations of youths and adults but not of children which could have affected the obtained levels are analyzed in appendix I. These factors include the timing of the exercise tolerance test, given to both children and youths but not to adults, in relation to blood pressure measurement; the extent of observer variability in the examinations of children and youths where blood pressure levels were determined by a small number of nurses (4 in the examination of children and 2 in that of youths in contrast to the 39 different physician observers in the examination of adults); and the timing of the measurement in relation to the venipuncture procedure in the examination of youths and adults but not of children. While the choice of cuff (pediatric or adult size) for the youth examinees could have influenced the obtained levels, the size used was not recorded and hence the effect of this factor cannot be assessed.

One factor common to all three surveys is not considered here—the effect of the time of day at which blood pressure was measured since the scheduling of examinations of children and youths was similar. In the Health Examination Surveys of both adults and children, systolic pressure tended to be slightly higher among those examined in the afternoon than among those examined in the morning.<sup>12,14</sup>

The exercise tolerance tests in the examinations of children and youths appear to have had a negligible effect on the obtained blood pressure

levels in either survey. While youths whose blood pressure was measured less than 20 minutes after exercise did show some elevation in systolic level, the proportion with that order of examination schedule was so small (less than 1 percent) that the overall effect on the national estimates for youths is negligible (less than 2 mm. Hg). In appendix I the effect of the exercise tolerance test on the blood pressure readings in the two surveys is explored further.

Observer variability in blood pressure measurements has been shown to be substantial when the measurements were obtained by a large number of trained observers as in the 1960-1962 Health Examination Survey<sup>12</sup> and when they were obtained by either physicians<sup>15</sup> or nurses<sup>16</sup> in previous smaller studies. However, the greater the number of observers used in such a national survey with standard procedures, the less likely it is that the national estimates of blood pressure will be substantially biased by the determinations of any one or group of deviant observers. The variability in systolic pressure levels obtained by nurse observers in the children's survey was very small—a range of less than 3 mm. Hg among median values obtained by the four observers—compared with the 4 mm. Hg difference in median values between the two nurse observers in the youths' study. The nurse observers in the survey of children showed more variability in diastolic pressure measurements (range of 9 mm. Hg in median values for observers) than did those in the present study (median observer difference of less than 2 mm. Hg).

As in the 1960-1962 survey of adults, the mean systolic pressure levels obtained on the first reading for youths in the present study were 3 mm. Hg or more above those for the second. Since the timing of the venipuncture procedure varied in the adult study, it was possible to assess its effect on the blood pressure levels. In the present study, however, it was done on each youth between the first and second blood pressure measurement. Hence in this study it is not possible to assess whether this procedure contributed significantly, if at all, to the elevation of the pressures among youths.

While the examinees in the children's survey were in the prone position for both blood pressure readings taken, those in the youths' survey were

in the prone position only for the first two blood pressure readings. Therefore the first two blood pressures taken in the youths' survey were averaged to provide a similar basis for comparison with those blood pressures published for the children's survey. Tables 15-18 contain data comparable to that published for the children's survey. The total mean systolic blood pressure in table 15 is only 1.0 mm. Hg higher than that in table 1 (based on the average of all three readings), and the total mean diastolic blood pressure in table 15 is only 1.4 mm. Hg lower than that in table 1.

In the earlier adult survey the examinees were sitting for all three blood pressure measurements; therefore it is not possible to produce data for children and youths similar to the data published for adults. For the sake of convenience, however, tables 15-18 will also be used in comparison with the adult survey.

Findings on systolic and diastolic blood pressures among youths are also presented in tables 19 and 20 for each of the three separate blood pressure readings. In tables 19 and 20 the third diastolic blood pressure reading is higher than the two others. This is probably due to the fact that the third blood pressure was taken with the youth in the sitting position. Apparently the body position of the examinee had an effect only on the diastolic reading since the third systolic is lower than the two others.

Hence the most likely of the identifiable factors to have affected comparability of the blood pressure levels obtained in the three national surveys appears to be the differences in observers.

*Age trend.*—Systolic blood pressure levels consistently increase with age from a mean of 105.9 mm. Hg at 6 years to 134.1 mm. Hg at 17 years, an annual increment of 2.6 mm. Hg or a 27-percent increase in systolic pressure during that 12-year age range (figure 3, table 15, and reference 14). The average annual increment is greater among youths (2.3 mm. Hg per year) than among children (1.6 mm. Hg per year). While the increase between ages 11 and 12 years (9.0 mm. Hg, which accounts for about one-third of the 12-year increase) is disproportionate in relation to the trend for children (where the annual increment is consistently 2 mm. Hg or less per year), it is more consistent with the trend among youths

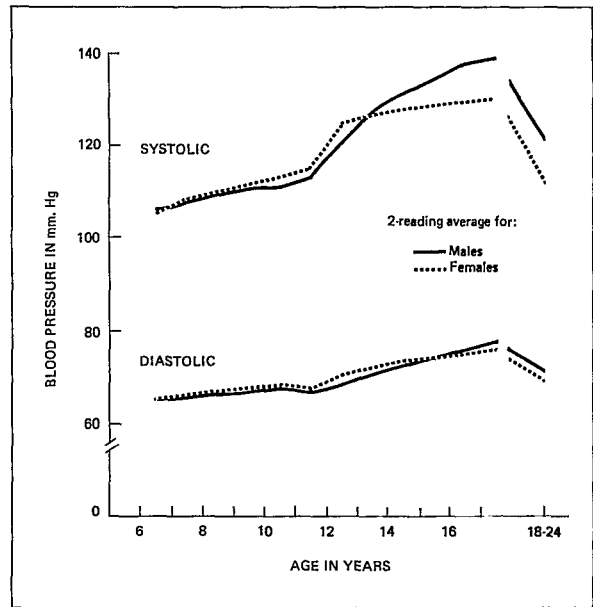


Figure 3. Mean systolic and diastolic blood pressure of males and females 6-24 years of age: United States, 1960-1970.

(where the mean differences show a fairly consistent decreasing pattern with age from 9.0 between 11 and 12 years, 4.2 between 12 and 13 years, and down to 0.7 between 16 and 17 years).

Among boys, the increase in systolic pressure with age is substantially slower among those 6-11 years old (average annual increment of 1.3 mm. Hg per year) than among those 12-17 years old, where the average annual increment is 3.6 mm. Hg. In contrast the rate of increase in systolic pressure among girls is twice as rapid at ages 6-11 years (average of 1.9 mm. Hg per year) as it is in the youths' age range (average of 0.9 mm. Hg per year).

The mean increment in systolic pressure among boys from 11 to 12 years (8.1 mm. Hg) accounts for one-fourth of the total mean increase from 6 to 17 years and is substantially greater than the trend among those 6-11 years. At 11-12 years, however, the mean increment appears to start a fairly consistent decreasing trend with age among males 12-17 years decreasing from 8.1 mm. Hg between ages 11 and 12 to 6.5 between 12 and 13 and to 1.2 between 16 and 17 years.

Among girls, the annual increase in mean systolic pressure remains at 2.2 mm. Hg or less throughout the age range 6-17 years, with the exception of the disproportionate increase between 11 and 12 years of 9.9 mm. Hg which, whether actual or an artifact of observer differences, accounts for more than 40 percent of the total increase from ages 6 to 17 years and is not consistent with the trend in either half of the age range.

The variability in systolic pressure levels as well as the mean values increase with age among both boys and girls, but the relative variability in relation to the mean values is less among children than among youths (coefficient of variation values of 7-8 among children compared with 9-10 among youths), probably reflecting the somewhat greater differences among observers in the youths' survey than in the children's survey.

Despite the substantial increase in mean systolic pressures between ages 11 and 12 years, the trend of higher mean values among girls than among boys continues from 7 through 12 years and then reverses until by age 17 years the mean levels for boys exceed those for girls by values as great as those among young U.S. adults 18-24 years of age from the 1960-1962 Health Examination Survey. In addition, the mean systolic pressure levels for boys 12-17 years of age and for girls 10-17 years exceed those for men and women 18-24 years old from the first national survey, presumably, in part if not entirely, because of examiner differences among the surveys (appendix I).

Similarly, for diastolic blood pressure there is a generally consistent increase with age (but less rapid than that for systolic pressure) from the mean of 65.5 mm. Hg for 6-year-old children to 76.8 mm. Hg for 17-year-old youths, an average annual increment of 1.0 mm. Hg. Among children the average increase in diastolic pressure with age (0.3 mm. Hg per year) is substantially less than among youths (1.5 mm. Hg per year). The diastolic pressure levels among boys and girls do not show the inconsistency between ages 11 and 12 years which is apparent in systolic pressures. However, the mean diastolic pressures for 17-year-old youths are about 6 mm. Hg above those from the 1960-1962 survey findings for young men and women. The

diastolic mean of boys 14-17 years old, and of girls 12-17 years old exceed, respectively, those of young men and young women 18-24 years of age from the 1960-1962 survey.

*Race.*—The age-related trend in systolic and diastolic blood pressure levels among the white population 6-24 years of age in the United States, as estimated from the first three Health Examination Surveys, is generally similar to that described in the preceding section for persons of all races (figure 4).

Negro boys show a substantially slower rate of increase in systolic pressure at 6-11 years than do white boys (0.5 mm. Hg per year compared with 1.4 mm. Hg) but only slightly less increase at 12-17 years (figures 4-6). The increase between 11 and 12 years is also slightly less for Negro boys, so their overall annual increment at 6-17 years of age is below that for white boys (2.3 mm. Hg compared with 3.1 mm. Hg). Among Negro girls the increase in systolic pressure with age is similar across both age groups, in contrast to the slower rate

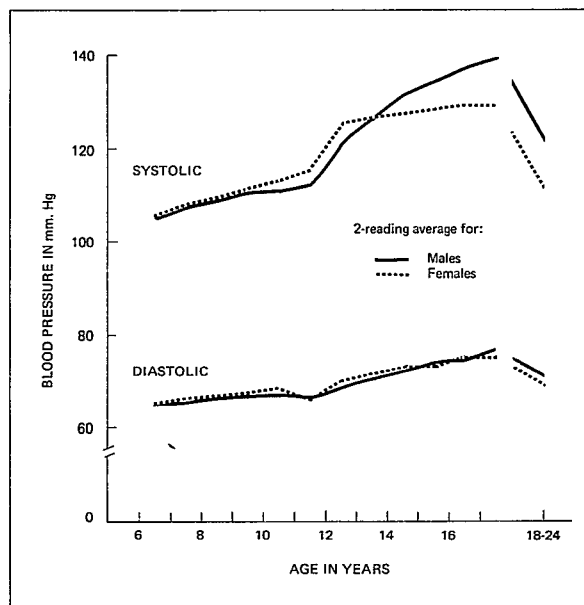


Figure 4. Mean systolic and diastolic blood pressure of white males and females 6-24 years of age: United States, 1960-1970.



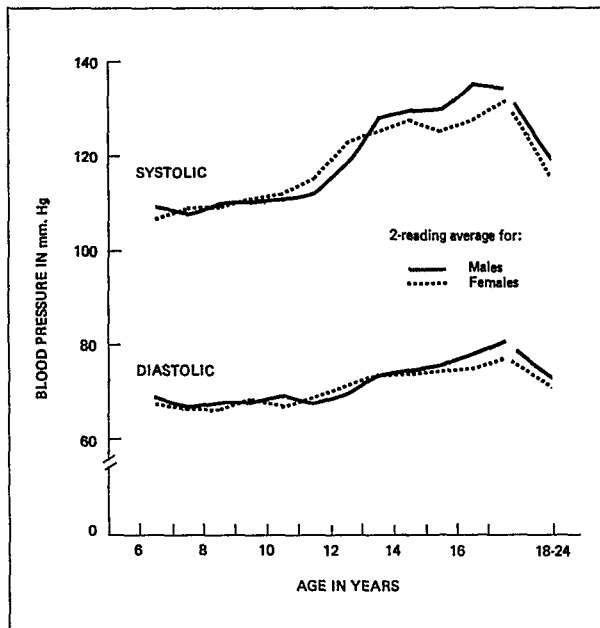


Figure 5. Mean systolic and diastolic blood pressure of Negro males and females 6-24 years of age: United States, 1960-1970.

for white girls in the range 12-17 years (figure 7). However, because the increase between 11 and 12 years for the Negro girls is less than that for white girls, the average annual increase over the range 6-17 years is similar for girls of both races (2.1 mm. Hg for white girls and 2.3 mm. Hg per year for Negro girls).

The increase in diastolic pressure with age is similar but slightly slower among Negro boys and girls than among white boys and girls, with the exception of the slight reversal among Negro boys 6-11 years where the trend with age is inconsistent.

Despite blood pressure levels among the youths that were somewhat higher than expected, the rank order of the race-sex specific mean systolic pressures for the 11-year-olds in the children's survey is the same as for the 12-year-olds in the youths' survey—the highest mean systolic pressures of white girls followed in order by those of Negro girls and white boys, and the lowest of Negro boys. With respect to diastolic blood pressure, at ages 11 and 12 Negro girls had higher mean levels than white girls had and the mean levels for Negro boys exceeded those for white boys.

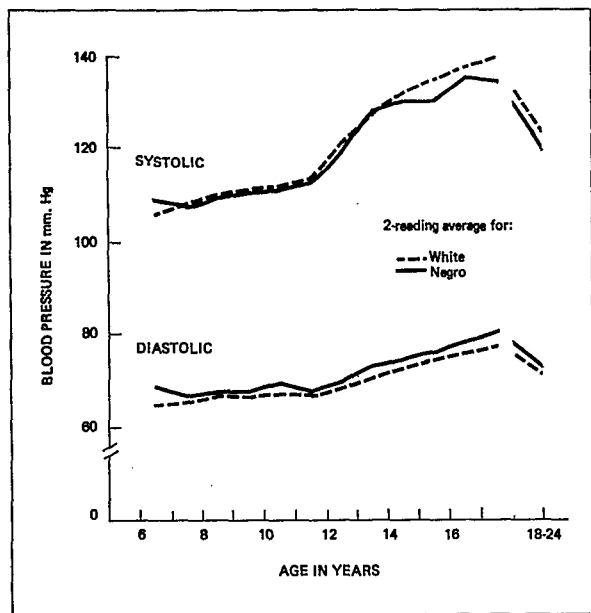


Figure 6. Mean systolic and diastolic blood pressure of white and Negro males 6-24 years of age: United States, 1960-1970.

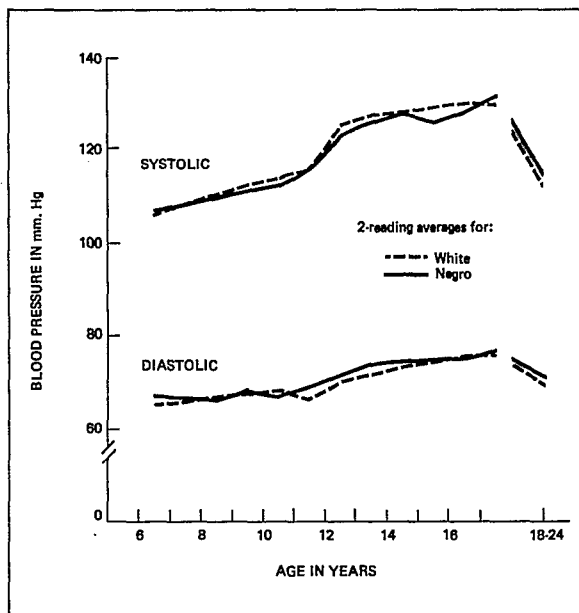


Figure 7. Mean systolic and diastolic blood pressure of white and Negro females 6-24 years of age: United States, 1960-1970.

While the mean systolic blood pressure levels among white and Negro young adults from the first national survey are below those for the 17-year-olds in this present study, the mean levels for males exceed those for females from 14-24 years in the white population and from 13-24 years in the Negro population. The rank order in mean levels among these older age groups also tends to be consistent, with the highest levels among white males followed in order by Negro males and females and white females ranking lowest. The racial pattern is less consistent for the diastolic pressure levels.

*Socioeconomic.*—As in the national survey of children, no association is evident between the systolic or diastolic blood pressure levels of youths and either the income level of their families or the educational level of the parents (tables A and B).

*Longitudinal data.*—In the 1966-70 Health Examination Survey of youths 12-17 years, the same sampling areas and housing units were utilized as in the previous 1963-65 Health Examination Survey of children 6-11 years. As a result, nearly one-third of the youths in the present study had also been examined in the

Table A. Systolic and diastolic median blood pressures taken in the prone position of youths 12-17 years by race and family income: United States, 1966-1970

Blood pressure and race	Annual family income		
	Less than \$3,000	\$3,000-\$9,999	\$10,000 or more
<u>Systolic</u>	Median pressure in mm. Hg		
All races-----	128.2	128.1	127.8
White-----	128.2	128.5	127.9
Negro-----	128.1	125.4	127.4
<u>Diastolic</u>			
All races-----	73.4	72.5	73.0
White-----	72.6	72.3	72.9
Negro-----	74.5	73.8	76.6

NOTE: All blood pressures are the average of the first two readings.

Table B. Systolic and diastolic median blood pressures taken in the prone position of youths 12-17 years by race and education of parent: United States, 1966-1970

Blood pressure and race	Education of parent			
	Less than 5 years	5-8 years	9-12 years	13 years or more
<u>Systolic</u>	Median pressure in mm. Hg			
All races-----	128.3	128.5	128.1	127.1
White-----	128.9	128.6	128.4	127.1
Negro-----	126.7	128.3	125.5	127.2
<u>Diastolic</u>				
All races-----	73.3	73.5	72.8	72.4
White-----	72.6	73.2	72.7	72.3
Negro-----	74.9	74.6	73.7	73.9

NOTE: All blood pressures are the average of the first two blood pressure readings.

children's survey. This group included about 52 percent boys and 48 percent girls, as did the total sample of examined youths. At the younger ages of 12-14 years these data were available for about 50 percent of all examined youths in those ages but only about 25 percent at 15 years and 1 percent at 16 years were available. The time lapse between the two examinations ranged from 28 months to 5 years, with a median time lapse of 4 years.

The examinees were in the prone position for both of the blood pressures taken in the children's survey and were in the prone position for the first two blood pressures taken in the youths' survey. In addition, the procedure used to measure blood pressures was the same in both surveys. Therefore a basis for comparison of the blood pressures from the two surveys exists, but comparison of the blood pressures from the two surveys reflects survey differences as well as actual change in the blood pressures of the examinees. Since the reexamined group is limited to those who remained in the same location during both surveys, were willing to be reexamined, and were primarily in the age range 12-15 years, the reexamined group cannot be considered typical of the total group of youths.

To assess the typicalness of the reexamined group with respect to blood pressures, tables 1 and 2 of the report on the blood pressures of children<sup>14</sup> can be compared with table 21 of this report and table 15 of this report can be compared with table 22 of this report. When these comparisons are made, it may be seen that the mean systolic pressure of the reexamined group when they were children was 2.2 mm. Hg higher and the mean diastolic pressure 0.7 mm. Hg higher than the total mean for all children from the previous survey. At the time of the survey of youths, the mean systolic and diastolic pressures of the reexamined group were similar to those for all youths 12-15 years.

Table 23 shows the increases in mean systolic and mean diastolic pressures of the reexamined group from the time their blood pressures were taken in the survey of children to the time their blood pressures were taken in the survey of youths. The systolic pressures increased by an average of 15.2 mm. Hg with the average increase

being 2.1 mm. Hg higher for boys than for girls. The diastolic pressures increased by an average of 4.6 mm. Hg, but in contrast with that for systolic pressure, the increase in diastolic pressures was 0.9 mm. Hg lower for boys than for girls.

The amount of increase in both the systolic and diastolic pressures was dependent upon the number of months that had elapsed between the time that the blood pressure of each examinee was taken in the children's survey and the time that the blood pressure of each examinee was taken in the survey of youths. As may be seen in table 23, this trend is more marked for the systolic pressures than it is for diastolic pressures.

### Comparison With Other Studies

Blood pressure level findings from six large-scale studies among more geographically limited groups of children and youths in the United States are available for comparison with findings from the present national study.

These include the longitudinal Child Research Council study of 1927-1967 among patients of Denver physicians from which McCammon<sup>17</sup> reports blood pressure level findings for 249 boys and girls 6-17 years of age. More than 4,500 blood pressure measurements were obtained in this study by an unspecified number of different observers.

Johnson et al<sup>18</sup> has reported findings from the first round of examinations in 1959-1960 for the total community study of Tecumseh, Michigan, residents including 2,509 in the age range 6-19 years.

Moss and Adams<sup>9</sup> published blood pressure level findings in 1962 for 944 boys and girls 6-17 years of age, but they do not indicate the area or basis for selection of the children included.

Blood pressure level findings from one examination for 1,159 healthy children 6-15 years of age seen in one physician's office and outpatient clinic in St. Louis, Missouri, were reported by Londe<sup>19</sup> in 1966.

Faber and James<sup>20</sup> have reported blood pressure findings obtained before 1920 for about 700 California schoolchildren and Graham et al<sup>21</sup> have reported on the 1926-1940 longitudinal

Table C. Design characteristics of selected studies of blood pressure among children and youths

Author	Type and time of study	Examinees		Methods of measurements
		Source	Number (6-17 years)	
McCammon <sup>17</sup> -----	Longitudinal 1927-1967	Children, Denver, Colorado area	249 (4,544 measurements)	Number of different examiners not stated, child sitting, diastolic muffled
Johnson et al. <sup>18</sup> -----	Single time 1959-1960	Children, Tecumseh, Michigan	2,509 (6-19 years)	49 examiners, child sitting, diastolic disappearance
Londe <sup>19</sup> -----	Not stated (Published 1966) (Not longitudinal)	Healthy children seen in physician's office and clinic, St. Louis, Missouri	1,159	One examiner, child supine, diastolic disappearance
Moss-Adams <sup>9</sup> -----	(Published in 1962)		944	Diastolic disappearance
Faber-James <sup>20</sup> -----	Before 1920	Schoolchildren, California	570	Two examiners, child sitting, diastolic muffled
Graham et al. <sup>21</sup> -----	1926-1940	Schoolchildren, Minnesota	3,500 (9,901 measurements)	One examiner, child sitting, diastolic disappearance
Health Examination Survey-----	Cross-sectional 1963-1965	U.S. national probability sample ages 6-11 years	7,119	Four examiners, child supine, diastolic disappearance
Health Examination Survey-----	Cross-sectional 1966-1970	U.S. national probability sample ages 12-17 years	6,768	Two examiners, youth supine (first two measurements only), diastolic disappearance

study of about 3,500 Minnesota schoolchildren on whom more than 9,900 blood pressure measurements were obtained.

A description of the methods of blood pressure measurement used and other design characteristics for each of these studies is shown in table C. However, there are so many factors that may affect blood pressure measurement—factors that either cannot be controlled or that differ, or factors that are not described in the various studies, for example, examiners, equipment, conditions of the examination, or condition of the examinee—that at least small differences in mean levels among the various study groups would be expected.

Mean systolic blood pressure levels of U.S. boys and girls 6-12 years of age, as estimated from the Health Examination Survey findings, are within the range of mean values reported from other studies. The values from the national study tend to be higher for youths 13-17 years, with the differences greater among boys (mean differences of 6-8 mm. Hg at 14-17) than among girls (mean differences of 2-6 mm. Hg at 13-17 years) (figures 8 and 9). The systolic pressure levels reported from McCammon's longitudinal study of Denver children<sup>17</sup> are substantially lower than those from the other studies

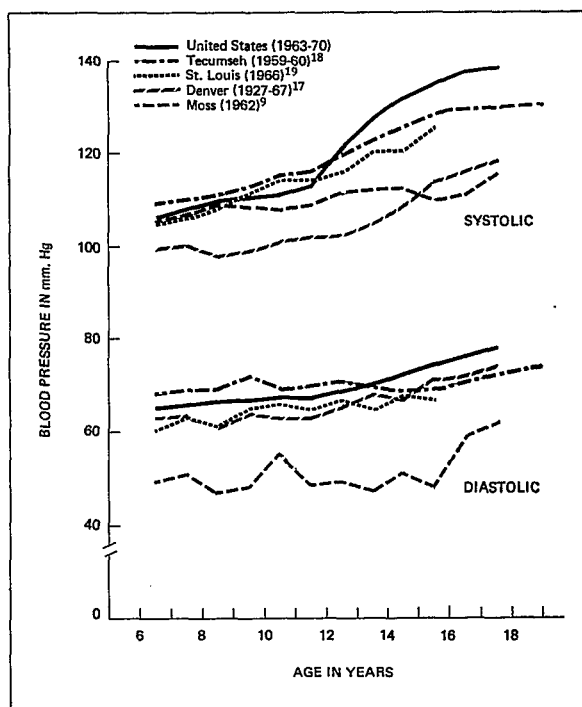


Figure 8. Mean systolic and diastolic blood pressure of boys by age from studies of Johnson et al (Tecumseh),<sup>18</sup> Londe (St. Louis),<sup>19</sup> McCammon (Denver),<sup>17</sup> Moss,<sup>9</sup> and national estimates for U.S. boys from the 1963-1970 Health Examination Survey.

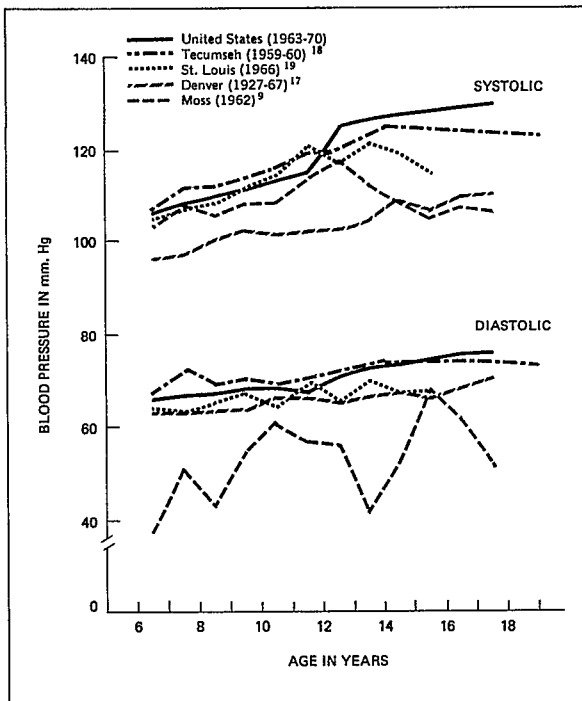


Figure 9. Mean systolic and diastolic blood pressure of girls by age from studies of Johnson et al (Tecumseh),<sup>18</sup> Londe (St. Louis),<sup>19</sup> McCammon (Denver),<sup>17</sup> Moss,<sup>9</sup> and national estimates for U.S. girls from the 1963-1970 Health Examination Survey.

at 6-14 for boys and 6-13 for girls and are among the lowest for the remainder of the youth age range. The systolic levels reported by Moss and Adams<sup>9</sup> for youths are also among the lowest of those from the available studies. Greater variability is evident among the various study findings for youths 12-17 years than for children 6-11 years of age.

Mean diastolic pressure levels for boys and girls in the various studies, except for those reported by Moss and Adams,<sup>9</sup> are in fairly close agreement, differing by no more than might be expected from observer variability alone (4-8 mm. Hg) across the age range 6-17 years (figures 8 and 9). National estimates based on Health Examination Survey findings tend to be within the range of values from the other studies (excluding those of Moss and Adams) for boys 6-12 years and girls 6-15 years and just slightly higher (less than 3 mm. Hg) for the older youths. If the diastolic pressure data of McCammon for

Denver children and Faber and James for California children had been determined at the point of cessation of sound, those levels would have been somewhat lower than shown.

The increase in systolic blood pressure levels with age is more consistent for boys than for girls among the various studies. The slightly more rapid increase in ages 12-17 years than in 6-11 years found among boys in the national survey is generally consistent with findings from the other studies. Similarly the slower increase in diastolic than systolic pressure with age is generally evident in the various studies discussed here.

## SUMMARY

This report presents national estimates of blood pressures of youths ages 12-17 years, based on findings of the Health Examination Survey of 1966-70.

The estimates are derived from blood pressure measurements obtained from a probability sample of 7,514 youths, representative of the 22.7 million youths in the noninstitutionalized civilian population 12-17 years living in the coterminous United States. Of these youths, 90 percent were examined.

Three measurements were obtained on each youth with the use of a sphygmomanometer. A standard set of procedures was followed by the two nurses responsible for the measurements.

Mean systolic pressures increased substantially with age from 121.8 mm. Hg at age 12 to 132.9 mm. Hg at age 17. Similarly mean diastolic pressures increased substantially but at a somewhat slower rate from 71.1 mm. Hg at age 12 to 77.9 mm. Hg at age 17.

The systolic pressures of girls were higher than those of boys only at age 12, they were about the same at age 13, and those of boys were higher at ages 14-17.

The diastolic pressures of girls were higher than those of boys at ages 12-14, but they were higher for boys than for girls at ages 15-17.

The systolic pressures of white youths were generally higher than those of Negro youths. However, the diastolic pressures of Negro youths were generally higher than those of white youths.

No relationship was found between the urban or rural area of residence, parent education, or family income of the youth and the youth's systolic or diastolic blood pressures.

Comparisons with previous national estimates obtained from the Health Examination Surveys of 1960-62 (adults' survey) and 1963-65 (children's survey) are included. Similarities and differences between the three surveys are noted. In general, the blood pressure levels, particularly systolic, from the youths' survey are substantially higher than would have been expected for youths of ages 12-17. Although these findings are somewhat higher than ex-

pected, the sex- and race-related differences are remarkably similar to those found in the previous two surveys.

Comparison with findings from other large-scale studies in various parts of the country indicate that the national estimates for youths age 12-17 years from the present survey, particularly for diastolic pressure levels, do not differ from previous findings more than might be expected on the basis of observer variability. The findings for systolic pressure of youths show greater variability among the various studies than do those for children.



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Table 1. Systolic and diastolic blood pressures of youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, selected percentiles, and population estimates: United States, 1966-1970

Blood pressure, age, and sex	Mean	S <sub>x</sub>	S <sub>̄x</sub>	Percentiles						n	
				5th	10th	25th	50th	75th	90th		95th
<u>Systolic</u>											
Blood pressure in mm. Hg											
Both sexes 12-17 years-----	128.5	12.9	0.32	108.6	112.6	119.0	126.9	136.0	144.7	150.4	22,692
12 years-----	121.8	11.3	0.43	103.8	107.2	113.6	120.7	128.8	136.3	140.4	4,002
13 years-----	126.0	11.8	0.38	108.1	111.0	116.8	124.9	132.8	140.1	146.2	3,952
14 years-----	128.6	12.3	0.43	109.6	114.0	120.1	126.8	135.6	144.4	149.7	3,852
15 years-----	130.3	12.3	0.38	111.6	115.7	121.1	128.9	137.3	145.7	150.4	3,751
16 years-----	132.4	13.0	0.53	113.1	116.6	122.9	130.7	140.2	149.2	154.6	3,625
17 years-----	132.9	13.2	0.50	112.7	116.4	123.6	131.3	140.6	149.3	155.5	3,510
Boys 12-17 years-----	130.3	13.6	0.31	108.6	112.8	120.4	128.8	138.5	147.4	152.9	11,489
12 years-----	119.7	10.8	0.59	102.5	106.2	112.0	118.8	125.7	133.5	138.0	2,032
13 years-----	126.2	12.4	0.53	107.0	110.7	116.6	124.9	133.9	140.8	148.1	2,006
14 years-----	130.5	12.2	0.49	110.8	114.7	122.0	128.6	138.1	146.9	151.6	1,951
15 years-----	133.3	11.9	0.60	115.2	117.9	124.0	132.4	140.6	147.2	151.6	1,900
16 years-----	136.5	13.0	0.51	116.9	120.7	126.6	134.6	143.8	152.8	158.2	1,836
17 years-----	137.5	12.7	0.53	119.1	122.6	128.4	135.0	144.6	153.8	160.2	1,764
Girls 12-17 years-----	126.7	11.8	0.40	108.6	112.3	118.2	125.6	133.2	140.8	146.8	11,203
12 years-----	124.0	11.5	0.48	106.1	109.0	115.9	123.9	130.7	138.5	143.3	1,970
13 years-----	125.9	11.3	0.51	108.7	111.6	117.3	124.9	132.5	139.5	144.5	1,946
14 years-----	126.7	12.0	0.60	108.4	112.8	118.0	125.3	132.9	141.4	146.7	1,901
15 years-----	127.3	12.0	0.43	109.2	113.6	118.6	125.7	134.1	140.8	148.8	1,851
16 years-----	128.3	11.6	0.74	111.0	114.4	119.2	126.5	134.5	142.3	148.3	1,789
17 years-----	128.3	12.0	0.73	110.6	113.3	119.5	126.8	135.1	142.9	148.5	1,746
<u>Diastolic</u>											
Both sexes 12-17 years-----	74.7	8.0	0.22	61.2	64.3	68.9	74.2	79.4	84.3	87.1	22,692
12 years-----	71.1	7.4	0.39	58.4	60.9	66.2	70.5	75.0	80.3	82.6	4,002
13 years-----	73.0	7.9	0.39	59.6	62.5	67.6	72.4	77.3	82.4	85.6	3,952
14 years-----	74.4	7.6	0.31	62.1	64.6	68.9	74.1	78.8	83.3	86.4	3,852
15 years-----	75.7	7.7	0.21	62.9	66.1	70.0	74.9	80.4	84.7	88.1	3,751
16 years-----	77.0	7.7	0.34	64.0	67.4	71.8	76.4	81.5	86.2	89.1	3,625
17 years-----	77.9	7.7	0.29	64.8	68.1	72.5	77.3	82.4	86.5	89.8	3,510
Boys 12-17 years-----	74.8	8.1	0.26	61.0	64.2	68.8	74.2	79.7	84.4	87.2	11,489
12 years-----	70.4	7.1	0.50	58.4	60.8	65.8	69.9	74.3	78.8	82.5	2,032
13 years-----	72.5	8.0	0.55	59.5	62.2	66.8	72.2	76.7	81.3	85.1	2,006
14 years-----	74.2	7.4	0.42	62.0	64.4	68.7	73.9	78.5	82.9	86.0	1,950
15 years-----	76.0	7.7	0.33	63.6	66.4	70.5	75.2	80.7	84.6	88.3	1,900
16 years-----	77.3	7.5	0.43	64.8	68.1	71.9	76.6	82.2	86.1	88.3	1,836
17 years-----	79.3	7.6	0.28	66.7	69.8	74.1	78.7	83.2	87.7	90.7	1,764
Girls 12-17 years-----	74.7	7.9	0.23	61.3	64.4	69.0	74.1	79.2	84.1	87.0	11,203
12 years-----	71.9	7.6	0.42	58.6	61.2	66.9	71.4	76.5	80.9	82.6	1,970
13 years-----	73.5	7.8	0.36	59.8	63.1	68.3	72.6	78.1	82.9	86.2	1,946
14 years-----	74.7	7.7	0.31	62.4	64.7	69.0	74.2	79.1	83.6	87.0	1,901
15 years-----	75.3	7.6	0.26	62.5	65.2	69.4	74.6	80.0	84.7	87.4	1,851
16 years-----	76.7	8.0	0.40	62.6	66.6	71.7	76.2	80.7	86.4	89.8	1,789
17 years-----	76.6	7.5	0.46	64.2	66.7	71.6	76.0	80.6	84.9	88.0	1,746

NOTE: S<sub>x</sub> = standard deviation; S<sub>̄x</sub> = standard error of the mean; n = estimated number of youths in population in thousands; all blood pressures are the average of three readings.

Table 2. Systolic and diastolic blood pressures of youths 12-17 years by age and sex, shown by percent distribution, skewness, and kurtosis: United States, 1966-1970

Blood pressure in mm. Hg	Boys						Girls					
	12 years	13 years	14 years	15 years	16 years	17 years	12 years	13 years	14 years	15 years	16 years	17 years
<u>Systolic</u>	Percent distribution											
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 90-----	-	-	-	-	-	-	0.3	-	-	-	-	-
90-99-----	2.2	0.7	-	-	-	-	1.6	0.9	0.6	0.6	0.1	0.2
100-109-----	15.7	6.5	3.6	0.9	1.0	0.5	8.1	4.8	5.0	4.3	2.8	3.4
110-119-----	33.2	26.6	13.9	11.7	6.9	4.4	25.6	23.2	22.1	21.4	21.6	20.4
120-129-----	30.5	29.2	34.8	26.8	26.0	23.5	33.7	35.9	36.9	35.0	34.8	34.4
130-139-----	14.9	23.4	26.7	30.9	27.5	32.3	22.0	24.3	22.0	27.2	26.1	25.6
140-149-----	2.9	9.2	13.7	22.0	22.4	23.4	7.3	9.0	9.5	6.6	10.4	11.3
150-159-----	0.5	3.7	6.0	5.6	11.7	10.6	1.4	1.6	3.0	3.3	3.2	3.4
160-169-----	0.1	0.5	1.0	1.1	3.4	4.1	-	0.2	0.4	1.0	0.8	0.7
170-179-----	-	0.1	0.3	0.6	0.7	0.7	-	0.1	0.3	0.4	0.1	0.4
180-189-----	-	0.1	-	0.2	0.2	0.5	-	-	-	0.2	0.1	0.2
190-199-----	-	-	-	0.1	-	-	-	-	0.2	-	-	-
200 and over-----	-	-	-	-	0.2	0.1	-	-	-	-	-	-
Skewness <sup>1</sup> -----	0.4	0.4	0.4	0.6	0.6	0.8	0.0	0.2	0.7	0.6	0.8	0.6
Kurtosis <sup>1</sup> -----	0.4	0.6	0.1	1.2	1.1	1.7	0.0	0.5	1.9	1.4	1.5	1.1
<u>Diastolic</u>	Percent distribution											
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 40-----	-	-	-	-	-	-	-	-	-	-	-	-
40-49-----	0.7	0.3	-	0.2	-	-	0.2	0.4	-	-	-	-
50-59-----	6.8	4.4	2.3	1.9	0.9	0.4	5.7	4.1	2.0	1.8	1.6	0.8
60-69-----	39.2	30.8	23.8	18.6	13.0	8.4	30.1	25.7	23.0	21.9	14.4	15.9
70-79-----	44.1	47.7	51.6	46.2	48.2	43.5	48.3	48.6	49.8	48.1	52.1	50.3
80-89-----	9.1	14.2	19.9	29.0	33.9	39.4	14.7	20.2	21.4	24.4	25.5	29.3
90-99-----	0.1	2.1	2.4	3.8	3.6	7.2	1.0	0.6	3.2	3.8	5.8	2.7
100-109-----	-	0.3	-	-	0.1	1.0	-	0.4	0.6	-	0.6	1.0
110-119-----	-	0.2	-	0.3	0.1	-	-	-	-	-	-	-
120 and over-----	-	-	-	-	-	0.1	-	-	-	-	-	-
Skewness-----	0.1	0.4	0.1	0.2	0.2	0.5	0.0	0.1	0.3	0.1	0.2	0.3
Kurtosis-----	0.1	1.5	0.1	1.4	1.4	2.6	0.4	0.5	0.5	-0.2	0.6	1.1

<sup>1</sup>For skewness,  $P_5 = .18$ ,  $P_1 = .26$ ; for positive kurtosis,  $P_5 = +.37$ ,  $P_1 = +.60$  - the probability levels based on simple random sampling theory for sample sizes of 500 which will somewhat understate the probability levels from the complex sample design used in this survey.

NOTE: All blood pressures are the average of three readings.

Table 3. Systolic and diastolic blood pressures of white youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, selected percentiles, and population estimates: United States, 1966-1970

Blood pressure, age, and sex	Mean	$s_x$	$s_{\bar{x}}$	Percentiles						$n$	
				5th	10th	25th	50th	75th	90th		95th
Systolic											
Blood pressure in mm. Hg											
Both sexes 12-17 years-----	128.8	12.9	0.37	108.9	112.8	119.4	127.2	136.2	145.1	150.8	19,552
12 years-----	122.2	11.5	0.50	104.1	107.4	114.0	120.9	129.5	136.6	140.7	3,432
13 years-----	126.1	11.8	0.48	108.5	111.6	116.9	124.9	132.8	140.2	146.4	3,396
14 years-----	128.8	12.2	0.47	110.1	114.3	120.3	126.9	135.6	144.3	150.2	3,318
15 years-----	130.9	12.3	0.45	112.8	116.3	121.9	129.6	137.9	146.4	150.8	3,240
16 years-----	132.7	12.9	0.52	114.0	117.0	123.2	130.7	140.3	149.4	154.8	3,136
17 years-----	133.2	13.4	0.56	112.6	116.3	123.6	131.8	140.9	150.0	155.9	3,030
Boys 12-17 years----	130.7	13.7	0.37	108.9	113.1	120.8	129.2	138.8	147.8	153.5	9,929
12 years-----	120.1	10.9	0.68	102.7	106.4	112.1	119.0	126.2	134.2	138.2	1,747
13 years-----	126.1	12.3	0.64	107.6	111.1	116.6	124.7	133.6	140.8	147.8	1,729
14 years-----	130.8	12.2	0.50	111.2	115.0	122.5	128.8	138.1	147.6	152.3	1,685
15 years-----	133.8	11.9	0.76	115.9	118.8	124.4	132.7	140.9	147.5	151.9	1,646
16 years-----	136.7	13.1	0.48	117.5	120.9	126.6	134.7	144.2	153.3	158.2	1,594
17 years-----	138.1	12.7	0.53	120.0	123.2	128.7	135.7	145.0	154.6	162.0	1,528
Girls 12-17 years---	126.9	11.8	0.44	108.9	112.7	118.4	125.9	133.4	140.9	147.1	9,623
12 years-----	124.3	11.6	0.55	106.2	109.2	116.0	124.2	131.1	138.8	144.2	1,685
13 years-----	126.2	11.3	0.62	109.0	112.1	117.6	125.5	132.5	139.6	144.8	1,667
14 years-----	126.8	12.0	0.68	108.8	113.5	118.2	125.2	132.9	141.0	146.6	1,633
15 years-----	127.9	12.1	0.45	110.3	114.5	119.2	126.3	134.3	141.9	149.5	1,594
16 years-----	128.5	11.3	0.74	112.2	114.7	120.0	126.8	134.5	142.0	148.1	1,542
17 years-----	128.2	12.1	0.78	110.7	113.2	119.0	126.5	134.9	143.0	148.7	1,502
Diastolic											
Both sexes 12-17 years-----	74.6	7.9	0.25	61.0	64.3	68.9	74.1	79.2	84.2	86.8	19,552
12 years-----	71.0	7.4	0.43	58.4	60.7	66.2	70.4	74.8	80.2	82.5	3,432
13 years-----	72.7	7.7	0.44	59.6	62.4	67.4	72.3	76.9	82.1	84.8	3,396
14 years-----	74.3	7.4	0.36	62.1	64.6	68.8	73.9	78.5	83.0	86.1	3,318
15 years-----	75.6	7.6	0.23	62.9	65.8	69.9	74.8	80.4	84.6	88.0	3,240
16 years-----	76.9	7.7	0.35	64.0	67.5	71.7	76.3	81.2	85.9	89.0	3,136
17 years-----	77.7	7.6	0.28	64.7	68.0	72.4	77.1	82.2	86.3	89.4	3,030
Boys 12-17 years----	74.6	8.0	0.29	60.9	64.2	68.8	74.1	79.4	84.2	86.9	9,929
12 years-----	70.3	7.2	0.53	58.3	60.5	65.7	69.9	74.2	78.7	82.5	1,747
13 years-----	72.2	7.6	0.59	59.6	62.2	66.7	72.1	76.4	80.8	84.4	1,729
14 years-----	74.0	7.3	0.46	62.0	64.4	68.6	73.3	78.3	82.7	85.8	1,685
15 years-----	75.8	7.6	0.38	63.6	66.4	70.4	75.1	80.6	84.6	88.3	1,646
16 years-----	77.0	7.6	0.49	64.5	67.9	71.3	76.4	82.0	85.5	88.2	1,594
17 years-----	79.0	7.6	0.35	66.4	69.1	74.0	78.4	82.9	87.0	90.4	1,528
Girls 12-17 years---	74.6	7.8	0.25	61.3	64.4	69.0	74.1	79.0	84.0	86.8	9,623
12 years-----	71.7	7.5	0.49	58.6	60.9	66.7	71.0	76.1	80.7	82.5	1,685
13 years-----	73.3	7.7	0.41	59.5	63.0	68.2	72.5	77.8	82.7	85.3	1,667
14 years-----	74.6	7.6	0.39	62.2	64.7	68.9	74.1	78.7	83.6	86.6	1,633
15 years-----	75.3	7.6	0.30	62.5	64.9	69.3	74.6	80.2	84.6	87.0	1,594
16 years-----	76.8	7.8	0.37	62.8	67.0	71.9	76.2	80.7	86.3	89.7	1,542
17 years-----	76.4	7.4	0.44	64.2	66.8	71.4	75.7	80.1	84.7	87.9	1,502

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean;  $n$  = estimated number of youths in population in thousands; all blood pressures are the average of three readings.

Table 4. Systolic and diastolic blood pressures of Negro youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, selected percentiles, and population estimates: United States, 1966-1970

Blood pressure, age, and sex	Mean	$s_x$	$s_x$	Percentiles						$n$	
				5th	10th	25th	50th	75th	90th		95th
<b>Systolic</b>											
Blood pressure in mm. Hg											
Both sexes 12-17 years-----	126.7	12.5	0.60	107.1	110.7	117.0	125.5	134.6	142.8	147.5	3,024
12 years-----	119.6	10.3	0.93	101.6	106.2	112.2	119.5	125.8	132.1	138.4	552
13 years-----	125.4	12.2	0.94	105.8	108.7	116.1	124.5	133.1	140.2	144.9	538
14 years-----	127.6	12.2	1.07	108.9	111.6	118.3	126.3	136.7	145.2	148.0	522
15 years-----	126.6	11.4	1.16	109.2	111.4	116.7	125.2	134.4	141.6	144.6	476
16 years-----	130.9	13.4	1.71	110.7	114.2	119.2	130.3	138.7	147.6	152.0	474
17 years-----	131.6	11.6	1.44	113.1	118.0	123.5	129.8	138.5	145.4	149.8	462
Boys 12-17 years----	128.0	13.1	0.70	107.1	111.2	118.2	126.8	136.5	145.4	149.5	1,496
12 years-----	117.5	9.7	1.20	100.6	104.8	110.9	117.0	122.8	128.8	132.9	280
13 years-----	126.7	13.0	1.91	105.2	107.8	116.3	126.6	134.6	142.9	148.6	263
14 years-----	128.8	12.1	1.31	110.3	112.8	119.5	127.1	138.2	146.5	148.6	256
15 years-----	129.1	11.7	1.15	110.4	114.7	118.3	128.7	136.1	144.4	148.8	241
16 years-----	135.1	12.5	1.62	113.8	118.4	126.7	134.2	142.6	151.4	152.0	231
17 years-----	133.5	11.7	1.64	113.7	119.1	124.5	132.3	140.5	147.2	152.3	225
Girls 12-17 years---	125.4	11.8	0.72	107.0	110.5	116.5	124.4	133.0	140.8	144.6	1,528
12 years-----	121.8	10.6	1.33	102.6	108.3	113.7	121.7	128.1	134.6	138.9	272
13 years-----	124.2	11.2	0.68	106.5	110.0	115.8	122.7	131.6	138.8	144.0	275
14 years-----	126.4	12.2	1.40	107.3	110.6	116.9	125.7	132.8	143.7	147.5	266
15 years-----	124.0	10.5	1.59	106.9	110.0	114.8	122.7	132.8	136.6	141.6	235
16 years-----	126.9	13.1	2.12	110.0	111.5	116.3	124.4	134.8	146.1	149.8	243
17 years-----	129.7	11.1	2.28	112.1	117.3	122.5	127.9	136.4	142.9	147.4	237
<b>Diastolic</b>											
Both sexes 12-17 years-----	75.8	8.4	0.32	62.1	64.7	69.6	75.0	80.9	85.7	89.0	3,024
12 years-----	71.8	7.4	0.47	58.8	62.2	66.9	70.8	76.6	81.0	82.9	552
13 years-----	74.8	9.1	0.55	59.8	63.1	68.4	73.8	79.7	85.3	88.3	538
14 years-----	75.8	7.9	0.53	62.8	64.7	70.0	74.8	80.9	84.9	89.1	522
15 years-----	76.2	8.2	0.65	62.1	67.4	70.4	75.4	80.7	86.2	90.0	476
16 years-----	77.7	7.8	0.90	64.2	66.9	72.7	77.2	82.5	87.2	89.8	474
17 years-----	79.5	7.9	1.20	66.2	70.7	73.0	79.5	83.0	88.0	90.9	462
Boys 12-17 years----	76.3	8.6	0.63	62.3	64.6	70.0	75.9	81.7	85.8	89.4	1,496
12 years-----	70.8	6.6	0.72	58.9	62.2	66.3	69.7	74.9	79.4	82.4	280
13 years-----	74.7	10.1	1.48	59.1	62.7	67.1	73.9	79.5	85.6	90.6	263
14 years-----	75.9	7.8	1.10	62.5	64.7	70.0	75.7	80.7	85.2	89.1	256
15 years-----	76.9	8.5	0.65	62.4	67.2	70.8	76.3	81.5	84.9	90.3	241
16 years-----	79.4	6.4	1.13	67.6	70.2	74.2	78.8	82.9	87.3	88.6	231
17 years-----	81.6	7.4	1.26	71.8	72.4	76.3	81.3	84.2	90.1	94.4	225
Girls 12-17 years---	75.4	8.2	0.65	61.5	64.8	69.4	74.5	80.3	85.6	88.6	1,528
12 years-----	72.9	7.9	0.78	58.6	62.3	67.6	72.4	77.6	81.9	85.5	272
13 years-----	74.8	8.0	1.27	60.4	64.5	68.9	73.7	79.9	84.8	87.7	275
14 years-----	75.7	8.1	0.69	63.2	64.7	70.0	74.5	81.0	84.0	89.4	266
15 years-----	75.5	7.8	1.09	59.5	67.5	69.7	74.2	79.1	86.5	89.7	235
16 years-----	76.1	8.7	1.13	62.1	65.0	69.7	75.4	80.4	86.9	91.7	243
17 years-----	77.5	7.8	1.79	64.2	66.6	72.4	76.7	82.3	87.2	90.3	237

NOTE:  $s_x$  = standard deviation;  $s_x$  = standard error of the mean;  $n$  = estimated number of youths in population in thousands; all blood pressures are the average of three readings.

Table 5. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and region, shown by mean and standard error of the mean: United States, 1966-1970

Blood pressure, age, and sex	Northeast		Midwest		South		West	
	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	128.6	0.39	128.4	0.87	129.4	0.35	127.7	0.53
12 years-----	120.9	0.65	122.4	1.23	122.3	0.55	121.5	1.23
13 years-----	126.7	0.89	125.7	0.99	127.2	0.44	124.8	0.71
14 years-----	128.8	0.75	127.9	0.96	129.4	1.12	128.5	0.46
15 years-----	129.8	1.11	130.0	0.79	130.9	0.65	130.5	0.74
16 years-----	133.7	0.77	132.8	0.65	133.0	1.08	130.5	1.17
17 years-----	133.8	0.60	132.8	1.41	134.0	1.20	131.4	0.46
Boys 12-17 years-----	130.5	0.63	129.7	0.83	131.6	0.39	129.7	0.47
12 years-----	119.1	0.89	119.2	1.88	121.0	0.65	119.7	1.12
13 years-----	126.7	1.16	124.8	1.40	128.8	0.82	124.8	0.96
14 years-----	131.1	0.62	129.1	1.09	130.7	1.56	131.1	0.91
15 years-----	132.4	2.02	132.4	1.17	133.5	0.67	134.7	1.16
16 years-----	137.9	0.89	136.8	0.80	136.5	1.03	134.8	1.56
17 years-----	139.6	0.35	137.7	1.51	138.8	1.44	134.5	1.20
Girls 12-17 years-----	126.7	0.47	127.1	0.96	127.2	0.43	125.7	0.69
12 years-----	122.8	0.95	125.6	0.81	123.7	0.71	123.5	1.47
13 years-----	126.7	1.09	125.6	0.93	125.5	0.77	124.7	1.06
14 years-----	126.2	1.22	126.7	1.61	128.1	0.81	125.7	0.73
15 years-----	127.2	0.72	127.1	0.91	128.4	0.82	126.5	0.96
16 years-----	129.6	1.50	128.6	1.34	128.6	1.22	126.7	1.40
17 years-----	128.3	0.82	128.5	1.92	128.9	0.93	127.6	1.57
<u>Diastolic</u>								
Both sexes 12-17 years-----	75.4	0.29	75.0	0.79	74.5	0.22	74.1	0.30
12 years-----	71.4	0.48	71.9	1.26	71.0	0.27	70.0	0.80
13 years-----	73.7	0.34	72.8	1.41	73.4	0.47	72.2	0.46
14 years-----	74.8	0.69	75.0	0.83	73.8	0.45	74.1	0.65
15 years-----	76.3	0.70	76.0	0.41	75.3	0.39	75.0	0.50
16 years-----	78.8	0.61	77.2	0.72	76.3	0.59	76.0	0.50
17 years-----	79.0	0.50	77.7	0.75	77.4	0.42	77.7	0.52
Boys 12-17 years-----	75.7	0.44	74.6	0.91	74.9	0.32	74.1	0.27
12 years-----	70.8	0.74	71.0	1.73	70.3	0.59	69.3	0.60
13 years-----	72.8	0.72	71.9	1.82	73.8	0.75	71.8	0.98
14 years-----	75.1	0.66	74.2	0.90	73.4	0.90	74.0	0.95
15 years-----	76.9	1.17	76.1	0.54	75.4	0.37	75.5	0.54
16 years-----	80.0	0.79	77.0	1.08	76.7	0.44	75.8	0.71
17 years-----	80.9	0.60	78.2	0.96	80.0	0.43	78.4	0.38
Girls 12-17 years-----	75.2	0.27	75.3	0.69	74.1	0.36	74.1	0.39
12 years-----	71.9	0.75	72.8	0.96	71.7	0.47	70.8	1.53
13 years-----	74.7	0.38	73.7	1.07	73.0	0.78	72.5	0.36
14 years-----	74.6	0.89	75.7	0.86	74.3	0.49	74.2	0.58
15 years-----	75.7	0.75	75.8	0.51	75.2	0.61	74.6	0.61
16 years-----	77.7	0.63	77.4	0.68	75.9	1.00	76.1	0.79
17 years-----	77.3	0.66	77.2	0.75	74.8	0.61	76.9	0.98

NOTE:  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 6. Systolic and diastolic blood pressures of white youths 12-17 years by age, sex, and region, shown by mean and standard error of the mean: United States, 1966-1970

Blood pressure, age, and sex	Northeast		Midwest		South		West	
	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	129.0	0.48	128.7	1.02	130.1	0.47	127.8	0.53
12 years-----	121.0	0.66	123.0	1.39	123.4	0.45	121.4	1.32
13 years-----	127.2	1.16	125.9	1.25	127.2	0.47	124.8	0.74
14 years-----	128.7	0.68	128.2	1.04	130.3	1.49	128.4	0.26
15 years-----	130.8	1.43	130.4	0.84	131.7	0.84	131.0	0.86
16 years-----	134.0	0.87	133.0	0.84	133.5	0.90	130.6	1.23
17 years-----	134.3	0.95	133.0	1.55	134.4	1.34	131.6	0.55
Boys 12-17 years-----	131.0	0.79	130.0	1.02	132.3	0.46	129.9	0.47
12 years-----	119.4	0.77	119.6	2.03	122.2	0.82	119.8	1.37
13 years-----	127.3	1.46	125.0	1.84	128.1	0.59	124.8	0.80
14 years-----	131.1	0.47	129.7	1.13	131.3	1.90	131.2	0.53
15 years-----	133.5	2.54	132.6	1.32	134.2	0.60	135.4	1.32
16 years-----	138.2	0.95	137.2	0.91	136.4	0.85	135.1	1.58
17 years-----	140.4	0.42	138.0	1.52	140.4	1.20	134.9	1.23
Girls 12-17 years-----	126.8	0.44	127.5	1.07	127.9	0.51	125.7	0.70
12 years-----	122.7	0.89	126.3	0.92	124.6	0.82	123.1	1.42
13 years-----	127.0	1.38	126.8	1.09	126.3	0.64	124.7	1.19
14 years-----	125.9	1.43	126.7	1.79	129.3	1.14	125.6	0.85
15 years-----	128.0	0.78	127.8	1.04	129.3	1.17	126.9	1.10
16 years-----	130.2	1.46	128.8	1.45	129.3	1.23	126.6	1.37
17 years-----	127.9	1.04	128.7	1.99	128.2	1.12	127.7	1.59
<u>Diastolic</u>								
Both sexes 12-17 years-----	75.4	0.24	74.8	0.85	74.3	0.26	73.9	0.30
12 years-----	71.3	0.48	71.8	1.32	71.1	0.39	69.5	0.74
13 years-----	73.6	0.17	72.6	1.52	72.8	0.47	72.0	0.43
14 years-----	74.7	0.78	75.0	0.97	73.3	0.44	73.9	0.64
15 years-----	76.1	0.78	75.8	0.37	75.3	0.52	75.2	0.50
16 years-----	78.8	0.78	77.1	0.81	76.0	0.42	75.9	0.51
17 years-----	79.2	0.44	77.5	0.80	76.9	0.42	77.4	0.50
Boys 12-17 years-----	75.8	0.43	74.4	0.99	74.3	0.32	74.0	0.28
12 years-----	70.9	0.68	70.9	1.72	70.1	0.70	69.2	0.68
13 years-----	72.7	0.65	71.7	2.01	72.9	0.71	71.8	0.81
14 years-----	75.2	0.61	74.1	1.10	72.4	0.95	73.9	0.94
15 years-----	76.8	1.37	75.8	0.50	75.0	0.43	75.7	0.71
16 years-----	79.8	1.04	76.8	1.21	76.0	0.50	75.8	0.75
17 years-----	81.2	0.80	77.9	1.07	79.1	0.49	78.1	0.53
Girls 12-17 years-----	75.0	0.26	75.3	0.74	74.2	0.44	73.8	0.37
12 years-----	71.7	0.82	72.7	1.09	72.1	0.59	70.0	1.41
13 years-----	74.6	0.54	73.5	1.15	72.8	0.79	72.3	0.40
14 years-----	74.2	1.13	75.8	0.95	74.2	0.65	73.9	0.62
15 years-----	75.3	0.62	75.8	0.58	75.6	0.91	74.7	0.56
16 years-----	77.8	0.65	77.5	0.75	76.0	0.79	75.9	0.79
17 years-----	77.0	0.93	77.1	0.79	74.5	0.62	76.6	0.96

NOTE:  $s_{\bar{x}}$  = standard error of the mean. All blood pressures are the average of three readings.

Table 7. Systolic and diastolic blood pressures of Negro youths 12-17 years by age, sex, and region, shown by mean and standard error of the mean: United States, 1966-1970

Blood pressure, age, and sex	Northeast		Midwest		South		West	
	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	126.0	2.00	125.2	0.76	127.5	0.68	126.9	2.61
12 years-----	120.3	1.77	115.9	1.98	119.5	1.79	122.8	3.39
13 years-----	124.1	1.88	122.9	2.52	127.0	1.16	124.0	4.11
14 years-----	130.0	2.65	125.0	1.52	126.8	1.16	129.8	6.11
15 years-----	122.2	2.22	127.0	3.95	128.6	1.17	124.6	4.47
16 years-----	131.1	2.72	129.9	1.47	131.5	2.74	129.9	3.55
17 years-----	130.7	5.19	130.7	1.90	132.7	1.96	130.6	3.16
Boys 12-17 years-----	126.4	1.40	126.7	1.58	129.5	0.82	126.8	2.52
12 years-----	116.9	3.15	113.9	2.04	118.3	2.10	119.1	3.17
13 years-----	122.9	3.25	121.4	6.79	130.3	2.47	122.2	10.62
14 years-----	132.0	4.73	123.7	1.70	128.9	0.79	130.4	8.12
15 years-----	121.9	3.28	130.2	3.27	131.5	1.51	127.0	28.87
16 years-----	136.4	2.99	132.6	2.79	136.8	2.14	130.6	41.40
17 years-----	131.3	7.21	135.2	6.49	134.1	2.29	131.8	29.77
Girls 12-17 years-----	125.7	2.57	123.6	0.76	125.4	0.86	127.1	2.75
12 years-----	123.0	3.03	117.7	2.71	121.0	1.74	126.8	40.21
13 years-----	124.9	1.32	124.3	2.70	123.4	1.28	125.5	5.62
14 years-----	128.3	2.16	126.6	1.52	125.0	2.36	128.9	4.46
15 years-----	122.5	2.57	123.2	6.64	125.7	1.73	120.4	5.12
16 years-----	125.4	4.38	125.8	3.37	127.1	3.23	129.5	4.75
17 years-----	130.3	6.58	125.4	2.22	131.2	3.73	129.0	2.45
<u>Diastolic</u>								
Both sexes 12-17 years-----	76.0	1.07	76.7	0.16	75.2	0.43	76.6	1.09
12 years-----	71.8	1.08	72.9	1.54	70.6	0.44	74.4	1.13
13 years-----	74.6	1.74	75.8	1.16	74.6	0.76	74.5	2.86
14 years-----	76.1	1.77	75.2	1.26	75.2	0.73	77.9	1.34
15 years-----	77.7	2.16	78.4	1.48	75.4	1.12	73.8	2.51
16 years-----	79.8	2.12	77.8	1.47	77.3	1.30	76.4	2.33
17 years-----	78.0	4.07	80.1	1.12	79.3	1.83	81.7	1.06
Boys 12-17 years-----	75.5	0.68	77.1	0.72	76.5	1.21	75.7	1.30
12 years-----	70.1	2.22	71.9	3.16	70.6	0.84	70.7	2.41
13 years-----	73.3	2.05	74.2	2.87	75.8	2.41	72.8	7.31
14 years-----	75.0	0.83	75.1	1.94	76.0	2.30	77.2	1.62
15 years-----	77.5	1.56	79.4	0.99	76.7	1.07	73.9	16.88
16 years-----	82.3	2.65	78.9	2.74	79.3	1.14	75.3	23.89
17 years-----	77.3	2.99	81.5	3.77	82.6	1.81	82.7	18.63
Girls 12-17 years-----	76.3	1.70	76.2	0.88	74.0	0.49	77.7	1.23
12 years-----	73.1	1.57	73.7	1.19	70.5	0.66	78.3	24.83
13 years-----	75.5	2.07	77.4	1.50	73.3	2.27	76.0	1.50
14 years-----	77.0	2.28	75.3	0.65	74.5	1.03	78.8	1.40
15 years-----	77.8	2.86	77.2	2.68	74.1	1.45	73.7	3.15
16 years-----	77.1	2.40	76.1	2.64	75.6	1.60	77.1	2.14
17 years-----	78.3	5.83	78.4	1.54	75.6	2.13	80.5	2.52

NOTE:  $s_{\bar{x}}$  standard error of the mean. All blood pressures are the average of three readings.



Table 8. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and urban/rural status: United States, 1966-1970

Age and sex	Systolic						Diastolic					
	Total		Urban		Rural		Total		Urban		Rural	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Blood pressure in mm. Hg												
Both sexes 12-17 years-----	128.5	0.32	128.2	0.38	129.1	0.39	74.7	0.22	74.8	0.26	74.6	0.27
12 years-----	121.8	0.43	121.2	0.56	122.9	0.44	71.1	0.39	71.1	0.42	71.1	0.54
13 years-----	126.0	0.38	126.1	0.43	125.8	0.61	73.0	0.39	73.2	0.43	72.5	0.49
14 years-----	128.6	0.43	128.4	0.56	129.0	0.68	74.4	0.31	74.2	0.40	74.8	0.44
15 years-----	130.3	0.38	130.2	0.47	130.5	0.67	75.6	0.21	75.9	0.30	75.3	0.31
16 years-----	132.4	0.53	131.8	0.73	133.4	0.65	77.0	0.34	76.8	0.49	77.4	0.48
17 years-----	132.9	0.50	132.4	0.49	133.8	0.85	77.9	0.29	78.3	0.33	77.3	0.57
Boys 12-17 years-----	130.3	0.31	130.1	0.36	130.6	0.41	74.8	0.26	75.0	0.30	74.4	0.29
12 years-----	119.7	0.59	119.0	0.73	120.9	0.58	70.4	0.50	70.4	0.51	70.2	0.73
13 years-----	126.2	0.53	126.3	0.56	126.0	1.03	72.5	0.55	73.0	0.63	71.8	0.74
14 years-----	130.5	0.49	130.3	0.66	130.8	0.78	74.2	0.42	74.0	0.55	74.5	0.52
15 years-----	133.2	0.60	133.3	0.78	133.1	0.68	76.0	0.33	76.3	0.44	75.4	0.48
16 years-----	136.4	0.51	136.4	0.70	136.4	0.65	77.2	0.43	77.4	0.56	77.0	0.54
17 years-----	137.5	0.53	137.4	0.77	137.6	0.70	79.3	0.28	80.1	0.44	77.9	0.54
Girls 12-17 years-----	126.7	0.40	126.3	0.48	127.4	0.49	74.7	0.23	74.6	0.26	74.9	0.35
12 years-----	124.0	0.48	123.5	0.60	124.9	0.68	71.8	0.42	71.8	0.47	72.0	0.73
13 years-----	125.9	0.51	126.0	0.70	125.6	0.66	73.5	0.36	73.5	0.46	73.4	0.45
14 years-----	126.7	0.60	126.4	0.85	127.2	0.73	74.7	0.31	74.4	0.48	75.2	0.56
15 years-----	127.3	0.43	127.0	0.55	127.9	0.82	75.3	0.26	75.4	0.35	75.2	0.43
16 years-----	128.3	0.74	127.6	1.01	129.6	1.03	76.7	0.40	76.2	0.57	77.8	0.58
17 years-----	128.3	0.73	127.6	0.81	129.7	1.37	76.6	0.46	76.6	0.54	76.6	0.79

NOTE: All blood pressures are the average of three readings;  $\bar{x}$  = mean and  $s_{\bar{x}}$  = standard error of the mean.

Table 9. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Annual family income less than \$3,000				Annual family income less than \$5,000			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	128.4	13.2	0.64	127.1	128.3	13.1	0.42	126.8
12 years-----	121.6	11.2	0.90	120.8	122.2	11.2	0.80	122.2
13 years-----	124.8	11.7	0.92	124.5	125.4	12.0	0.69	124.6
14 years-----	128.8	12.8	0.83	127.2	128.4	13.1	0.79	126.8
15 years-----	129.0	11.6	0.68	128.2	129.5	12.5	0.49	128.0
16 years-----	132.5	14.2	1.66	131.3	132.4	13.2	0.90	130.4
17 years-----	134.0	13.2	1.82	133.0	133.6	12.9	1.09	132.7
Boys 12-17 years-----	130.3	13.6	0.83	129.5	130.2	13.6	0.49	128.7
12 years-----	119.7	10.5	1.55	118.5	120.1	10.3	1.00	120.1
13 years-----	125.7	12.4	2.07	125.6	125.9	12.8	1.35	124.9
14 years-----	130.5	12.7	1.60	128.4	130.2	12.3	1.04	128.4
15 years-----	129.9	11.6	1.43	129.1	132.1	12.7	0.82	129.9
16 years-----	136.1	14.0	2.44	134.3	135.8	13.4	1.22	134.1
17 years-----	138.1	11.7	1.57	136.2	137.3	12.0	1.08	135.5
Girls 12-17 years-----	126.7	12.5	0.67	125.6	126.6	12.2	0.48	125.6
12 years-----	122.9	11.6	1.20	122.7	124.1	11.6	1.06	124.0
13 years-----	124.1	11.1	0.97	124.3	124.9	11.3	0.53	124.4
14 years-----	127.3	12.7	1.17	126.5	126.9	13.5	0.99	126.0
15 years-----	128.1	11.5	1.06	126.4	127.2	11.8	0.73	124.8
16 years-----	129.6	13.8	1.17	126.8	128.5	11.9	0.80	126.3
17 years-----	128.8	13.3	2.47	127.3	129.0	12.5	1.47	128.0
<u>Diastolic</u>								
Both sexes 12-17 years-----	75.5	8.7	0.37	74.5	74.9	8.4	0.21	74.0
12 years-----	71.9	7.0	0.73	71.1	71.4	7.5	0.65	70.6
13 years-----	73.3	9.1	0.76	72.4	72.9	8.8	0.37	71.9
14 years-----	75.8	8.8	0.99	74.5	74.7	8.2	0.45	74.0
15 years-----	75.7	8.5	0.68	74.6	75.7	8.2	0.35	74.7
16 years-----	77.7	8.6	0.81	76.7	77.1	7.7	0.42	76.3
17 years-----	78.8	7.7	1.06	78.7	78.5	7.7	0.55	78.2
Boys 12-17 years-----	75.7	8.7	0.70	75.0	74.9	8.5	0.38	74.1
12 years-----	70.7	6.9	1.24	69.9	70.2	7.1	0.72	69.4
13 years-----	74.7	10.5	2.06	73.2	72.5	9.6	0.89	71.4
14 years-----	75.6	8.2	1.23	74.8	74.3	7.8	0.93	73.2
15 years-----	74.3	8.5	0.67	74.0	75.3	8.6	0.54	74.6
16 years-----	78.1	7.2	1.02	78.8	77.6	6.9	0.59	76.9
17 years-----	80.0	7.1	1.00	79.6	79.5	7.3	0.70	79.3
Girls 12-17 years-----	75.3	8.6	0.47	74.2	74.9	8.3	0.30	74.0
12 years-----	72.8	7.0	0.76	71.9	72.4	7.8	0.85	71.9
13 years-----	72.2	7.6	1.27	71.4	73.3	8.0	0.66	72.2
14 years-----	75.9	9.4	1.33	74.4	75.1	8.5	0.53	74.2
15 years-----	77.0	8.2	0.80	75.9	76.1	7.8	0.42	74.8
16 years-----	77.4	9.6	0.86	75.9	76.6	8.5	0.51	75.7
17 years-----	77.4	8.2	1.51	75.4	77.3	8.0	0.68	75.6

See note at end of table.

Table 9. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970—Con.

Blood pressure, age, and sex	Annual family income \$5,000-\$9,999				Annual family income \$10,000 or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	128.7	13.1	0.43	127.2	128.4	12.6	0.47	126.8
12 years-----	121.5	11.7	0.72	120.3	121.8	11.2	0.67	120.1
13 years-----	126.6	12.1	0.77	125.4	125.7	11.8	0.96	124.9
14 years-----	129.2	12.2	0.46	127.3	128.2	11.7	0.60	126.2
15 years-----	130.5	12.7	0.60	129.7	130.4	11.4	0.69	130.3
16 years-----	132.4	12.9	0.80	130.2	132.8	12.9	0.64	131.7
17 years-----	133.8	13.3	0.73	131.9	132.0	13.2	0.91	129.9
Boys 12-17 years-----	130.3	14.0	0.44	129.0	130.4	13.4	0.60	128.8
12 years-----	119.3	10.9	0.82	118.6	119.7	11.0	1.25	118.1
13 years-----	126.7	13.0	0.98	124.9	125.8	11.9	1.12	124.8
14 years-----	131.4	12.5	0.45	128.9	129.8	11.8	0.81	128.3
15 years-----	133.8	11.5	0.74	132.8	133.0	11.3	1.19	133.0
16 years-----	135.7	13.6	1.03	134.2	138.7	11.7	0.77	136.8
17 years-----	137.8	13.0	0.99	133.8	137.8	12.7	1.37	136.8
Girls 12-17 years-----	127.0	11.8	0.51	126.1	126.4	11.5	0.47	125.0
12 years-----	124.1	12.0	1.01	124.0	123.9	11.1	0.68	123.5
13 years-----	126.6	11.1	0.98	126.2	125.6	11.7	1.27	125.1
14 years-----	127.0	11.6	0.71	126.1	126.4	11.3	0.93	124.3
15 years-----	127.1	12.9	0.87	125.7	127.5	10.8	0.81	126.2
16 years-----	128.6	10.9	0.98	126.5	127.6	11.6	0.97	126.8
17 years-----	129.1	11.9	0.96	128.0	127.6	11.9	1.02	125.3
<u>Diastolic</u>								
Both sexes 12-17 years----	74.6	8.1	0.32	74.1	74.8	7.6	0.27	74.3
12 years-----	70.8	7.5	0.53	70.3	71.3	7.3	0.55	70.9
13 years-----	73.1	7.9	0.69	72.6	72.7	7.2	0.75	72.2
14 years-----	73.8	7.7	0.50	73.2	74.9	7.0	0.38	74.4
15 years-----	75.8	7.5	0.28	75.1	75.5	7.1	0.39	75.0
16 years-----	76.9	8.1	0.49	76.6	76.9	7.3	0.53	76.2
17 years-----	78.3	7.8	0.47	78.0	77.5	7.6	0.51	76.8
Boys 12-17 years-----	74.7	8.4	0.31	74.2	74.8	7.6	0.40	74.3
12 years-----	70.1	7.0	0.56	69.4	70.7	7.4	0.97	70.3
13 years-----	72.6	7.9	0.89	72.3	72.2	7.0	0.99	72.0
14 years-----	73.6	7.9	0.60	73.4	74.5	6.6	0.62	74.1
15 years-----	76.4	7.7	0.47	75.9	75.9	6.6	0.52	75.4
16 years-----	77.0	8.2	0.69	76.6	77.5	7.0	0.60	76.5
17 years-----	79.7	7.9	0.58	78.8	79.0	7.5	0.56	78.4
Girls 12-17 years-----	74.5	7.9	0.41	74.1	74.8	7.6	0.22	74.2
12 years-----	71.6	7.9	0.80	70.9	71.8	7.1	0.47	71.7
13 years-----	73.6	7.9	0.64	72.8	73.4	7.3	0.70	72.5
14 years-----	74.1	7.5	0.61	73.2	75.5	7.3	0.59	74.6
15 years-----	75.1	7.4	0.40	74.5	75.0	7.5	0.49	74.6
16 years-----	76.7	8.1	0.64	76.6	76.5	7.6	0.62	75.9
17 years-----	76.6	7.3	0.62	76.5	76.3	7.5	0.83	75.4

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  standard error of the mean; all blood pressures are the average of three readings.

Table 10. Systolic and diastolic blood pressures of white youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Annual family income less than \$3,000				Annual family income less than \$5,000			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	128.5	13.1	0.74	127.6	128.9	13.2	0.56	127.5
12 years-----	122.2	11.8	1.28	121.3	123.0	11.6	1.20	122.8
13 years-----	124.6	10.5	1.19	124.4	125.4	11.7	0.47	124.6
14 years-----	127.8	12.2	1.17	126.4	128.7	13.0	1.23	126.8
15 years-----	130.1	11.7	0.91	128.7	130.6	12.8	0.82	128.6
16 years-----	131.7	13.2	1.73	130.6	132.7	12.6	0.90	130.4
17 years-----	135.2	14.7	2.52	134.4	134.4	13.8	1.58	133.8
Boys 12-17 years-----	130.6	13.4	0.85	130.0	130.9	13.7	0.58	129.5
12 years-----	122.4	10.6	2.19	121.2	121.6	10.6	1.58	122.0
13 years-----	123.9	11.9	2.14	122.5	124.7	12.4	1.04	122.8
14 years-----	129.8	12.1	2.44	126.5	130.2	12.0	1.21	128.5
15 years-----	131.5	11.7	1.40	129.9	134.0	12.8	1.47	132.0
16 years-----	132.9	13.3	2.51	130.9	134.9	13.1	1.29	132.4
17 years-----	140.4	12.0	2.02	138.4	139.2	12.1	1.48	136.8
Girls 12-17 years-----	126.8	12.5	0.90	125.8	127.1	12.4	0.70	126.3
12 years-----	122.1	12.5	1.65	122.1	124.3	12.3	1.42	123.8
13 years-----	125.1	9.2	0.93	124.7	125.9	11.1	0.57	125.3
14 years-----	126.3	12.0	1.00	126.0	127.4	13.6	1.54	125.8
15 years-----	129.0	11.5	1.34	128.2	127.9	12.2	0.82	126.4
16 years-----	130.7	13.0	1.50	128.0	129.9	11.2	0.95	128.0
17 years-----	128.5	15.2	3.47	126.4	128.4	13.5	2.06	128.3
<u>Diastolic</u>								
Both sexes 12-17 years----	74.8	8.3	0.47	73.8	74.4	8.1	0.27	73.3
12 years-----	71.7	7.1	1.16	71.0	71.1	7.5	0.90	70.4
13 years-----	72.8	7.3	1.03	72.3	72.5	8.0	0.42	71.9
14 years-----	74.3	8.5	1.40	73.7	74.0	8.0	0.62	73.3
15 years-----	75.1	8.8	0.92	73.4	75.3	8.3	0.46	74.3
16 years-----	76.5	8.4	0.96	75.8	76.4	7.4	0.51	75.5
17 years-----	78.7	7.9	1.33	78.3	77.8	7.5	0.63	77.0
Boys 12-17 years-----	74.4	8.1	0.49	73.5	74.2	8.1	0.45	73.0
12 years-----	70.8	7.1	2.28	70.3	70.1	7.2	0.92	69.5
13 years-----	73.3	8.2	1.54	72.7	71.6	8.3	0.71	70.9
14 years-----	73.4	7.8	1.67	73.0	73.1	7.5	1.22	72.2
15 years-----	73.1	8.7	1.16	72.2	74.9	8.8	0.77	74.1
16 years-----	76.3	7.1	1.12	76.1	76.5	6.8	0.65	75.0
17 years-----	79.0	6.6	1.43	79.1	78.5	6.8	0.80	78.5
Girls 12-17 years-----	75.0	8.5	0.72	74.0	74.6	8.2	0.40	73.6
12 years-----	72.2	7.1	1.06	71.7	72.0	7.6	1.13	71.4
13 years-----	72.4	6.5	1.20	71.6	73.2	7.7	0.60	72.2
14 years-----	75.1	8.9	2.05	74.1	74.8	8.4	0.82	74.1
15 years-----	76.7	8.5	0.94	74.5	75.6	8.0	0.48	74.4
16 years-----	76.6	9.3	1.55	75.4	76.3	8.2	0.86	75.8
17 years-----	78.3	9.2	2.07	74.9	77.0	8.1	0.98	74.8

See note at end of table.

Table 10. Systolic and diastolic blood pressures of white youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970—Con.

Blood pressure, age, and sex	Annual family income \$5,000-\$9,999				Annual family income \$10,000 or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	129.1	13.2	0.47	127.6	128.5	12.7	0.48	126.9
12 years-----	121.8	11.7	0.83	120.4	121.9	11.3	0.66	120.1
13 years-----	126.8	12.1	0.85	125.6	125.6	11.9	0.99	124.9
14 years-----	129.5	12.4	0.51	127.9	128.3	11.7	0.60	126.4
15 years-----	131.2	12.6	0.55	130.1	130.5	11.4	0.73	130.3
16 years-----	132.7	13.1	0.82	130.4	132.8	13.0	0.67	131.6
17 years-----	134.2	13.3	0.76	132.2	132.0	13.3	0.98	129.8
Boys 12-17 years-----	130.8	14.1	0.49	129.6	130.4	13.5	0.61	128.7
12 years-----	119.7	11.0	0.89	118.7	119.6	11.0	1.33	117.8
13 years-----	126.9	13.0	1.14	125.2	125.8	12.0	1.14	124.9
14 years-----	132.2	12.6	0.54	130.3	130.0	11.8	0.83	128.4
15 years-----	134.3	11.5	0.73	133.0	132.9	11.4	1.24	132.8
16 years-----	136.4	13.9	1.09	134.6	138.8	11.8	0.77	136.8
17 years-----	138.1	12.9	0.96	134.3	137.8	12.9	1.43	136.6
Girls 12-17 years-----	127.2	11.9	0.58	126.2	126.5	11.5	0.46	125.1
12 years-----	124.5	12.0	1.18	124.3	124.1	11.1	0.68	124.0
13 years-----	126.6	11.1	1.10	126.2	125.4	11.7	1.30	124.9
14 years-----	126.8	11.6	0.76	126.2	126.5	11.3	0.91	124.2
15 years-----	127.8	12.9	0.84	126.0	127.7	10.8	0.82	126.4
16 years-----	128.6	10.8	0.93	126.6	127.6	11.6	0.99	126.7
17 years-----	129.4	12.2	1.02	128.1	127.5	11.8	0.98	125.2
<u>Diastolic</u>								
Both sexes 12-17 years-----	74.5	8.2	0.35	74.0	74.7	7.6	0.28	74.2
12 years-----	70.6	7.5	0.57	70.2	71.2	7.3	0.55	70.8
13 years-----	72.7	8.0	0.72	72.3	72.6	7.2	0.75	72.2
14 years-----	73.9	7.6	0.53	73.0	74.9	7.0	0.40	74.4
15 years-----	75.9	7.6	0.29	75.2	75.5	7.1	0.41	75.0
16 years-----	76.8	8.3	0.47	76.6	77.0	7.3	0.54	76.2
17 years-----	78.3	7.9	0.47	77.9	77.3	7.5	0.48	76.6
Boys 12-17 years-----	74.6	8.4	0.33	74.1	74.7	7.6	0.42	74.2
12 years-----	70.0	7.0	0.59	69.4	70.6	7.4	1.01	70.3
13 years-----	72.2	7.9	0.93	71.9	72.1	7.0	1.02	72.0
14 years-----	73.8	7.7	0.62	73.1	74.4	6.6	0.64	74.0
15 years-----	76.3	7.8	0.48	75.8	75.9	6.7	0.54	75.3
16 years-----	76.9	8.4	0.77	76.6	77.4	7.0	0.63	76.5
17 years-----	79.7	7.9	0.60	78.7	78.8	7.5	0.60	78.3
Girls 12-17 years-----	74.4	8.0	0.44	74.0	74.8	7.6	0.24	74.2
12 years-----	71.2	8.0	0.89	70.6	71.8	7.2	0.46	71.7
13 years-----	73.2	8.0	0.70	72.6	73.3	7.3	0.71	72.5
14 years-----	73.9	7.6	0.65	73.0	75.5	7.4	0.58	74.6
15 years-----	75.4	7.4	0.39	74.9	75.0	7.5	0.56	74.5
16 years-----	76.8	8.1	0.58	76.6	76.6	7.6	0.61	76.0
17 years-----	76.5	7.5	0.62	76.4	76.2	7.3	0.71	75.2

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 11. Systolic and diastolic blood pressures of Negro youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Annual family income less than \$3,000				Annual family income less than \$5,000			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	128.1	13.3	1.02	126.7	127.0	12.8	0.73	125.8
12 years-----	120.4	9.9	1.51	120.3	120.4	10.1	1.32	120.2
13 years-----	125.2	13.3	1.57	125.1	125.2	12.6	1.86	124.4
14 years-----	130.4	13.6	1.26	128.5	127.9	13.3	0.75	126.8
15 years-----	126.7	11.1	1.36	123.7	126.8	11.3	1.14	124.7
16 years-----	133.9	15.8	2.42	134.5	131.7	14.7	1.84	130.6
17 years-----	132.0	10.1	2.03	129.5	131.8	10.8	1.46	129.6
Boys 12-17 years-----	129.9	13.9	1.49	128.8	128.7	13.6	0.88	127.4
12 years-----	115.5	8.6	1.27	114.2	117.2	9.2	1.60	116.7
13 years-----	128.3	12.8	3.86	127.5	127.7	13.3	3.27	128.1
14 years-----	131.4	13.3	1.83	129.2	130.3	12.9	1.39	128.3
15 years-----	127.2	11.0	2.00	126.4	128.4	11.7	1.22	128.1
16 years-----	141.7	13.5	2.93	143.4	138.3	13.7	1.80	138.0
17 years-----	134.2	10.0	2.36	131.8	133.3	11.0	1.47	131.0
Girls 12-17 years-----	126.4	12.5	0.83	125.2	125.4	11.7	0.71	124.1
12 years-----	124.8	8.8	1.96	125.1	123.8	10.0	1.98	124.0
13 years-----	122.7	13.2	1.86	120.8	122.8	11.4	1.28	121.4
14 years-----	129.1	13.8	2.79	126.7	125.9	13.2	1.37	126.2
15 years-----	126.1	11.2	2.10	122.5	124.8	10.5	2.00	122.4
16 years-----	147.7	14.7	2.37	125.1	125.9	12.9	1.57	123.0
17 years-----	129.3	9.6	2.83	127.5	130.2	10.3	2.35	127.8
<u>Diastolic</u>								
Both sexes 12-17 years-----	76.7	9.0	0.73	76.1	76.0	8.9	0.48	75.3
12 years-----	72.4	6.7	0.75	71.2	71.9	7.5	0.63	70.9
13 years-----	74.1	11.2	1.17	72.6	73.8	10.1	0.76	72.2
14 years-----	78.0	8.9	1.08	76.8	76.3	8.3	0.86	74.9
15 years-----	77.0	7.6	0.99	76.3	76.8	8.0	0.49	76.2
16 years-----	80.0	8.4	1.47	80.1	78.8	8.0	1.10	78.3
17 years-----	79.1	7.4	1.40	79.4	79.9	8.0	1.28	79.6
Boys 12-17 years-----	77.7	9.2	1.55	76.9	76.4	9.2	0.77	76.2
12 years-----	70.7	6.5	1.01	68.6	70.6	6.7	0.74	69.6
13 years-----	76.8	12.9	4.43	75.5	74.2	11.4	2.03	72.3
14 years-----	78.4	7.8	2.00	79.0	76.8	7.9	1.66	76.3
15 years-----	76.3	7.7	0.99	75.0	76.1	8.4	0.61	76.0
16 years-----	81.5	6.1	1.57	82.0	80.6	6.4	1.24	81.0
17 years-----	81.6	7.5	1.89	79.9	81.8	7.9	1.40	80.4
Girls 12-17 years-----	75.8	8.8	0.65	74.8	75.7	8.5	0.60	74.6
12 years-----	74.0	6.5	1.16	74.4	73.2	8.1	1.04	73.0
13 years-----	71.9	9.0	2.49	70.8	73.4	8.6	1.85	72.1
14 years-----	77.5	10.0	1.15	75.6	75.9	8.7	0.79	74.5
15 years-----	77.9	7.5	1.33	76.9	77.6	7.4	1.12	76.4
16 years-----	78.9	9.8	1.67	76.7	77.2	9.0	1.14	75.4
17 years-----	76.2	6.1	1.54	76.1	77.8	7.6	1.41	76.8

See note at end of table.

Table 11. Systolic and diastolic blood pressures of Negro youths 12-17 years by age, sex, and annual family income, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970—Con.

Blood pressure, age, and sex	Annual family income \$5,000-\$9,999				Annual family income \$10,000 or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	125.8	11.8	0.70	125.1	127.7	11.5	1.54	126.4
12 years-----	118.7	11.0	1.55	118.7	119.9	10.0	1.83	120.3
13 years-----	125.7	12.0	2.00	124.1	129.0	8.3	5.47	125.0
14 years-----	127.0	9.6	1.83	124.3	122.5	11.5	2.43	120.1
15 years-----	125.6	10.8	2.20	125.6	128.7	10.3	3.15	131.7
16 years-----	130.1	11.2	1.54	128.0	129.6	9.6	4.67	132.8
17 years-----	129.7	12.1	1.79	130.0	135.1	10.4	2.65	138.8
Boys 12-17 years-----	126.0	12.4	0.85	125.6	129.6	10.0	1.55	129.9
12 years-----	116.3	9.9	2.08	116.3	124.6	9.3	3.48	120.7
13 years-----	125.2	13.0	3.05	122.5	124.8	1.2	39.46	124.5
14 years-----	125.4	8.9	2.15	121.3	120.9	10.7	3.98	118.8
15 years-----	128.2	11.1	2.82	130.3	133.2	5.6	1.96	134.2
16 years-----	130.9	10.5	2.48	130.0	135.4	5.2	67.85	132.4
17 years-----	133.3	14.1	4.29	132.2	138.4	7.6	4.16	140.3
Girls 12-17 years-----	125.6	11.1	0.79	124.8	126.3	12.3	2.48	124.9
12 years-----	121.1	11.6	2.58	120.4	115.5	8.6	6.47	112.4
13 years-----	126.3	10.7	2.84	126.1	133.2	10.0	6.50	134.5
14 years-----	129.2	10.1	1.89	126.0	123.8	11.9	4.15	124.3
15 years-----	123.7	10.3	2.18	124.4	124.1	11.8	9.02	124.6
16 years-----	128.9	12.1	2.97	126.3	127.0	10.0	6.08	133.3
17 years-----	126.8	9.0	2.28	126.8	133.3	11.3	5.48	132.4
<u>Diastolic</u>								
Both sexes 12-17 years-----	75.6	7.2	0.44	74.7	76.5	8.0	0.92	77.0
12 years-----	72.5	7.0	1.01	71.7	71.4	6.8	1.66	70.7
13 years-----	76.7	6.9	1.09	75.9	76.7	5.6	2.43	80.3
14 years-----	74.3	7.1	1.67	74.2	75.5	6.7	0.69	76.5
15 years-----	75.0	6.9	1.02	72.3	76.4	7.2	2.45	76.6
16 years-----	77.3	6.7	1.31	76.6	76.0	7.4	3.05	77.1
17 years-----	78.6	6.6	1.47	78.8	81.5	8.6	3.06	84.7
Boys 12-17 years-----	75.6	7.5	0.68	74.7	78.3	7.5	0.91	78.7
12 years-----	70.4	6.8	1.83	68.9	72.2	6.9	2.55	70.6
13 years-----	76.1	7.3	2.22	76.4	74.9	6.0	24.06	70.7
14 years-----	73.2	7.2	2.10	74.0	76.2	7.5	2.54	78.2
15 years-----	77.2	6.0	1.31	76.7	78.5	4.4	1.85	80.3
16 years-----	78.4	5.8	1.95	78.0	82.8	4.8	41.42	84.6
17 years-----	80.4	6.9	2.61	82.9	85.9	3.6	1.93	85.3
Girls 12-17 years-----	75.6	6.9	0.82	74.9	75.1	8.1	1.66	74.9
12 years-----	74.6	6.6	1.51	72.9	70.7	6.7	3.34	71.1
13 years-----	77.4	6.5	1.20	75.7	78.6	4.4	3.85	80.5
14 years-----	75.9	6.6	1.44	75.1	75.0	5.8	3.14	74.6
15 years-----	73.5	7.1	1.47	71.4	74.3	8.8	4.90	74.5
16 years-----	75.7	7.6	2.20	76.5	73.0	6.3	2.65	70.8
17 years-----	77.0	6.0	1.28	76.7	79.1	9.5	5.00	81.7

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 12. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Education of parent less than 5 years				Education of parent 5-8 years			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	128.5	12.6	0.73	127.6	129.0	13.2	0.49	127.6
12 years-----	121.8	10.7	1.37	122.0	122.0	12.1	0.82	121.2
13 years-----	127.2	11.7	1.86	127.0	125.7	12.1	0.61	124.2
14 years-----	129.9	13.2	1.65	128.1	128.9	11.7	0.72	127.4
15 years-----	129.5	11.1	1.42	128.2	130.7	12.9	0.93	128.9
16 years-----	131.8	14.4	1.55	128.7	132.7	13.0	0.89	130.9
17 years-----	131.8	11.1	1.77	133.0	134.2	13.3	1.17	132.6
Boys 12-17 years-----	130.5	13.4	0.76	130.1	130.6	14.3	0.72	129.3
12 years-----	120.4	10.6	2.09	118.8	117.9	10.5	1.20	116.8
13 years-----	126.2	12.7	3.64	126.2	126.1	12.8	0.85	124.5
14 years-----	133.2	14.2	4.21	130.7	129.9	11.5	1.08	128.0
15 years-----	130.5	10.9	2.31	130.3	134.8	12.5	1.02	133.4
16 years-----	138.2	14.1	3.37	135.0	135.7	13.3	1.16	134.1
17 years-----	135.2	8.9	2.27	134.1	138.7	13.5	1.54	136.6
Girls 12-17 years-----	126.5	11.4	0.99	126.3	127.4	11.9	0.52	126.4
12 years-----	123.2	10.5	2.64	125.2	125.5	12.3	1.05	125.8
13 years-----	128.0	10.7	1.82	129.4	125.4	11.3	1.19	124.1
14 years-----	127.8	12.0	1.15	126.6	127.8	11.7	0.91	126.7
15 years-----	128.5	11.2	2.53	127.2	127.2	12.3	0.91	125.4
16 years-----	124.5	10.8	1.87	122.9	129.4	11.9	1.16	128.2
17 years-----	126.7	12.1	3.21	127.9	129.3	11.2	1.48	127.8
<u>Diastolic</u>								
Both sexes 12-17 years----	75.2	8.3	0.81	74.3	75.1	8.2	0.37	74.4
12 years-----	71.7	6.7	1.04	71.4	71.4	7.4	0.66	70.7
13 years-----	74.9	10.1	1.93	73.3	73.0	8.3	0.63	72.5
14 years-----	74.0	8.9	1.43	72.6	74.4	7.4	0.64	73.5
15 years-----	75.0	7.5	1.60	73.9	76.1	7.8	0.44	74.9
16 years-----	77.5	7.1	1.13	76.7	76.8	8.0	0.46	76.4
17 years-----	78.9	6.6	1.71	79.2	79.1	7.8	0.65	78.4
Boys 12-17 years-----	75.2	8.8	1.24	73.8	75.3	8.4	0.41	74.8
12 years-----	70.5	5.7	0.90	70.9	70.4	6.3	0.75	70.4
13 years-----	75.0	11.8	4.81	72.9	72.6	8.6	0.86	72.5
14 years-----	73.6	9.0	3.76	72.0	73.6	7.5	0.68	73.2
15 years-----	73.7	7.6	1.57	72.3	77.2	8.5	0.60	76.7
16 years-----	77.9	8.3	1.74	77.1	77.1	7.5	0.48	76.7
17 years-----	80.0	5.6	1.70	79.9	80.2	7.6	0.75	78.9
Girls 12-17 years-----	75.2	7.9	0.61	74.6	75.0	8.0	0.49	73.9
12 years-----	72.8	7.5	1.83	72.0	72.2	8.2	0.83	71.3
13 years-----	74.9	8.5	2.02	74.1	73.4	8.1	0.88	72.5
14 years-----	74.2	8.9	0.99	73.0	75.2	7.2	1.06	73.8
15 years-----	76.3	7.3	1.98	76.3	75.1	7.0	0.50	73.7
16 years-----	77.0	5.5	0.78	76.5	76.5	8.5	0.88	76.2
17 years-----	77.2	7.5	2.63	78.4	77.9	7.9	0.99	76.9

See note at end of table.



Table 12. Systolic and diastolic blood pressures of youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970—Con.

Blood pressure, age, and sex	Education of parent 9-12 years				Education of parent 13 years or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	128.8	12.9	0.40	127.0	127.4	12.7	0.47	126.2
12 years-----	122.1	11.3	0.66	121.0	121.0	10.8	0.67	120.0
13 years-----	126.5	11.6	0.45	125.1	124.9	12.1	1.11	124.6
14 years-----	128.7	12.4	0.69	126.8	127.8	12.2	0.81	126.2
15 years-----	130.5	12.0	0.51	130.0	129.8	12.6	0.90	128.4
16 years-----	133.0	13.2	0.82	131.4	131.0	12.0	0.64	128.9
17 years-----	133.0	13.5	0.74	131.0	131.7	12.9	0.98	129.7
Boys 12-17 years-----	130.4	13.6	0.38	128.7	129.3	13.2	0.70	127.9
12 years-----	120.3	10.7	0.60	119.1	119.8	11.0	1.24	119.2
13 years-----	126.2	12.2	0.73	124.4	125.9	12.5	1.55	125.3
14 years-----	130.8	12.2	0.61	128.7	129.5	12.2	1.07	128.0
15 years-----	133.0	12.0	0.82	132.2	132.9	11.1	1.27	132.5
16 years-----	136.8	13.5	1.10	134.9	135.9	11.2	0.76	134.6
17 years-----	136.9	12.9	0.85	134.2	137.4	12.6	1.43	136.3
Girls 12-17 years-----	127.1	11.8	0.49	125.9	125.5	11.8	0.48	124.2
12 years-----	124.1	11.5	1.00	124.2	122.3	10.4	0.71	120.6
13 years-----	126.8	11.0	0.58	126.1	123.5	11.5	0.97	122.6
14 years-----	126.6	12.3	0.96	125.1	125.6	11.8	1.04	124.3
15 years-----	127.8	11.5	0.67	126.5	126.3	13.3	1.24	124.2
16 years-----	129.0	11.4	0.97	127.8	126.9	11.1	1.11	124.4
17 years-----	128.5	12.8	0.98	126.0	128.2	11.7	1.38	126.5
<u>Diastolic</u>								
Both sexes 12-17 years----	74.8	8.0	0.26	74.3	74.2	7.7	0.30	73.8
12 years-----	71.2	7.4	0.49	70.4	70.6	7.4	0.55	70.4
13 years-----	73.1	7.6	0.44	72.6	72.1	7.3	0.78	71.7
14 years-----	74.4	7.7	0.43	74.1	74.7	6.9	0.47	74.4
15 years-----	75.9	7.7	0.32	75.2	74.9	7.7	0.56	74.3
16 years-----	77.4	7.9	0.56	76.8	76.5	7.2	0.48	76.0
17 years-----	77.6	7.9	0.30	76.6	77.4	7.1	0.57	77.1
Boys 12-17 years-----	74.7	8.1	0.25	74.1	74.3	7.9	0.47	74.1
12 years-----	70.1	7.2	0.53	68.8	70.7	8.0	1.00	70.3
13 years-----	72.4	7.4	0.72	72.2	72.0	7.5	1.04	72.0
14 years-----	74.1	7.4	0.45	73.7	74.9	7.0	0.73	74.6
15 years-----	75.9	7.4	0.38	74.9	75.7	7.7	0.81	75.3
16 years-----	77.7	7.4	0.73	77.1	76.6	7.6	0.79	76.0
17 years-----	78.7	8.2	0.39	78.5	79.0	6.9	0.81	78.6
Girls 12-17 years-----	74.9	8.0	0.32	74.5	74.1	7.3	0.30	73.4
12 years-----	72.3	7.5	0.71	71.9	70.6	6.7	0.56	70.6
13 years-----	73.8	7.8	0.44	73.2	72.2	7.0	0.71	71.6
14 years-----	74.7	8.0	0.56	74.4	74.4	6.9	0.59	74.2
15 years-----	75.8	8.0	0.55	75.6	74.1	7.6	0.78	72.5
16 years-----	77.1	8.3	0.59	76.5	76.4	6.8	0.59	75.9
17 years-----	76.3	7.3	0.49	74.8	76.4	7.1	0.61	76.2

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 13. Systolic and diastolic blood pressures of white youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Education of parent less than 5 years				Education of parent 5-8 years			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	129.1	12.0	1.00	128.3	129.1	13.3	0.55	127.9
12 years-----	122.7	10.3	1.71	122.8	122.4	12.2	0.86	122.3
13 years-----	126.4	9.3	1.36	126.8	125.9	12.3	0.66	124.1
14 years-----	130.4	13.8	2.73	128.4	128.5	11.6	0.77	127.3
15 years-----	130.5	10.9	1.87	128.5	131.1	13.2	1.13	128.9
16 years-----	133.4	13.1	2.43	130.4	133.1	12.9	0.81	131.0
17 years-----	133.3	10.4	2.67	133.8	134.1	13.9	1.47	132.4
Boys 12-17 years-----	131.3	12.6	0.86	130.5	131.0	14.5	0.90	129.8
12 years-----	122.0	10.4	2.75	120.0	118.2	10.8	1.48	117.1
13 years-----	125.2	9.0	3.09	126.4	125.6	13.4	1.03	122.9
14 years-----	132.4	15.0	5.66	130.5	129.6	11.4	1.01	127.8
15 years-----	133.2	10.0	2.16	133.0	135.5	12.6	1.44	134.5
16 years-----	136.8	13.0	4.32	134.4	136.3	13.1	1.10	134.2
17 years-----	136.8	8.3	2.36	136.2	139.6	13.8	1.96	136.8
Girls 12-17 years-----	126.9	11.0	1.71	126.8	127.4	11.9	0.47	126.5
12 years-----	123.3	10.2	4.32	125.8	125.5	12.1	0.94	126.5
13 years-----	127.1	9.5	1.64	128.6	126.2	11.0	1.09	124.6
14 years-----	128.8	12.5	2.29	127.4	127.4	11.6	1.10	126.5
15 years-----	127.9	11.0	3.02	128.0	127.8	12.6	1.00	125.7
16 years-----	127.2	10.8	3.34	127.0	129.6	11.7	1.18	128.4
17 years-----	128.0	11.0	4.63	128.1	128.1	11.4	1.65	127.0
<u>Diastolic</u>								
Both sexes 12-17 years----	74.4	7.8	1.00	73.6	74.8	8.1	0.43	74.2
12 years-----	71.2	6.6	1.52	71.5	71.2	7.3	0.75	70.6
13 years-----	73.5	7.4	1.90	72.9	72.8	8.3	0.63	72.3
14 years-----	73.0	8.7	2.04	72.3	73.9	6.9	0.74	73.2
15 years-----	74.1	6.9	2.00	72.7	76.1	7.8	0.56	75.1
16 years-----	77.0	7.1	1.37	76.6	76.6	8.2	0.52	76.4
17 years-----	78.8	7.0	2.75	78.8	78.5	7.5	0.74	78.1
Boys 12-17 years-----	74.2	8.0	1.25	72.9	75.0	8.3	0.49	74.6
12 years-----	70.4	5.8	1.39	71.3	70.2	6.3	0.69	70.3
13 years-----	72.2	7.1	2.33	72.1	72.5	8.8	0.96	72.4
14 years-----	71.9	8.9	4.26	70.2	73.1	6.8	0.69	73.0
15 years-----	73.2	6.9	2.50	72.1	77.2	8.8	0.68	77.5
16 years-----	76.8	8.3	2.05	75.5	76.7	7.7	0.53	76.5
17 years-----	80.0	6.1	2.63	80.0	79.7	7.2	0.92	78.8
Girls 12-17 years-----	74.5	7.5	0.91	74.2	74.7	7.8	0.56	73.6
12 years-----	71.9	7.2	2.89	72.0	71.9	7.9	0.98	70.9
13 years-----	74.3	7.5	2.23	74.1	73.0	7.8	0.77	72.3
14 years-----	73.9	8.4	1.38	74.2	74.7	6.8	1.24	73.3
15 years-----	74.9	6.8	2.13	74.4	75.2	6.9	0.61	74.0
16 years-----	77.4	4.2	1.24	77.3	76.4	8.7	0.99	76.2
17 years-----	76.8	7.8	3.64	78.3	77.3	7.6	1.04	76.5

See note at end of table.

Table 13. Systolic and diastolic blood pressures of white youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970—Con.

Blood pressure, age, and sex	Education of parent 9-12 years				Education of parent 13 years or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years----	129.2	12.9	0.45	127.6	127.5	12.8	0.48	126.2
12 years-----	122.7	11.4	0.74	122.1	120.8	10.9	0.69	119.4
13 years-----	126.8	11.8	0.54	125.3	124.9	12.0	1.13	124.8
14 years-----	129.1	12.4	0.79	126.9	128.0	12.2	0.81	126.4
15 years-----	131.3	12.0	0.54	130.4	130.1	12.6	0.94	128.8
16 years-----	133.2	13.2	0.78	131.5	131.0	12.2	0.65	128.4
17 years-----	133.3	13.6	0.77	131.8	131.9	13.0	0.98	129.7
Boys 12-17 years-----	130.9	13.6	0.44	129.0	129.4	13.3	0.71	128.0
12 years-----	120.8	10.7	0.62	119.6	119.5	11.1	1.31	118.4
13 years-----	126.2	12.2	0.88	124.2	126.0	12.3	1.64	125.6
14 years-----	131.5	12.2	0.73	129.0	129.9	12.1	1.07	128.2
15 years-----	133.7	12.0	0.89	132.6	132.9	11.2	1.32	132.4
16 years-----	137.0	13.8	1.03	134.9	136.3	11.5	0.84	134.9
17 years-----	137.4	12.8	0.74	134.7	137.9	12.7	1.54	137.1
Girls 12-17 years-----	127.5	11.9	0.54	126.3	125.6	11.8	0.50	124.2
12 years-----	124.8	11.9	1.15	124.6	122.2	10.4	0.71	120.1
13 years-----	127.3	11.2	0.66	126.5	123.4	11.4	1.00	122.8
14 years-----	126.7	12.0	1.06	125.1	125.6	11.9	1.07	124.3
15 years-----	128.6	11.4	0.58	127.0	126.8	13.4	1.27	124.6
16 years-----	129.2	11.3	0.97	128.1	126.8	11.1	1.09	124.4
17 years-----	128.5	13.0	1.05	126.0	128.3	11.7	1.37	126.4
<u>Diastolic</u>								
Both sexes 12-17 years----	74.7	8.0	0.28	74.2	74.2	7.7	0.31	73.7
12 years-----	71.1	7.4	0.56	70.2	70.5	7.5	0.57	70.4
13 years-----	73.0	7.7	0.50	72.5	72.0	7.3	0.79	71.7
14 years-----	74.2	7.8	0.52	73.9	74.8	6.8	0.47	74.4
15 years-----	75.8	7.5	0.32	75.1	75.0	7.8	0.58	74.4
16 years-----	77.4	7.9	0.53	76.6	76.5	7.3	0.52	76.0
17 years-----	77.5	8.0	0.30	76.6	77.3	7.1	0.53	76.9
Boys 12-17 years-----	74.5	8.0	0.29	73.8	74.4	7.9	0.48	74.1
12 years-----	70.0	7.1	0.55	68.9	70.7	8.0	1.04	70.4
13 years-----	72.2	7.4	0.76	72.0	71.8	7.5	1.07	71.9
14 years-----	73.8	7.4	0.53	73.0	75.1	6.7	0.68	74.7
15 years-----	75.8	7.1	0.42	74.8	75.7	7.7	0.82	75.3
16 years-----	77.4	7.5	0.78	76.8	76.6	7.7	0.84	76.2
17 years-----	78.5	8.3	0.46	78.3	78.8	6.9	0.79	78.3
Girls 12-17 years-----	75.0	8.1	0.34	74.5	74.1	7.4	0.33	73.3
12 years-----	72.3	7.5	0.81	71.6	70.3	6.7	0.60	70.4
13 years-----	73.7	7.9	0.53	73.0	72.2	7.1	0.73	71.6
14 years-----	74.6	8.1	0.64	74.4	74.3	6.9	0.62	74.1
15 years-----	75.9	8.0	0.56	75.7	74.2	7.8	0.86	72.5
16 years-----	77.3	8.2	0.57	76.6	76.4	6.9	0.61	75.6
17 years-----	76.4	7.4	0.57	74.9	76.4	7.1	0.57	76.2

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 14. Systolic and diastolic blood pressures of Negro youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median: United States, 1966-1970

Blood pressure, age, and sex	Education of parent less than 5 years				Education of parent 5-8 years			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>								
Blood pressure in mm. Hg								
Both sexes 12-17 years-----	127.1	13.6	1.33	126.2	128.2	12.8	0.90	127.1
12 years-----	119.6	11.3	2.02	119.5	120.1	12.0	3.28	119.2
13 years-----	128.6	14.8	3.35	128.5	125.1	11.6	1.28	124.6
14 years-----	128.7	11.2	1.34	126.6	131.2	11.7	1.52	128.6
15 years-----	127.0	11.1	2.00	123.4	129.1	12.1	2.06	128.9
16 years-----	129.1	15.9	1.47	126.0	130.0	13.7	2.87	127.9
17 years-----	128.6	11.8	1.83	129.4	135.0	10.5	1.33	135.0
Boys 12-17 years-----	128.8	15.0	1.27	129.0	128.9	13.2	1.29	128.2
12 years-----	116.6	10.3	2.36	116.4	116.8	9.2	2.74	116.5
13 years-----	127.4	16.0	5.05	125.6	127.8	10.3	1.93	127.9
14 years-----	136.4	9.2	2.91	138.4	131.4	12.2	3.21	128.6
15 years-----	124.4	10.2	2.52	120.2	132.7	12.0	2.54	132.1
16 years-----	142.7	16.2	3.92	146.0	132.0	14.5	3.53	132.9
17 years-----	131.6	9.0	4.41	129.6	135.6	11.8	1.69	136.7
Girls 12-17 years-----	125.6	12.0	1.61	124.9	127.4	12.4	1.38	126.2
12 years-----	122.9	11.3	2.99	124.3	125.0	13.9	5.76	122.9
13 years-----	130.0	13.1	4.50	131.9	122.0	12.2	3.34	120.3
14 years-----	125.9	10.6	1.78	125.8	130.9	11.2	2.27	129.0
15 years-----	130.0	11.4	3.92	127.1	123.9	10.3	2.70	123.3
16 years-----	122.2	10.3	1.81	119.7	128.1	12.7	4.71	126.0
17 years-----	124.2	13.9	4.80	126.5	134.3	9.1	3.38	131.5
<u>Diastolic</u>								
Both sexes 12-17 years-----	77.0	9.2	1.42	76.4	76.6	8.7	0.48	75.9
12 years-----	72.9	6.9	1.65	70.7	72.3	7.9	1.10	71.0
13 years-----	77.5	13.2	3.62	74.0	74.3	8.5	1.32	74.2
14 years-----	76.4	9.1	1.30	73.4	77.6	8.3	0.90	78.6
15 years-----	77.4	8.5	1.89	78.3	76.2	7.7	0.64	74.6
16 years-----	78.2	7.1	1.53	77.0	78.2	7.1	1.25	78.1
17 years-----	79.2	5.5	1.15	79.6	81.6	9.0	1.74	81.6
Boys 12-17 years-----	77.5	10.1	2.60	76.9	76.5	8.5	0.46	75.8
12 years-----	70.9	5.2	1.21	70.0	71.3	6.3	1.34	70.7
13 years-----	78.5	15.0	7.65	74.0	73.1	7.8	1.49	73.6
14 years-----	80.6	5.7	2.80	79.7	77.1	8.0	1.29	77.8
15 years-----	74.9	8.9	1.93	74.4	77.2	7.4	0.76	76.1
16 years-----	81.2	7.5	2.57	81.8	79.7	5.9	1.56	78.7
17 years-----	80.1	4.3	2.07	79.8	82.9	9.1	1.75	79.8
Girls 12-17 years-----	76.5	8.4	0.58	76.1	76.6	8.9	0.92	76.0
12 years-----	75.1	7.9	2.61	71.9	73.8	9.7	2.49	73.7
13 years-----	76.3	10.4	3.61	75.1	75.6	9.1	1.93	74.6
14 years-----	74.9	9.7	1.63	70.9	78.1	8.5	1.69	79.5
15 years-----	80.2	7.0	2.73	78.8	74.9	7.9	1.36	72.5
16 years-----	76.7	6.3	1.16	75.0	76.8	7.8	1.74	75.5
17 years-----	77.8	6.8	2.38	78.7	80.4	8.7	2.81	82.1

See note at end of table.

Table 14. Systolic and diastolic blood pressures of Negro youths 12-17 years by age, sex, and education of parent, shown by mean, standard deviation, standard error of the mean, and median; United States, 1966-1970—Con.

Blood pressure, age, and sex	Education of parent 9-12 years				Education of parent 13 years or more			
	Mean	$s_x$	$s_{\bar{x}}$	Median	Mean	$s_x$	$s_{\bar{x}}$	Median
<u>Systolic</u>	Blood pressure in mm. Hg							
Both sexes 12-17 years----	125.9	12.1	0.57	124.6	125.5	10.5	1.82	126.1
12 years-----	118.5	9.3	0.87	118.3	123.5	9.4	2.35	124.9
13 years-----	124.6	10.5	1.18	124.1	124.4	16.0	7.70	115.8
14 years-----	126.5	12.5	2.07	125.4	121.6	7.2	3.96	120.7
15 years-----	125.7	10.3	1.45	124.6	118.9	9.6	0.70	118.8
16 years-----	131.6	12.6	2.44	130.9	131.9	6.6	1.65	131.2
17 years-----	130.7	12.4	2.25	127.7	130.0	5.7	2.50	130.1
Boys 12-17 years-----	127.2	12.8	0.84	126.0	126.2	10.0	2.10	126.2
12 years-----	116.5	10.2	1.63	115.4	124.9	4.7	2.73	121.0
13 years-----	125.9	12.2	3.25	126.4	122.9	17.1	10.72	115.5
14 years-----	127.1	11.2	2.06	125.7	118.8	6.9	3.84	120.4
15 years-----	127.3	10.5	1.73	125.1	129.5	6.8	64.93	134.2
16 years-----	135.2	11.4	3.44	134.9	131.8	5.8	2.29	130.8
17 years-----	133.0	13.0	3.10	130.9	129.3	7.2	50.25	126.6
Girls 12-17 years-----	124.7	11.2	0.85	123.7	124.7	10.9	2.85	125.8
12 years-----	120.2	8.0	1.21	119.5	122.4	11.9	4.77	126.3
13 years-----	123.6	8.8	0.97	122.8	127.8	12.9	50.17	121.6
14 years-----	125.7	13.9	2.31	125.2	126.0	5.3	40.04	124.5
15 years-----	124.3	10.0	2.05	124.3	114.6	6.9	3.45	116.9
16 years-----	127.7	12.7	2.09	124.4	132.3	8.2	93.51	136.3
17 years-----	128.6	11.3	2.62	127.0	130.7	3.7	2.07	130.5
<u>Diastolic</u>								
Both sexes 12-17 years----	75.3	7.9	0.39	74.6	75.4	6.9	1.45	74.7
12 years-----	71.5	7.3	0.69	71.2	72.2	6.4	2.53	72.0
13 years-----	74.3	7.2	1.16	74.2	73.7	6.0	4.66	71.6
14 years-----	75.3	7.1	0.66	74.6	74.6	8.9	4.12	78.1
15 years-----	76.1	8.8	0.99	76.1	74.4	4.1	1.45	73.2
16 years-----	77.4	8.0	1.59	78.2	77.6	4.0	2.83	76.6
17 years-----	78.0	7.6	1.52	76.6	81.3	6.3	4.81	82.5
Boys 12-17 years-----	76.0	8.3	0.45	75.5	75.2	8.2	1.68	74.6
12 years-----	70.5	7.4	1.26	68.6	69.2	6.1	4.37	68.4
13 years-----	74.2	8.1	1.84	74.3	74.2	7.2	6.72	70.9
14 years-----	75.3	7.1	1.13	74.8	70.8	9.5	5.75	74.2
15 years-----	77.1	9.4	0.69	76.6	77.3	5.9	38.87	81.2
16 years-----	79.5	6.4	1.75	79.0	77.9	4.6	3.10	74.9
17 years-----	80.6	7.1	1.96	81.3	85.4	2.4	33.08	84.4
Girls 12-17 years-----	74.6	7.5	0.94	73.8	75.6	5.0	1.52	74.8
12 years-----	72.5	7.1	1.38	72.6	74.6	5.5	2.15	74.2
13 years-----	74.4	6.4	1.31	74.1	72.6	0.9	28.13	71.7
14 years-----	75.3	7.1	0.66	74.4	80.6	1.7	25.52	79.5
15 years-----	75.3	8.2	1.47	74.8	73.2	2.2	1.36	73.0
16 years-----	75.1	8.9	2.15	73.6	77.0	1.7	54.44	77.3
17 years-----	75.6	7.2	1.74	73.1	77.5	6.5	4.83	78.5

NOTE;  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of three readings.

Table 15. Systolic and diastolic blood pressures taken in the prone position of youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, and selected percentiles: United States, 1966-1970

Blood pressure, age, and sex	Mean	$s_x$	$s_{\bar{x}}$	Percentiles						
				5th	10th	25th	50th	75th	90th	95th
<u>Systolic</u>										
Blood pressure in mm. Hg										
Both sexes 12-17 years-----	129.5	13.6	0.42	108.6	112.9	119.7	128.0	137.2	146.6	152.6
12 years-----	122.7	11.9	0.52	103.9	107.6	114.1	121.7	130.0	137.9	143.1
13 years-----	126.9	12.5	0.49	107.6	111.1	117.3	125.9	134.3	142.1	148.1
14 years-----	129.7	13.0	0.50	109.3	114.0	120.1	128.0	136.9	146.3	152.8
15 years-----	131.2	13.0	0.45	111.6	115.4	121.7	129.9	138.9	147.1	151.9
16 years-----	133.4	13.9	0.63	112.8	116.9	123.6	131.3	141.4	150.7	157.8
17 years-----	134.1	14.0	0.58	113.7	116.8	124.2	131.9	142.1	152.0	158.0
Boys 12-17 years-----	131.3	14.5	0.41	108.8	113.3	120.8	129.7	139.7	149.5	155.2
12 years-----	120.5	11.4	0.65	101.9	106.1	112.3	119.9	126.7	135.0	139.6
13 years-----	127.0	13.0	0.67	107.3	110.6	116.8	126.0	134.7	143.2	150.7
14 years-----	131.6	13.0	0.56	111.7	114.9	122.2	129.6	138.6	149.3	154.3
15 years-----	134.2	13.0	0.76	113.9	117.2	124.1	133.2	142.3	149.4	154.2
16 years-----	137.4	14.2	0.60	116.4	120.5	127.0	135.3	146.3	154.8	161.4
17 years-----	138.6	13.8	0.63	118.2	123.3	128.2	136.6	146.2	156.1	163.5
Girls 12-17 years-----	127.7	12.4	0.49	108.4	112.5	118.7	126.3	134.6	142.9	148.8
12 years-----	125.0	12.0	0.55	105.5	109.9	116.2	124.1	132.5	139.9	145.0
13 years-----	126.8	12.0	0.58	107.9	111.8	117.7	125.8	133.9	140.9	145.4
14 years-----	127.7	12.7	0.66	108.1	112.3	118.7	126.2	134.3	143.5	149.3
15 years-----	128.2	12.4	0.46	109.0	113.8	119.6	126.8	134.7	142.5	148.0
16 years-----	129.3	12.3	0.85	110.5	115.0	119.9	127.1	135.9	144.9	151.0
17 years-----	129.6	12.7	0.75	111.0	114.1	120.0	128.2	136.6	145.5	152.1
<u>Diastolic</u>										
Both sexes 12-17 years-----	73.3	8.8	0.28	58.6	61.8	67.2	72.8	78.5	83.9	87.0
12 years-----	69.5	8.3	0.47	55.1	58.4	64.1	69.2	74.3	79.4	82.3
13 years-----	71.4	8.8	0.48	55.8	60.1	65.3	70.9	76.4	81.4	85.6
14 years-----	73.0	8.3	0.38	59.4	61.9	67.0	72.3	77.9	82.9	86.2
15 years-----	74.2	8.4	0.28	60.8	63.3	68.0	73.8	79.4	84.3	87.8
16 years-----	75.7	8.4	0.40	61.2	65.0	69.8	74.7	80.6	85.5	89.1
17 years-----	76.8	8.3	0.31	62.5	66.1	71.0	76.0	81.4	86.0	89.6
Boys 12-17 years-----	73.2	8.9	0.33	58.2	61.5	66.9	72.6	78.6	83.7	86.9
12 years-----	68.5	8.0	0.57	54.8	57.9	63.1	67.9	73.2	78.0	81.6
13 years-----	70.8	8.9	0.69	55.5	59.4	64.5	70.4	75.7	80.6	84.4
14 years-----	72.7	8.0	0.49	59.5	62.1	66.8	72.1	77.5	82.5	85.6
15 years-----	74.3	8.5	0.42	60.4	63.2	68.3	74.0	79.6	84.4	87.9
16 years-----	75.8	8.3	0.47	62.1	65.0	69.9	74.9	80.9	85.0	87.9
17 years-----	77.7	8.3	0.29	64.2	67.3	72.1	77.1	82.2	87.0	90.2
Girls 12-17 years-----	73.5	8.6	0.28	59.0	62.2	67.5	73.0	78.4	84.1	87.0
12 years-----	70.4	8.4	0.51	55.5	59.0	64.8	69.9	75.0	79.9	83.0
13 years-----	72.1	8.6	0.42	56.6	60.7	66.5	71.4	77.0	82.5	86.2
14 years-----	73.3	8.5	0.39	59.4	61.7	67.3	72.6	78.5	83.9	87.1
15 years-----	74.0	8.2	0.31	61.1	63.6	67.6	73.6	79.1	84.3	87.7
16 years-----	75.6	8.5	0.44	60.2	64.9	69.8	74.6	80.3	86.0	89.4
17 years-----	75.8	8.2	0.51	62.1	64.7	69.8	75.0	80.2	84.9	88.4

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of the first two readings.

Table 16. Systolic and diastolic blood pressures taken in the prone position for white youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, and selected percentiles: United States, 1966-1970

Blood pressure, age, and sex	Mean	$s_x$	$s_{\bar{x}}$	Percentiles						
				5th	10th	25th	50th	75th	90th	95th
<u>Systolic</u>				Blood pressure in mm. Hg						
Both sexes 12-17 years-----	129.8	13.7	0.48	108.8	113.2	120.0	128.3	137.5	146.9	153.2
12 years-----	123.1	12.0	0.62	104.2	107.7	114.3	122.2	130.6	138.4	143.6
13 years-----	127.0	12.5	0.62	107.9	111.4	117.3	125.9	134.4	142.1	148.3
14 years-----	129.9	13.0	0.54	109.6	114.3	120.4	128.1	137.0	146.2	153.0
15 years-----	131.8	13.1	0.52	112.5	116.2	122.5	130.5	139.3	147.7	152.6
16 years-----	133.7	13.9	0.63	114.0	117.4	123.9	131.4	141.5	151.3	158.0
17 years-----	134.4	14.3	0.64	113.5	116.8	124.1	132.5	142.6	152.6	158.1
Boys 12-17 years----	131.7	14.6	0.49	108.9	113.6	121.2	130.0	140.1	150.2	155.6
12 years-----	120.9	11.6	0.75	103.1	106.2	112.6	120.2	127.4	135.8	140.1
13 years-----	126.9	13.0	0.82	107.6	110.7	116.7	125.8	134.7	143.2	150.4
14 years-----	132.0	13.0	0.59	111.9	115.5	123.0	129.9	138.8	149.7	155.1
15 years-----	134.9	13.1	0.94	115.1	118.2	124.5	133.7	143.2	150.2	154.6
16 years-----	137.7	14.3	0.60	117.0	121.4	127.1	135.6	146.7	155.4	161.5
17 years-----	139.4	13.9	0.63	119.0	123.8	128.6	137.4	146.5	156.8	165.3
Girls 12-17 years---	127.9	12.4	0.54	108.7	112.9	119.0	126.6	134.8	143.0	149.2
12 years-----	125.4	12.1	0.67	105.8	110.0	116.3	124.5	132.9	140.2	145.0
13 years-----	127.0	12.0	0.69	108.3	112.2	117.8	126.0	134.0	141.0	145.4
14 years-----	127.8	12.7	0.74	108.1	113.1	119.0	126.3	134.3	143.3	149.3
15 years-----	128.7	12.4	0.45	110.0	114.5	120.3	127.3	134.9	143.0	150.0
16 years-----	129.6	12.1	0.86	111.4	115.8	120.8	127.4	136.0	144.5	151.2
17 years-----	129.3	12.8	0.83	111.2	113.9	119.4	127.6	136.4	145.4	152.4
<u>Diastolic</u>										
Both sexes 12-17 years-----	73.1	8.7	0.32	58.6	61.7	67.1	72.6	78.2	83.6	86.7
12 years-----	69.3	8.3	0.53	54.8	58.3	64.0	69.2	74.1	79.2	82.2
13 years-----	71.1	8.6	0.55	55.6	59.9	65.2	70.6	76.2	81.2	84.9
14 years-----	72.9	8.1	0.45	59.6	62.0	66.9	72.2	77.5	82.6	85.7
15 years-----	74.0	8.3	0.29	60.6	63.0	68.0	73.7	79.3	84.2	87.5
16 years-----	75.5	8.4	0.42	61.0	65.1	69.8	74.6	80.5	85.5	88.9
17 years-----	76.5	8.3	0.28	62.4	65.9	70.8	75.9	81.1	85.8	89.5
Boys 12-17 years----	72.9	8.8	0.37	58.1	61.4	66.7	72.4	78.2	83.4	86.6
12 years-----	68.4	8.1	0.62	54.4	57.6	62.8	67.9	72.9	77.9	81.7
13 years-----	70.4	8.5	0.77	55.4	59.4	64.4	70.1	75.4	80.1	83.9
14 years-----	72.5	7.8	0.53	59.8	62.2	66.6	71.8	77.1	82.1	85.0
15 years-----	74.1	8.4	0.47	60.2	63.0	68.3	73.7	79.4	84.2	87.8
16 years-----	75.5	8.5	0.54	61.9	65.0	69.5	74.7	80.7	84.9	87.9
17 years-----	77.4	8.3	0.36	63.3	67.0	71.7	77.0	81.9	86.8	89.8
Girls 12-17 years---	73.3	8.6	0.32	59.0	62.0	67.5	72.9	78.2	83.9	86.8
12 years-----	70.2	8.3	0.60	55.4	59.0	64.7	69.8	74.8	79.7	82.8
13 years-----	71.8	8.6	0.47	56.3	60.5	66.4	71.1	76.9	82.1	85.9
14 years-----	73.2	8.4	0.48	59.4	61.7	67.2	72.6	78.2	83.5	86.5
15 years-----	74.0	8.2	0.33	61.0	63.1	67.6	73.7	79.2	84.2	87.1
16 years-----	75.6	8.4	0.41	60.5	65.2	70.1	74.6	80.2	86.0	89.2
17 years-----	75.6	8.2	0.48	62.2	64.7	69.8	75.0	79.8	84.8	88.6

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of the first two readings.

Table 17. Systolic and diastolic blood pressures taken in the prone position for Negro youths 12-17 years by age and sex, shown by mean, standard deviation, standard error of the mean, and selected percentiles: United States, 1966-1970

Blood pressure, age, and sex	Mean	$s_x$	$s_{\bar{x}}$	Percentiles						
				5th	10th	25th	50th	75th	90th	95th
<u>Systolic</u>				Blood pressure in mm. Hg						
Both sexes 12-17 years-----	127.6	13.1	0.62	107.6	111.0	117.5	126.3	135.4	144.8	149.2
12 years-----	120.4	11.1	0.86	101.6	106.3	112.6	119.4	127.1	134.2	139.7
13 years-----	126.3	12.5	0.80	106.2	109.8	116.5	125.7	133.9	142.2	146.7
14 years-----	128.4	12.8	1.22	108.8	112.3	118.4	126.8	136.5	146.4	149.4
15 years-----	127.4	11.9	1.23	109.2	111.8	116.6	126.1	136.4	142.6	146.8
16 years-----	131.3	14.3	1.85	109.9	113.0	119.5	130.2	139.2	149.5	153.8
17 years-----	132.9	11.8	1.55	114.6	118.3	124.8	131.2	139.2	148.0	152.6
Boys 12-17 years-----	128.6	13.6	0.67	107.8	111.4	118.2	127.9	136.8	146.4	150.7
12 years-----	118.1	10.3	1.20	99.5	105.0	111.0	117.5	123.4	131.0	135.1
13 years-----	127.6	13.2	1.63	106.2	109.7	116.5	127.1	136.1	143.6	152.2
14 years-----	129.5	12.5	1.50	110.7	114.1	118.9	128.2	138.0	146.4	149.3
15 years-----	129.7	12.0	1.16	111.1	113.4	119.6	128.4	137.9	146.1	148.0
16 years-----	135.2	13.9	1.85	113.9	116.7	125.3	132.8	143.6	150.6	154.0
17 years-----	134.1	12.1	1.73	115.2	119.1	125.8	131.6	140.6	148.1	159.2
Girls 12-17 years-----	126.5	12.4	0.80	107.4	110.7	117.1	125.4	134.3	141.9	147.6
12 years-----	122.7	11.4	1.26	103.3	107.7	114.6	121.9	129.0	136.1	143.8
13 years-----	125.2	11.7	0.73	106.2	109.8	116.5	124.9	133.2	140.0	145.3
14 years-----	127.4	13.0	1.64	108.2	110.8	117.0	125.9	135.4	146.6	151.1
15 years-----	125.1	11.3	1.71	108.3	110.0	115.6	123.0	133.0	139.9	143.6
16 years-----	127.7	13.6	2.26	108.0	110.9	117.0	125.3	135.4	147.3	149.8
17 years-----	131.7	11.5	2.42	113.1	118.2	123.8	130.7	138.3	146.8	149.8
<u>Diastolic</u>										
Both sexes 12-17 years-----	74.6	9.1	0.33	58.8	62.8	67.9	74.1	80.0	85.0	89.2
12 years-----	70.5	8.1	0.44	56.1	58.6	65.0	69.6	75.3	80.4	82.9
13 years-----	73.4	9.9	0.56	57.2	61.5	66.5	73.0	77.9	84.2	89.5
14 years-----	74.3	8.7	0.52	59.3	61.8	68.2	73.4	79.7	85.6	89.2
15 years-----	75.2	9.0	0.72	61.4	64.8	68.4	74.4	80.5	85.6	91.1
16 years-----	76.4	8.5	0.99	61.4	64.4	70.3	76.6	81.5	85.7	89.5
17 years-----	78.5	8.3	1.39	64.4	67.6	72.8	78.0	83.4	87.5	92.0
Boys 12-17 years-----	74.8	9.3	0.62	58.6	62.6	68.0	74.4	80.4	85.1	89.4
12 years-----	69.3	7.2	0.68	56.3	58.8	64.8	68.0	74.1	78.8	81.1
13 years-----	73.2	10.8	1.55	56.5	58.1	64.9	72.2	78.8	83.0	92.2
14 years-----	74.4	8.6	1.21	59.3	62.0	69.3	74.2	80.4	85.4	89.0
15 years-----	75.8	9.3	0.82	61.2	64.2	68.6	75.3	81.5	85.5	91.2
16 years-----	77.8	7.2	1.10	63.1	67.2	72.8	78.2	82.8	86.0	89.1
17 years-----	80.1	8.1	1.51	68.0	69.5	74.3	79.4	84.0	91.1	103.4
Girls 12-17 years-----	74.3	9.0	0.69	59.1	62.9	67.8	73.7	79.4	84.8	89.1
12 years-----	71.8	8.8	0.65	55.9	57.8	65.5	71.2	77.2	81.8	84.5
13 years-----	73.7	8.9	1.46	59.4	62.7	67.7	73.3	77.6	84.8	89.0
14 years-----	74.1	8.9	0.80	59.2	61.7	67.7	72.1	79.5	86.2	89.7
15 years-----	74.6	8.6	1.08	64.1	65.5	68.1	73.1	77.9	85.9	89.9
16 years-----	75.1	9.5	1.20	59.4	62.6	68.3	74.3	80.7	85.4	90.3
17 years-----	77.0	8.2	1.89	62.3	65.1	70.0	76.8	82.8	85.9	88.0

NOTE:  $s_x$  = standard deviation;  $s_{\bar{x}}$  = standard error of the mean; all blood pressures are the average of the first two readings.



Table 18. Systolic and diastolic blood pressures taken in the prone position of youths 12-17 years by age and sex, shown by percent distribution: United States, 1966-1970

Blood pressure in mm. Hg	Boys						Girls					
	12 years	13 years	14 years	15 years	16 years	17 years	12 years	13 years	14 years	15 years	16 years	17 years
<u>Systolic</u>	Percent distribution											
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 90-----	-	-	-	-	-	-	0.3	-	-	-	-	-
90-99-----	2.5	0.8	0.4	-	0.2	-	1.6	0.5	0.8	1.0	0.1	0.2
100-109-----	15.3	5.3	3.0	1.5	1.0	0.3	6.6	5.4	5.4	4.1	3.5	3.9
110-119-----	28.4	23.2	13.5	11.0	6.3	5.3	24.9	21.6	19.7	18.0	17.9	18.1
120-129-----	32.8	28.7	31.5	25.0	24.5	21.8	31.9	30.8	34.0	34.4	35.0	30.6
130-139-----	15.3	25.8	27.6	28.4	27.8	29.8	23.4	29.0	23.9	27.3	25.3	26.7
140-149-----	4.7	10.3	13.6	23.7	21.5	24.3	8.4	9.4	11.2	10.4	12.5	12.4
150-159-----	0.6	5.3	8.0	8.0	12.3	11.7	2.7	2.8	3.4	3.2	4.1	5.9
160-169-----	0.4	0.4	1.8	1.1	3.8	4.1	0.2	0.4	1.1	1.0	0.8	1.6
170-179-----	-	0.2	0.5	1.0	1.5	1.4	-	-	0.2	0.4	0.7	0.4
180-189-----	-	-	0.1	-	0.7	1.1	-	0.1	0.3	0.2	0.1	0.2
190-199-----	-	-	-	0.2	0.2	0.1	-	-	-	-	-	-
200 and over-----	-	-	-	0.1	0.2	0.1	-	-	-	-	-	-
<u>Diastolic</u>	Percent distribution											
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 40-----	-	-	-	-	-	-	-	-	-	-	-	-
40-49-----	1.1	1.0	0.4	0.2	0.6	-	1.6	0.4	0.3	0.2	-	-
50-59-----	11.2	8.2	3.8	3.3	1.5	1.4	8.5	6.0	4.2	2.7	3.5	2.0
60-69-----	41.5	33.5	29.2	24.0	19.2	12.4	32.3	30.2	26.8	27.0	17.8	18.0
70-79-----	37.4	42.5	46.1	44.2	46.2	43.9	44.4	44.5	44.7	44.8	49.6	48.4
80-89-----	8.6	12.5	18.2	24.7	27.9	34.2	12.1	16.9	20.5	21.2	23.4	27.1
90-99-----	0.2	1.9	2.2	3.3	4.2	7.2	0.9	1.6	3.2	4.1	5.4	3.6
100-109-----	-	0.2	0.1	-	0.2	0.8	0.2	0.4	0.3	-	0.3	0.7
110-119-----	-	0.2	-	0.3	0.2	0.1	-	-	-	-	-	0.2
120 and over-----	-	-	-	-	-	-	-	-	-	-	-	-

NOTE: All blood pressures are the average of the first two readings.

Table 19. Systolic and diastolic blood pressures of youths 12-17 years of all races by age and sex for each of three separate readings, shown by mean and standard error of the mean: United States, 1966-1970

Age and sex	First systolic		First diastolic		Second systolic		Second diastolic		Third systolic		Third diastolic	
	Mean	$s_x$	Mean	$s_x$	Mean	$s_x$	Mean	$s_x$	Mean	$s_x$	Mean	$s_x$
	Blood pressure in mm. Hg											
Both sexes 12-17 years----	131.8	0.53	74.6	0.32	127.2	0.36	72.0	0.27	126.5	0.23	77.6	0.18
12 years-----	125.0	0.66	70.8	0.49	120.5	0.46	68.1	0.47	120.0	0.39	74.3	0.30
13 years-----	129.1	0.62	72.6	0.51	124.7	0.42	70.3	0.50	124.3	0.30	76.1	0.32
14 years-----	131.9	0.64	74.5	0.41	127.4	0.40	71.5	0.43	126.5	0.39	77.3	0.26
15 years-----	133.5	0.55	75.3	0.31	129.0	0.46	73.0	0.31	128.5	0.39	78.6	0.20
16 years-----	135.6	0.71	77.0	0.48	131.1	0.64	74.3	0.38	130.4	0.50	79.7	0.34
17 years-----	136.6	0.67	77.8	0.44	131.7	0.55	75.7	0.24	130.5	0.44	80.3	0.36
Boys 12-17 years-----	133.7	0.54	74.6	0.35	128.8	0.34	71.7	0.34	128.4	0.26	78.0	0.21
12 years-----	122.9	0.80	69.9	0.62	118.1	0.60	67.2	0.57	118.2	0.57	74.0	0.43
13 years-----	129.2	0.83	72.0	0.69	124.9	0.56	69.6	0.75	124.4	0.49	76.0	0.43
14 years-----	134.0	0.72	74.7	0.53	129.2	0.49	70.7	0.51	128.1	0.49	77.1	0.39
15 years-----	136.7	0.93	75.9	0.47	131.7	0.64	72.7	0.42	131.4	0.46	79.3	0.33
16 years-----	140.0	0.74	77.3	0.56	134.8	0.59	74.2	0.45	134.5	0.51	80.3	0.50
17 years-----	141.5	0.79	78.8	0.43	135.8	0.58	76.6	0.35	135.2	0.47	82.3	0.44
Girls 12-17 years-----	129.8	0.58	74.5	0.33	125.6	0.44	72.4	0.28	124.7	0.31	77.2	0.19
12 years-----	127.2	0.69	71.8	0.52	122.9	0.46	69.1	0.57	121.9	0.58	74.7	0.38
13 years-----	128.9	0.71	73.2	0.46	124.6	0.55	71.0	0.43	124.2	0.47	76.2	0.39
14 years-----	129.8	0.80	74.2	0.46	125.6	0.59	72.4	0.45	124.8	0.55	77.5	0.25
15 years-----	130.2	0.52	74.8	0.37	126.2	0.61	73.2	0.37	125.5	0.53	77.9	0.28
16 years-----	131.2	0.89	76.7	0.48	127.4	0.88	74.4	0.47	126.2	0.65	79.1	0.44
17 years-----	131.6	0.74	76.7	0.60	127.5	0.83	74.8	0.50	125.8	0.78	78.2	0.49

NOTE:  $s_x$  = standard error of the mean.

Table 20. Systolic and diastolic blood pressures of white and Negro youths 12-17 years by age and sex for each of three separate readings, shown by mean and standard error of the mean: United States, 1966-1970

Race, age, and sex	First systolic		First diastolic		Second systolic		Second diastolic		Third systolic		Third diastolic	
	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$	Mean	$s_{\bar{x}}$
<u>White</u>	Blood pressure in mm. Hg											
Both sexes 12-17 years----	132.1	0.60	74.4	0.36	127.5	0.41	71.9	0.31	126.8	0.22	77.5	0.17
12 years-----	125.5	0.77	70.6	0.56	120.8	0.54	67.9	0.52	120.3	0.38	74.3	0.32
13 years-----	129.1	0.74	72.2	0.58	124.8	0.54	70.0	0.57	124.4	0.30	75.9	0.32
14 years-----	132.2	0.68	74.3	0.47	127.6	0.44	71.4	0.49	126.6	0.41	77.1	0.28
15 years-----	134.1	0.64	75.2	0.33	129.5	0.50	72.9	0.33	129.1	0.46	78.6	0.25
16 years-----	136.0	0.75	76.8	0.49	131.4	0.62	74.2	0.41	130.4	0.46	79.6	0.35
17 years-----	136.9	0.72	77.5	0.38	131.8	0.65	75.5	0.28	130.8	0.47	80.1	0.39
Boys 12-17 years-----	134.2	0.62	74.4	0.38	129.1	0.39	71.4	0.39	128.6	0.24	77.9	0.22
12 years-----	123.4	0.89	69.8	0.68	118.4	0.71	67.0	0.61	118.5	0.62	74.0	0.45
13 years-----	129.1	1.00	71.6	0.80	124.8	0.69	69.2	0.79	124.3	0.39	75.7	0.40
14 years-----	134.4	0.74	74.5	0.57	129.5	0.53	70.5	0.57	128.3	0.41	76.9	0.42
15 years-----	137.5	1.14	75.7	0.52	132.2	0.80	72.5	0.47	131.8	0.57	79.3	0.38
16 years-----	140.4	0.81	77.0	0.59	135.1	0.56	74.0	0.57	134.4	0.43	80.0	0.54
17 years-----	142.4	0.78	78.6	0.46	136.3	0.61	76.2	0.41	135.7	0.49	82.0	0.49
Girls 12-17 years-----	130.0	0.63	74.3	0.38	125.9	0.49	72.4	0.31	124.9	0.32	77.2	0.18
12 years-----	127.6	0.85	71.5	0.62	123.2	0.54	68.8	0.65	122.2	0.58	74.6	0.40
13 years-----	129.1	0.82	72.8	0.48	124.9	0.66	70.8	0.51	124.5	0.57	76.1	0.42
14 years-----	129.9	0.85	74.1	0.55	125.7	0.70	72.3	0.53	124.8	0.65	77.3	0.30
15 years-----	130.7	0.61	74.6	0.40	126.8	0.53	73.3	0.41	126.3	0.60	78.0	0.36
16 years-----	131.5	0.90	76.7	0.49	127.7	0.90	74.5	0.43	126.2	0.65	79.2	0.45
17 years-----	131.3	0.83	76.5	0.61	127.3	0.93	74.7	0.46	125.9	0.79	78.2	0.46
<u>Negro</u>												
Both sexes 12-17 years----	129.6	0.64	75.9	0.29	125.6	0.71	73.2	0.40	125.0	0.80	78.3	0.42
12 years-----	121.9	0.86	71.6	0.57	118.9	0.99	69.4	0.41	118.0	1.19	74.4	0.66
13 years-----	128.8	0.82	75.0	0.78	123.9	0.95	71.9	0.72	123.7	1.39	77.3	0.59
14 years-----	130.5	1.59	76.0	0.44	126.3	0.97	72.5	0.72	125.9	1.22	78.8	0.62
15 years-----	129.2	1.19	76.5	0.76	125.6	1.40	73.8	0.72	124.8	1.26	78.2	0.59
16 years-----	133.5	1.82	77.9	1.10	129.2	1.93	74.8	1.07	130.0	1.65	80.4	1.02
17 years-----	134.8	1.63	79.5	1.66	130.9	1.59	77.6	1.17	128.9	1.38	81.6	1.20
Boys 12-17 years-----	130.4	0.63	76.2	0.59	126.8	0.83	73.5	0.68	126.8	0.98	79.1	0.75
12 years-----	119.7	1.16	70.3	0.52	116.5	1.46	68.2	0.89	116.3	1.40	73.6	1.00
13 years-----	129.8	1.64	74.2	1.22	125.4	1.74	72.2	2.07	125.2	2.66	77.6	1.39
14 years-----	131.4	1.71	76.8	1.31	127.5	1.45	72.0	1.21	127.4	1.61	78.8	0.98
15 years-----	131.2	1.27	77.0	0.83	128.2	1.31	74.5	0.86	127.8	1.31	79.1	0.56
16 years-----	137.3	1.91	79.6	1.44	133.0	1.88	75.9	1.14	134.8	1.73	82.7	1.61
17 years-----	135.4	2.03	80.6	2.03	132.8	1.56	79.7	1.21	132.2	1.66	84.6	1.30
Girls 12-17 years-----	128.7	0.88	75.7	0.65	124.3	0.81	72.8	0.77	123.2	0.82	77.5	0.65
12 years-----	124.2	1.27	73.0	0.96	121.3	1.35	70.5	0.76	119.8	1.61	75.3	1.17
13 years-----	127.9	1.14	75.7	1.71	122.4	0.60	71.6	1.32	122.3	0.80	77.1	1.01
14 years-----	129.6	2.18	75.2	1.09	125.2	1.17	73.0	0.68	124.4	1.30	78.9	0.67
15 years-----	127.3	1.78	76.0	1.21	122.9	1.88	73.1	1.03	121.8	1.71	77.4	1.28
16 years-----	129.8	2.23	76.3	1.11	125.6	2.36	73.8	1.38	125.4	1.91	78.2	1.16
17 years-----	134.3	2.58	78.4	2.12	129.0	2.41	75.5	1.91	125.8	2.25	78.7	1.84

NOTE:  $s_{\bar{x}}$  = standard error of the mean.

Table 21. Systolic and diastolic blood pressures taken during Cycle II on those examined in both Cycle II and Cycle III of the Health Examination Survey, shown by mean and standard error of the mean

Blood pressure, age, and sex in HES III	Total		Time lapse from HES-II to HES-III for each examinee							
			Less than 36 months		36-41 months		42-47 months		More than 47 months	
	$\bar{x}_2$	$s_{\bar{x}_2}$	$\bar{x}_2$	$s_{\bar{x}_2}$	$\bar{x}_2$	$s_{\bar{x}_2}$	$\bar{x}_2$	$s_{\bar{x}_2}$	$\bar{x}_2$	$s_{\bar{x}_2}$
<u>Systolic</u>	Blood pressure in mm. Hg									
Both sexes 12-17 years-	112.1	0.24	112.1	0.81	111.8	0.41	113.0	0.46	111.8	0.35
12 years-----	110.0	0.40	109.8	1.07	110.4	0.60	110.3	0.90	109.8	0.78
13 years-----	112.0	0.39	112.6	0.68	111.7	0.40	112.6	1.40	111.5	0.78
14 years-----	113.0	0.49	113.8	1.67	113.2	0.66	113.7	0.60	111.8	0.61
15 years-----	114.7	0.66	-	-	113.7	2.09	116.4	0.74	114.2	0.88
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Boys 12-17 years-----	111.2	0.28	110.8	0.79	110.7	0.49	112.1	0.46	111.4	0.55
12 years-----	109.0	0.38	108.5	1.35	109.6	0.77	108.1	0.88	109.4	0.76
13 years-----	111.3	0.43	111.3	0.93	110.5	0.69	112.4	0.71	111.6	0.93
14 years-----	111.9	0.57	113.4	1.06	111.5	0.85	113.0	0.45	110.8	0.94
15 years-----	114.3	0.74	-	-	113.8	3.00	116.6	0.96	113.5	0.98
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Girls 12-17 years-----	113.0	0.39	113.6	1.02	112.9	0.61	113.8	0.73	112.3	0.51
12 years-----	111.1	0.61	111.7	1.74	111.0	0.88	112.8	1.65	110.2	0.93
13 years-----	112.8	0.61	114.4	1.03	112.8	0.56	112.7	2.06	111.5	0.99
14 years-----	114.1	0.71	114.2	2.48	115.0	0.94	114.2	0.93	113.1	0.67
15 years-----	115.1	0.85	-	-	113.7	2.06	116.2	1.10	114.9	1.19
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
<u>Diastolic</u>										
Both sexes 12-17 years-	67.3	0.55	65.1	1.23	68.4	1.31	67.3	0.64	67.9	1.29
12 years-----	67.4	0.59	65.5	1.52	68.6	1.54	66.8	0.40	68.0	1.39
13 years-----	67.6	0.70	65.3	1.42	68.3	1.30	67.8	1.71	68.7	1.29
14 years-----	67.0	0.65	64.3	1.30	68.2	1.18	67.2	0.52	68.1	1.56
15 years-----	67.2	0.78	-	-	68.6	2.18	67.2	0.86	67.0	1.18
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Boys 12-17 years-----	67.1	0.61	64.6	1.57	67.9	1.25	66.6	1.02	68.2	1.27
12 years-----	66.7	0.79	65.3	2.06	67.8	1.75	65.6	1.44	67.7	1.42
13 years-----	67.3	0.78	64.7	1.69	67.9	1.39	68.4	1.87	68.7	1.36
14 years-----	66.7	0.65	63.7	1.31	68.1	0.86	65.1	1.38	67.9	1.56
15 years-----	68.3	0.94	-	-	68.0	2.54	67.6	1.40	68.6	1.31
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Girls 12-17 years-----	67.5	0.56	65.5	1.07	68.8	1.43	67.8	0.38	67.6	1.37
12 years-----	68.1	0.69	65.9	1.62	69.3	1.41	68.1	1.29	68.2	1.81
13 years-----	67.9	0.67	66.1	1.22	68.8	1.28	67.4	1.71	68.7	1.38
14 years-----	67.4	0.82	64.8	1.60	68.2	1.74	68.7	0.86	68.3	1.70
15 years-----	66.0	0.89	-	-	69.0	2.55	66.7	1.17	65.0	1.16
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-

NOTE: All blood pressures found in this table were taken in the prone position and are the average of two readings. The blood pressures in this table are not population estimates.  $\bar{x}_2$  and  $s_{\bar{x}_2}$  are mean and standard error of mean from the Health Examination Survey of 1963-65 (HES-II).

Table 22. Systolic and diastolic blood pressures taken during Cycle III on those examined in both Cycle II and Cycle III of the Health Examination Survey, shown by mean and standard error of the mean

Blood pressure, age, and sex in HES III	Total		Time lapse from HES-II to HES-III for each examinee							
			Less than 36 months		36-41 months		42-47 months		More than 47 months	
	$\bar{x}_3$	$s_{x_3}$	$\bar{x}_3$	$s_{x_3}$	$\bar{x}_3$	$s_{x_3}$	$\bar{x}_3$	$s_{x_3}$	$\bar{x}_3$	$s_{x_3}$
<u>Systolic</u>			Blood pressure in mm. Hg							
Both sexes 12-17 years-	127.3	0.52	123.8	1.03	127.5	0.62	129.4	1.49	128.1	0.67
12 years-----	123.0	0.60	119.7	1.39	124.3	0.73	124.4	1.57	123.6	1.12
13 years-----	127.0	0.64	125.3	1.30	126.8	1.57	127.7	0.76	128.4	1.18
14 years-----	129.5	0.64	126.1	1.20	130.8	1.07	132.2	2.12	129.6	1.33
15 years-----	131.8	0.83	-	-	132.2	4.77	134.7	1.71	130.5	0.88
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Boys 12-17 years-----	127.4	0.55	123.6	1.19	127.2	0.53	129.0	2.01	129.4	0.60
12 years-----	120.2	0.64	117.7	1.39	121.9	0.92	119.8	1.98	121.4	1.13
13 years-----	127.3	0.87	124.6	1.92	125.3	1.39	128.6	1.18	131.3	2.01
14 years-----	131.3	0.64	130.1	1.25	132.0	1.56	133.5	1.44	130.5	1.78
15 years-----	134.7	1.47	-	-	141.1	9.66	137.8	4.03	132.7	0.95
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Girls 12-17 years-----	127.1	0.60	124.0	1.46	127.8	1.05	129.7	1.26	126.8	0.96
12 years-----	125.8	0.77	122.6	2.08	126.6	1.13	129.5	1.71	125.2	1.57
13 years-----	126.7	0.81	126.2	1.60	128.2	2.22	127.1	1.28	125.2	1.27
14 years-----	127.8	1.05	123.1	1.99	129.3	1.72	131.1	2.74	128.6	1.33
15 years-----	128.9	1.05	-	-	126.0	2.29	132.1	1.49	128.0	1.57
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
<u>Diastolic</u>										
Both sexes 12-17 years-	71.9	0.43	69.6	1.11	71.5	0.44	72.7	0.58	73.0	0.43
12 years-----	69.5	0.61	66.6	1.44	69.4	0.74	71.3	1.03	70.9	0.80
13 years-----	71.6	0.58	70.6	1.34	70.9	0.89	71.6	0.45	73.4	0.62
14 years-----	73.1	0.46	71.7	0.88	73.6	0.97	73.6	0.82	73.7	0.78
15 years-----	74.5	0.52	-	-	75.3	2.67	74.9	0.73	74.2	0.50
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Boys 12-17 years-----	71.2	0.55	68.6	1.58	70.9	0.52	72.2	0.80	72.6	0.37
12 years-----	68.2	0.70	66.0	2.06	68.4	0.83	69.6	0.97	69.3	0.97
13 years-----	71.2	0.84	69.6	2.03	70.0	0.85	72.0	1.45	73.3	0.63
14 years-----	72.7	0.66	70.7	1.05	73.3	1.11	72.9	0.94	73.4	1.31
15 years-----	74.7	0.79	-	-	77.5	5.76	75.7	1.23	74.0	0.64
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Girls 12-17 years-----	72.5	0.41	70.8	0.93	72.0	0.70	73.1	0.48	73.5	0.59
12 years-----	70.8	0.67	67.4	1.85	70.4	0.93	73.2	1.60	72.1	0.74
13 years-----	72.2	0.60	71.9	1.17	71.7	1.42	71.2	0.60	73.5	1.08
14 years-----	73.5	0.50	72.4	1.48	73.9	1.07	74.0	1.14	73.9	0.85
15 years-----	74.3	0.55	-	-	73.8	1.63	74.3	0.43	74.4	0.79
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-

NOTE: All blood pressures found in this table were taken in the prone position and are the average of two readings. The blood pressures in this table are not population estimates.  $\bar{x}_3$  and  $s_{x_3}$  are mean and standard error of mean from the Health Examination Survey of 1966-70 (HES-III).

Table 23. Increase in mean systolic and mean diastolic blood pressures of those examined in both Cycle II and Cycle III of the Health Examination Survey, shown by difference between means

Age and sex in HES III	Total		Time lapse from HES-II to HES-III for each examinee							
			Less than 36 months		36-41 months		42-47 months		More than 47 months	
	Systolic $\bar{x}_3 - \bar{x}_2$	Diastolic $\bar{x}_3 - \bar{x}_2$	Systolic $\bar{x}_3 - \bar{x}_2$	Diastolic $\bar{x}_3 - \bar{x}_2$	Systolic $\bar{x}_3 - \bar{x}_2$	Diastolic $\bar{x}_3 - \bar{x}_2$	Systolic $\bar{x}_3 - \bar{x}_2$	Diastolic $\bar{x}_3 - \bar{x}_2$	Systolic $\bar{x}_3 - \bar{x}_2$	Diastolic $\bar{x}_3 - \bar{x}_2$
Blood pressure in mm. Hg										
Both sexes 12-17 years-----	15.2	4.6	11.7	4.5	15.7	3.1	16.4	5.4	16.3	5.1
12 years-----	13.0	2.1	9.9	1.1	13.9	0.8	14.1	4.5	13.8	2.9
13 years-----	15.0	4.0	12.7	5.3	15.1	2.6	15.1	3.8	16.9	4.7
14 years-----	16.5	6.1	12.3	7.4	17.6	5.4	18.5	6.4	17.8	5.6
15 years-----	17.1	7.3	-	-	18.5	6.7	18.3	7.7	16.3	7.2
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Boys 12-17 years---	16.2	4.1	12.8	4.0	16.5	3.0	16.9	5.6	18.0	4.4
12 years-----	11.2	1.5	9.2	0.7	12.2	0.6	11.7	4.0	12.0	1.6
13 years-----	16.0	3.9	13.3	4.9	14.8	2.1	16.2	3.6	19.7	4.6
14 years-----	19.4	6.0	16.7	7.0	20.5	5.2	20.5	7.8	19.7	5.5
15 years-----	20.4	6.4	-	-	27.3	9.5	21.2	8.1	19.2	5.4
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-
Girls 12-17 years--	14.1	5.0	10.4	5.3	14.9	3.2	15.9	5.3	14.5	5.9
12 years-----	14.7	2.7	10.9	1.5	15.6	1.1	16.7	5.1	15.0	3.9
13 years-----	13.9	4.3	11.8	5.8	15.4	2.9	14.4	3.8	13.7	4.8
14 years-----	13.7	6.1	8.9	7.6	14.3	5.7	16.9	5.3	15.5	5.6
15 years-----	13.8	8.3	-	-	12.3	4.8	15.9	7.6	13.1	9.4
16 years-----	*	*	-	-	-	-	-	-	*	*
17 years-----	-	-	-	-	-	-	-	-	-	-

NOTE:  $\bar{x}_2$  = mean from Health Examination Survey of 1963-65 (HES-II),  $\bar{x}_3$  = mean from Health Examination Survey of 1966-70 (HES-III).

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## APPENDIX I

### SOURCES OF VARIATION IN THE MEASUREMENT OF BLOOD PRESSURE

The three readily identifiable potential sources of variation in the measurement of blood pressure existing in two, but not all three, of the Health Examination Survey cycles are analyzed here to determine their impact, if any, on the levels obtained. These include the exercise tolerance test in the examinations of children and youths but not of adults, the venipuncture in the examinations of adults and youths but not of children, and the more limited number of observers in the examinations of children and youths than in those of adults.

#### Exercise Tolerance Test

Both the examinations of children and of youths included an exercise tolerance test.<sup>4,6</sup> In the examinations of children the test consisted of a 2-minute ride on a bicycle ergometer, and in the examination of youths the exercise consisted of a 5-minute walk on a treadmill surface which was raised to a 10-percent grade after an initial 2-minute period of zero grade.

Among the children, blood pressure was measured before exercise for more than half of the examinees (56 percent) compared with about one-third in the youths' study (36 percent) as shown in table I. Four percent of children compared with 0.6 percent of youths had their first blood pressure measurement within 20 minutes after exercise. The first blood pressure level was determined 50 minutes or more after exercise for only about one-fifth (19 percent) of the children as compared with 50 percent of the youths.

Among children, but not among youths, there was a slightly larger proportion of the older examinees whose pressures were read within 20 minutes after exercise. Among children, no difference was found in the examination sequence between boys and girls. However, among youths nearly twice as many girls as boys had their blood pressure taken before the exercise tolerance test. No racial difference in examination sequence is evident in either the examinations of children or of youths.

The apparent magnitude of the effect of the exercise tolerance test on the first systolic blood pressure

measurement varied with the time lapse between the exercise tolerance test and that blood pressure measurement. Among both children and youths the mean systolic pressure levels for those first measured within 20 minutes after exercise were higher than for those whose pressures were determined before exercise or 20 minutes or more afterward (table II). Among children, the first mean systolic pressure for both boys and girls measured within 20 minutes after exercise was 3 mm. Hg or more higher than for those measured either before or 20 minutes or longer after exercise, a difference large enough to be statistically significant at the 5-percent probability level. While the youths measured within 20 minutes after exercise showed an even greater elevation in systolic pressure (mean difference of 7 mm. Hg) than others, this group was so small that the elevation could represent only a chance deviation. The pattern of elevated first systolic pressure among this group was generally consistent across the age range in both studies, but the magnitude varied.

The apparent effect of the exercise on the second systolic pressure is similar but slightly less than that for the first reading, as would be expected since the second was taken about 30 minutes after the first.

The diastolic blood pressure levels of children and youths appear to have been unaffected by the time lapse between the measurement and the exercise test.

As previously indicated, a substantial proportion of children (56 percent) and youths (36 percent) took the exercise test after their blood pressure had been measured. The mean systolic levels for these examinees tended to be somewhat higher than levels of those measured 30-40 minutes or more after exercise, although the mean differences are not large enough to be statistically significant at the 5-percent level. Since examinees in both surveys whose blood pressures were taken before exercise had this procedure done within the first hour of the examination while the rest were measured during the second and third hours of the examination, the slight but consistent elevation in systolic pressure among this earlier group may, if it is not just due to chance, be a reflection of some anxiety or apprehension among examinees during the earlier part of the examination.



Table I. Percent distribution of examinees 6-11 years and 12-17 years in the Health Examination Surveys of 1963-1965 and 1966-1970 by time of exercise tolerance test, according to age, race, and sex: Health Examination Surveys, 1963-1970

Time of blood pressure measurement	Age						Race					
	6 years	7 years	8 years	9 years	10 years	11 years	All races <sup>1</sup>		White		Negro	
							6-11 years	12-17 years	6-11 years	12-17 years	6-11 years	12-17 years
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Before exercise-----	68.8	54.4	58.7	55.6	57.5	42.4	55.9	36.0	56.8	36.3	51.6	34.2
After exercise:												
Less than 20												
minutes-----	2.1	2.2	2.4	2.2	4.9	9.9	4.0	0.6	3.9	0.7	4.3	0.3
20-29 minutes-----	6.6	10.0	6.3	5.6	6.6	16.6	8.7	2.6	8.3	2.8	10.6	1.8
30-39 minutes-----	7.4	11.4	6.2	4.1	4.8	10.8	7.4	3.3	7.2	3.2	8.9	4.0
40-49 minutes-----	5.1	7.2	3.8	2.6	4.4	8.7	5.3	7.5	5.3	7.5	5.3	8.0
50 minutes or more--	10.0	14.8	22.6	29.9	21.8	11.6	18.7	50.0	18.5	49.5	19.3	51.7

Time of blood pressure measurement	Age						Sex					
	12 years	13 years	14 years	15 years	16 years	17 years	Both sexes		Male		Female	
							6-11 years	12-17 years	6-11 years	12-17 years	6-11 years	12-17 years
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Before exercise-----	32.2	34.0	36.9	36.1	37.9	39.8	55.9	36.0	55.6	25.3	56.4	47.9
After exercise:												
Less than 20												
minutes-----	0.6	0.6	0.7	1.0	0.4	0.4	4.0	0.6	3.9	0.8	4.0	0.4
20-29 minutes-----	2.8	2.7	2.5	1.9	2.6	3.6	8.7	2.6	8.1	3.5	9.2	1.7
30-39 minutes-----	2.8	3.5	2.5	4.6	2.6	4.2	7.4	3.3	8.3	4.0	6.6	2.5
40-49 minutes-----	8.0	7.4	7.3	7.9	7.9	6.3	5.3	7.5	5.7	10.0	4.8	4.8
50 minutes or more--	53.6	51.8	50.1	48.5	48.6	45.7	18.7	50.0	18.4	56.4	19.0	42.7

<sup>1</sup>Includes other racial groups in addition to white and Negro.

In order to assess the net effect of the exercise tolerance test upon the national estimates of systolic blood pressure for children and youths, a comparison can be made between the mean levels for those who were presumably not affected by the exercise tolerance test (blood pressure determined 50 minutes or more after exercise) and the mean for the rest of the examinees measured after exercise (table III). Among children the first systolic pressure mean is 1.3 mm. Hg higher and the second systolic 0.8 mm. Hg higher, with the average of the two readings among those measured within 50 minutes after exercise elevated by 1.0 mm. Hg above the levels for other children. The apparent effect of the exercise is greater among youths where the first mean pressure is 3.7 mm. Hg higher and the second is 3.3 mm. Hg higher for an average elevation of 3.5 mm. Hg above the levels of

those measured at least 50 minutes after exercise. Also apparent here, if the systolic pressure levels obtained 50 minutes or more after exercise can be considered the actual normal levels for these groups of examinees, the children would seem to have had their pressures elevated more by anxiety or apprehension during the initial part of the examination than by the exercise test later (first mean of 112.0 mm. Hg before exercise compared with 111.7 mm. Hg less than 50 minutes afterward) while the youths do show some slight residual effect from exercise (table III).

#### Observer Differences

During the earlier examination survey of adults two physicians were assigned to each examination location, making possible the previously published

Table II. Mean systolic and diastolic blood pressure levels and standard errors for examinees 6-11 years and 12-17 years on the first and second reading by time in relation to exercise tolerance test and sex: Health Examination Surveys, 1963-1970

Age, sex, and blood pressure	First blood pressure taken					Second blood pressure taken						
	Be-fore-exer-cise test	After exercise test					Be-fore-exer-cise test	After exercise test				
		Under 20 min.	20-29 min.	30-39 min.	40-49 min.	50 min. or more		Under 20 min.	20-29 min.	30-39 min.	40-49 min.	50 min. or more
Mean pressure in mm. Hg												
<u>Systolic</u>												
Both sexes:												
6-11 years-----	112.0	115.0	112.2	110.9	109.8	110.4	108.8	111.2	108.7	107.6	106.6	107.5
12-17 years-----	133.4	141.2	134.5	134.7	133.6	129.9	128.3	130.3	129.4	129.2	127.7	126.0
Boys:												
6-11 years-----	111.7	114.6	111.9	110.3	109.2	109.8	108.2	109.9	108.2	106.7	106.5	107.0
12-17 years-----	137.1	143.1	136.6	136.2	134.9	131.5	130.9	131.3	131.8	130.1	128.9	127.5
Girls:												
6-11 years-----	112.4	115.5	112.5	111.7	110.6	111.0	109.4	112.4	109.2	108.7	106.8	108.1
12-17 years-----	131.4	136.9	130.1	132.4	130.5	127.6	126.9	128.0	124.5	127.5	124.9	124.0
<u>Diastolic</u>												
Both sexes:												
6-11 years-----	67.4	67.2	68.0	67.9	67.6	67.9	65.6	66.7	66.3	66.8	66.6	66.5
12-17 years-----	74.6	75.5	74.4	75.6	74.9	74.4	72.4	72.7	73.0	73.4	71.5	71.7
Boys:												
6-11 years-----	67.3	67.1	67.5	68.0	67.8	67.5	65.3	66.4	65.7	66.6	67.0	66.0
12-17 years-----	74.9	78.2	74.8	75.8	75.0	74.3	72.1	74.5	72.9	73.2	71.5	71.3
Girls:												
6-11 years-----	67.6	67.4	68.4	67.7	67.4	68.3	65.9	66.9	66.8	67.0	66.2	66.9
12-17 years-----	74.5	69.9	73.5	75.4	74.9	74.5	72.5	68.7	73.0	73.5	71.5	72.2
Standard error of mean												
<u>Systolic</u>												
Both sexes:												
6-11 years-----	0.29	0.58	0.53	0.79	0.60	0.43	0.32	0.49	0.63	0.83	0.68	0.47
12-17 years-----	0.64	3.50	1.51	1.28	0.93	0.52	0.44	2.51	1.21	1.02	0.82	0.37
Boys:												
6-11 years-----	0.39	0.76	0.68	0.85	0.81	0.54	0.36	0.60	0.79	1.05	0.80	0.56
12-17 years-----	0.69	4.58	1.76	1.37	1.08	0.53	0.64	2.61	1.89	1.29	0.87	0.35
Girls:												
6-11 years-----	0.35	0.89	0.65	1.09	0.92	0.48	0.37	0.80	0.67	0.93	0.99	0.47
12-17 years-----	0.65	4.90	2.30	2.06	1.15	0.67	0.46	5.04	1.63	1.22	1.37	0.54
<u>Diastolic</u>												
Both sexes:												
6-11 years-----	0.61	0.72	0.89	0.69	0.73	0.64	0.59	0.70	0.76	0.71	0.86	0.69
12-17 years-----	0.36	2.23	1.20	0.97	0.58	0.31	0.30	1.84	1.11	0.56	0.54	0.31
Boys:												
6-11 years-----	0.63	0.99	0.88	0.63	0.80	0.65	0.61	1.19	0.78	0.79	0.85	0.70
12-17 years-----	0.44	2.26	1.28	1.28	0.58	0.34	0.47	1.56	1.55	0.97	0.53	0.34
Girls:												
6-11 years-----	0.62	0.83	0.97	1.03	1.01	0.70	0.61	0.79	0.79	0.84	1.22	0.78
12-17 years-----	0.36	2.83	1.36	1.12	0.80	0.37	0.35	3.44	1.13	0.74	0.94	0.35

within-stand paired comparisons of blood pressure levels from the various examination locations controlled for age and sex differences.<sup>12</sup>

Blood pressure measurements in the examination survey of youths, however, were obtained by one of the two nurses assigned to work at different examination locations. In the previous examination survey of children, except for 12 percent of the children who were examined at locations with more than one nurse present, all children at a particular location were examined by

the same nurse, one of the four nurses employed in that program.

The percent distributions of examinees in the surveys of children and youths by age, sex, race, geographic region (for youths only), and examining nurse are shown in table IV. Among the nurses in each of the surveys there are only small differences in the distribution of examinees by age and sex and larger differences in the distribution of children, but not the youths, by race. The distribution of youths

Table III. Mean systolic blood pressure levels and percent of children and youths in relation to the exercise tolerance test procedure: Health Examination Surveys, 1963-1970

First blood pressure taken	Percent of examinees	Systolic pressure	
		First	Second
		Mean pressure in mm. Hg	
All children (6-11 years)-----	100.0	111.7	108.4
Before exercise-----	55.9	112.0	108.8
After exercise:			
Under 50 minutes-----	25.4	111.7	108.3
50 minutes or more---	18.7	110.4	107.5
All youths (12-17 years)-----	100.0	131.8	127.2
Before exercise-----	36.0	133.4	128.3
After exercise:			
Under 50 minutes-----	14.0	133.6	129.3
50 minutes or more---	50.0	129.9	126.0

by geographic region for each nurse indicates a disproportionately small group in the West and Northeast Regions examined by nurse 2 who obtained the measurements for only one-third of the youth examinees.

Comparisons of differences in median systolic blood pressure levels obtained by each nurse were smaller among children (largest difference, 2.8 mm. Hg) than youths (difference of 4.1 mm. Hg). (For this comparison the children examined at locations where more than one nurse was stationed, 12 percent, were excluded.) The somewhat greater observer differences in systolic pressure among youths will not have affected the analysis of the blood pressure levels of youths by age, sex, or race because the distribution of examinees for the two nurses in those respects are similar (table V). However, it will have affected and probably account for the regional systolic pressure differences since the nurse who obtained the higher levels made very few of the measurements among youths in the West Region, where the mean systolic pressures of youths were found to be the lowest.

Median diastolic blood pressure levels of youths obtained by the two nurses are in close agreement (difference of 1.6 mm. Hg) in contrast to the substantially poorer agreement among nurse observers in the children's survey where the maximum difference in median levels between nurses of 8.8 mm. Hg may have produced an underestimation of differences in diastolic pressure levels between white and Negro children.<sup>14</sup>

Those youths whose blood pressure was measured by nurse 1 (who made 69 percent of such determinations

Table IV. Number and percent distribution of examinees in the Health Examination Surveys of 1963-1965 and 1966-1970 by age, sex, race, geographic region (youths only), and examining nurse

Age, sex, race, and region for examinees	Nurse examiner <sup>1</sup>			
	1	2	3	4
<u>All examinees</u>	Number			
6-11 years <sup>2</sup> -----	1,465	2,960	732	1,123
12-17 years-----	4,671	2,097	-	-
<u>All examinees</u>	Percent distribution			
6-11 years-----	23.3	47.1	11.7	17.9
12-17 years-----	69.0	31.0	-	-
<u>Male</u>				
6-11 years-----	50.6	52.3	49.2	50.4
12-17 years-----	53.0	51.0	-	-
<u>Female</u>				
6-11 years-----	49.4	47.7	50.8	49.6
12-17 years-----	47.0	49.0	-	-
<u>White</u>				
6-11 years-----	79.8	89.7	94.8	84.8
12-17 years-----	86.4	82.5	-	-
<u>Negro</u>				
6-11 years-----	20.2	10.3	5.2	15.2
12-17 years-----	13.6	17.5	-	-
<u>Children</u>				
6-11 years----	100.0	100.0	100.0	100.0
6-7 years-----	33.0	32.9	32.9	32.7
8-9 years-----	34.1	33.6	32.7	35.4
10-11 years-----	32.9	33.5	34.4	32.0
<u>Youths</u>				
12-17 years---	100.0	100.0	-	-
12-13 years-----	35.2	36.0	-	-
14-15 years-----	34.7	33.3	-	-
16-17 years-----	30.1	30.7	-	-
<u>Geographic region</u>				
12-17 years---	100.0	100.0	-	-
Northeast-----	27.4	17.3	-	-
Midwest-----	22.1	34.6	-	-
South-----	18.3	40.5	-	-
West-----	32.2	7.6	-	-

<sup>1</sup>The nurse examiners in the two surveys were all different individuals.

<sup>2</sup>Excludes the 839 children 6-11 years examined at locations with more than one nurse.

in the 1966-70 Health Examination Survey) showed consistently lower mean systolic and diastolic blood pressures on the first two measurements and higher on the third than the remaining 31 percent of youths measured by nurse 2. The mean difference between

Table V. Median blood pressures of children and youths by examining nurse; Health Examination Surveys, 1963-1965 and 1966-1970

Blood pressure and age of examinee	Nurse examiner <sup>1</sup>			
	1	2	3	4
<u>Systolic</u>	Median pressure in mm. Hg <sup>2</sup>			
6-11 years-----	110.2	108.4	111.2	110.4
12-17 years-----	128.3	132.4	-	-
<u>Diastolic</u>				
6-11 years-----	60.5	69.3	64.9	66.6
12-17 years-----	72.8	74.4	-	-

<sup>1</sup>The nurse examiners in the two surveys were all different individuals.

<sup>2</sup>First two readings in each survey with values adjusted to age-race distribution of all examinees in each survey.

those measured by the two nurses was greatest on the first and least on the third blood pressure determination. Youths observed by nurse 2 had mean levels 5.3 mm. Hg higher than those observed by nurse 1 on the first systolic reading and 3.1 mm. Hg higher for their second systolic reading but 1.1 mm. Hg lower on their third (table VI). The mean age-sex specific differences in the first systolic blood pressure levels of the youths measured by the two nurses ranged from 2.3 mm. Hg to 9.3 mm. Hg for boys and from 3.0 mm. Hg to 7.4 mm. Hg for girls, those measured by nurse 2 being consistently the higher.

The pattern of apparent nurse differences in observed diastolic levels among these youths is similar to that for their systolic pressures but is less marked. The mean diastolic pressures for youths measured by nurse 2 were 2.1 mm. Hg higher than for those measured by nurse 1 on the first reading, 1.1 mm. Hg higher for the second, but 0.9 mm. Hg lower on the third. The age-sex specific differences in diastolic levels for the youths measured by the two nurses ranged from 0.9 mm. Hg to 3.1 mm. Hg for boys on the first reading and from 1.1 mm. Hg to 3.2 mm. Hg for the girls.

During the survey, replicate examinations, including a second set of blood pressure measurements, were done by the original examiner 2 to 4 weeks after the regular examinations among a sample of 302 youths. Of these 7 to 10 were from each of the examination locations. The replicate blood pressure readings were consistently lower than the original readings by an average of 3-5 mm. Hg for systolic and 2 mm. Hg for diastolic pressure. The pattern of decrease was sim-

ilar for both nurses and one nurse replicated about as well as the other. These lower replicate blood pressure levels probably reflect the lessened concern on the part of the youths because they knew what to expect in the examination.

In the 1960-1962 Health Examination Survey of adults, the physician observer differences were greater than in either of the two subsequent surveys. The deviations of the mean blood pressure measurements of each of the physicians from the mean for all physicians (standardized on the basis of the age and sex of examinees) were as large as 17 mm. Hg for systolic and 12 mm. Hg for diastolic.

Although the range of observer differences may increase with an increase in the number of observers, the mean values and distributions obtained under standardized conditions may be expected to provide a closer approximation to the true mean and distribution in the population than those from a more limited number of observers.

### Venipuncture

A sample of blood was taken from every youth between the first and second blood pressure readings. Venipuncture and other parts of the examination could have been viewed with anxiety by the youths, thereby boosting the blood pressures of those who were most anxious. Hence, the decrease in blood pressure with time in the examination may reflect in part the decreased anxiety about this procedure after venipuncture had been taken. It was concluded that the venipuncture in the survey of adults where the timing of this procedure varied had no effect upon the blood pressures.<sup>12</sup> Presumably, the venipuncture was not a significant factor in the youths' survey either.

### End-Digit Preference

As in the two previous Health Examination Surveys, the examiners in the survey of youths were instructed to record blood pressures to the nearest 2 mm. Hg. However, a number of odd digits were recorded with "5" being the most common. On all systolic and diastolic blood pressure readings for youths the "0" was the most frequently occurring end-digit with both the "2" and "8" being recorded less frequently than would be expected by chance. This end-digit preference among nurse observers is generally similar for children and youths (table VII) but is substantially less than that shown by the physicians who measured the blood pressure of adults in the 1960-1962 Health Examination Survey.<sup>12</sup>

Table VI. Mean reading and nurse observer differences in blood pressure levels of youths 12-17 years by race, geographic region, and sex: Health Examination Survey, 1966-1970

Blood pressure measure, race, and sex	Nurse difference (#2-#1)			Reading differences				Nurse differences (#2-#1) (mean of three readings)			
				First-second		Second-third					
	First	Second	Third	Nurse #1	Nurse #2	Nurse #1	Nurse #2	North-east	Mid-west	South	West
<u>ALL YOUTHS</u>											
Mean pressure differences in mm. Hg											
<u>Systolic</u>											
Both sexes-----	5.3	3.1	-1.1	3.9	6.1	-0.6	3.6	4.7	3.5	1.4	-3.4
Boys-----	5.4	2.5	-1.5	4.1	7.0	-0.7	3.3	5.8	3.0	-0.3	-2.4
Girls-----	5.4	4.0	-0.5	3.7	5.0	-0.4	4.1	4.2	4.2	3.2	-4.2
<u>Diastolic</u>											
Both sexes-----	2.1	1.1	-0.9	2.2	3.2	-6.2	-4.2	0.7	2.7	-0.5	-1.3
Boys-----	2.0	1.3	-1.2	2.7	3.4	-7.1	-4.6	0.2	3.0	-0.7	-1.5
Girls-----	2.2	1.0	-0.8	1.7	2.9	-5.4	-3.6	1.2	2.3	-0.4	-1.2
<u>WHITE</u>											
<u>Systolic</u>											
Both sexes-----	5.6	3.4	-0.6	4.0	6.2	-0.5	3.5	---	---	---	---
Boys-----	5.9	2.9	-0.9	4.3	7.3	-0.6	3.2	---	---	---	---
Girls-----	5.3	3.9	-0.1	3.7	5.1	-0.3	3.7	---	---	---	---
<u>Diastolic</u>											
Both sexes-----	2.1	1.3	-0.8	2.2	3.0	-6.3	-4.2	---	---	---	---
Boys-----	2.1	1.6	-0.9	2.8	3.3	-7.1	-4.6	---	---	---	---
Girls-----	2.0	1.1	-0.7	1.7	2.6	-5.4	-3.6	---	---	---	---
<u>NEGRO</u>											
<u>Systolic</u>											
Both sexes-----	4.0	2.1	-3.8	3.3	5.2	-1.6	4.3	---	---	---	---
Boys-----	2.4	-0.2	-5.1	2.7	5.3	-1.6	3.3	---	---	---	---
Girls-----	5.8	4.7	-2.3	4.0	5.1	-1.7	5.3	---	---	---	---
<u>Diastolic</u>											
Both sexes-----	1.6	-0.3	-2.1	2.0	3.9	-5.8	-4.0	---	---	---	---
Boys-----	0.9	-0.9	-2.6	2.0	3.8	-6.2	-4.5	---	---	---	---
Girls-----	2.2	0.3	-1.3	2.1	4.0	-5.4	-3.8	---	---	---	---

Table VII. Distribution of end-digit on blood pressure measurements by order of measurements among children and youths: Health Examination Surveys, 1963-1965 and 1966-1970

Order of blood pressure measurement	End-digit of blood pressure measurement										
	0	1	2	3	4	5	6	7	8	9	Missing
<u>YOUTHS 12-17 YEARS</u>											
<u>Systolic</u>											
First-----	1,617	2	1,311	3	1,490	14	1,352	1	973	-	5
Second-----	1,655	-	1,172	2	1,493	10	1,422	1	1,004	2	7
Third-----	1,655	-	1,140	3	1,520	12	1,473	4	946	4	11
<u>Diastolic</u>											
First-----	2,506	1	761	2	1,289	19	1,348	1	834	1	6
Second-----	2,504	-	727	2	1,294	6	1,388	1	838	1	7
Third-----	2,214	1	717	-	1,220	16	1,542	5	1,039	1	13
<u>CHILDREN 6-11 YEARS</u>											
<u>Systolic</u>											
First-----	1,759	-	1,442	-	1,534	6	1,047	1	1,321	3	6
Second-----	1,724	3	1,375	3	1,490	9	1,071	2	1,405	10	17
<u>Diastolic</u>											
First-----	1,756	-	1,319	2	1,216	5	954	1	1,860	-	6
Second-----	1,856	2	1,240	12	1,212	9	1,049	13	1,705	3	18

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## APPENDIX II

### STATISTICAL NOTES

#### The Survey Design

The sample designs for the first three programs or Cycles I-III of the Health Examination Survey have been essentially similar in that each has been a multistage, stratified probability sample of clusters of households in land-based segments. The successive elements for this sample design are primary sampling units, census enumeration district, segment (a cluster of households), eligible persons, and finally the sample person.

The 40 sample areas and segments utilized in the design of Cycle III were the same as those in Cycle II. Previous reports describe in detail the sample design used for Cycle II and in addition discuss the problems and considerations given to other types of sampling frames, cluster versus random sampling, and whether or not to control the selection of siblings.<sup>4,6</sup>

Requirements and limitations placed on the design for Cycle III, similar to those for children in Cycle II, were that:

- The target population be defined as the civilian noninstitutionalized population of the United States, including Alaska and Hawaii, of ages 12-17 years for Cycle III, with the special exclusion of children residing on reservation lands of the American Indians because of operational problems encountered on these lands in Cycle I.
- The time period of data collection be limited to about 3 years for each cycle and the length of the individual examination within the specially constructed mobile examination center be between 2 and 3 hours.
- Ancillary data be collected on specially designed household, medical history, and school questionnaires and from birth certificate copies.
- Examination objectives be related primarily to factors of physical and intellectual growth and development.
- The sample be sufficiently large to yield reliable findings within broad geographic regions and population density groups as well as age, sex, and limited socioeconomic groups for the total sample.

The sample was drawn jointly with the U.S. Bureau of the Census starting with the 1960 decennial census list of addresses and the nearly 1,900 primary sampling units (PSU's) into which the entire United States was divided. Each PSU is either a standard metropolitan statistical area, a county, or a group of two or three contiguous counties. These PSU's were grouped into 40 strata, each stratum having an average size of about 4.5 million persons, in such a manner as to maximize the degree of homogeneity within strata with regard to the population size of the PSU's, degree of urbanization, geographic proximity, and degree of industrialization. The 40 strata were classified into four broad geographic regions of 10 strata each and then, within each region, were cross-classified by four population density classes and classes of rate of population change from 1950 to 1960. Using a modified Goodman-Kish controlled-selection technique, one PSU was drawn from each of the 40 strata.

Further stages of sampling within PSU's required first the selection of census enumeration districts (ED's). The ED's are small well-defined areas of about 250 housing units into which the entire Nation was divided for the 1960 population census. Each ED was assigned a "measure of size" equal to the rounded whole number resulting from a "division by nine" of the number of children aged 5-9 in the ED at the time of the 1960 census. A sample of 20 ED's in the sample PSU were selected by systematic sampling with each ED having a probability of selection proportional to the population of children 5-9 years at the time of the 1960 census date. A further random selection by size of segments (smaller clusters of housing units) within each ED was then made.

Because of the 3-year time interval between Cycle II and Cycle III, the Cycle III frame had to be supplemented for new construction and to compensate for segments where housing was partially or totally demolished to make room for highway construction or urban redevelopment.

Advanced planning for the examinations at the various locations or stands provided for about 17 days of examinations which limited the number of examinees per location to approximately 200. When the number of eligible youths in the sample drawn for a particular location exceeded this number, subsampling was done

by deleting from the master list of eligible youths (ordered by segment, household order within segment, and age within household) every  $n$ th name on the list starting with the  $y$ th name,  $y$  being a number between 1 and  $n$  selected randomly and  $n$  being the extent of oversampling in the original draw.

In both Cycles II and III twins who were deleted in the sample selection were also scheduled for examination if time permitted, as were youths deleted from the Cycle III sample who had been examined in Cycle II. The sample was selected in Cycles II and III to contain the correct proportion of youths from families having only one eligible youth, two eligible youths, and so on to be representative of the total target population. However, since households were one of the elements in the sample frame, the number of related youths in the resultant sample is greater than would come from a design which samples youths 12-17 years without regard to household. The resultant estimated mean measurements or rates should be unbiased but their sampling variability will be somewhat greater than those from a more costly, time-consuming systematic sample design in which every  $k$ th youth would be selected.

The total probability sample for Cycle III included 7,514 youths representative of the approximately 22.7 million noninstitutionalized youths of 12-17 years in the United States. The sample contained approximately 1,000 youths in each single year of age from 25 different States.

The response rate in Cycle III was 90 percent, with 6,768 youths examined out of the total sample. These examinees were closely representative of those in the samples as well as of the population from which the samples were drawn with respect to age, sex, race, geographic region, population density, and population growth in area of residence. Hence it appears unlikely that nonresponse could bias the findings appreciably.

## Reliability

While measurement processes in the surveys were carefully standardized and closely controlled, the correspondence between the real world and survey results cannot be expected to be exact. Survey data are imperfect for three major reasons: Results are subject to sampling error, the actual conduct of a survey never agrees perfectly with the design, and the measurement processes themselves are inexact even though standardized and controlled.

The first reports on Cycle III<sup>5,6</sup> describe in detail the faithfulness with which the sampling design was carried out.

Data recorded for each sample youth are inflated in the estimation process to characterize the larger universe of which the sample youth is representative. The weights used in this inflation process are a product of the reciprocal of the probability of selecting

the youth, an adjustment for nonresponse cases, and a poststratified ratio adjustment which increases precision by bringing survey results into closer alignment with known U.S. population figures by color and sex within single years of age 12 through 17 for the youths' survey. It should also be noted that all of the blood pressures in the findings sections of this report are weighted to provide population estimates for the respective age groups in the noninstitutionalized population.

In Cycles II and III of the Health Examination Survey the samples were the result of three principal stages of selection—the single PSU from each stratum, the 20 segments from each sample PSU, and the sample youth from the eligible persons. The probability of selecting an individual youth is the product of the probability of selection at each stage.

Since the strata are roughly equal in population size and a nearly equal number of sample youths were examined in each of the sample PSU's, the same design is essentially self-weighting with respect to the target population; that is, each youth 12-17 years of age had about the same probability of being drawn into the respective samples.

The adjustment upward for nonresponse is intended to minimize the impact of nonresponse on final estimates by imputing to nonrespondents the characteristics of "similar" respondents. Here "similar" respondents were judged to be examined youths in a sample PSU having the same age in years and sex as youths not examined in that sample PSU.

The poststratified ratio adjustment used in the third cycle achieved most of the gains in precision which would have been attained if the sample had been drawn from a population stratified by age, color, and sex and made the final sample estimates of population agree exactly with independent controls prepared by the U.S. Bureau of the Census for the U.S. noninstitutionalized population as of March 9, 1968 (approximate midsurvey point for Cycle III), by color and sex for each single year of age 12-17. The weights of every responding sample youth in each of the 24 age, color, and sex classes are adjusted upward or downward so that the weighted total within the class equals the independent population control for each survey.

Sample frequencies and estimated U.S. population frequencies as of the approximate midsurvey point are shown by age, sex, and race in table VIII. In addition to youths not examined at all, there were some whose examination was incomplete in one procedure or another.

The extent of missing and out-of-tolerance blood pressures is shown in table IX. Out-of-tolerance systolic blood pressures were those that were less than 60 mm. Hg or more than 280 mm. Hg. Out-of-tolerance diastolic blood pressures were those that were less than 35 mm. Hg or more than 150 mm. Hg. Blood pressure values were imputed for those persons



Table VIII. Sample of examinees and estimated U.S. population frequency distribution of youths in the noninstitutional population of the United States, by race, age, and sex: Health Examination Survey, 1966-1970

Age and sex	Total	White	Negro	Other races	Total	White	Negro	Other races
<u>Both sexes</u>	Number of examinees				Population in thousands			
12-17 years-----	6,768	5,735	999	34	22,692	19,552	3,024	116
<u>Boys</u>								
12-17 years-----	3,545	3,047	479	19	11,489	9,929	1,496	64
12 years-----	643	540	101	2	2,032	1,747	280	5
13 years-----	626	542	80	4	2,006	1,729	262	15
14 years-----	618	527	88	3	1,951	1,686	256	9
15 years-----	613	525	84	4	1,900	1,646	241	13
16 years-----	556	496	57	3	1,836	1,594	231	11
17 years-----	489	417	69	3	1,764	1,528	225	11
<u>Girls</u>								
12-17 years-----	3,223	2,688	520	15	11,203	9,623	1,527	53
12 years-----	547	455	88	4	1,970	1,685	272	14
13 years-----	582	490	91	1	1,946	1,667	275	4
14 years-----	586	484	101	1	1,901	1,633	266	2
15 years-----	503	425	73	5	1,851	1,594	235	21
16 years-----	536	441	93	2	1,789	1,542	243	5
17 years-----	469	393	74	2	1,746	1,502	237	7

who had missing or out-of-tolerance blood pressures. If a youth was missing all blood pressures, the blood pressures of a youth of the same age, sex, race, height, weight, and upper arm girth were used as the best indicator of the missing blood pressures. However, if all of the blood pressures were not missing for a particular youth, the blood pressures that were taken and recorded were considered when the missing reading was imputed.

### Sampling and Measurement Error

In the present report, reference has been made to efforts to minimize bias and variability of measurement techniques.

The probability design of the survey makes possible the calculation of sampling errors. The sampling error is used here to determine how imprecise the survey test results may be because they come from a sample rather than from the measurements of all elements in the universe.

The estimation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: 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, the survey design and estimation procedure are complex and accordingly require computationally involved techniques for the calculation of variances, and from the survey are coming thousands of statistics, many for subclasses of the population for which there are a small number of 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.

Estimates of approximate sampling variability for selected statistics used in this report are included in the detailed tables. 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 the measurement variance.

In accordance with usual practice, the interval estimate for any statistic may be considered 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

Table IX. Extent of missing and out-of-tolerance blood pressures by age and sex: Health Examination Survey, 1966-1970

Age and sex	Number of persons	First reading		Second reading		Third reading	
		Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic
Both sexes 12-17 years-----	19	5	8	7	7	11	14
12 years-----	1	-	-	-	-	1	1
13 years-----	4	1	2	2	2	2	2
14 years-----	5	1	2	1	1	3	3
15 years-----	4	0	1	0	0	1	3
16 years-----	1	0	0	1	1	1	1
17 years-----	4	3	3	3	3	3	4
Boys 12-17 years----	8	1	2	2	2	5	6
12 years-----	1	-	-	-	-	1	1
13 years-----	3	1	2	2	2	1	1
14 years-----	2	-	-	-	-	2	2
15 years-----	2	-	-	-	-	1	2
16 years-----	-	-	-	-	-	-	-
17 years-----	-	-	-	-	-	-	-
Girls 12-17 years---	11	4	6	5	5	6	8
12 years-----	-	-	-	-	-	-	-
13 years-----	1	-	-	-	-	1	1
14 years-----	3	1	2	1	1	1	1
15 years-----	2	0	1	0	0	0	1
16 years-----	1	0	0	1	1	1	1
17 years-----	4	3	3	3	3	3	4

confidence. The latter is used as the level of significance in this report.

An approximation of the 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 sampling errors, respectively, of  $x$  and  $y$ . Of course, where the two groups or measures are positively or negatively correlated, this will give an overestimate or underestimate, respectively, of the actual standard error.

### Tests of Significance

The procedure used in this report for testing the significance of the difference between two means consisted of dividing the difference between the two means by the standard error of the difference as computed above. In other words, a  $z$ -statistic was computed. If the  $z$ -statistic was greater than or equal to 1.96, the difference was considered to be statistically significant at the 95-percent confidence level. If more than one test is implied (such as, regional differences—six implied tests) then the Bonferroni test was used to test for significance. In the Bonferroni

test the  $z$ -statistic is also computed, but for the difference between two means to be considered significant at the 95-percent confidence level, the  $z$ -statistic must be greater than or equal to 2.64 when six tests are implied.

### Tests of Normality

In this report the formulas used to measure kurtosis and skewness were those defined in the *Statistical Package for the Social Sciences (SPSS)*.<sup>22</sup> Kurtosis is defined as the general peakedness of a distribution. The formula is:

$$\text{Kurtosis} = \frac{\sum_{i=1}^N \left( \frac{x_i - \bar{x}}{s} \right)^4}{N} - 3$$

A positive value indicates that the distribution is more peaked than the normal distribution, and a negative value indicates that the distribution is flatter than the normal distribution.

A skewed distribution is one that has a larger number of cases in one tail of the distribution than in the other. The formula is:

$$\text{Skewness} = \frac{\sum_{i=1}^N \left( \frac{x_i - \bar{x}}{s} \right)^3}{N}$$

A positive value indicates that the distribution is skewed to the right; a negative value indicates that the distribution is skewed to the left.

## Small Numbers

In some tables magnitudes are shown for cells for which the 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. Some such numbers have been included in the belief that they may help to convey an impression of the overall story of the table.



## APPENDIX III

### DEMOGRAPHIC AND SOCIOECONOMIC TERMS

*Age.*—The age recorded for each youth was the age at last birthday on the date of examination. The age criterion for inclusion in the sample used in this survey was defined as age at time of interview. Since the examination usually took place 2-4 weeks after the interview, some of those who were 17 years old at the time of interview became 18 years old by the time of the examination. There were 23 such cases. In the adjustment and weighting procedures used to produce national estimates, these 23 were included in the group 17 years old.

*Race.*—The race classification recorded by observation was confirmed by comparison with the race classification on the youth's birth certificate. Race was recorded as "white," "Negro," or "other." "Other" races included American Indians, Chinese, Japanese, and all races other than white or Negro. Mexican persons were included with "white" unless definitely known to be American Indian or of a race other than white. Negroes and persons of mixed Negro and other parentage were recorded as "Negro."

*Family income.*—The income recorded was the total income received during the past 12 months by the head of the household and all other household members related to the head by blood, marriage, or adoption. This income was the gross cash income (excluding pay in kind, e.g., meals, living quarters, or supplies provided in place of cash wages) except in the case of a family with its own farm or business, in which case net income was recorded. Also included in the family income figure were allotments and other money received by the family from a member of the Armed Forces whether he was living at home or not.

*Education of head of household.*—The highest grade that had been completed in school was recorded. The only grades counted were those that had been completed in a regular graded school where persons were given formal education, either public or private school, either day or night school, and either full-time or part-time attendance. A regular school is one that advances a person toward an elementary or high school diploma or toward a college, university, or professional school degree. Education in vocational, trade, or business schools outside a regular school system was not counted in determining the highest grade of school completed.

*Geographic region.*—For purposes of stratification the United States was divided into four geographic regions of approximately equal population. These regions, which correspond closely to those used by the U.S. Bureau of the Census, were as follows:

<i>Region</i>	<i>States Included</i>
Northeast-----	Maine, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, and Pennsylvania
Midwest-----	Ohio, Illinois, Indiana, Michigan, Wisconsin, Minnesota, Iowa, and Missouri
South-----	Delaware, Maryland, District of Columbia, West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Arkansas
West-----	Washington, Oregon, California, Nevada, New Mexico, Arizona, Texas, Oklahoma, Kansas, Nebraska, North Dakota, South Dakota, Idaho, Utah, Colorado, Montana, Wyoming, Alaska, and Hawaii

*Urban or rural areas.*—The definition of urban areas was the same as that used in the 1960 census. According to this definition, the urban population was comprised of 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 contained no incorporated municipalities as subdivisions and had either 2,500 inhabitants or more, or a population of 2,500 to 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 had no incorporated municipalities within their boundaries and had 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 areas were classified as rural.

Urban areas are further classified by population size for places within urbanized areas and other urban places outside urbanized areas.



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