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NATIONAL
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For HEALTH
STATISTICS



Weight, Height, and Selected Body Dimensions of Adults

United States - 1960 - 1962

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U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service



VITAL and HEALTH STATISTICS

DATA FROM THE NATIONAL HEALTH SURVEY

Weight, Height, and Selected Body Dimensions of Adults

United States - 1960 - 1962

Age and sex distributions for weight, height, erect sitting height, normal sitting height, knee height, popliteal height, elbow rest height, thigh clearance height, buttock-knee length, buttock-popliteal length, elbow-to-elbow breadth, and seat breadth.

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Anthony J. Celebrezze
Secretary

Public Health Service
Luther L. Terry
Surgeon General

Computation of estimated SD's for both men and women, total 18-79 years column only, in tables 1-12, National Center for Health Statistics, Series 11, Number 8.

Table 1 Weight (pounds)

Men	Est SD	27.73
Women	Est SD	27.73

Table 9 Buttock Knee Length (in.)

Men	Est SD	1.17
Women	Est SD	1.21

Table 2 Height (inches)

Men	Est SD	2.85
Women	Est SD	2.58

Table 10 Buttock-Popliteal Lth (in.)

Men	Est SD	1.21
Women	Est SD	1.29

Table 3 Sitting Height-Erect (in.)

Men	Est SD	1.48
Women	Est SD	1.48

Table 11 Elbow-to-Elbow Brd (in.)

Men	Est SD	1.84
Women	Est SD	2.11

Table 4 Sitting Height-Normal (in.)

Men	Est SD	1.45
Women	Est SD	1.52

Table 12 Seat Breadth (in)

Men	Est SD	1.17
Women	Est SD	1.45

Table 5 Knee Height (inches)

Men	Est SD	1.13
Women	Est SD	1.09

Table 6 Popliteal Height (inches)

Men	Est SD	1.09
Women	Est SD	1.09

Table 7 Elbow Rest Ht (inches)

Men	Est SD	1.17
Women	Est SD	1.21

Table 8 Thigh Clearance Ht (in.)

Men	Est SD	.78
Women	Est SD	.90

90° - 15°
÷ 2.56

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IN THIS REPORT are presented findings from 12 of the 18 measurements of body size taken during the examinations of Cycle I of the Health Examination Survey. This phase of the Survey was started in October 1959 and completed in December 1962. Out of the nationwide probability sample of 7,710 persons 18-79 years of age selected from the U.S. civilian, noninstitutional population, 6,672 (or more than 85 percent) were examined.

The measurements obtained in Cycle I were those which could be reliably taken within the time and facility limitations of the examination and which are most widely used in the assessment of the health status of the population; in the design of commercial, industrial, medical, and military equipment; in the assessment of various physiological processes; and for many other research and commercial purposes.

This report contains findings by age for men and women on weight, height, erect and normal sitting height, knee and popliteal height, elbow rest and thigh clearance height, buttock-knee and buttock-popliteal length, elbow-to-elbow breadth, and seat breadth. Measurement techniques are described.

Comparisons are made with findings from previous anthropometric surveys among various groups in the United States and Canada. The possible influence on the findings of such factors as age, racial and ethnic differences, socioeconomic differences, civilian and military differences, secular changes in body size, and differences in measuring techniques which have been noted in previous studies are discussed.

SYMBOLS

Data not available-----	---
Category not applicable-----	...
Quantity zero-----	-
Quantity more than 0 but less than 0.05-----	0.0
Figure does not meet standards of reliability or precision-----	*

WEIGHT, HEIGHT, AND SELECTED BODY DIMENSIONS OF ADULTS

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INTRODUCTION

The Health Examination Survey

This report presents findings on certain of the physical measurements of adults obtained in the first cycle of the Health Examination Survey.

The Health Examination Survey is one of three programs of the National Health Survey developed to secure statistics on the health status of the population of the United States. It obtains data through medical examination, tests, and measurements on a scientifically selected random sample of the population. Methods used in other programs are the household interview and the obtaining of data from available hospital and other medical records.

The first cycle of the Health Examination Survey was limited to civilian adults living outside of institutions. Its purpose was to determine the prevalence of certain chronic diseases; the status of auditory and visual acuity; the level of dental health; and certain measurements of body size. A nationwide probability sample of 7,710 persons 18-79 years of age was selected. During the Survey, which extended from October 1959 through December 1962, 6,672 sample persons were examined. Medical and other Survey staff

performed the standard examination, which lasted about 2 hours, in mobile clinics especially designed for the purpose.

Previous publications describe the general plan and initial program of the Health Examination Survey¹ as well as the sample population response and the effect of nonresponse on the findings.² Data available from the examination, the household interview preceding the examination, and a subsequent physician record check with a subsample of respondents and nonrespondents indicate that no major features of the adult population of the United States are seriously distorted and that the effects of nonresponse on the demographic picture are not serious.

The Utility of Anthropometric Data

Anthropometric data were collected in the first cycle of the Health Examination Survey for the following purposes:

1. As reference standards to describe the physique of the adult population of the Nation at a point in time. Time trends within such a population can be detected by comparison with earlier or later surveys. Regional differences within the United States and differences between this and other nations may be assessed more reliably using this standard. Indications may also be obtained of the effects on human body size of such factors as social and

^aWork done during the tenure of an Established Investigatorship of the American Heart Association.

geographic mobility, shifting rural-urban and occupational patterns, and improved medical and public health conditions.

2. To provide anthropometric data essential to the designing of equipment for human use. This report presents, in addition to the basic dimensions of height and weight, the 10 body dimensions obtained in the Health Examination Survey which are most important for equipment design—commercial, industrial, military, or medical—to ensure its safe, efficient, and comfortable use. Principles and directions for their application are fully treated elsewhere^{3 4} and hence will not be given here.

Height and weight are especially useful in equipment design since both correlate closely enough with other body dimensions—height with segmental and limb lengths, weight with breadths, depths, and girths—to permit reasonable predictions for groups of persons for whom these other dimensions may not be available.

3. To provide data which can be used in the study of various physiological functions and human health problems. For example, anthropometric data are used to estimate body surface areas in investigations of the effects of heat or radiation. Similarly, skinfold and weight-height data are used in studies of nutritional status or requirements.

Anthropometric Surveys Among Adults:

A Brief Historical Account

Because of the cost and practical difficulty of conducting a survey of a truly representative national sample, most anthropometric descriptions on a national scale have come from military rather than civilian sources. Probably the first adequate sampling survey of a national population was the Canadian height and weight survey of 1953,^{5 6} which recorded the height, weight, and triceps skinfold on a stratified probability sample of 22,000 Canadians wearing indoor clothing without shoes.

Previous large-scale civilian surveys, less systematically sampled, have been made in Turkey, the United States, and Britain.⁷⁻⁹ The Turkish survey reported measurements on some 60,000 subjects; the British, height and weight on 22,500 men and 33,500 women in certain industries, but fully clothed and shod; and the United States survey included 10,000 women aged 18-75 in four occupational groups, chiefly urban and of low income levels. All were volunteers, with the limitations in representativeness thereby implied.

Apart from occasional surveys of industrial or consumer groups,¹⁰⁻¹⁴ most anthropometric surveys have been made on students and soldiers. Students are a special group in any population with respect to age, residence, socioeconomic status, nutrition, and intelligence. Servicemen and women, though possibly geographically representative, are probably physically superior to the general population because they are selected to meet minimum standards. Moreover, they span a narrow age range, with recruits—the most feasible group to measure—falling in the late teens and early twenties. The older a military population the more highly selected it is, for reasons of self-selection, occupational specialization, and medical elimination of the less fit. The military group that most nearly represents a segment of the national population would therefore be those men examined in a general mobilization or in a universal peacetime draft, both those accepted and rejected. Such mass data have been reported from the Selective Service Systems of Britain¹⁵ and the United States^{16 17} during and subsequent to the Second World War.

Mass surveys of this sort have the advantages of broad representativeness and large numbers of subjects. They have serious disadvantages, however, in respect to sex and age restriction, few measurements, and measuring techniques that are not sufficiently standardized in actual practice. Usually, only height and weight are taken—rarely, chest circumference as well. In the experience of many investigators height so taken has been found to be subject to substantial error, while Kossman, Green, and White¹⁸ demonstrated that chest circumference obtained by untrained observers can be so unreliable as to be virtually useless.

Early large-scale military surveys were made on recruits during the American Civil War^{19 20} and subsequently in most European countries. The focus of interest was medical rather than anthropological, with height, weight, and chest circumference being the usual dimensions taken. The data were also used for more general purposes later. For example, Livi in 1897 and 1911^{21 22} compared the "robustness" of various occupational groups among 300,000 Italian recruits. During the 1920's detailed anthropometric studies were made on Swedish and Norwegian soldiers^{23 24} as a basis for racial anthropology in these countries. The most recent study of this "classical" type is by Schlaginhaufen²⁵ on 35,500 Swiss recruits, while Martin²⁶ has utilized Belgian military data to test the size increase of recruits between 1842 and 1953.

The first military anthropometric survey that included body measurements in addition to height and weight and which was intended to guide the equipment designer was apparently Davenport and Love's *Army Anthropology*,²⁷ based on some 100,000 American troops measured upon demobilization in 1919-20. This monumental work became the standard description of U.S. men between the two World Wars, but appears never to have been used for its intended purpose, the sizing of clothing.

In the Second World War anthropometry was for the first time successfully applied to equipment design, based on surveys made in the U.S. Air Force,²⁸ the British Navy,²⁹ and the Royal Air Force.³⁰ Since then military anthropometry has been carried out extensively in the U.S. Army and Air Force^{31 32} and in many other countries as well, while few civilian anthropometric studies have been undertaken.

THE MEASUREMENTS

Eighteen measurements of body size were taken during the examination to provide base-line data not previously available on the anthropometry of the adult population of the United States. The measurements selected were those which could be reliably obtained within the time and facility limitation of the examination, and which are most widely used in (a) the assessment of growth, aging, and other aspects of the

health status of the population; (b) the design of commercial, industrial, medical, and military equipment to ensure its safe, efficient, and comfortable use; (c) the assessment of various physiological processes; and (d) many other research and commercial purposes.

This report is limited to descriptions of the age and sex distributions of weight, height, and 10 other body measurements among the total civilian, noninstitutional, adult population of the United States.

Measuring Techniques

All measurements were made with the examinee stripped to the waist and without shoes, but wearing paper slippers and a lightweight, knee-length examining gown. Men's trouser pockets were emptied. Sitting measurements were made with the examinee seated on a flat, horizontal board, with the knees at right angles, thighs horizontal, and popliteal areas (underpart of thigh behind knee) lightly touching the seat surface. This was accomplished by inserting or removing the necessary number of ½-inch plywood boards under the feet. All measurements not in the midsagittal plane (parallel to the long axis of the body) were measured on the right side of the body, unless otherwise noted.

Measurements were taken by a team of two trained staff observers using the following standardized procedures illustrated in Appendix I:

Weight.—The examinee stood without support on the platform of an automatic balancing scale. The examinee's weight was reproduced on his record, which was inserted in the scale's automatic printer.

Height.—The examinee stood erect on a horizontal platform with his back against a vertical measuring scale 3 inches wide, looking straight ahead with his head in the Frankfort horizontal plane (that horizontal plane which includes the lower margin of the bony orbit—the bony socket containing the eye—and the most forward point in the supratragal notch—the notch just above the anterior cartilaginous projection of the

external ear). A horizontal measuring bar (1½ inches wide) was then brought down snugly but not tightly on the top of the head. An adhesive strip with the examinee's case number was attached to the scale's pointer support and the position of the pointer on the scale was photographed. For examinees too tall to be photographed (over 75 inches), height was measured with an anthropometer. The examinee stood erect on the floor, heels together, looking straight ahead with head in the Frankfort horizontal, arms hanging at sides. The anthropometer was held perpendicular to the floor in the midline of the examinee's back, and the movable bar was brought down into firm contact with the top of the head, compressing the hair if necessary.

Sitting height erect.—The examinee sat erect—assisted, if necessary, by a gentle push in the sacral area of the back—looking straight ahead, head in the Frankfort horizontal, knees together, elbows at sides, forearms at right angles, hands open, palms facing each other. The anthropometer was held vertically along the middle of the back, and the measuring bar was brought down into firm contact with the top of the head, in the midline.

Sitting height normal.—The examinee sat normally relaxed, hands in lap, looking straight ahead with head in the Frankfort horizontal. The measurement was taken as for sitting height erect, above.

Knee height.—The examinee sat erect, heels and knees together. The anthropometer was held vertically, and the measurement was made from the top of the footboard to the top of the knee just in back of the patella (knee cap), with the horizontal bar in light contact with the leg.

Popliteal height.—The examinee sat relaxed. The measurement was made with an anthropometer from the top of the footboard to the top of the sitting surface.

Elbow rest height.—The examinee sat erect, shoulders relaxed, both elbows at right angles, fingers straight. The measurement was made with an anthropometer held vertically from the sitting surface to the lowest bony portion of the elbow, using light contact only.

Thigh clearance height.—The examinee sat erect, knees together, heels together, right hand on left shoulder. The measurement was made with an anthropometer, from the top of the sitting surface to the junction of the abdomen and thigh, with the crossbar in firm contact to compress the clothing.

Buttock-knee length.—The examinee sat erect, knees together, hands in lap, popliteal fossae (hollows at the back of the knee) at the front edge of the sitting board. The measurement was made between the bars of the anthropometer, from the most posterior protrusion of the sacral area to the foremost edge of the patella.

Buttock-popliteal length.—The examinee sat erect, hands on knees, popliteal fossae at the edge of the sitting board. The measurement was made with an anthropometer, from the inner edge of a backboard (held in light contact with the examinee's back at right angles to the sitting board) to the front edge of the sitting surface.

Elbow-to-elbow breadth.—The examinee sat erect, knees together, forearms at right angles, hands open, palms facing each other, and elbows held as tightly as possible to the sides. The measurement was made with an anthropometer, across the humeral epicondyles (lateral projections of the elbows) with firm pressure.

Seat breadth.—The examinee sat erect, knees together, hands on knees. The measurement was made with an anthropometer, across the greatest lateral protrusion on each side of the buttocks, using light but sure contact to compress the clothing but not the body.

The Effect of Clothing on

Body Measurements

As noted, all measurements were made with the examinee stripped to the waist, pockets emptied, without shoes, and wearing a knee-length examining gown and paper slippers. Measurements uninfluenced or insignificantly influenced by the clothing worn are height, sitting height erect, sitting height normal, knee height, popliteal height, elbow rest height, and elbow-to-elbow breadth. Body dimensions in which clothing could have affected the measured values are thigh clearance height, buttock-knee length, buttock-popliteal length, and seat breadth. However, all of these dimensions were taken with enough pressure on the anthropometer to compress the clothing. While the present values may not be identical to nude values, it is likely that the differences, if any, are negligible—at least from the point of view of equipment design. All body dimensions are, therefore, published without a correction for clothing.

Weight, however, is a different problem. Underclothing, trousers or skirt, hospital gown, and paper slippers significantly increase nude weight. Although the precise amount varies, average increments can be estimated. In the Canadian height and weight survey⁶ 166 persons, 74 men and 92 women, were measured nude and with "ordinary indoor clothing" minus shoes and jacket. The average weight of men's clothing was found to be 3.07 pounds, and of women's clothing, 2.15 pounds. In the present survey the removal of all clothing above the waist and, for men, pocket contents as well, generally subtracted more weight than was added by the examining gown and slippers, thus making total clothing weights somewhat less than in the Canadian survey. A small series of representative clothing checked by the authors showed

the weight of men's clothing worn in the survey to be slightly *over* 2 pounds and that of women's clothing to be slightly *less* than 2 pounds. The values for weight presented in table 1 are shown as measured during the survey and are not corrected for clothing. For approximate nude weights, 2 pounds should be subtracted from these figures.

RELIABILITY OF MEASUREMENTS

The quality of the data obtained through the standardized measurement procedures was maintained in three ways—by training, by using automatic measuring devices where possible, and by building safeguards into a team system.

Prior to the start of the survey, the staff nurse and technician on each of the two caravans were given intensive training by two of the authors, who advised on the selection of the series of measurements and developed the specific techniques used in the survey. At several times during the course of the survey, these authors visited the examining units to observe and retrain the staff team.

Recording errors for height and weight were essentially eliminated through the use of the automatic recording devices described in the preceding sections—automatic printing of weight and photographs of height in both centimeters and inches.

All other measurements were taken by a team of two persons, the nurse and the technician, one acting as observer and the other as recorder. The observer took the measurements, calling out the results (read to the nearest millimeter) to the recorder, who repeated them and then called out the name of the next measurement. The observer kept the measuring instrument in place until the recorder repeated the number. The recorder positioned the right-angle backboard for the buttock-popliteal length and generally checked the examinee's position during the procedure.

Any modification in measurement techniques—such as left-side rather than right-side measurements required because of amputations or casts, abnormal conditions such as height decreased from a hunched condition, or weight increased from pregnancy—were noted on the

record, where they could be taken into consideration in data analysis. Weight was read off the stamp on the record to the nearest half pound. Other measurements were recorded to the nearest millimeter. Body dimensions measured with the upper sections of the anthropometer were recorded as read from the anthropometer scale, and the length of the anthropometer base section, which was not used in these measurements, was later subtracted mechanically. Conversion of measurements from centimeters to inches was also done later mechanically.

FACTORS INFLUENCING COMPARISONS OF HUMAN BODY SIZE

For the proper interpretation of the anthropometric data from the Health Examination Survey, the following critical factors that can cause group differences in body size need to be kept in mind:

1. The makeup of the population measured, in terms of age, race, and socioeconomic background.
2. Differences between civilians and military personnel.
3. The time period of the study, since there may be population changes in body size over time.
4. Differences in the measuring techniques employed.

It is particularly desirable to consider these factors carefully when the anthropometric data from the present study are compared with those from other studies of various population segments of the United States. A more thorough review of the possible effect of these factors on the findings is contained in the section entitled "Discussion."

When assessing differences between findings from this Survey and those from other studies, the size of the groups and their appropriate sampling or standard errors also need to be considered in order to avoid claiming significance when, in fact, none exists. For this Survey the design of the sample made possible the calculation from the sample data of the sampling errors shown in Appendix II. These errors, of course, tend to be large when the number of examinees in a particular age-sex group is small. For ex-

ample, differences in weight of a pound or more would be considered statistically significant here (would fall outside the 95 percent confidence limit) for persons in the age groups under 65, while differences of 1.5 pounds or more would be needed to support the statement that a real difference exists for the oldest age group.

FINDINGS

Anthropometric data for the adult civilian, noninstitutional population of the United States aged 18-79 years as determined from the Health Examination Survey are presented here. The findings are discussed briefly, and comparisons are restricted to data from previous anthropometric surveys of different segments of the United States or of the Canadian population. Where the data available for certain dimensions from previous studies are not strictly comparable, special problems concerning these studies are noted.

Weight

For men in the general civilian population, weight averages 168 pounds. The youngest group, 18-24 years, averages 160 pounds. Weight then increases with age to 171 pounds for those aged 25-34 years, and to a maximum average of 172 pounds for those between 35 and 54 years of age. Thereafter weight decreases to 166 pounds at 55-64 years, 160 pounds at 65-74 years, and finally to the lowest average—150 pounds—for the oldest age group measured, 75-79 years (table 1 and fig. 1).

This pattern of weight gain in the middle years and of gradual decline with advancing age is clearly illustrated in figure 2, which shows the proportionate change in average weight with age over the mean for the group aged 18-24 years. How much this trend is influenced by secular changes in body size for successive generations represented in this cross-sectional view of the population cannot be accurately assessed from the data available.

About 90 percent of all men in this population range in weight between 126 and 217 pounds, and probably 97 to 99 percent weigh between 112 and 241 pounds (tables 1 and 13).

Weights are available for comparative purposes on samples of various civilian and military groups, though most of the data for civilians

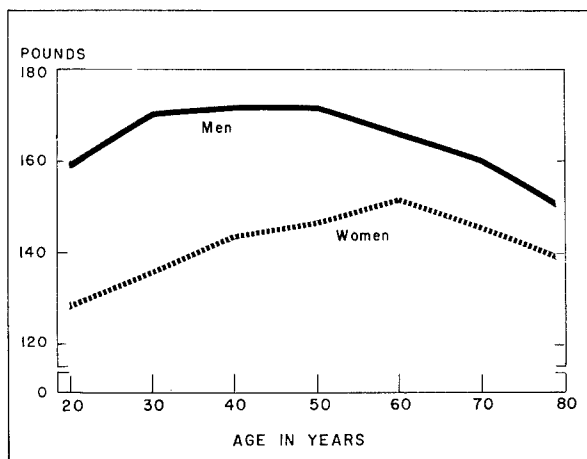


Figure 1. Average weight in pounds for adults 18-79 years.

are not as recent, representative, nor reliable as could be wished. To permit more accurate comparisons, the weights of all groups presented in this section have been standardized for clothing (i.e., 2 pounds have been added to all nude weights to approximate the partly clothed weights obtained in the present Survey; similarly, appropriate amounts of 2-4 pounds have been subtracted from groups weighed fully clothed). Because of the marked association of weight with age, special attention needs to be paid to the age range of the groups compared.

Civilian registrants for Selective Service during 1957 and 1958 in the age range 20-25 years (including those subsequently rejected as well as those accepted) when age-adjusted to correspond to the U.S. male population of comparable age¹⁷ were 2 pounds lighter than the average for the group 18-24 years in the present study.

A large series of more than 75,000 male students, aged 18-24 years, measured at 87 colleges across the country in 1948-50 for the American College Health Association study³³ had an average weight 3 pounds less than for the same age range of the general population. A smaller series of some 15,000 students aged 25-34 years measured at the same time in the same colleges for that study averaged 10 pounds less than the present civilian population of that age. Students

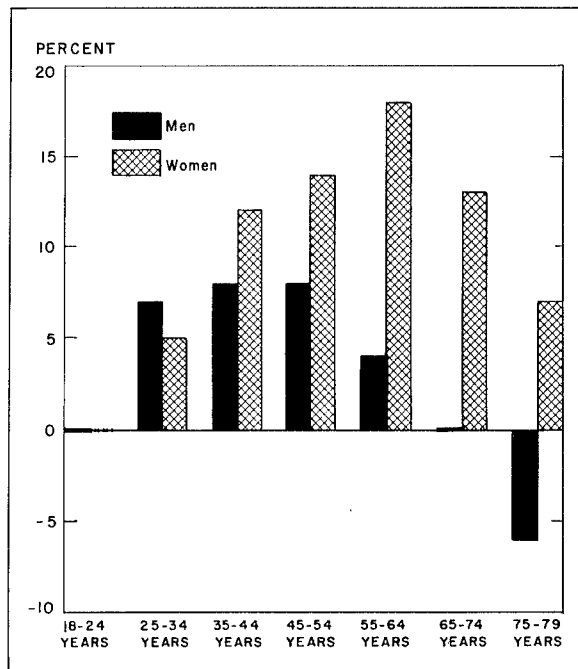


Figure 2. Relative change in weight with age over the mean for men and women aged 18-24 years.

aged 18-22 years entering the University of Kansas in 1948-52³⁴ averaged 2 pounds lighter, and more recently, 18-year-old students entering Amherst and Yale in 1955-57^{35 36} had the same weight as the present findings for those 18-24 years of age.

At the other end of the age range a series of Spanish-American War veterans with an average age of 81 years in 1959³⁷ were 4 pounds heavier than the average of 150 pounds for the group of the general population aged 75-79 years.

Nearly 2,000 male railroad travelers, with an average age of 38 as reported in 1945,³⁸ had a median weight 3 pounds lighter than present findings for the general population, while a series of truck and bus drivers with an average age of 36 years were 1 pound heavier.³⁹ Airline pilots,⁴⁰ averaging 32 years, had about the same average weight, as stated (not measured).

Comparison with data obtained in the 1959 study made by the Society of Actuaries¹⁴ on weights of some 290,000 men insured by 26 large life insurance companies in the United States and Canada between 1935 and 1954 is difficult because

no adequate basis is available to use in compensating for highly variable clothing weights and different measuring techniques. For example, some examinees weighed with, and some without, coats and shoes, and some weights were measured, while others were reported by the examinee.

The Canadian Survey of 1953 is the only study similar to the Health Examination Survey in which height and weight data were obtained on a stratified, probability sample of a national population—in this case, Canadians aged 2 years and above.^{5 6} The differences over the age ranges between 18 and 64 years, when compared with the United States population, varied from 6 to 12 pounds, with an average difference of about 8 pounds, the U.S. population being consistently heavier. The disparity between the two national populations was most marked, 12 pounds, in the range 18-24 years.

Comparison with weight data for various groups of military personnel shows that Army separaees of 1946³¹ with an average age of 23 years averaged 3 pounds lighter than the group aged 18-24 years of the present civilian population, but more recent data show Army inductees aged 20-25 years to be 1 pound heavier than this civilian group.¹⁷ Four hundred white soldiers in 1960, average age 24, weighed 3 pounds more⁴¹ than the present civilian findings at 18-24 years, while Army aviators, average age 30, were 3 pounds lighter⁴² than the present civilian findings at 25-34 years. Air Force flyers of 1950, average age 27,⁴³ were about 5 pounds lighter than civilians roughly comparable in age, while Air Force basic trainees,⁴⁴ average age 18, were 11 pounds lighter than civilians aged 18-24 years. When compared with various Navy groups, the civilians aged 18-24 years range from 18 pounds heavier on the average than a group of 18-year-old recruits⁴⁵ to 15 pounds lighter than a group of 24-year-old submarine officers.⁴⁶

For women in the civilian population, weight averages 142 pounds, or 26 pounds less than the average for men. The distribution of average weights by age for women differs somewhat from that for men, as indicated in table 1 and figure 1. The youngest age group, 18-24 years, is the lightest, averaging 129 pounds. Thereafter weight increases with age to 136 pounds at 25-34 years, 144 pounds at 35-44 years, 147 pounds at 45-54 years, and a maximum of 152 pounds for those

55-64 years of age. After 55-64 years, weight drops to 146 pounds at 65-74 years and to 138 pounds at 75-79 years. Thus women generally appear to achieve their maximum weights about two decades later than do men and to have a greater relative gain with age. This lag may, of course, be due to the greater attention to "weight watching" and appearance on the part of younger women. Here again it is not possible to determine from the Survey data how much these findings may be influenced by any changes in body size for the successive generations in this cross section of the population.

Roughly 90 percent of all women in this population range in weight between 104 and 199 pounds and probably 97 to 99 percent fall between 93 and 236 pounds (tables 1 and 14).

Comparisons of the current findings with those from some of the major studies among specific subgroups of women in the United States follow.

In the Department of Agriculture clothing survey of 1939 and 1940,⁸ a series of 10,000 women with an average age of 34 years were measured. Their weight averaged 1 pound less than the present findings for women aged 25-34 years throughout the country and 9 pounds less than the group aged 35-44 years.

A group of 1,900 women railroad travelers, average age 35 years, as reported in 1945³⁸ were 6 pounds lighter than the present population; a group of 100 healthy working women reported in 1934,⁴⁷ average age 36, were 4 pounds lighter.

The 40,000 women aged 18-24 years who entered 88 different colleges across the country in 1948-50 measured in the American College Health Association study averaged 2 pounds lighter than those in the same age group of the general population. A smaller series of students aged 25-34 years at the same colleges³³ were 7 pounds lighter than their counterparts in the present study. In more recent studies, students entering Vassar and Smith in 1955-57^{48 49} weighed the same, while women students at the University of Kansas during 1953-57⁵⁰ averaged 2 pounds lighter than the present population of roughly comparable age.

Weight data for women from the 1959 study of the Society of Actuaries are not strictly comparable for the reasons mentioned above.

The stratified, random sample of Canadian women aged 18-64 years and above^{5 6} has an average weight about 6 pounds lighter than their present-day counterparts from the United States over the various age groups between 18 and 64 years.

When compared with women of similar age in the Armed Forces in 1944-46, the general civilian population tends to be slightly heavier. Women's Army Corps (WAC) officers, average age 31 years, were 1 pound heavier than those aged 25-34 years of the civilian population; WAC enlisted women, average age 26, were 1 pound lighter; and Army nurses, average age again 26, were also 1 pound lighter.⁵¹ Army Air Forces flight nurses, age span not given, and Womens' Auxiliary Service Pilots (WASP'S) ranging in age from 18 to 35 years⁵² were 12 and 5 pounds lighter, respectively, than the age range 25-34 years of the civilian population. Basic trainees of Women in the Air Force (WAF) with an average age of 19 years⁵³ were 4 pounds lighter than women civilians in the age range 18-24 years.

Height

Men in the general civilian population average 68.2 inches in height. By age, the maximum average height (69.1 inches) occurs in the age range 25-34 years and is just 0.4 inch taller than the youngest and 3.2 inches taller than the oldest age group (table 2 and fig. 3). From ages 25-34 on, there is a small but consistent decrease in height with increasing age to 68.5 inches for those aged 35-44 years; 68.2 inches at 45-54 years of age; 67.4 inches at 55-64 years; 66.9 inches at 65-74 years; and a low of 65.9 inches at 75-79 years.

About 90 percent of all men in this population range in height between 63.6 and 72.8 inches, and probably 97 to 99 percent fall between 61.7 and 74.6 inches (tables 2 and 15).

Measured heights are available from studies among various subgroups of the population of this country, civilian and military. Comparison of the present findings with those from other studies is made here after appropriate adjustment is taken for shoe height.

Civilian registrants for Selective Service in the age range 17-25 years during 1957 and 1958 (including those subsequently inducted and re-

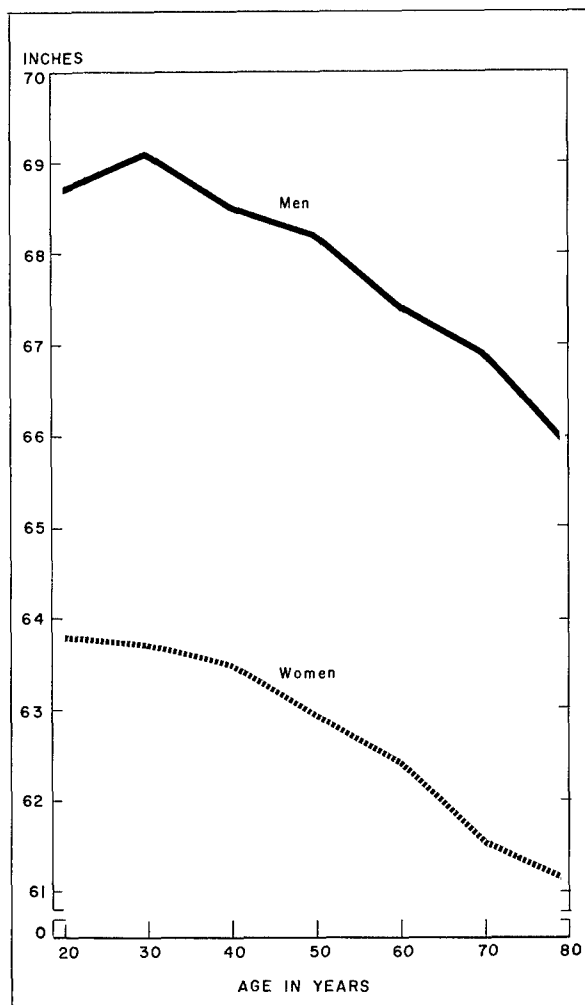


Figure 3. Average height in inches for adults 18-79 years.

jected), when age-adjusted to correspond to the U.S. male population of comparable age,¹⁷ were similar in height to those of comparable age in the general population.

The series of 75,000 male students, aged 18-24 years, measured at 87 colleges across the country between 1948 and 1950 averaged 69.6 inches in height,³³ 0.9 inch taller than the same age range of the general population. The 15,000 older students, aged 25-34 years, from the same colleges in that study averaged 69.3 inches in height, or approximately the same as for the comparable age range of the general population.

Students 18-22 years of age entering the University of Kansas between 1948 and 1952 averaged 70.0 inches in height,³⁴ while more recently, 18-year-old students entering Amherst and Yale in 1955-57 averaged 70.6 and 70.5 inches, respectively.^{35 36} All three groups were taller than present findings for the general population of that age.

At the older end of the adult age range, the group of 100 Spanish-American War veterans averaging 81 years of age³⁷ were of approximately the same height as those 75-79 years of age in the present study.

The large series of adult railroad travelers,³⁸ as well as the commercial truck and bus drivers,³⁹ were of essentially the same height. In 1946 some 7,000 licensed airline pilots—a highly selected group physically—averaging 32 years of age, had stated heights that were greater by 1.8 inches.⁴⁰

Heights, with an estimated correction for shoes, from the 1959 Society of Actuaries study¹⁴ were consistently shorter than present findings for adult men by amounts varying according to age, but averaging over 0.4 inch. More precise estimates of differences in height between these two studies are difficult to obtain because of certain features inherent in the collection and presentation of the data on the insured population.

Canadian survey findings of 1953^{5 6} for men 18-64 years showed an average height 1.1 inches less than present findings in the United States. By age, these national height differences are more marked for the older groups, varying 1.4 inches at 55-64 years and thereafter declining consistently with decreasing age to 0.7 inch at 18-24 years.

Comparative data for the present civilian population and those for various military groups are shown in table A. Army and Navy pilots averaged somewhat taller, while other military groups were of about the same height as the present-day civilians of roughly comparable age.

For women in the general civilian population, height averages 63.0 inches, or 5.2 inches less than the average for men. Unlike men, the maximum average height for women, 63.8 inches, is attained in the youngest age group measured, 18-24 years (table 2). By 25-34 years, average height decreases slightly to 63.7 inches, then continues to fall off with age to 63.5 inches for those 35-44 years old; 62.9 inches at 45-54 years; 62.4 inches at 55-64 years; 61.5 inches at 65-74 years; and finally, 61.1 inches among persons 75-79 years of age. The maximum difference between the youngest and oldest is 2.7 inches.

On the average, the relative decrease of height with age from 45-79 years is similar for men and women, as shown in figure 4.

Table A. Average height in inches of men in the civilian population of the United States, 1960-62, and selected military groups, data measured, number examined, and average age.

Selected group	Date measured	Number examined	Average	
			Age	Height
Total civilian men:				
18-24 years-----	1960-62	411	21	¹ 68.7
25-34 years-----	1960-62	675	30	¹ 69.1
Army separatees ³¹ -----	1946	24,508	24	68.4
Army drivers ⁴¹ -----	1960	431	24	69.2
Army aviators ⁴² -----	1959	500	30	69.5
Air Force flyers ⁴³ -----	1950	4,062	27	69.1
Air Force ground trainees ⁴⁴ -----	1952	3,331	18	68.5
Navy recruits ⁵⁴ -----	1947	5,010	18	68.5
Navy pilots ⁵⁵ -----	1955	1,190	-	70.2

¹Averages based on findings from the sample when weighted to produce estimates for the population from which it was drawn in the manner described in Appendix II.

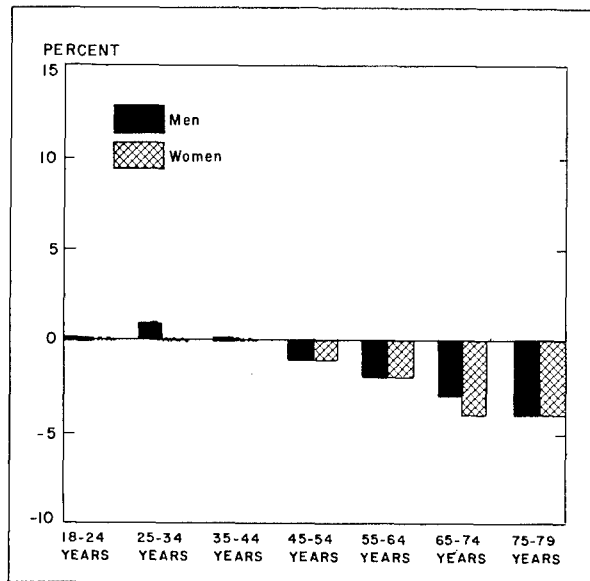


Figure 4. Relative change in height with age over the mean for men and women aged 18-24 years.

About 90 percent of all women in the civilian population fall between 59.0 and 67.1 inches in height, while probably 97 to 99 percent fall between 57.1 and 68.8 inches (tables 2 and 16).

Specific comparisons of the present findings for women in this country with previously measured groups of the population yield the following results.

On the average, they are approximately the same height as the large series of women of comparable age measured in the Department of Agriculture clothing-size survey of 1939-40;⁸ 0.6 inch shorter than a small group of white working women in California chiefly of Northwestern European descent, who were specially selected for their good health;⁴⁷ and approximately the same height as the large series of women railroad travelers.³⁸

They are taller than 70,000 insured women in the Society of Actuaries study, measured between 1935 and 1954,¹⁴ by amounts varying up to 0.8 inch in some age groups. As noted above, special characteristics of this actuarial study, plus the difficulty of obtaining an adequate correction factor for women's shoes, preclude more accurate comparisons with this group.

More than 40,000 women students, 18-24 years of age, who entered 88 different colleges across the country in 1948-50 had an average height of 64.5 inches, 0.7 inch more than present findings for all women in this age group. A smaller series of 2,600 older students, aged 25-34 years, from the same colleges and measured in the same years, had an average height of 64.3 inches, 0.6 inch taller than the comparable age group of the general population.³³ More recently, students entering Vassar and Smith in 1955-57 had average heights of 65.2 and 65.3 inches, respectively,^{48 49} and women students at the University of Kansas during 1953-57 aged 17-21 years averaged 65.2 inches.⁵⁰

The 1953 Canadian Survey findings showed that women 18-64 years of age in that country averaged 61.9 inches in height, or 1.1 inches shorter than their present U.S. counterparts.^{5 6} The trend in "height changes" with age is similar for the two national groups, with the U.S. women remaining taller by roughly the same amount at every age level.

As for women in military service for whom published height data are available, most were taller than the present civilian population of women, as indicated in table B.

Sitting Height, Erect

Erect sitting height for men aged 18-79 years averages 35.6 inches. This measurement has a maximum average value of 36.0 inches between 25 and 34 years, then decreases slightly with each succeeding age group to a minimum value of 34.2 inches at 75-79 years, a pattern similar to that for total height. About 90 percent of the men in this population have sitting heights ranging between 33.2 inches and 38.0 inches, and probably 97 to 99 percent measure between 31.9 and 38.9 inches (table 3 and fig. 5).

This measurement is available on various subgroups of the population—civilian and military—most of which have slightly longer trunks than in the present study, as shown in table C.

For women 18-79 years of age, erect sitting height averages 33.3 inches, or 2.3 inches less than that for men. This measurement has its highest average values, 33.7 inches, between 25 and 44 years, and thereafter declines slowly with

Table B. Average height in inches of women in the civilian population of the United States, 1960-62, and for selected military groups, date measured, number examined, and average age.

Selected group	Date measured	Number examined	Average	
			Age	Height
Total civilian women:				
18-24 years-----	1960-62	534	21	¹ 63.8
25-34 years-----	1960-62	746	30	¹ 63.7
Army (WAC) officers ⁵¹ -----	1946	466	31	64.9
Army enlisted women ⁵¹ -----	1946	4,300	26	64.0
Army nurses ⁵¹ -----	1946	3,488	26	64.3
Air Force WASP's ⁵² -----	1943	447	-	64.9
Air Force flight nurses ⁵² -----	1943	152	-	63.5
Air Force WAF trainees ⁵³ -----	1952	851	19	64.1

¹Averages based on findings from the sample when weighted to produce estimates for population from which it was drawn in the manner described in Appendix II.

Table C. Average sitting height, erect, in inches for civilian men in the United States, 1960-62, and for selected groups of civilian and military men, date measured, number examined, and average age.

Selected group	Date measured	Number examined	Average	
			Age	Sitting height
<u>Civilian</u>				
Total civilian men, 18-79 years-----	1960-62	3,091	¹ 44	¹ 35.6
18-24 years-----	1960-62	411	-	¹ 35.8
25-34 years-----	1960-62	675	-	¹ 36.0
35-44 years-----	1960-62	703	-	¹ 35.9
75-79 years-----	1960-62	72	-	¹ 34.2
Harvard freshmen ⁵⁶ -----	1940	174	18	36.5
Bus and truck drivers ³⁹ -----	1950	269	37	36.2
Healthy veterans ⁵⁷ -----	1960	114	38	36.6
Spanish American War veterans ³⁷ -----	1960	119	81	34.8
<u>Military servicemen</u>				
Army separatees ³¹ -----	1946	24,352	24	35.8
Army drivers ⁴¹ -----	1960	431	24	35.9
Army aviators ⁴² -----	1960	500	30	35.6
Air Force flyers ⁴³ -----	1950	4,061	27	35.9
Naval enlisted men ⁵⁸ -----	1955	124	-	36.3
Naval aviation cadets ⁵⁸ -----	1955	340	-	36.7
Naval pilots ⁵⁵ -----	1958	1,190	-	36.0

¹Averages based on findings from the sample when weighted to produce estimates for population from which it was drawn in the manner described in Appendix II.

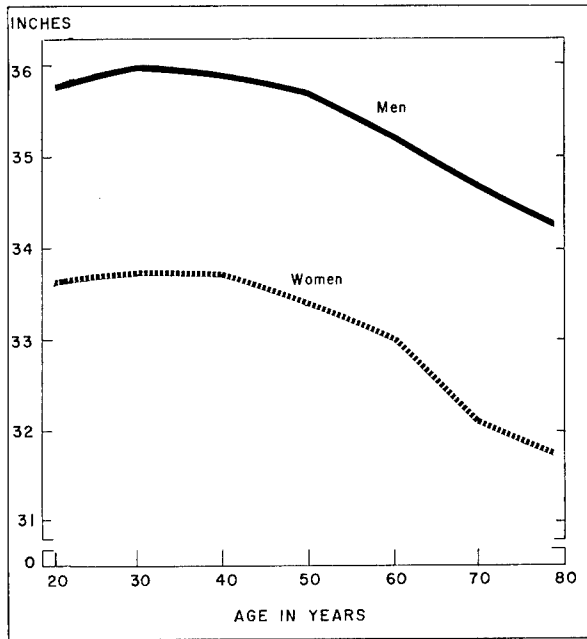


Figure 5. Average sitting height erect for adults 18-79 years.

age to 31.7 inches for those 75-79 years of age. In this population about 90 percent of the women's sitting heights range between 30.9 and 35.7 inches, and probably 97 to 99 percent fall between 29.5 and 36.6 inches.

Comparable data, available only from small studies completed 20 to 30 years ago, are shown in table D.

Sitting Height, Normal

For men in the civilian population, this dimension averages 34.1 inches—1.5 inches less than erect sitting height. Normal sitting height has a maximum average value of 34.4 inches at 25-34 years, then declines with age to a low of 33.0 inches for the group 75-79 years of age. A range between 31.6 and 36.6 inches will include roughly 90 percent of this population, and a range between 30.4 and 37.6 inches will include probably 97 to 99 percent (table 4 and fig. 6).

Few comparative data are available for this measurement. The series of civilian truck and bus drivers were larger by 0.3 inch,³⁹ while the group

Table D. Average sitting height, erect, in inches, for women in the United States, date measured, number examined, and average age.

Selected group	Date measured	Number examined	Average	
			Age	Sitting height
Total civilian women, 18-79 years-----	1960-62	3,581	¹ 44	¹ 33.3
18-24 years-----	1960-62	534	-	¹ 33.6
25-34 years-----	1960-62	746	-	¹ 33.7
35-44 years-----	1960-62	784	-	¹ 33.7
College girls, "Old American" ⁵⁹ -----	1930	161	19	33.6
College girls, "Old American" ⁶⁰ -----	1920's	198	18	34.2
Working women ⁴⁷ -----	1930	100	36	33.7
Air Force WASP's ⁵² -----	1943	446	-	34.1
Air Force flight nurses ⁵² -----	1943	152	-	33.7

¹Averages based on findings from the sample when weighted to produce estimates for population from which it was drawn in the manner described in Appendix II.

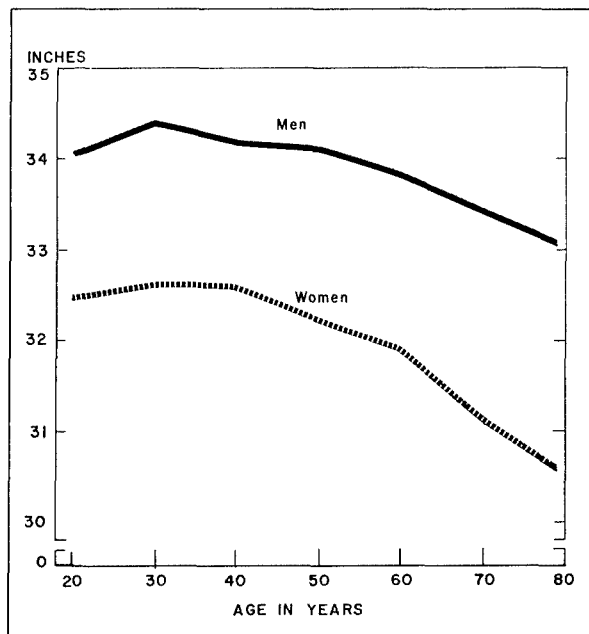


Figure 6. Average sitting height normal for adults 18-79 years.

of white Army drivers⁴¹ had nearly the same average value as the total civilian population of comparable age.

In women, normal sitting height averages 32.2 inches, 1.9 inches less than the same measurement in men. The maximum average value of 32.6 inches occurs among those aged 25-44 years; the average then declines to a minimum of 30.5 inches for those 75-79 years of age. About 90 percent of the women range between 29.6 and 34.7 inches in normal sitting height, and probably 97 to 99 percent fall between 28.2 and 35.7 inches.

Sitting height, normal, is not available from other studies among women.

"Slump," which is obtained by subtracting the normal from the erect measurements of sitting height, averages 1.5 inches in men. It is maximum, 1.6 to 1.7 inches, for those 18-54 years of age, and lowest, 1.2 inches, at 75-79 years. The difference reflects the greater spinal rigidity among older persons. "Slump" is very slightly greater among smaller persons (1.5 inches at the 1st percentile and 1.6 inches at the 5th) than among the larger (1.4 inches at the 95th percentile and 1.3 inches at the 99th). In men, "slump" averages about 4.2 percent of erect sitting height.

"Slump" averages about 1.1 inches in women, or 3.3 percent of erect sitting height, and varies little with age. As with men, it is greatest at the lower percentiles (1.3 inches at the 1st and 5th) and less at the higher percentiles (1.0 inch at the 95th and 0.9 inch at the 99th).

Knee Height

Knee height in men averages 21.3 inches. In a manner similar to the pattern for total height, it reaches a maximum of 21.6 inches by 25-34 years, then declines slowly to 20.6 inches for those 75-79 years of age. About 90 percent of the men in this population fall between 19.3 and 23.4 inches in this measurement, and probably 97 to 99 percent fall between 18.3 and 24.1 inches (table 5 and fig. 7).

Data available from previous studies on selected groups of civilian and military persons show similar but slightly greater knee heights. The white civilian truck and bus drivers were larger by 0.4 inch;³⁹ white Army separatees, by 0.3 inch;³¹ Army Air Forces flyers, by 0.4 inch;⁴³ and white Army drivers by 0.2 inch.⁴¹

In women, knee height averages 19.6 inches, or 1.7 inches less than in men, and changes little with age. The maximum average value of 19.7 inches occurs through the age groups 18-44 years, and declines to 19.4 inches for those aged 55-64. A range between 17.9 and 21.5 inches will include

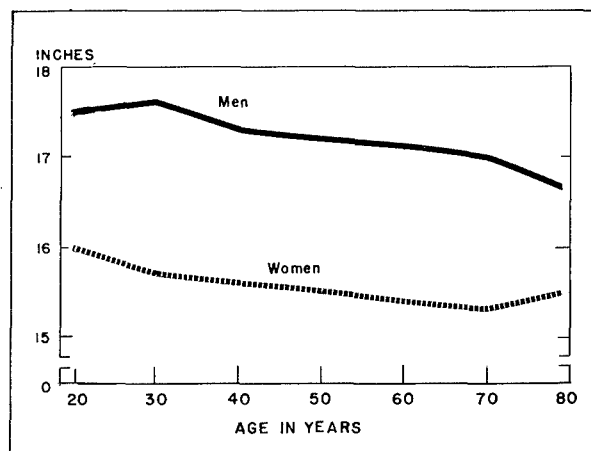


Figure 7. Average knee height for adults 18-79 years.

about 90 percent of the present population of women, and probably 97 to 99 percent will be included within the extremes of 17.1 to 22.4 inches.

Groups of women previously measured for knee height include Army Air Forces flight nurses, who were shorter than the present population by 0.1 inch, and Womens' Auxiliary Service Pilots, who were taller by 0.5 inch.⁵²

Popliteal Height

For men this dimension averages 17.3 inches. Maximum average height, 17.6 inches, is reached by ages 25-34 years; the average declines slowly thereafter with age to a minimum of 16.6 inches for those of 75-79 years. About 90 percent of men have popliteal heights between 15.5 and 19.3 inches, and probably 97 to 99 percent have heights between 14.9 and 20.0 inches (table 6 and fig. 8).

Average values from other studies show 17.0 inches for Air Force flying personnel⁴³ and 17.4 inches for white Army drivers.⁴¹ The high median of 19.0 inches obtained for men railway travelers³⁸ was due to the shoes worn by the subjects, which add about 1.0 inch, and to differences in measuring technique.

For women, popliteal height averages 15.6 inches, or 1.7 inches less than for men. This

measurement has its highest average of 16.0 inches in the youngest age group, 18-24 years. Thereafter, popliteal height decreases with each successive age group to a minimum of 15.3 inches by 65-74 years. A range between 14.0 and 17.5 inches includes some 90 percent of all women, and a range between 13.1 and 18.0 inches includes probably 97 to 99 percent.

Popliteal height has been measured on only one other group of women—the railway travelers—where the median is 18.1 inches,³⁸ or 2.4 inches greater than the comparable median for women in the present population. This large difference was due to the shoes worn by the traveler group, which in women may add an average increment of as much as 2.0 inches, and to differences in measuring technique.

Elbow Rest Height

Elbow rest height for men averages 9.5 inches. The maximum average value of 9.7 inches occurs between 25 and 44 years and is followed by a steady decline thereafter to 8.6 inches for those aged 75-79 years. About 90 percent of all men have elbow rest heights between 7.4 and 11.6 inches, probably 97 to 99 percent have heights between 6.3 and 12.5 inches (table 7 and fig. 9).

For the series of railroad travelers³⁸ this distance was 0.1 inch greater than for the comparable segments of the present population; for Air Force flying personnel, it was 0.4 inch less;⁴³ and for white Army drivers, 0.3 inch greater.⁴¹

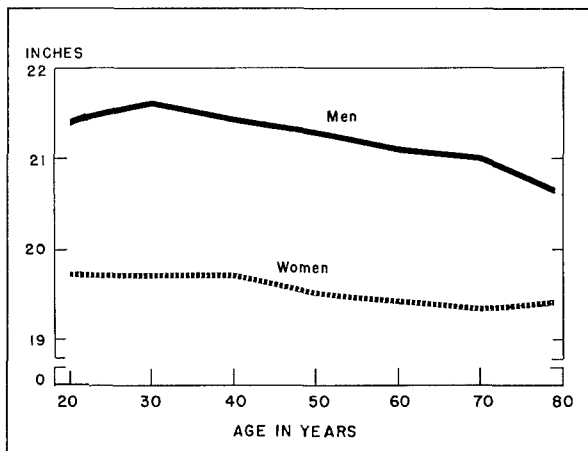


Figure 8. Average popliteal height for adults 18-79 years.

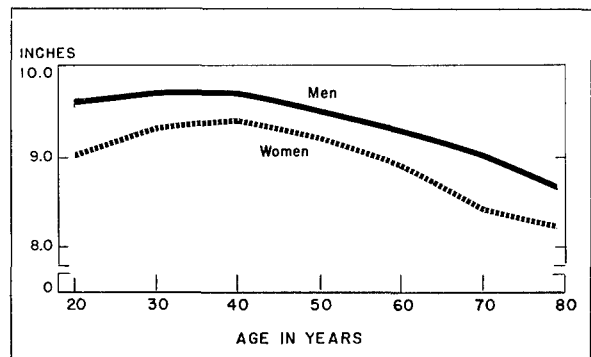


Figure 9. Average elbow rest height for adults 18-79 years.

Among women, the average value of this dimension is 9.1 inches, 0.4 inch less than for men. The maximum mean of 9.4 inches is found at ages 35-44, after which a decline with age sets in, reaching a minimum of 8.2 inches at ages 75-79 years. The approximate 90-percent range for women extends from 7.1 to 11.0 inches, while probably 97 to 99 percent of the women are within the range from 6.1 to 11.9 inches.

Women railroad travelers³⁸ had an elbow rest height 0.6 inch higher than the present population. This difference may be due largely to the laterally fixed armrests in the special measuring chair used for the travelers which forced smaller women to extend their arms to the sides and slightly upward for this measurement.

Thigh Clearance Height

For men this dimension averages 5.7 inches. It is at a maximum of 5.8 inches between 25 and 44 years, and declines to 5.2 inches for those aged 75-79 years (table 8 and fig. 10). The relative decline occurs at about the same rate as for elbow rest height.

About 90 percent of the men in the civilian population have thigh clearance heights between 4.3 and 6.9 inches, and probably 97 to 99 percent fall between 4.1 and 7.7 inches.

Comparable measurements are available for two military groups. Air Force flying personnel were smaller by 0.1 inch,⁴³ while white Army drivers averaged 0.2 inch larger⁴¹ than the present civilian population.

Thigh clearance height for women averages 5.4 inches, 0.3 inch less than for men. It is at a maximum of 5.5 inches between ages 35 and 54, and declines to a low of 5.2 inches for those 75-79 years of age. Less variation with age is found in this dimension among women than among men; in addition, less variation occurs here than for elbow rest height among women.

About 90 percent of all women fall between 4.1 and 6.9 inches in this measurement, and probably 97 to 99 percent fall between 3.8 and 7.7 inches.

No comparable data are available from previous studies among women.

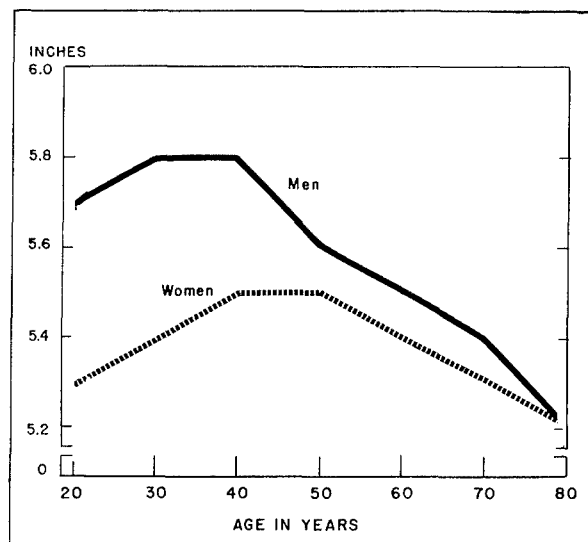


Figure 10. Average thigh clearance for adults 18-79 years.

Buttock-Knee Length

Buttock-knee length for men averages 23.3 inches. This measurement shows a maximum of 23.6 inches at 25-34 years, drops to 23.3 inches from 35 through 54 years, and has a minimum of 22.7 inches for the group 75-79 years of age. The range between 21.3 and 25.2 inches includes roughly 90 percent of the adult men, and 20.3 to 26.3 inches includes probably 97 to 99 percent (table 9 and fig. 11).

The series of commercial truck and bus drivers³⁹ measured for buttock-knee length averaged 0.4 inch larger than the present population.

Most military groups measured for this dimension exhibit average values similar to, or slightly higher than, the adult civilian population. The large series of Army separatees of World War II were larger by 0.1 inch in this measurement;³¹ Army aviators, 0.5 inch;⁴² white Army drivers, by 0.4 inch;⁴¹ Air Force flyers, by 0.3 inch;⁴³ and Navy aviation cadets, by 1.1 inch.⁵⁸

For women this measurement averages 22.3 inches, 1.0 inch less than for men. By age the

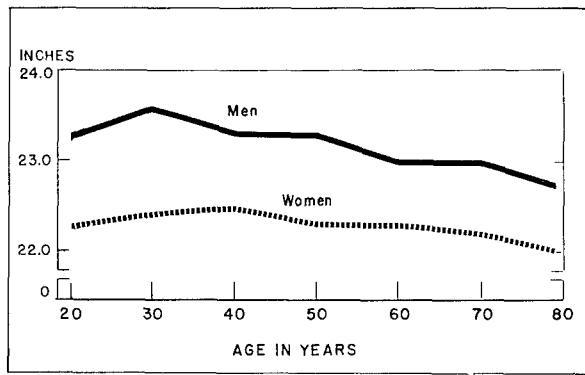


Figure 11. Average buttock-knee length for adults 18-79 years.

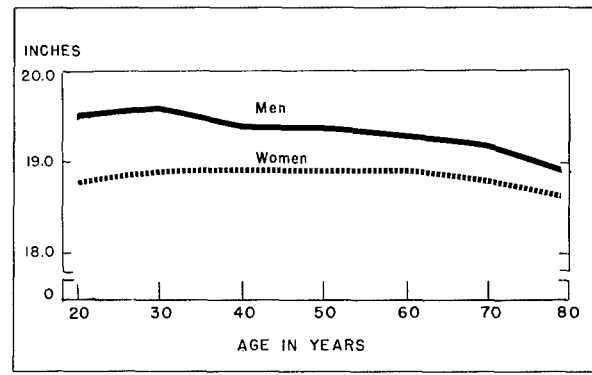


Figure 12. Average buttock-popliteal length for adults 18-79 years.

maximum value of 22.5 inches occurs at 35-44 years; the value then gradually declines to a minimum of 22.0 inches for women 75-79 years of age. The approximate 90-percent range in this dimension for women falls between 20.4 and 24.6 inches, while probably 97 to 99 percent of the women fall between 19.5 and 25.7 inches.

Two groups of women on which this measurement was taken in 1943 were both larger, Army Air Forces flight nurses, by 0.1 inch and Womens' Auxiliary Service Pilots, by 0.3 inch.⁵²

Buttock-Popliteal Length

For men, buttock-popliteal length averages 19.4 inches. The maximum value of 19.6 inches is found between 25 and 34 years and is followed by a gradual decline for each successive age group to 18.9 inches at 75-79 years. About 90 percent of all men fall between 17.3 and 21.6 inches in this dimension, and probably 97 to 99 percent fall between 16.5 and 22.7 inches (table 10 and and fig. 12).

Male railroad travelers showed a median value of 18.9 inches in this dimension,³⁸ 0.5 inch below the median for men in the general population. Since the travelers were only 0.3 inch shorter than the present population, part of this difference may result from the correction factor which was applied to obtain the estimated true seat length for the travelers, who were measured

in a special type of chair. The group of Spanish-American War veterans with a mean age of 81 years averaged 18.6 inches³⁷ as opposed to 18.9 inches for the oldest age group, 75-79 years, in the present study. Among the military groups the only data available were for white Army drivers, who averaged 0.2 inch smaller in this measurement.⁴¹

Buttock-popliteal length for women averages 18.9 inches, or 0.5 inch less than the average for men. There is little association with age, the maximum value of 18.9 inches occurring among those 25-64 years, with a decline to 18.6 inches for those 75-79 years of age. Roughly 90 percent of all women vary between 17.0 and 21.0 inches in this dimension, and probably 97 to 99 percent are between 16.1 and 22.0 inches.

The series of women railroad travelers had a median buttock-popliteal length of 18.2 inches, 0.7 inch less than women in the present population, the reason for this difference being noted above.

Elbow-to-Elbow Breadth

For men, elbow-to-elbow breadth, generally the greatest width across the body, averages 16.6 inches. Age differences in this dimension are not marked other than for the youngest group, 18-24 years, where the minimum average of 15.6 inches occurs. This average varies between 16.8 and 16.9

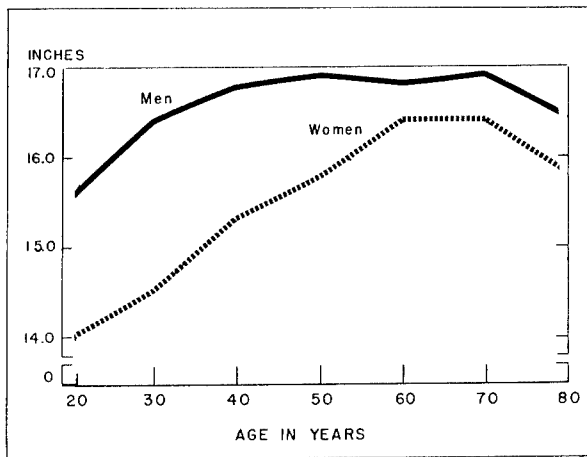


Figure 13. Average elbow-to-elbow breadth for adults 18-79 years.

inches in the age span for persons 35-74 years of age, with a slightly lower value in the preceding and succeeding age groups. About 90 percent of the men in this population fall between 13.7 and 19.9 inches in elbow-to-elbow breadth, and probably 97 to 99 percent fall between 13.0 and 21.4 inches (table 11 and fig. 13).

In comparisons with previous findings on groups in the population, it should be noted that in the present survey the examinees held their elbows tightly pressed to their sides, whereas in many of the other studies the elbows were held lightly against the sides. For the survey of Air Force cadets and gunners in which maximal press was used, the results were very similar to those in the present study—median values of 16.7 and 16.4 inches, respectively.⁵² In other studies, where maximal elbow press was not exerted, the resulting values were larger. For example, the series of civilian truck and bus drivers were broader than men in the present survey by 0.9 inch;³⁹ Air Force flyers, by 0.7 inch;⁴³ Army separatees by 0.9 inch;³¹ and white Army drivers by 1.1 inches.⁴¹

Women average 15.3 inches in this measurement—1.3 inches less than the comparable value for men—and show larger changes with age than

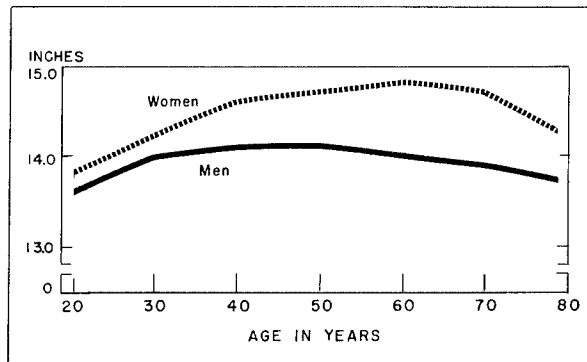


Figure 14. Average seat breadth for adults 18-79 years.

do men. The smallest average, 14.0 inches, occurs in the youngest group, 18-24 years, but the measurement then increases steadily with age for each group until it reaches a maximum of 16.4 inches at 55-74 years. It then declines to 15.8 inches among those 75-79 years of age. Roughly 90 percent of the women fall between 12.3 and 19.3 inches in this dimension, and probably 97 to 99 percent fall between 11.4 and 21.2 inches.

Elbow-to-elbow breadth on other female populations is available only for Womens' Auxiliary Service Pilots in 1943, who were 0.2 inch smaller than the women in the present study, and Army Air Forces flight nurses, also in 1943, who were 0.4 inch smaller.⁵²

Seat Breadth

Seat breadth for men averages 14.0 inches. This measurement is minimal at 18-24 years, averaging 13.6 inches. It increases to 14.1 inches at 35-54 years, then decreases slowly to 13.7 inches for those 75-79 years of age. In this population about 90 percent of the men fall between 12.2 and 15.9 inches, and probably 97 to 99 percent fall between 11.5 and 17.0 inches (table 12 and fig. 14).

In previous studies among civilians, truck and bus drivers averaged broader than the present population by 0.6 inch³⁹ and men railroad travelers, by 1.3 inches.³⁸ The latter difference

was doubtless due to the travelers' clothing and to a difference in measuring techniques, since the railroad travelers were lighter in weight than the present findings for the general population.

Army separatees of 1946 were just as broad as the men in this study,³¹ as were white Army drivers⁴¹ and Air Force flyers.⁴³ Army aviators were broader by 0.2 inch.⁴²

Seat breadth in women averages 14.4 inches, 0.4 inch larger than the same value for men. This is one of the few body measurements in which women exceed men. The relative increase in size to the middle-age maximum is slightly greater for women than for men.

The smallest average value for women, 13.8 inches, is found in the youngest age group, 18-24 years of age. Thereafter, seat breadth increases by small increments to a maximum breadth of 14.8 inches for the group aged 55-64 years, and then decreases to 14.2 inches by 75-79 years. The range between 12.3 and 17.1 inches includes roughly 90 percent of this population, and 11.7 to 18.8 inches includes probably 97 to 99 percent.

Women railroad travelers were broader by 0.2 inch;³⁸ Army Air Forces flight nurses, by 0.7 inch; and Womens' Auxiliary Service Pilots, by 0.6 inch⁵² than present findings for the general population. The latter two differences could be due in part to the girdles or other size-reducing garments that were probably worn by a greater proportion of the civilian women while being measured.

DISCUSSION

Age of Examinees

Marked differences in most of the body measurements included in this report occur during adult life. Full growth in regard to stature and related body dimensions is generally achieved by the late teens or early twenties for men, and a few years earlier for women. Body dimensions such as weight and body breadths and girths, which are affected by deposits of fatty tissue, usually continue to increase through middle age, after which a gradual decline is observed. The reason for the weight loss late in life is not fully understood; neither are the precise age of onset nor the amount of decrement. Stature and related

body heights do not increase after maturity, but actually decrease with advancing age. These decreases may be negligible during the first few decades of adulthood, but become more marked as old age is approached. Among the causes of reduced body lengths are the inability to maintain erect posture, compression of the spinal column, and various forms of arthritis.

The differences in body size evident among age groups in this cross-sectional study may result from any combination of changes in the individual with age, from the secular trend to increasing body size, or from preferential survival of smaller persons. Changes with age in the individual and preferential survival can be adequately studied only on a longitudinal or prospective basis.

It is difficult to draw valid inferences from comparisons with the findings from other studies because of the noted age changes in body size. For many of the studies referred to in this report, published data contained only the average age or age span of the examinees. The exact age distribution was often not available, and may have been quite different from that in the general population. For example, significant differences in body size would be expected between a group with an average age of 18 or 19 years and the group aged 18-24 years from the present survey.

Racial and Ethnic Differences

Despite some overlapping, the major races of man—Caucasian, Negroid, and Mongoloid—have been found in previous studies to differ in body size and proportion. Similarly, marked variations have been noted among ethnic groups of varying national ancestry within one racial stock, such as Swedes and Spaniards. Northwestern Europeans in these studies have tended to be taller than Southern Europeans; Central Europeans, to be stockier in build than those from the Mediterranean; and most Negroes tend to have longer extremities, relative to their stature, than do white persons.

Since the Health Examination Survey utilizes a stratified, random sample of virtually the entire adult, civilian population in all parts of the United States at one period in time, it may be expected to contain the various racial or ethnic groups in roughly the same proportion that they are found

in the country as a whole. It includes for example, approximately 10 percent nonwhites, most of whom are Negroes. Thus these anthropometric data describe an average or "composite" American, and as such they may differ from the data obtained on groups of different racial or ethnic makeup.

Socioeconomic Differences

Various studies such as that by Karpinos on Selective Service Registrants of World War II¹⁶ have shown that persons from the higher social and economic strata of society tend to be taller than those from the lower strata. Correlated with these differences in height are corresponding differences in the other linear dimensions. Weight and the related body breadths, depths, and circumferences have also been found to be greater for upper socioeconomic groups, except where dieting or "weight watching" is a commonly accepted cultural norm.

Very likely the single most important factor in these body-size differences is the superior nutrition available, especially during the growth years, to persons with higher incomes. This permits the attainment of a greater percentage of the individual's genetic growth potential, an opportunity denied in varying degree to those whose diets are nutritionally less adequate. A secondary factor that contributes in some instances to the larger body size of upper socioeconomic groups is relatively greater freedom from childhood diseases. A third is ancestry. Since "Old Americans" were predominantly of Northwest European ancestry, many of these relatively tall peoples were able, for purely historical reasons, to place themselves higher in the socioeconomic scale than many of the later arrivals in this country, the relatively short-statured Southern and Eastern Europeans. Though such socioeconomic distinctions between groups of different national ancestry are tending to disappear today, this factor has undoubtedly been responsible in part for the anthropometric differences observed among various population subgroups in previous studies.

Since the opportunity for higher education has been, in the past, closely related to higher socioeconomic status (and still is today, though less so), these same nutritional and historical factors account for the almost uniformly higher

statures recorded for college students, as compared with noncollege persons of the same age.

Civilian-Military Differences

Persons in the U.S. military services are physically a highly selected group, as previously noted. Minimum and maximum height-weight standards for acceptance eliminate from the military those at the extremes of the body-size distribution. Military personnel are, in addition, a relatively healthy group, since all have passed a physical examination before acceptance, and those who develop various incapacitating conditions while in the services are normally discharged. Because of more regular physical activity, military personnel are generally in better physical condition than most civilians.

Since all of these factors influence human body size and shape, it is not surprising that military personnel differ anthropometrically from members of the civilian population of comparable age. On the whole, despite much individual variation as well as differences among some of the specialty fields, previous studies indicate that service men and women tend to be taller, leaner, and more muscular. They also include fewer persons at the extremes of body size. Generally, data from the present survey show good agreement with those military findings which are available for comparison, when the above limitations are considered.

Differences in Measuring Technique

Differences among the results of various anthropometric surveys can be caused by differences in the kind and quality of measuring techniques employed. If properly trained personnel and standard techniques are not used, significant variations in the measurements are likely. Equally suspect are the results of large surveys where many different observers have taken the measurements, each according to his own techniques. In some surveys the results are further confused by the fact that heights and weights are occasionally recorded as stated by the subject and are not measured. This presents a major difficulty since many persons know neither their weight

nor their height within acceptable limits of accuracy.

Even with trained anthropometrists, small differences may occur because of minor variations in the techniques used. In measurements over soft tissues, such as seat breadth, differences in the amount of pressure exerted on the bars of the instrument will influence the recorded values. Different techniques may also be used to measure the same body dimension. For example, stature measured with the examinee standing against a wall is almost always higher, by amounts averaging some 0.4 inch, than when he is measured standing erect but free.⁶¹ Again, the examinee himself may vary—stature is less in the evening than in the morning because of the compression of the intervertebral disks of the spinal column. Weight may vary a pound or two or more, depending on food and liquid intake, elimination, perspiration, and physical activity.

It should be emphasized that the above comments are not intended to cast doubt upon the validity or reliability of *all* anthropometric surveys, or to discourage comparisons between different anthropometric surveys. Rather they are intended to point out some of the difficulties in interpretation that *can* occur, if the data are not evaluated critically.

In the present comparisons, the attempt has been made to include only surveys considered reasonably accurate and reliable. Where this has not been possible, owing to the scarcity of comparative data for certain dimensions, pertinent problems are noted.

Secular Changes in Body Size

Changes in body size have been taking place throughout the course of human evolution, but various studies, some of which are cited here, indicate that these changes may have been sufficiently accelerated in very recent times to cause significant differences in anthropometric surveys made only a few years apart. An indication of this trend is afforded by a comparison of Army inductees measured at three different times over the past 40 years. Inductees during World War II were 0.67 inches taller and 10.7 pounds heavier than the inductees of World War I. Inductees measured during 1957-58 were 0.50 inches taller

and over 7 pounds heavier than the World War II inductees, thus making a total increase from 1917-18 to 1957-58 of about 1.2 inches and 18 pounds.¹⁶¹⁷

The same trend toward increased body size is also suggested in civilian studies. In two successive generations of Harvard students from the same families, the sons were 1.3 inches taller and 10 pounds heavier than their fathers were at the same age.⁶⁰ A more recent study suggests that the average height of college students is continuing to increase.⁶² These changes may be due largely to improved nutrition and better medical care during childhood, though it has been suggested⁶³ that an additional explanation may be the breakdown of breeding isolates, producing heterosis, or hybrid vigor, well known to plant and animal breeders. There is some evidence in man that offspring of parents from different towns are taller than those whose parents were born in the same town.⁶⁴

Lack of a comparable national survey for an earlier period prevents making direct comparisons of the measurements found in this survey with those at an earlier period for the entire United States. Such comparisons could, hopefully, be made when similar surveys are conducted in future years.

SUMMARY

Findings on selected measurements of physique from the Health Examination Survey among adults in the civilian, noninstitutional population aged 18-79 years in 1960-62 show the following:

1. Men average 168 pounds in weight, with about 90 percent falling between 126 and 217 pounds. Their weight decreases with age from the maximum average of 172 for those 35-54 years of age to 150 pounds at 75-79 years.

For women, about 90 percent fall between 104 and 199 pounds, averaging 142 pounds. Their maximum average, 152 pounds, is in the 55-64 year age group, or about 20 years later than that for men. Average weight then drops 14 pounds by 75-79 years.

2. In height, men average 68.2 inches, with some 90 percent between 63.6 and 72.8 inches. Their average height decreases with age from a maximum of 69.1 inches for those aged 25-34 years to 65.9 inches in the age group 75-79 years.

Women average 63.0 inches in height, but for them there is a steady decline in stature with each successive age group, beginning with 63.8 inches at 18-24 years and falling to 61.1 inches at 75-79 years. About 90 percent of all adult women are between 59.0 and 67.1 inches in height.

3. Sitting height, erect, averages 35.6 inches for men and 2.3 inches less for women. Roughly 90 percent are between 33.2 and 38.0 inches for men and 30.9 and 35.7 inches for women.

When the examinee is sitting normally, this height averages 1.5 inches less for men and 1.1 inches less for women.

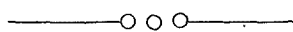
4. Knee height averages 21.3 inches for men and 19.6 inches for women, while popliteal height, measured at the back of the knee, is roughly 4 inches less.
5. Elbow rest height averages 9.5 inches for men and 0.4 inch less (9.1 inches) for women.
6. Thigh clearance height also is similar for men and women, with men averaging 5.7 inches and women, 5.4 inches.
7. Measurements of the upper part of the leg show an average buttock-knee length of 23.3 inches for men and 1 inch shorter for women, while buttock-popliteal length averages 19.4 inches for men and 0.5 inch less for women.
8. Elbow-to-elbow breadth averages 16.6 inches for men and 15.3 inches for women, while seat breadth averages 14.0 inches for men and 0.4 inch more for women.



REFERENCES

- ¹U.S. National Health Survey: Plan and initial program of the Health Examination Survey. *Health Statistics*. PHS Pub. No. 584-A4. Public Health Service. Washington. U.S. Government Printing Office, May 1962.
- ²National Center for Health Statistics: Cycle I of the Health Examination Survey, sample and response. *Vital and Health Statistics*. PHS Pub. No. 1000-Series 11-No. 1. Public Health Service. Washington. U.S. Government Printing Office, Apr. 1964.
- ³Damon, A., Stoudt, H. W., and McFarland, R. A.: Anthropometry, Chapter 11, in C. T. Morgan, J. S. Cook, A. Chapanis, and M. W. Lund, eds., *Human Engineering Guide to Equipment Design*. New York. McGraw-Hill Book Co., 1963.
- ⁴Damon, A., Stoudt, H. W., and McFarland, R. A.: *The Human Body in Equipment Design*. Cambridge, Mass. Harvard University Press, in press.
- ⁵Pett, L. B., and Ogilvie, G. F.: The Canadian weight-height survey. *Human Biol.* 28(2):177-188, May 1956.
- ⁶Pett, L. B., and Ogilvie, G. F.: The report on Canadian average weights, heights and skinfolds. *Canadian Bulletin on Nutrition* 5(1):1-81, Sept. 1957.
- ⁷Kansu, S. A.: *Enquête anthropométrique turque faite sur 59,728 individus de deux sexes*. Publication No. 151. Ankara, Turkey. Central Statistical Office, 1937.
- ⁸U.S. Department of Agriculture: *Women's Measurements for Garment and Pattern Construction*, by R. O'Brien and W. C. Shelton. Miscellaneous Publications No. 454. Washington. U.S. Government Printing Office, 1941.
- ⁹Kemsley, W. F. F.: Weight and height of a population in 1943. *Ann. Eugenics* 15:161-183, 1950.
- ¹⁰U.S. Public Health Service: A health study of 10,000 male industrial workers, by R. H. Britten and L. R. Thompson. *Public Health Bulletin*, No. 162. Washington. U.S. Government Printing Office, 1926.
- ¹¹Great Britain Medical Research Council, Industrial Health Research Board: *The Physique of Man in Industry*, by E. P. Cathcart, D. E. R. Hughes, and J. G. Chalmers. Report No. 71. London. His Majesty's Stationery Office, 1935.
- ¹²Sittig, J., and Freudenthal, H.: *De juiste maat*. Leyden, Netherlands. N. V. Magazijn "De Bijenkorf," 1951.
- ¹³de Felice, S.: *Recherches sur l'anthropologie des Françaises*. Paris. Masson et Cie., 1958.
- ¹⁴Society of Actuaries: *Build and Blood Pressure Study*. Chicago, 1959.
- ¹⁵Stewart, A. M., Webb, J. W., and Hewitt, D.: Social medicine studies based on civilian medical board records; National Service rejects. *Brit. J. Prev. & Social Med.* 9:19-25, Apr. 1955.
- ¹⁶Karpinos, B. D.: Height and weight of Selective Service registrants processed for military service during World War II. *Human Biol.* 30(4):292-321, Dec. 1958.
- ¹⁷Karpinos, B. D.: Current height and weight of youths of military age. *Human Biol.* 33(4):335-354, Dec. 1961.
- ¹⁸U.S. Army Air Forces: *The Reliability and Value of Thoracic and Abdominal Measurements in the Physical Examination for Flying*, by C. E. Kossman, E. L. Green, and E. C. White. Report No. 1, Project No. 243. Randolph Field, San Antonio, Texas. School of Aviation Medicine, Nov. 1945.
- ¹⁹Gould, B. A.: *Investigations in the Military and Anthropological Statistics of American Soldiers*. New York. Hurd, 1869.
- ²⁰Baxter, J. H.: *Statistics, Medical and Anthropological, of the Provost-Marshal-General's Bureau*. Washington. U.S. Government Printing Office, 1875.
- ²¹Livi, R.: *Taille et périmètre thoracique des militaires en rapport avec les professions*. Moscow, Russia. 12th International Medical Congress, 1897.
- ²²Livi, R.: Über den Nutzen Anthropometrischer Grenzwerte für die Assentierung. *Militärärzt* 45:3-10, 1911.
- ²³Lundborg, H., and Linders, F.: *Anthropologica Suecica*. Uppsala, Sweden. Almqvist and Wiksell, 1926.
- ²⁴Bryn, H., and Schreiner, K. E.: *Die somatologie der Norweger*. Oslo, Norway. Skrifter utgitt av det Norske Videnskaps-Akademi, 1929.
- ²⁵Schlaginhaufen, O.: *Anthropologica Helvetica*. Zurich, Switzerland. Institut Orell Füssli, 1956.
- ²⁶Martin, L.: *Etude biometrique de grandeurs somatiques recueillies sur les conscrits et recrues belges et de leur evolution*. Brussels, Belgium. Institute National de Statistique, 1958.
- ²⁷Davenport, C. B., and Love, A. G.: *Army Anthropology*. Washington. U.S. Government Printing Office, 1921.
- ²⁸Damon, A., and Randall, F. E.: Physical anthropology in the Army Air Forces. *Am. J. Phys. Anthropol.* 2:293-316, Sept. 1944.
- ²⁹Clark, W. E. le Gros: Physical anthropology applied to problems of war. *Brit. M. J.* 1:39-43, Jan. 1946.
- ³⁰Morant, G. M.: Applied physical anthropology in Great Britain in recent years. *Am. J. Phys. Anthropol.* 6:329-339, Sept. 1948.
- ³¹U.S. Department of the Army: *Reference Anthropometry of Army Men*, by R. W. Newman and R. M. White. Report No. 180. Natick, Mass. Environmental Protection Section, Quartermaster Climatic Research Laboratory, 1951.
- ³²U.S. Department of the Air Force: *Annotated Bibliography of Applied Physical Anthropology in Human Engineering*, by R. Hansen, D. R. Cornog, and H. T. E. Hertzberg. WADC TR 56-30. Wright-Patterson Air Force Base, Ohio. Wright Air Development Center, 1958.
- ³³American College Health Association: Data on heights and weights of 160,000 students entering 104 colleges, in U.S. Department of Agriculture, *Height and Weights of Adults in the United States*, by M. L. Hathaway and E. D. Foard. Home Economics Research Report No. 10. Washington. U.S. Government Printing Office, 1960.
- ³⁴Elbel, E. R.: Body measurements of male students entering the University of Kansas. *Kansas Studies in Education* 4(2):1-24, 1954.
- ³⁵Hitchcock, E., Marsh, A., Whitmore, S. C., and Durken, R.: Unpublished data from Amherst College, 1861-1957, in U.S. Department of Agriculture, *Height and Weights of Adults in the United States*, by M. L. Hathaway and E. D. Foard. Home Economics Research Report No. 10. Washington. U.S. Government Printing Office, 1960.
- ³⁶Kiphuth, R. J. H., and Reilly, J. J.: Unpublished data from Yale University, 1883-1957, in U.S. Department of Agriculture, *Height and Weights of Adults in the United States*, by M. L. Hathaway and E. D. Foard. Home Economics Research Report No. 10. Washington. U.S. Government Printing Office, 1960.
- ³⁷Damon, A., and Stoudt, H. W.: The functional anthropometry of old men. *Human Factors* 5(5):485-491, Oct. 1963.
- ³⁸Hooton, E. A.: *A Survey in Seating*. Gardner, Mass. Heywood-Wakefield Co., 1945.
- ³⁹Damon, A., and McFarland, R. A.: The physique of bus and truck drivers: with a review of occupational anthropology. *Am. J. Phys. Anthropol.* 13(4):711-742, Dec. 1955.

- ⁴⁰U.S. Department of Commerce, Civil Aeronautics Administration: *Physical Characteristics of the 1946 Airline Transport Pilot Population*, by M. Y. McCormick. Washington. U.S. Government Printing Office, 1947.
- ⁴¹Damon, A., Bleibtreu, H. K., Elliot, O., and Giles, E.: Predicting somatotype from body measurements. *Am. J. Phys. Anthropol.* 20:461-73, Dec. 1962.
- ⁴²U.S. Department of the Army: *Anthropometry of Army Aviators*, by R. M. White. TR EP-150. Natick, Mass. Quartermaster Research and Engineering Center, 1961.
- ⁴³U.S. Department of the Air Force: *Anthropometry of Flying Personnel—1950*, by H. T. E. Hertzberg, G. S. Daniels, and E. Churchill. WADC TR 52-321. Wright-Patterson Air Force Base, Ohio. Wright Air Development Center, 1954.
- ⁴⁴U.S. Department of the Air Force: *Anthropometry of Male Basic Trainees*, by G. S. Daniels, H. C. Meyers, and E. Churchill. WADC TR 53-49. Wright-Patterson Air Force Base, Ohio. Wright Air Development Center, 1953.
- ⁴⁵U.S. Department of the Navy: Weight distribution of recruits. *Stat. Navy Med.* 5:2-3, June 1949.
- ⁴⁶U.S. Department of the Navy: Unpublished data. New London, Conn. Medical Research Laboratory, Naval Submarine Base.
- ⁴⁷Bayer, L. M., and Gray, H.: Anthropometric standards for working women. *Human Biol.* 6(3):472-488, Sept. 1934.
- ⁴⁸Mosscrop, A., Newcomer, M., and Myers, M. G.: Unpublished data from Vassar College, 1884-1957, in U.S. Department of Agriculture, *Height and Weights of Adults in the United States*, by M. L. Hathaway and E. D. Foard. Home Economics Research Report No. 10. Washington. U.S. Government Printing Office, 1960.
- ⁴⁹Richards, E., Mott, J., Russell, H., and Ainsworth, D.: Unpublished data from Smith College, 1899-1956, in U.S. Department of Agriculture, *Height and Weights of Adults in the United States*, by M. L. Hathaway and E. D. Foard. Home Economics Research Report No. 10. Washington. U.S. Government Printing Office, 1960.
- ⁵⁰Elbel, E. R., and Barland, J. K.: Height and weight of female students entering the University of Kansas. *University of Kansas Bulletin of Education* 14(1):19-26, Nov. 1959.
- ⁵¹U.S. Department of the Army: *Survey of Body Size of Army Personnel, Male and Female*: 4) *Body Dimensions of Army Fe-*
- males—Methodology and General Considerations*, by F. E. Randall. Report No. 123, Project E 54-46. Natick, Mass. Quartermaster Climatic Research Laboratory, 1947.
- ⁵²U.S. Department of the Army: *Human Body Size in Military Aircraft and Personal Equipment*, by F. E. Randall, A. Damon, R. S. Benton, and D. I. Patt. AAF TR 5501. Wright Field, Dayton, Ohio. Air Materiel Command, 1946.
- ⁵³U.S. Department of the Air Force: *Anthropometry of WAF Basic Trainees*, by G. S. Daniels, H. C. Meyers, and S. H. Worrall. WADC TR 53-12. Wright-Patterson Air Force Base, Ohio. Wright Air Development Center, 1953.
- ⁵⁴U.S. Department of the Navy: Height distribution of recruits. *Stat. Navy Med.* 5:2-3, July 1949.
- ⁵⁵U.S. Department of the Navy: *Compilation of Anthropometric Measures on U.S. Navy Pilots*, by E. C. Gifford. NAMC-ACEL-437. Philadelphia. Air Crew Equipment Laboratory, 1960.
- ⁵⁶Damon, A.: Physique and success in military flying. *Am. J. Phys. Anthropol.* 13(2):217-252, June 1955.
- ⁵⁷Damon, A.: Delineation of the body-build variables associated with cardiovascular diseases. *Ann. New York Acad. Sc.*, in press.
- ⁵⁸U.S. Department of the Navy: Unpublished data. Pensacola, Fla. Naval Air Station.
- ⁵⁹Carter, I. G.: Physical measurements of Old American college women. *Am. J. Phys. Anthropol.* 16(4):497-514, April-June 1932.
- ⁶⁰Bowles, G. T.: *New Types of Old Americans at Harvard and at Eastern Women's Colleges*. Cambridge. Harvard University Press, 1932.
- ⁶¹Damon, A.: Notes on anthropometric technique: I. Stature against a wall and standing free. *Am. J. Phys. Anthropol.*, in press.
- ⁶²Newman, R. N.: The body sizes of tomorrow's young men, Chapter 8, in E. Bennett, J. Degan, and J. Spiegel, eds., *Human Factors in Technology*. New York. McGraw-Hill Book Co., 1963.
- ⁶³Dahlberg, G.: *Race, Reason and Rubbish*. London. Allen and Unwin, 1942.
- ⁶⁴Hulse, F. S.: Exogamie et hétérosis. *Archives Suisses d'Anthropologie Générale.* 20:103-125, 1957.



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Table 1. Weight in pounds, average weight and selected percentiles, by age and sex: United States, 1960-62

Average weight and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Weight in pounds ¹						
Average weight--	168	160	171	172	172	166	160	150
<u>Percentile</u> ²								
99-----	241	231	248	244	241	230	225	212
95-----	217	214	223	219	219	213	207	198
90-----	205	193	208	207	209	203	198	191
80-----	190	180	195	193	194	190	183	170
70-----	181	171	185	184	185	180	172	161
60-----	173	164	177	177	178	172	166	150
50-----	166	157	169	171	171	165	161	146
40-----	159	151	162	164	163	158	153	141
30-----	152	145	154	158	156	151	146	137
20-----	144	140	146	151	149	143	138	132
10-----	134	131	136	141	139	131	126	120
5-----	126	124	129	134	131	123	117	107
1-----	112	115	114	121	116	112	99	99
<u>WOMEN</u>								
Average weight--	142	129	136	144	147	152	146	138
<u>Percentile</u> ²								
99-----	236	218	239	238	240	244	214	205
95-----	199	170	191	204	205	211	196	193
90-----	182	157	173	184	190	195	183	178
80-----	164	145	152	165	171	176	169	162
70-----	152	137	143	153	158	165	160	155
60-----	144	131	136	144	149	154	151	147
50-----	137	126	130	137	143	146	145	137
40-----	131	122	125	131	137	140	138	127
30-----	125	117	120	125	130	134	132	119
20-----	118	111	114	119	122	129	125	113
10-----	111	104	107	113	113	120	114	105
5-----	104	99	102	109	106	112	106	95
1-----	93	91	92	100	95	95	92	74

¹Weight, partially clothed (see section on "The Measurements").

²Measurement below which the indicated percent of persons in the given age group fall.

Table 2. Height in inches, average height and selected percentiles, by age and sex: United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
MEN								
Height in inches ¹								
Average height--	68.2	68.7	69.1	68.5	68.2	67.4	66.9	65.9
<u>Percentile</u> ²								
99-----	74.6	74.8	76.0	74.1	74.0	73.5	72.0	72.6
95-----	72.8	73.1	73.8	72.5	72.7	72.2	70.9	70.5
90-----	71.8	72.4	72.7	71.7	71.7	71.0	70.2	69.5
80-----	70.6	70.9	71.4	70.7	70.5	69.8	68.9	68.1
70-----	69.7	70.1	70.5	70.0	69.5	68.8	68.3	67.0
60-----	68.8	69.3	69.8	69.2	68.8	68.3	67.5	66.6
50-----	68.3	68.6	69.0	68.6	68.3	67.6	66.8	66.2
40-----	67.6	67.9	68.4	68.1	67.7	66.8	66.2	65.0
30-----	66.8	67.1	67.7	67.3	66.9	66.0	65.5	64.2
20-----	66.0	66.5	66.8	66.4	66.1	64.7	64.8	63.3
10-----	64.5	65.4	65.5	65.2	64.8	63.7	64.1	62.0
5-----	63.6	64.3	64.4	64.2	64.0	62.9	62.7	61.3
1-----	61.7	62.6	62.6	62.3	62.3	61.2	60.8	57.7
WOMEN								
Average height--	63.0	63.8	63.7	63.5	62.9	62.4	61.5	61.1
<u>Percentile</u> ²								
99-----	68.8	69.3	69.0	69.0	68.7	68.7	67.0	68.2
95-----	67.1	67.9	67.3	67.2	67.2	66.6	65.5	64.9
90-----	66.4	66.8	66.6	66.6	66.1	65.6	64.7	64.5
80-----	65.1	65.9	65.7	65.5	64.8	64.3	63.7	63.6
70-----	64.4	65.0	64.9	64.7	64.1	63.6	62.8	62.8
60-----	63.7	64.5	64.4	64.1	63.4	62.9	62.1	62.3
50-----	62.9	63.9	63.7	63.4	62.8	62.3	61.6	61.8
40-----	62.4	63.0	62.9	62.8	62.3	61.8	61.1	61.3
30-----	61.8	62.3	62.4	62.2	61.7	61.3	60.2	60.1
20-----	61.1	61.6	61.8	61.4	60.9	60.6	59.5	59.0
10-----	59.8	60.7	60.6	60.4	59.8	59.4	58.3	57.3
5-----	59.0	60.0	59.7	59.6	59.1	58.4	57.5	55.3
1-----	57.1	58.4	58.1	57.6	57.3	56.0	55.8	46.8

¹Height, without shoes.

²Measurement below which the indicated percent of persons in the given age group fall.

Table 3. Sitting height erect in inches, average height and selected percentiles, by age and sex: United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	35.6	35.8	36.0	35.9	35.7	35.2	34.7	34.2
<u>Percentile</u> ¹								
99-----	38.9	39.1	39.0	38.9	38.9	38.7	37.7	37.6
95-----	38.0	38.3	38.4	38.0	38.0	37.7	36.9	36.7
90-----	37.6	37.8	37.9	37.7	37.6	37.1	36.5	36.1
80-----	36.9	37.1	37.3	37.1	36.9	36.6	35.9	35.3
70-----	36.5	36.7	36.9	36.7	36.5	36.1	35.5	34.9
60-----	36.0	36.3	36.5	36.3	36.0	35.7	35.1	34.6
50-----	35.7	35.9	36.1	36.0	35.7	35.3	34.8	34.3
40-----	35.3	35.4	35.7	35.6	35.3	35.0	34.4	34.1
30-----	34.9	35.0	35.3	35.2	35.0	34.5	34.1	33.6
20-----	34.4	34.5	34.9	34.8	34.5	34.1	33.7	33.2
10-----	33.8	34.0	34.3	34.2	34.1	33.3	33.1	32.4
5-----	33.2	33.3	33.9	33.7	33.5	32.9	32.5	31.8
1-----	31.9	31.8	32.5	32.2	32.8	31.4	31.3	27.7
<u>WOMEN</u>								
Average height--	33.3	33.6	33.7	33.7	33.4	33.0	32.1	31.7
<u>Percentile</u> ¹								
99-----	36.6	36.7	36.8	36.8	36.4	36.4	35.8	35.7
95-----	35.7	35.9	35.9	35.8	35.6	35.4	34.5	34.8
90-----	35.2	35.4	35.5	35.4	35.0	34.8	33.9	34.0
80-----	34.6	34.8	34.9	34.8	34.6	34.2	33.4	33.3
70-----	34.2	34.4	34.5	34.4	34.1	33.8	32.9	32.8
60-----	33.8	34.0	34.1	34.1	33.8	33.4	32.6	32.5
50-----	33.4	33.7	33.8	33.7	33.5	33.0	32.2	32.1
40-----	33.1	33.4	33.4	33.4	33.2	32.7	31.9	31.6
30-----	32.6	33.0	33.1	33.1	32.8	32.3	31.5	31.1
20-----	32.2	32.6	32.6	32.6	32.3	31.9	31.0	30.4
10-----	31.4	32.1	32.1	32.1	31.7	31.2	30.3	29.2
5-----	30.9	31.4	31.4	31.5	31.2	30.7	29.7	28.1
1-----	29.5	30.4	30.3	30.3	30.1	30.0	28.6	17.8

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 4. Sitting height normal in inches, average height and selected percentiles, by age and sex: United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	34.1	34.1	34.4	34.2	34.1	33.8	33.4	33.0
<u>Percentile</u> ¹								
99-----	37.6	37.8	37.8	37.7	37.7	36.9	36.4	36.7
95-----	36.6	36.7	36.8	36.7	36.7	36.0	35.7	35.8
90-----	35.9	36.0	36.3	36.2	36.0	35.6	35.1	35.2
80-----	35.3	35.4	35.6	35.5	35.5	35.0	34.6	34.6
70-----	34.8	34.9	35.1	34.9	35.0	34.6	34.1	34.1
60-----	34.5	34.5	34.8	34.6	34.6	34.3	33.8	33.7
50-----	34.1	34.2	34.4	34.3	34.2	33.9	33.4	33.3
40-----	33.7	33.8	34.0	34.0	33.8	33.5	33.1	32.9
30-----	33.3	33.3	33.6	33.5	33.4	33.2	32.7	32.5
20-----	32.9	32.9	33.2	33.1	32.9	32.6	32.4	32.1
10-----	32.2	32.3	32.6	32.4	32.3	31.8	31.9	30.7
5-----	31.6	31.9	32.1	32.0	31.8	31.3	31.2	29.8
1-----	30.4	30.5	31.0	30.8	30.8	30.2	30.1	26.7
<u>WOMEN</u>								
Average height--	32.2	32.5	32.6	32.6	32.2	31.9	31.1	30.5
<u>Percentile</u> ¹								
99-----	35.7	35.7	35.9	35.8	35.5	35.4	34.9	35.0
95-----	34.7	34.8	34.9	34.9	34.6	34.4	33.9	33.4
90-----	34.1	34.3	34.5	34.4	34.0	33.8	33.1	32.8
80-----	33.6	33.7	33.8	33.8	33.5	33.2	32.5	32.3
70-----	33.1	33.4	33.4	33.3	33.0	32.8	31.9	31.8
60-----	32.7	33.0	33.0	32.9	32.7	32.4	31.6	31.4
50-----	32.3	32.6	32.6	32.6	32.3	32.1	31.2	31.0
40-----	31.9	32.3	32.3	32.3	32.0	31.7	30.8	30.6
30-----	31.5	31.9	31.9	31.9	31.5	31.3	30.4	30.1
20-----	31.0	31.3	31.4	31.4	31.1	30.8	30.0	29.2
10-----	30.2	30.6	30.7	30.8	30.3	30.2	29.3	27.6
5-----	29.6	30.1	30.1	30.2	29.7	29.7	28.7	27.1
1-----	28.2	29.2	28.9	29.2	28.7	28.3	27.0	14.8

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 5. Knee height in inches, average height and selected percentiles, by age and sex: United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	21.3	21.4	21.6	21.4	21.3	21.1	21.0	20.6
<u>Percentile</u> ¹								
99-----	24.1	23.9	24.6	24.4	23.9	24.0	23.7	23.3
95-----	23.4	23.4	23.7	23.4	23.3	23.1	22.9	22.7
90-----	22.9	22.9	23.3	22.9	22.8	22.8	22.5	22.2
80-----	22.4	22.5	22.7	22.5	22.4	22.2	21.9	21.7
70-----	22.0	22.1	22.2	22.1	22.0	21.8	21.6	21.4
60-----	21.7	21.8	21.9	21.8	21.7	21.4	21.3	21.0
50-----	21.4	21.5	21.6	21.5	21.4	21.1	21.0	20.7
40-----	21.1	21.2	21.3	21.2	21.1	20.8	20.7	20.4
30-----	20.7	20.8	21.1	20.8	20.7	20.5	20.5	20.0
20-----	20.4	20.5	20.6	20.4	20.3	20.2	20.2	19.6
10-----	20.0	20.1	20.2	20.0	19.9	19.6	19.9	19.2
5-----	19.3	19.4	19.8	19.4	19.3	19.1	19.2	19.0
1-----	18.3	18.3	19.0	18.4	18.2	18.1	18.2	18.0
<u>WOMEN</u>								
Average height--	19.6	19.7	19.7	19.7	19.5	19.4	19.3	19.4
<u>Percentile</u> ¹								
99-----	22.4	22.7	22.5	22.4	22.5	21.9	22.0	21.5
95-----	21.5	21.6	21.6	21.5	21.6	21.4	21.0	20.9
90-----	21.0	21.0	21.0	21.0	21.0	20.9	20.7	20.7
80-----	20.5	20.6	20.6	20.6	20.5	20.4	20.1	20.2
70-----	20.1	20.3	20.3	20.2	20.1	20.0	19.8	19.9
60-----	19.8	20.0	20.0	19.9	19.8	19.7	19.5	19.6
50-----	19.6	19.7	19.7	19.6	19.5	19.5	19.2	19.4
40-----	19.3	19.5	19.4	19.4	19.2	19.2	19.0	19.2
30-----	19.1	19.2	19.2	19.1	19.0	19.0	18.7	18.9
20-----	18.6	18.9	18.8	18.8	18.5	18.6	18.4	18.4
10-----	18.2	18.4	18.3	18.3	18.1	18.2	18.1	18.0
5-----	17.9	18.1	18.0	18.0	17.6	17.8	17.8	17.3
1-----	17.1	17.3	17.2	17.2	17.1	16.6	17.1	16.3

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 6. Popliteal height in inches, average height and selected percentiles, by age and sex:
United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	17.3	17.5	17.6	17.3	17.2	17.1	17.0	16.6
<u>Percentile</u> ¹								
99-----	20.0	20.4	20.6	19.9	19.9	19.8	19.8	19.3
95-----	19.3	19.6	19.7	19.1	19.1	19.0	18.9	18.4
90-----	18.8	19.0	19.2	18.8	18.6	18.6	18.4	17.9
80-----	18.2	18.5	18.6	18.2	17.9	18.0	17.8	17.4
70-----	17.8	18.0	18.1	17.8	17.7	17.7	17.6	17.0
60-----	17.6	17.7	17.8	17.6	17.5	17.4	17.3	16.8
50-----	17.3	17.5	17.5	17.3	17.2	17.1	17.1	16.6
40-----	17.0	17.2	17.3	17.0	17.0	16.9	16.8	16.4
30-----	16.7	17.0	17.0	16.7	16.7	16.5	16.5	16.2
20-----	16.4	16.6	16.6	16.4	16.3	16.2	16.2	15.9
10-----	16.0	16.2	16.2	16.1	16.0	15.8	15.6	15.4
5-----	15.5	16.0	16.0	15.6	15.5	15.3	15.2	15.2
1-----	14.9	15.2	15.1	15.0	14.7	14.9	14.2	15.0
<u>WOMEN</u>								
Average height--	15.6	16.0	15.7	15.6	15.5	15.4	15.3	15.5
<u>Percentile</u> ¹								
99-----	18.0	18.5	18.2	17.9	18.3	17.9	17.9	17.8
95-----	17.5	17.8	17.5	17.5	17.5	17.1	17.0	17.2
90-----	17.0	17.4	17.0	17.0	17.0	16.8	16.8	16.9
80-----	16.6	16.9	16.7	16.6	16.6	16.4	16.3	16.6
70-----	16.3	16.6	16.4	16.3	16.2	16.1	15.9	16.2
60-----	16.0	16.4	16.1	16.0	15.9	15.7	15.6	15.9
50-----	15.7	16.1	15.8	15.7	15.5	15.4	15.3	15.6
40-----	15.4	15.8	15.6	15.4	15.2	15.0	15.0	15.4
30-----	15.1	15.5	15.3	15.1	14.9	14.7	14.7	15.1
20-----	14.7	15.2	15.0	14.7	14.5	14.4	14.4	14.6
10-----	14.2	14.6	14.4	14.2	14.2	14.1	14.1	14.1
5-----	14.0	14.2	14.1	14.0	13.8	13.6	13.9	13.5
1-----	13.1	13.5	13.2	13.1	13.1	13.1	13.0	9.6

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 7. Elbow rest height in inches, average height and selected percentiles, by age and sex:
United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	9.5	9.6	9.7	9.7	9.5	9.3	9.0	8.6
<u>Percentile</u> ¹								
99-----	12.5	12.8	12.6	12.6	12.0	12.2	11.9	11.0
95-----	11.6	11.9	11.7	11.8	11.5	11.4	10.9	10.6
90-----	11.0	11.4	11.1	11.3	11.0	10.9	10.6	10.2
80-----	10.6	10.7	10.7	10.7	10.5	10.4	10.0	9.7
70-----	10.2	10.3	10.3	10.4	10.1	9.9	9.6	9.3
60-----	9.8	9.9	10.0	10.0	9.8	9.6	9.3	8.9
50-----	9.5	9.6	9.7	9.7	9.6	9.3	9.0	8.6
40-----	9.2	9.4	9.4	9.4	9.3	9.0	8.7	8.2
30-----	8.9	9.1	9.1	9.1	9.1	8.6	8.4	7.8
20-----	8.5	8.6	8.7	8.7	8.7	8.3	8.0	7.5
10-----	8.0	8.1	8.3	8.2	8.2	7.7	7.4	7.1
5-----	7.4	7.6	8.0	7.8	7.7	7.2	7.1	6.5
1-----	6.3	6.3	7.0	6.5	7.0	6.0	6.1	5.7
<u>WOMEN</u>								
Average height--	9.1	9.0	9.3	9.4	9.2	8.9	8.4	8.2
<u>Percentile</u> ¹								
99-----	11.9	11.8	11.9	12.0	12.1	11.9	11.3	10.7
95-----	11.0	10.8	11.1	11.3	11.0	10.9	10.2	10.0
90-----	10.7	10.5	10.8	10.8	10.7	10.6	9.8	9.8
80-----	10.1	9.9	10.3	10.3	10.3	10.0	9.5	9.4
70-----	9.7	9.6	9.9	9.9	9.9	9.6	9.1	9.1
60-----	9.5	9.4	9.6	9.7	9.6	9.3	8.8	8.7
50-----	9.2	9.1	9.3	9.4	9.3	9.0	8.5	8.4
40-----	8.9	8.8	9.1	9.2	9.0	8.6	8.2	8.0
30-----	8.5	8.5	8.7	8.9	8.7	8.3	7.8	7.7
20-----	8.2	8.2	8.4	8.5	8.3	8.0	7.4	7.4
10-----	7.6	7.6	8.0	8.0	7.8	7.4	7.0	7.0
5-----	7.1	7.2	7.4	7.5	7.3	7.1	6.4	6.4
1-----	6.1	6.2	6.1	6.7	6.4	5.9	5.4	2.8

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 8. Thigh clearance height in inches, average height and selected percentiles, by age and sex: United States, 1960-62

Average height and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Height in inches						
Average height--	5.7	5.7	5.8	5.8	5.6	5.5	5.4	5.2
<u>Percentile</u> ¹								
99-----	7.7	7.7	7.9	7.8	7.1	7.4	7.0	7.2
95-----	6.9	6.9	7.0	7.0	6.9	6.8	6.7	6.6
90-----	6.7	6.8	6.9	6.8	6.7	6.6	6.5	6.1
80-----	6.4	6.4	6.6	6.5	6.3	6.1	6.0	5.8
70-----	6.0	6.1	6.3	6.2	6.0	5.9	5.8	5.6
60-----	5.8	5.9	6.0	6.0	5.8	5.7	5.6	5.4
50-----	5.7	5.7	5.8	5.8	5.6	5.5	5.4	5.2
40-----	5.5	5.5	5.6	5.6	5.5	5.3	5.3	5.0
30-----	5.3	5.3	5.4	5.4	5.3	5.2	5.1	4.7
20-----	5.1	5.1	5.2	5.2	5.1	4.9	4.8	4.5
10-----	4.7	4.7	4.9	5.0	4.9	4.5	4.4	4.2
5-----	4.3	4.3	4.5	4.6	4.4	4.2	4.2	4.1
1-----	4.1	4.1	4.1	4.1	4.1	4.0	4.0	3.9
<u>WOMEN</u>								
Average height--	5.4	5.3	5.4	5.5	5.5	5.4	5.3	5.2
<u>Percentile</u> ¹								
99-----	7.7	7.0	7.7	7.8	7.7	8.3	7.0	6.9
95-----	6.9	6.7	6.9	7.0	6.9	6.9	6.6	6.5
90-----	6.6	6.3	6.6	6.7	6.6	6.6	6.2	6.1
80-----	6.0	5.9	6.0	6.3	6.1	6.0	5.9	5.8
70-----	5.8	5.7	5.8	5.9	5.9	5.8	5.7	5.6
60-----	5.6	5.5	5.6	5.7	5.7	5.6	5.5	5.4
50-----	5.4	5.4	5.4	5.5	5.5	5.4	5.3	5.2
40-----	5.2	5.2	5.2	5.3	5.3	5.2	5.1	4.9
30-----	5.1	5.0	5.1	5.1	5.1	5.0	4.9	4.7
20-----	4.7	4.7	4.7	4.9	4.8	4.7	4.6	4.4
10-----	4.3	4.3	4.4	4.4	4.4	4.3	4.2	4.1
5-----	4.1	4.1	4.2	4.2	4.2	4.1	4.1	4.0
1-----	3.8	3.6	4.0	4.0	4.0	3.5	3.4	3.2

¹Measurements below which the indicated percent of persons in the given age group fall.

Table 9. Buttock-knee length in inches, average length and selected percentiles, by age and sex: United States, 1960-62

Average length and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Length in inches						
Average length--	23.3	23.3	23.6	23.3	23.3	23.0	23.0	22.7
<u>Percentile</u> ¹								
99-----	26.3	26.5	26.8	26.2	26.1	25.8	25.9	24.9
95-----	25.2	25.4	25.7	25.1	25.2	24.9	24.8	24.7
90-----	24.8	24.9	25.0	24.8	24.8	24.6	24.4	24.4
80-----	24.4	24.4	24.6	24.4	24.4	24.1	23.9	23.9
70-----	23.9	23.9	24.2	24.0	24.0	23.7	23.6	23.3
60-----	23.6	23.6	23.9	23.7	23.7	23.4	23.3	22.9
50-----	23.3	23.3	23.6	23.4	23.4	23.1	23.0	22.6
40-----	23.0	23.0	23.3	23.1	23.1	22.8	22.7	22.3
30-----	22.7	22.7	22.9	22.7	22.7	22.4	22.4	22.0
20-----	22.3	22.3	22.5	22.4	22.4	22.1	22.2	21.6
10-----	21.8	21.9	22.1	21.9	21.9	21.5	21.5	21.2
5-----	21.3	21.3	21.6	21.3	21.3	21.2	21.0	21.0
1-----	20.3	20.4	20.8	20.3	20.4	19.6	20.1	20.2
<u>WOMEN</u>								
Average length--	22.3	22.3	22.4	22.5	22.3	22.3	22.2	22.0
<u>Percentile</u> ¹								
99-----	25.7	25.6	25.6	25.9	25.5	25.7	25.9	24.7
95-----	24.6	24.6	24.6	24.7	24.6	24.7	24.6	23.9
90-----	24.0	23.9	24.0	24.0	24.1	24.0	23.9	23.5
80-----	23.4	23.3	23.5	23.5	23.5	23.4	23.4	22.9
70-----	22.9	22.9	23.0	23.0	22.9	22.9	22.9	22.6
60-----	22.6	22.5	22.7	22.7	22.6	22.6	22.6	22.4
50-----	22.4	22.2	22.4	22.5	22.4	22.3	22.2	22.2
40-----	22.1	21.9	22.1	22.2	22.1	22.0	21.9	21.9
30-----	21.7	21.6	21.8	21.9	21.7	21.7	21.5	21.4
20-----	21.3	21.3	21.4	21.5	21.3	21.3	21.2	21.0
10-----	20.9	20.8	21.0	21.1	20.9	20.9	20.6	20.3
5-----	20.4	20.3	20.5	20.5	20.3	20.3	20.2	19.9
1-----	19.5	19.3	20.0	20.0	19.4	19.4	19.4	18.5

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 10. Buttock-popliteal length in inches, average length and selected percentiles, by age and sex: United States, 1960-62

Average length and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Length in inches						
Average length--	19.4	19.5	19.6	19.4	19.4	19.3	19.2	18.9
<u>Percentile</u> ¹								
99-----	22.7	22.9	23.1	22.7	22.0	22.2	21.9	22.1
95-----	21.6	21.6	21.9	21.8	21.5	21.5	20.9	21.2
90-----	21.0	21.0	21.4	21.1	20.9	20.9	20.7	20.8
80-----	20.5	20.5	20.8	20.6	20.5	20.4	20.3	20.2
70-----	20.1	20.0	20.4	20.1	20.1	20.0	19.9	19.7
60-----	19.8	19.7	20.0	19.8	19.7	19.7	19.6	19.2
50-----	19.5	19.5	19.6	19.5	19.5	19.4	19.3	18.9
40-----	19.2	19.2	19.3	19.2	19.2	19.0	19.0	18.6
30-----	18.8	19.0	19.0	18.9	18.8	18.6	18.6	18.3
20-----	18.4	18.5	18.5	18.5	18.3	18.2	18.3	17.9
10-----	17.9	18.0	18.1	18.0	17.8	17.6	17.8	17.3
5-----	17.3	17.4	17.6	17.4	17.4	17.2	17.3	17.0
1-----	16.5	16.5	16.6	16.5	17.0	16.4	16.3	16.2
<u>WOMEN</u>								
Average length--	18.9	18.8	18.9	18.9	18.9	18.9	18.8	18.6
<u>Percentile</u> ¹								
99-----	22.0	21.9	21.9	22.4	22.0	22.0	21.9	20.8
95-----	21.0	21.1	21.0	21.1	20.9	21.0	20.9	20.0
90-----	20.6	20.6	20.5	20.7	20.6	20.5	20.4	19.9
80-----	19.9	19.8	19.9	20.0	20.0	19.9	19.8	19.6
70-----	19.5	19.5	19.5	19.6	19.6	19.5	19.4	19.3
60-----	19.2	19.1	19.2	19.3	19.3	19.2	19.1	19.0
50-----	18.9	18.8	18.9	18.9	18.9	18.9	18.8	18.7
40-----	18.6	18.5	18.6	18.6	18.6	18.6	18.5	18.3
30-----	18.2	18.1	18.3	18.3	18.2	18.3	18.2	18.0
20-----	17.9	17.7	18.0	18.0	17.8	18.0	17.8	17.6
10-----	17.3	17.2	17.3	17.4	17.3	17.4	17.3	17.2
5-----	17.0	16.9	17.0	17.1	17.0	17.1	16.9	17.0
1-----	16.1	16.1	16.1	16.2	15.8	16.1	16.1	14.7

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 11. Elbow-to-elbow breadth in inches, average breadth and selected percentiles, by age and sex: United States, 1960-62

Average breadth and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Breadth in inches						
Average breadth-	16.6	15.6	16.4	16.8	16.9	16.8	16.9	16.4
<u>Percentile</u> ¹								
99-----	21.4	20.8	21.4	21.5	21.8	22.0	21.0	20.7
95-----	19.9	19.4	19.7	20.0	20.0	20.0	19.9	19.5
90-----	19.0	18.2	18.8	19.2	19.2	19.3	19.3	18.7
80-----	18.1	17.2	17.8	18.3	18.4	18.3	18.5	17.8
70-----	17.5	16.5	17.3	17.7	17.8	17.7	17.8	17.1
60-----	17.0	15.9	16.8	17.2	17.3	17.2	17.3	16.7
50-----	16.5	15.4	16.3	16.7	16.8	16.7	16.8	16.4
40-----	16.0	15.0	15.9	16.3	16.3	16.1	16.3	16.0
30-----	15.5	14.5	15.4	15.9	15.9	15.6	15.9	15.5
20-----	15.0	14.1	15.0	15.3	15.3	15.2	15.3	14.9
10-----	14.3	13.4	14.2	14.6	14.6	14.5	14.6	14.3
5-----	13.7	13.1	13.7	14.1	14.1	14.1	14.0	14.0
1-----	13.0	12.3	13.1	13.1	13.2	13.2	13.2	12.4
<u>WOMEN</u>								
Average breadth-	15.3	14.0	14.5	15.3	15.8	16.4	16.4	15.8
<u>Percentile</u> ¹								
99-----	21.2	20.0	20.6	21.5	21.7	21.8	20.8	19.8
95-----	19.3	16.9	18.3	19.3	19.7	20.2	19.7	19.1
90-----	18.3	16.0	17.3	18.2	18.7	19.3	18.8	18.1
80-----	17.1	15.1	15.8	16.9	17.6	18.2	17.9	17.5
70-----	16.3	14.6	15.2	16.0	16.8	17.4	17.4	16.9
60-----	15.6	14.2	14.7	15.5	16.0	16.8	16.9	16.3
50-----	15.1	13.8	14.2	14.9	15.5	16.3	16.4	15.7
40-----	14.6	13.4	13.8	14.5	15.1	15.8	16.0	15.3
30-----	14.1	13.1	13.5	14.1	14.6	15.2	15.5	14.7
20-----	13.5	12.6	13.1	13.6	14.1	14.7	14.9	14.2
10-----	12.9	12.1	12.5	13.1	13.3	14.0	14.2	13.5
5-----	12.3	11.7	12.2	12.5	12.7	13.4	13.7	13.1
1-----	11.4	11.0	11.4	11.7	11.6	12.3	12.4	12.3

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 12. Seat breadth in inches, average breadth and selected percentiles, by age and sex: United States, 1960-62

Average breadth and percentile	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
<u>MEN</u>		Breadth in inches						
Average breadth--	14.0	13.6	14.0	14.1	14.1	14.0	13.9	13.7
<u>Percentile</u> ¹								
99-----	17.0	17.3	17.4	17.1	16.9	16.9	16.6	16.5
95-----	15.9	15.8	16.0	15.9	16.0	15.9	15.7	15.5
90-----	15.5	15.0	15.6	15.6	15.7	15.6	15.1	14.9
80-----	14.9	14.6	14.9	15.0	15.1	15.0	14.7	14.5
70-----	14.6	14.1	14.6	14.7	14.8	14.6	14.5	14.2
60-----	14.3	13.8	14.3	14.4	14.5	14.3	14.2	13.9
50-----	14.0	13.5	14.0	14.1	14.2	14.0	13.9	13.6
40-----	13.7	13.3	13.7	13.8	13.9	13.7	13.6	13.4
30-----	13.4	13.0	13.4	13.5	13.5	13.4	13.4	13.2
20-----	13.1	12.6	13.1	13.3	13.2	13.1	13.1	12.9
10-----	12.5	12.2	12.5	12.9	12.6	12.6	12.6	12.4
5-----	12.2	12.0	12.2	12.4	12.2	12.2	12.2	12.1
1-----	11.5	11.3	11.7	12.0	11.5	11.6	11.4	11.4
<u>WOMEN</u>								
Average breadth--	14.4	13.8	14.2	14.6	14.7	14.8	14.7	14.2
<u>Percentile</u> ¹								
99-----	18.8	18.4	19.0	19.2	19.0	18.7	18.2	17.1
95-----	17.1	15.9	16.8	17.3	17.6	17.4	17.3	16.8
90-----	16.4	15.4	16.0	16.5	16.7	16.8	16.7	16.5
80-----	15.6	14.8	15.3	15.7	15.8	16.0	15.9	15.8
70-----	15.1	14.4	14.8	15.1	15.4	15.6	15.4	15.0
60-----	14.7	14.1	14.4	14.8	15.0	15.1	14.9	14.5
50-----	14.3	13.8	14.0	14.5	14.6	14.7	14.6	14.0
40-----	14.0	13.5	13.7	14.2	14.2	14.3	14.3	13.7
30-----	13.6	13.2	13.4	13.8	13.8	13.9	14.0	13.3
20-----	13.3	12.8	13.1	13.4	13.4	13.6	13.5	13.0
10-----	12.7	12.3	12.6	12.9	13.0	13.2	12.9	12.2
5-----	12.3	12.1	12.2	12.4	12.4	12.9	12.4	11.7
1-----	11.7	11.3	11.5	12.0	12.0	12.1	12.1	9.8

¹Measurement below which the indicated percent of persons in the given age group fall.

Table 13. Weight distribution in pounds for men: United States, 1960-62

Weight	Total, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
Number of persons in thousands								
Total-----	52,744	7,139	10,281	11,373	10,034	7,517	4,972	1,428
Under 100 pounds	124	-	8	-	21	22	57	16
100-109 pounds--	270	-	13	46	31	19	82	79
110-119 pounds--	843	145	189	42	83	174	162	48
120-129 pounds--	2,265	524	337	210	299	492	323	80
130-139 pounds--	4,249	798	763	737	631	566	441	313
140-149 pounds--	6,520	1,305	1,168	1,017	1,039	921	749	321
150-159 pounds--	7,573	1,122	1,403	1,820	1,468	1,049	579	132
160-169 pounds--	7,693	1,052	1,364	1,672	1,357	1,100	997	151
170-179 pounds--	6,860	766	1,392	1,799	1,428	922	468	85
180-189 pounds--	5,800	656	1,163	1,458	1,333	769	371	50
190-199 pounds--	3,911	208	881	964	863	586	311	98
200-209 pounds--	2,821	154	696	692	539	455	247	38
210-219 pounds--	1,702	137	323	403	475	245	102	17
220-229 pounds--	1,096	198	237	234	243	114	70	-
230-239 pounds--	453	21	184	129	110	9	-	-
240-249 pounds--	311	38	77	82	92	9	13	-
250+ pounds-----	253	15	83	68	22	65	-	-

Table 14. Weight distribution in pounds for women: United States, 1960-62

Weight	Women, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
Number of persons in thousands								
Total-----	58,343	8,430	11,291	12,325	10,542	8,121	6,192	1,442
Under 90 pounds-	286	40	51	-	17	77	42	59
90-99 pounds----	1,167	415	349	104	180	8	85	26
100-109 pounds--	3,898	1,076	991	593	570	228	321	119
110-119 pounds--	7,652	1,494	1,991	1,938	1,051	497	427	254
120-129 pounds--	9,475	1,949	2,251	2,036	1,328	946	799	166
130-139 pounds--	9,488	1,310	1,893	2,058	1,555	1,536	986	150
140-149 pounds--	8,039	975	1,351	1,540	1,806	1,278	962	127
150-159 pounds--	5,112	492	694	1,179	1,072	736	719	220
160-169 pounds--	3,873	255	501	789	769	737	679	143
170-179 pounds--	3,204	199	346	681	736	727	471	44
180-189 pounds--	1,845	32	283	434	419	361	274	42
190-199 pounds--	1,500	37	190	257	400	366	188	62
200-209 pounds--	1,052	48	139	243	232	209	151	30
210-219 pounds--	634	29	80	148	163	142	72	-
220-229 pounds--	372	23	37	162	69	65	16	-
230-239 pounds--	291	29	35	49	71	107	-	-
240-249 pounds--	145	-	38	29	28	50	-	-
250-259 pounds--	101	18	-	40	-	43	-	-
260-269 pounds--	80	-	26	14	40	-	-	-
270-279 pounds--	41	9	-	24	-	8	-	-
280+ pounds-----	88	-	45	7	36	-	-	-

Table 15. Height distribution in inches for men: United States, 1960-62

Height	Men, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
	Number of persons in thousands							
Total-----	52,744	7,139	10,281	11,373	10,034	7,517	4,972	1,428
Under 60 inches-	90	-	-	10	22	-	37	21
60 inches-----	100	-	8	9	16	37	16	14
61 inches-----	485	11	15	42	30	173	107	107
62 inches-----	874	98	127	151	110	184	122	82
63 inches-----	1,720	157	164	224	304	527	166	178
64 inches-----	3,691	286	487	550	664	818	714	172
65 inches-----	3,488	360	453	698	772	540	614	51
66 inches-----	7,021	1,129	1,015	1,384	1,240	960	920	373
67 inches-----	6,249	908	1,121	1,325	1,281	927	556	131
68 inches-----	9,379	1,057	1,794	2,183	2,086	1,313	824	122
69 inches-----	5,421	895	1,233	1,342	926	632	320	73
70 inches-----	6,239	881	1,456	1,633	1,216	641	349	63
71 inches-----	3,216	375	800	1,018	508	338	177	-
72 inches-----	2,817	602	820	493	524	305	32	41
73 inches-----	1,103	225	348	186	235	91	18	-
74 inches-----	581	101	311	96	55	18	-	-
75 inches-----	126	38	29	29	30	-	-	-
76+ inches-----	144	16	100	-	15	13	-	-

Table 16. Height distribution in inches for women: United States, 1960-62

Height	Women, 18-79 years	18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
	Number of persons in thousands							
Total-----	58,343	8,430	11,291	12,325	10,542	8,121	6,192	1,442
Under 53 inches-	57	-	-	-	-	40	-	17
53 inches-----	44	-	-	-	-	-	-	44
54 inches-----	43	-	-	17	18	8	-	-
55 inches-----	194	-	15	-	34	32	81	32
56 inches-----	193	9	24	49	-	48	43	20
57 inches-----	994	18	63	97	182	143	392	99
58 inches-----	1,259	152	76	109	188	318	342	74
59 inches-----	3,801	255	582	581	788	620	842	133
60 inches-----	4,482	578	613	881	985	654	677	94
61 inches-----	8,358	1,059	1,153	1,622	1,387	1,671	1,216	250
62 inches-----	10,498	1,312	2,218	2,041	2,237	1,518	874	298
63 inches-----	7,277	938	1,293	1,703	1,359	1,148	668	168
64 inches-----	9,023	1,631	2,065	2,191	1,521	865	599	151
65 inches-----	4,738	896	1,285	1,043	723	442	305	44
66 inches-----	4,389	896	1,222	1,324	528	325	94	-
67 inches-----	1,400	288	369	299	296	138	10	-
68 inches-----	1,199	300	208	256	272	106	39	18
69 inches-----	191	54	31	91	15	-	-	-
70 inches-----	136	33	36	12	-	45	10	-
71+ inches-----	67	11	38	9	9	-	-	-

APPENDIX I

RECORDING FORMS AND DIAGRAMS OF PHYSICAL MEASUREMENTS IN THIS REPORT

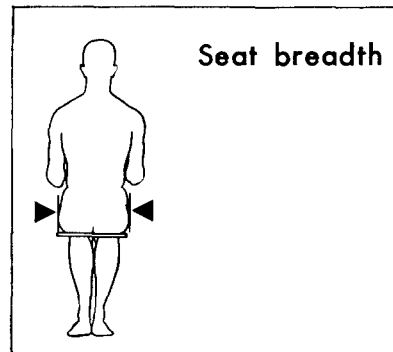
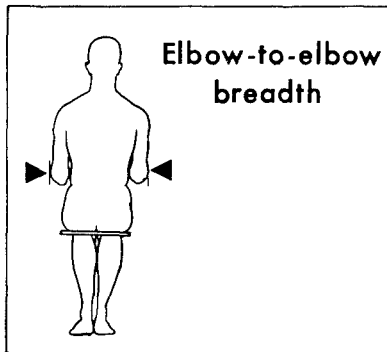
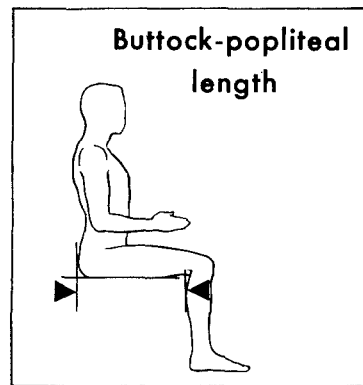
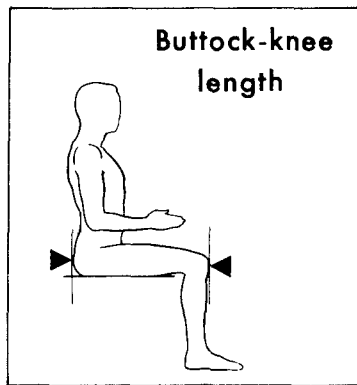
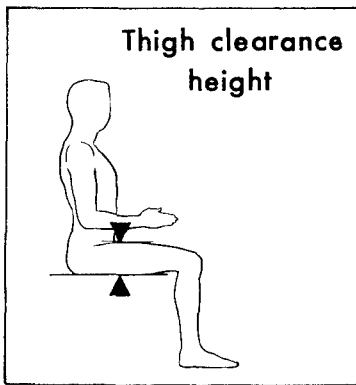
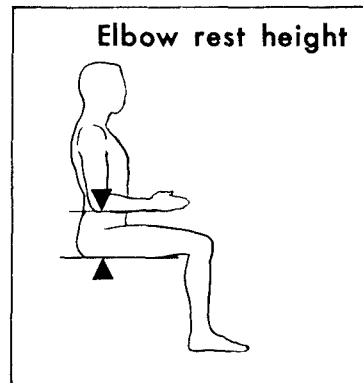
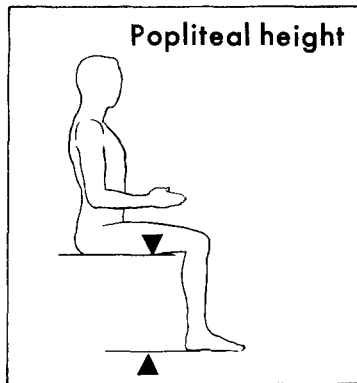
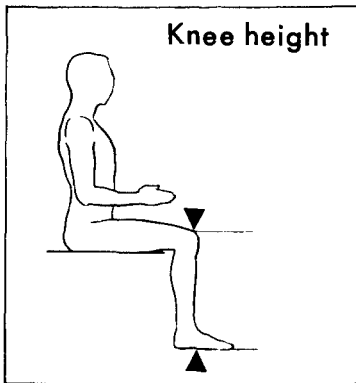
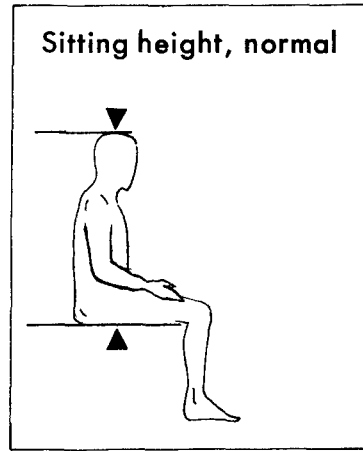
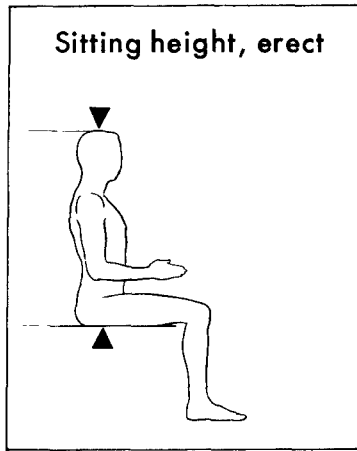
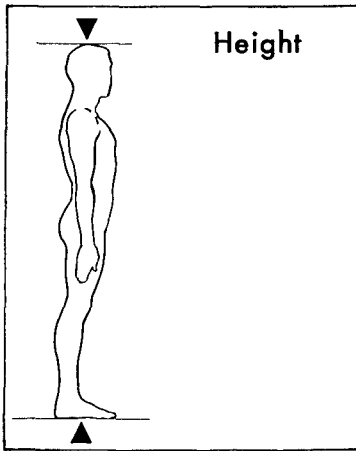
RECORDING FORMS USED

✓ IF NO REPORT	REASON FOR NO REPORT	PROCEDURE	RECORDING	CODE
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		9. Height	<div style="border: 1px solid black; width: 80px; height: 20px; margin: 0 auto;"></div> <p style="text-align: center; margin: 0;">cm.</p> <p style="margin: 0;">Height decreased by</p> <p style="margin: 0;">Curved Spine <input type="checkbox"/></p> <p style="margin: 0; padding-left: 100px;">NO <input type="checkbox"/></p> <p style="margin: 0;">Deformed Legs <input type="checkbox"/></p>	
		10. Weight	<div style="border: 1px solid black; width: 80px; height: 20px; margin: 0 auto;"></div> <p style="text-align: center; margin: 0;">Lbs.</p>	

✓ IF NO REPORT	REASON FOR NO REPORT	MEASUREMENT	RECORDING IN Cm.	FOR OFFICE USE	CODE
		11. Sitting height normal	_ _ _ . _ _		
		12. Sitting height erect	_ _ _ . _ _		
		13. Knee height*	_ _ _ . _ _		
		14. Popliteal height	_ _ _ . _ _		
		15. Thigh clearance height	_ _ _ . _ _		
		16. Buttock-knee length	_ _ _ . _ _	<div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto; transform: rotate(45deg);"></div>	
		17. Buttock-popliteal length	_ _ _ . _ _	<div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto; transform: rotate(45deg);"></div>	
		18. Seat breadth (across hips)	_ _ _ . _ _	<div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto; transform: rotate(45deg);"></div>	
		19. Elbow-to-elbow breadth	_ _ _ . _ _	<div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto; transform: rotate(45deg);"></div>	
		20. Elbow rest height	_ _ _ . _ _		

DIAGRAMS OF MEASUREMENTS
(exclusive of weight)



APPENDIX II

SURVEY DESIGN, RESPONSE, AND SAMPLING VARIABILITY

Survey Design

The sampling plan of the first cycle of the Health Examination Survey followed a highly stratified multi-stage probability design in which a sample of the civilian, noninstitutional population of the conterminous United States, 18-79 years of age, was selected. In the first stage of this plan a sample of 42 primary sampling units (PSU's) was drawn from among the 1,900 geographic units into which the United States was divided. Here a PSU is either a standard metropolitan statistical area or one to three contiguous counties. Later stages result in the random selection of clusters of typically about four persons from a small neighborhood within the PSU. The total sampling included some 7,700 persons in 29 different States. The detailed structure of the design and the conduct of the survey are described in references 1 and 2.

Reliability

Measurement processes employed in the Survey were highly standardized and closely controlled. This does not mean, of course, that the correspondence between the real world and the survey results is exact. Data from the survey are imperfect for three major reasons: (1) results are subject to sampling error; (2) the actual conduct of a survey never agrees perfectly with the design; and (3) the measurement processes themselves are inexact, even though standardized and controlled.

A first-stage evaluation of the Survey is reported in reference 2, which deals largely with an analysis of the faithfulness with which the sampling design was carried out. This study notes that out of the 7,700 sample persons, the 6,670 who were examined—a response rate of over 86 percent—gave evidence that they were a highly representative sample of the civilian, non-institutional population of the United States. The age and sex distribution of these adults examined in Cycle I of the Health Examination Survey is as follows:

Table I. Number of examinees by age and sex: Health Examination Survey, 1960-62

Age	Total	Men	Women
Number of examinees			
Total-18-79 years----	6,672	3,091	3,581
18-24 years-----	945	411	534
25-34 years-----	1,421	675	746
35-44 years-----	1,487	703	784
45-54 years-----	1,252	547	705
55-64 years-----	861	418	443
65-74 years-----	564	265	299
75-79 years-----	142	72	70

Imputation for the nonrespondents was accomplished by attributing to the nonexamined persons the characteristics of comparable examined persons as described in reference 2. The specific procedure used amounted to inflating the sampling weight for each examined person to compensate for sample persons at that stand of the same age-sex group who were not examined. This inflation procedure would be expected to introduce little, if any, distortion, judging from the data obtained in the physician followup. Here the height and weight data for the subsample of examined and nonexamined sample persons were found to be in good agreement. Measuring techniques used by the physicians and in the examination were also apparently comparable, since physicians' reports showed, on the average, good agreement with the examination findings on height and weight.

In addition to persons not examined at all, there were some whose examination was incomplete in one procedure or another. Age, sex, and race were known for every examined person, but for a number of examinees one or more of the anthropometric measurements were not available. The extent of these missing measurements is indicated in table II.

Table II. Number of examinees with one or more missing anthropometric measurements: Health Examination Survey, 1960-62

Measurement missing	Number of examinees
Total examinees-----	137
All measurements-----	2
Height and weight-----	4
Height but not weight-----	12
Weight but not height-----	14
Sitting height erect and normal----	22
Sitting height erect but not normal-	8
Sitting height normal but not erect-	11
Knee and popliteal height-----	17
Knee but not popliteal height-----	13
Popliteal but not knee height-----	5
Thigh clearance-----	18
Buttock-knee and buttock-popliteal length-----	37
Buttock-knee but not buttock-popliteal length-----	7
Buttock-popliteal but not buttock-knee length-----	4
Seat breadth-----	12
Elbow-to-elbow breadth-----	18
Elbow rest height-----	16

There were, in addition to these 137 examinees, 21 for whom one of the recorded measurements was obviously in error—for example, popliteal height the same as or only one-half of an inch shorter than knee height, and similar discrepancies.

Estimates for missing (and erroneous) data were generally made subjectively on the basis of a multiple regression-type decision, substituting for the missing measurements those for an individual who was of the same age, sex, and race, and who had other dimensions similar to the ones available for the examinee with incomplete data. The findings were essentially unaffected by the few deviations that had to be made in the standard measurement techniques for amputees and others.

For those with no measurements available, a respondent of the same age-sex-race group was selected at random, and his measurements were assigned to the nonexamined person.

Sampling and Measurement Error

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

The probability design of the Survey makes possible the calculation of sampling errors. Traditionally, the

sampling error is used to determine how imprecise the survey results may be because they come from a sample rather than from the measurements of all elements in the universe.

The presentation of sampling errors for a study of the type of the Health Examination Survey is difficult for at least three reasons: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately; (2) the survey design and estimation procedure are complex and accordingly require computationally involved techniques for the calculation of variances; and (3) from the survey come thousands of statistics, many for subclasses of the population for which there are a small number of sample cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error, which may be large when the number of cases in the 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 presented in table III for the averages and in table IV for percentages. 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 to be the range within one standard error of the tabulated statistic, with 68 percent confidence; or the range within two standard errors of the tabulated statistic, with 95 percent confidence.

An overestimate of the standard error of a difference $\bar{d} = \bar{x} - \bar{y}$ of two statistics \bar{x} and \bar{y} is generally given by the formula $s_d = (\bar{x}^2 v_x^2 + \bar{y}^2 v_y^2)^{1/2}$, where v_x and v_y are the relative sampling errors, respectively, of \bar{x} and \bar{y} .

For example, table 2 shows the average height of men 18-24 years of age to be 68.7 inches (\bar{x}) and that of men 25-34 years of age to be 69.1 inches (\bar{y}). Table III gives relative sampling errors of $v_x = 0.003$ and $v_y = 0.002$ for the respective averages. The formula yields the estimate for the standard error of the difference ($d = 0.4$ inch) as $s_d = 0.19$. Here the difference is more than twice the sampling error and, hence, is significant.

Confidence limits for the quantile measures—percentiles, deciles, and medians—presented in this report may be estimated from the relative standard errors for the percentages shown in table IV. For example, to determine the two-standard-error confidence limits for the 90th percentile (the point below which 90 percent of the population fall) of height for women 35-44 years

Table III. Relative sampling error of averages for weight, height, and selected body dimensions of adults, by age: United States, 1960-62

Measurement	Total, 18-79 years	Relative sampling error for men or women						
		18-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75-79 years
Weight-----	0.002	0.003	0.003	0.003	0.003	0.003	0.004	0.005
Height-----	0.001	0.003	0.002	0.002	0.002	0.002	0.003	0.005
Sitting height, erect-----	0.001	0.003	0.002	0.002	0.002	0.002	0.002	0.005
Sitting height, normal-----	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.005
Knee height-----	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.010
Popliteal height-----	0.002	0.004	0.003	0.003	0.003	0.003	0.004	0.010
Elbow rest height-----	0.004	0.005	0.005	0.005	0.005	0.005	0.010	0.020
Thigh clearance-----	0.004	0.010	0.005	0.005	0.005	0.010	0.010	0.020
Buttock-knee length-----	0.002	0.003	0.002	0.002	0.002	0.002	0.003	0.010
Buttock-popliteal length-----	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.010
Elbow-elbow breadth-----	0.003	0.010	0.005	0.005	0.005	0.005	0.010	0.020
Seat breadth-----	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.010

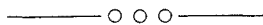
Table IV. Relative sampling error for percentages for weight, height, and the 10 other body dimensions for adults: United States, 1960-62

Percentage	Relative sampling error for average						
	0.001	0.002	0.003	0.004	0.005	0.010	0.020
	Corresponding relative sampling error for percentage						
1-----	0.100	0.200	0.300	0.400	0.500	1.000	2.000
5-----	0.080	0.100	0.200	0.240	0.300	0.400	0.600
10-----	0.050	0.060	0.150	0.200	0.250	0.250	0.400
20-----	0.040	0.050	0.100	0.125	0.150	0.150	0.250
50-----	0.020	0.025	0.050	0.060	0.070	0.080	0.140
80-----	0.010	0.012	0.025	0.031	0.038	0.038	0.062
90-----	0.006	0.007	0.017	0.022	0.028	0.027	0.044
95-----	0.004	0.005	0.010	0.013	0.016	0.020	0.032
99-----	0.001	0.002	0.003	0.004	0.005	0.010	0.020

of age, the following steps are taken: From table 2, the 90th percentile (x) is observed to be 66.6 inches; table IV shows that the relative standard error of this percentage or percentile is 0.007 (v_x); the standard error ($s_x = xv_x$), then, would be 1.53, and the two-standard-error confidence limit, 87-93 percent. These limits correspond to heights of 66.3 and 67.0 as obtained from table 2 by interpolation.

Small Categories

In some tables magnitudes are shown for cells in 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. Such numbers, if shown, have been included in the belief that they help to convey an impression of the overall story of the table.



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