ANTHROPOMETRY OF AIR TRAFFIC CONTROL TRAINEES

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September 1965

FEDERAL AVIATION AGENCY
Office of Aviation Medicine

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I. Introduction.

The Air Traffic Service (ATS) of the Federal Aviation Agency currently employs nearly 18,000 individuals in various centers, terminals, and flight service stations throughout the United States and Puerto Rico. Although some hold supervisory or clerical positions, the vast majority are actively engaged in controlling air traffic.[15]

As a visit to any moderately active air traffic control (ATC) facility makes obvious, the physical and psychological stresses imposed upon the controller during the course of his normal daily duties are intense. In the older facilities, especially, little attention was paid to the basic precepts of human engineering that attempt to maximize performance efficiency by providing the individual with a comfortable and orderly work environment. Under noisy, crowded and uncomfortable conditions, the controller must make numerous, rapid, effective, and, above all, correct decisions, and the cost of a single error can be incalculable in terms of human lives and equipment. It is safe to say that there are very few occupations that make more rigid physical and mental demands upon their practitioners than does air traffic control.

With these facts in mind, an anthropometric survey of ATC trainees, under the direction of Mr. John J. Swearingen, Chief, Protection and Survival Laboratory, Civil Aeromedical Research Institute, was undertaken in 1960. The purpose of the study was threefold. First, it was felt that anthropometric data based on a sample of men soon to be engaged in ATS careers would be extremely useful in the design of comfortable and efficient workspace layouts and personal equipment "tailored" to fit the controller population, as has proven valuable in other specialized tasks, such as electronic maintenance in close quarters.[3] The present report fulfills this primary objective.

A second objective was to explore the relationship between physical constitution and effectiveness of performance, both in training and on the job. Stated differently, what, if any, are those morphological or biometric traits that correlate with the psychological and physiological attributes of the successful controller? If such correlates exist and can be defined, they would aid in the establishment of selective criteria for potential controllers. The present report, by presenting the basic anthropometric statistics of the sample, fulfills only a necessary preliminary step of this second objective. Further work must include the evaluation of somatotype data gathered on the same population and the search for and assessment of relationship between physical traits of the individual subjects and their physiological and psychological attributes. These are being measured by researchers of the Psychology and Physiology Laboratories of the Civil Aeromedical Research Institute.[2, 12–14]

The third objective of the study was to provide baseline anthropometric data for a long-range study of the aging ATC population. Here again, it will form a modest contribution to a wider program involving the Physiology and Psychology Laboratories of the Civil Aeromedical Research Institute. Long-range plans call for the continual monitoring of the job-performance and health records throughout the service careers of our input population punctuated by periodic full-scale psychological, physiological, and somatometric reexaminations. By thus following the careers of a large sample of healthy young men engaged in a rigidly selective and stressful occupation, it may be possible to further elucidate the relationship between stress and the occurrence of certain diseases as well as the aging process in general. Thus, the anthropometrics of this initial study, supplemented in most cases by a standard somatotype photograph, will pro-

vide a precise and accurate picture of the individual as he entered his training and will serve as a "baseline" for studies of the same individual in later years.

II. The Sample.

The sample consists of 684 ATS students enrolled in training programs conducted at the Federal Aviation Agency Aeronautical Center in Oklahoma City, Oklahoma. With a few unavoidable exceptions, it includes all members of each class initiated at the Center between August 12, 1960, and June 30, 1961. Separate programs are conducted for those students assigned to air route traffic control centers and those who are assigned to terminal facilities.

Although the selection criteria for the center and terminal categories are identical, the possibility that the sample measured here might consist of two distinct subpopulations was considered. To test this hypothesis, the means of age, weight, and stature of the two groups were compared statistically by means of the Student's t test. The results of this procedure are presented in Table 1.

There is a difference of "borderline" significance ($0.1 > P > 0.05$) between the mean ages of the terminal and enroute students, the latter being older, on the average by approximately 1 year. Since this difference is not reflected in the means of stature and body weight, however, the sample may be considered anthropometrically homogeneous, and the two groups, enroute and terminal, are treated as one in this report.

A. *Geographical Origins.* In Table 2, the birthplaces of the individuals composing the sample are presented and compared with those of the distribution of the U.S. male population in 1960 and 1930, the latter year chosen because it is the census year closest to 1933—the mean birthyear of the 684 subjects.

When considered in terms of regional distribution, the most striking characteristic in the sample is in the representation of individuals of the West North Central Region, comprising the states of Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas. Among the ATS trainees, men from

TABLE 1

Statistical comparison of means of age, body weight, and stature of terminal and enroute trainees comprising the present sample

Variable	Terminal (N = 187)	Enroute (N = 497)	Student's t test	P
	$\bar{x}$	$\bar{x}$		
Age (yr)	27.01	28.11	1.917	$0.1 > P > 0.05$
Body wt (lb)	161.66	161.86	0.1108	n. s.
Stature (in.)	69.46	69.65	0.8589	n. s.

TABLE 2

Distribution of 684 ATS trainees by region of birth compared with 1930 and 1960 U.S. male population distribution *

Region	U. S. Males		ATC
	1930	1960	
	%	%	%
New England (Me., N.H., Vt., Mass., R.I., Conn.)	6.7	5.8	5.4
Middle Atlantic (N.Y., N.J., Pa.)	21.4	18.7	13.7
East North Central (O., Ind., Ill., Mich., Wis.)	20.6	20.2	25.9
West North Central (Minn., Ia., Mo., N.D., S.D., Neb., Kan.)	10.8	8.6	20.9
South Atlantic (Del., Md., D.C., Va., W. Va., N.C., S.C., Ga., Fla.)	12.9	14.5	7.7
East South Central (Ky., Tenn., Ala., Miss.)	8.1	6.8	3.9
West South Central (Ark., La., Okla., Tex.)	9.9	9.5	9.1
Mountain (Mont., Id., Wyo., Colo., N.M., Ariz., Ut., Nev.)	3.0	3.9	5.0
Pacific (Wash., Ore., Calif., Alaska, Hawaii)	6.7	12.0	6.9
Puerto Rico and Foreign	—	—	1.5

* Census data from Statistical Abstract of the United States, U. S. Bureau of the Census, Washington, D. C., 1962.

these states comprise 20.9% of the total sample, compared to 10.8% in 1930 and 8.6% in 1960 for the U. S. male population as a whole. The East North Central states are also somewhat excessively represented in the ATS sample, while the Middle and South Atlantic regions are underrepresented, as is the Pacific region when it is compared to the 1960 male population distribution.

In summary, the ATS trainees are characterized by a strong representation of men from the Upper Middle West, the combined percentages for the two regions, East North Central and West North Central being 46.8%, compared to only 28.8% for the 1960 and 31.4% for the 1930 U.S. male populations.

B. *Education.* The educational background of the subjects was rated by means of a nine-level scale based on the number of years of schooling completed (Table 3). Nearly two-thirds (62.6%) of the trainees were high-school graduates, while 4.4% had completed 4 years of college-level training.

TABLE 3

Distribution of 684 Air Traffic Service Trainees by Educational Level

Level	Criterion of Level	% ATS Trainees
1	Less than high school	5.1
2	Completed high school	62.6
3	Less than 1 year college	5.0
4	1 year college	10.9
5	2 years college	8.5
6	3 years college	2.6
7	4 years college	4.4
8	5 years college	0.6
9	6 or more years college	0.3

C. *Race.* The race of each subject was determined anthroposcopically and recorded as White, Negro, or Mongoloid (includes American Indians). Whites constituted 97.5% of the sample, Negroes 2.5%, and Mongoloids were not represented in the present series. In subsequent statistical treatment, the racial groups were combined.

D. *Health and Physical Status.* Before acceptance for ATC training, an applicant must have passed a physical examination performed by a designated FAA Medical Examiner. This examination is presently a Class II physical identical to that requird by commercial pilots. Anthropometrically, it differs from the military flight physical in that no height or weight limitations are explicitly imposed. Thus, the ATC sample is probably comparable with respect to general health and fitness to those reported upon in the several anthropometric surveys of armed forces fiying personnel,[1, 5, 6, 8-11, 16, 17] while, at the same time, anthropometrically more variable than these later due to relaxation of weight and height limitations.

E. *Age.* The age of each subject was recorded to his nearest birthday. Applicants for entry into the ATS must be at least 21 years of age. No upper age limits are imposed. The subjects of the present sample range from 21 to 46 years in age. The age distribution of the sample is distinctly bimodal with the major mode at age 23 and a second peak at age 39.

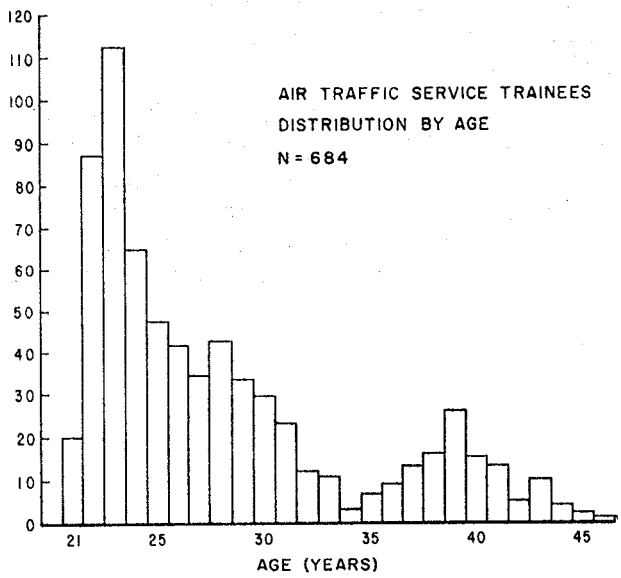

Figure I. ATS trainees: distribution by age (N=684).

III. Anthropometric Techniques.

A. *General Remarks.* Measurements based on standard anthropometric landmarks given in the Appendix, were selected on the basis of their usefulness in providing a biometric description of the ATS population that could be applied both to the requirements of workspace design and to the biomedical objectives of the program. In instances where the measurement

selected was identical to one used in the 1950 Air Force anthropometric survey,[6] the definition and technique employed followed the latter as closely as technical limitations would permit.

In addition to the more commonly employed anthropometric measurements, several entirely new measurements, especially related to the workspace requirements of the air traffic controller, were devised and are included in the present survey.

Due to time and personnel limitations, wall-board techniques were used for most standing and sitting stem measurements such as stature, sitting height, etc. Wall-board measurements of stature tend to exceed those taken by a conventional anthropometer by about 0.4 inch[4, 7] and, presumably, proportional discrepancies between these techniques exist for other linear measurements. This factor should be taken into account in comparisons between the present survey and others in which the anthropometer is employed. All unilateral measurements were taken on the right side.

For body breadth and depth measurements, a Hrdlička caliper was used; for circumferences, cloth measuring tapes, these being checked frequently to guard against distortion due to stretching and continued use. Weight was recorded on a standard medical scale. Linear and girth measurements were recorded to the nearest 0.25 inch and weight to the closest 1.0 pound.

Measurements were taken in the morning, between 8:30 A.M. and 11:30 A.M., except in a few cases in which the measuring period extended into the early afternoon. Subjects were garbed in athletic supporters and nylon shorts and these were included in the record of body weight. These garments have been weighed and an appropriate correction to the body weights reported herein applied.

The measurements were divided into three related groups: (1) weight and standing linear; (2) sitting; and (3) breadth, depth, and girth. Three measuring stations were accordingly established, each manned by a measurer and his recorder. After the subject's name, class code number and birthdate were recorded, he was processed through the three stations in the order described above. Insofar as possible, the same personnel were employed at the three measurement stations throughout the period of the survey, although in a few unavoidable instances substitutions and rotations of personnel occurred. Before the survey was initiated, personnel selected to take measurements were required to practice those assigned to their stations until proficiency and repeatability were attained.

B. *Statistical Treatment.* All measurements were recorded directly upon standard data-recording sheets used to transfer the data to punched cards. After this transfer was accomplished, the initial read-outs were reviewed and screened for errors. Obvious errors were eliminated or, where possible corrected. "Border-line"values that could represent either errors or true but aberrant measurements were reviewed in relation to the subject's other measurements and, on this basis, the decision to include or exclude them from survey was made. Such cases were not sufficiently frequent however, to significantly affect the statistics presented here.

After the initial screening, the data were programmed for a 75 x 75 correlation matrix, and the means and standard deviations were derived from the latter. Computation of the coefficient of variation, standard errors of the mean, standard error of the standard deviation, and standard error of the coefficient of variation were computed on a desk calculator. Percentiles were calculated on a desk calculator from programmed univariate frequency distribution of each measurement.

IV. Conclusion.

In summary, 75 anthropometric measurements were taken on 684 Air Traffic Service students in training at the Federal Aviation Agency Aeronautical Center at Oklahoma City, Oklahoma, between August 12, 1960 and June 30, 1961. Although controllers in the enroute subgroup averaged 1 year older (28 years) than those in the terminal subgroup (27 years), no statistically significant difference between them was found as far as stature or body weight is concerned and they were

treated as one anthropometrically homogenous group. Age ranged from 21 to 46 years with bimodal peaks at ages 23 and 39.

All were required to pass a Class II physical examination upon entrance, which is also required for commercial pilots and is similar to the physical requirements of the military flight physical, with the exception of height and weight, which are not specified within rigid limitations. Information concerning means, standard deviation from the means, and percentiles have been found and tabulated for each measurement.

It is interesting to note that in this group there was a much higher geographical representation (20.9%) from the upper Midwest (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas) than from any other region, with correspondingly less representation from the Middle and South Atlantic and Pacific regions. Nearly two-thirds (62.6%) were high-school graduates, while 4.4% had completed 4 years of college-level education training. Racially, whites (Caucasoid) constituted 97.5% of the sample, with 2.5% being Negroes.

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AGE

Subject's age to nearest birthday.

N: 678
Mean: 27.90±.24 yrs.
S.D.: 6.18±.17 yrs.
Range: 21–50 yrs.
C.V.: 22.14±.63%

r: Weight: .18
Stature: .00

%	Yrs.
5	21.2
10	21.8
20	22.3
30	22.9
40	23.9
50	25.3
60	27.1
70	28.9
80	31.9
90	38.2
95	39.9

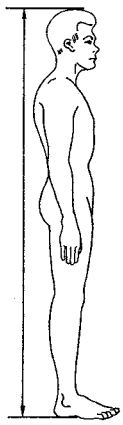
STATURE

The vertical distance from vertex to the floor, with the subject standing erect and the head oriented in the Frankfort plane.

N: 678
Mean: 69.56±.09 in. 176.67±.23 cm.
S.D.: 2.50±.07 in. 6.35±.18 cm.
Range: 61.25–76.50 in. 156–194 cm.
C.V.: 3.59±.10% 3.59±.10%

r: Weight: .46
Stature: 1.00

%	In.	Cm.
5	65.5	166.4
10	66.5	168.9
20	67.3	170.9
30	68.1	173.0
40	68.8	174.8
50	69.5	176.6
60	70.1	178.1
70	70.7	179.6
80	71.7	182.1
90	72.6	184.4
95	73.6	187.0



WEIGHT

The subject's weight as recorded on standard medical scales.

N: 678
Mean: 161.81±.85 lbs. 73.39±.39 kg.
S.D.: 22.09±.60 lbs. 10.02±.27 kg.
Range: 105.00–239.00 lbs. 48–108 kg.
C.V.: 13.65±.38% 13.65±.38%

r: Weight: 1.00
Stature: .46

%	Kg.	Lbs.
5	58.0	127.9
10	60.6	133.5
20	63.7	140.5
30	67.0	147.7
40	69.6	153.4
50	72.0	158.7
60	74.4	164.1
70	77.3	170.4
80	80.8	178.1
90	86.0	189.6
95	90.3	199.0

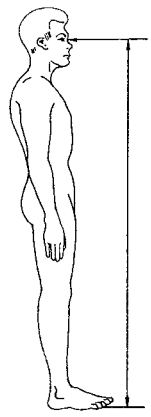
EYE HEIGHT

Vertical distance from the inner angle of the eye to the floor.

N: 678
Mean: 64.87±.09 in. 164.77±.24 cm.
S.D.: 2.43±.07 in. 6.18±.17 cm.
Range: 57.75–71.75 in. 147–182 cm.
C.V.: 3.75±.10% 3.75±.10%

r: Weight: .45
Stature: .93

%	In.	Cm.
5	60.9	154.7
10	61.9	157.2
20	62.8	159.4
30	63.5	161.4
40	64.2	163.0
50	64.8	164.5
60	65.3	165.9
70	66.0	167.5
80	66.9	169.8
90	67.9	172.4
95	68.7	174.6



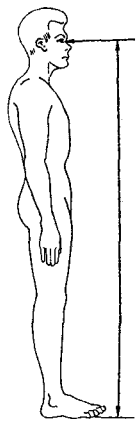
NASAL ROOT HEIGHT

Vertical distance from nasion to floor, with the subject standing erect and the head oriented in the Frankfort plane.

N:	678	
Mean:	65.17±.09 in.	165.54±.23 cm.
S.D.:	2.35±.06 in.	5.97±.15 cm.
Range:	57.75–72.00 in.	147–183 cm.
C.V.:	3.60±.10%	3.60±.10%

r: Weight .46
Stature: .96

%	In.	Cm.
5	61.2	155.5
10	62.1	157.7
20	63.0	160.0
30	63.8	162.1
40	64.4	163.6
50	65.1	165.4
60	65.6	166.6
70	66.2	168.2
80	67.1	170.4
90	68.1	173.0
95	69.0	175.3



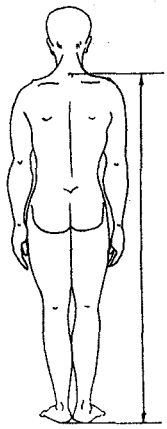
CERVICALE HEIGHT

Vertical distance from point *cervicale* (the bony prominence at the base of the neck) to the floor.

N:	678	
Mean:	59.16±.09 in.	150.27±.22 cm.
S.D.:	2.28±.06 in.	5.79±.16 cm.
Range:	52.50–65.75 in.	133–167 cm.
C.V.:	3.86±.11%	3.86±.11%

r. Weight: .48
Stature: .95

%	In.	Cm.
5	55.3	140.5
10	56.2	142.7
20	57.0	144.8
30	57.8	146.8
40	58.4	148.3
50	59.0	150.0
60	59.6	151.4
70	60.2	152.9
80	61.0	155.0
90	62.0	157.5
95	62.9	159.8



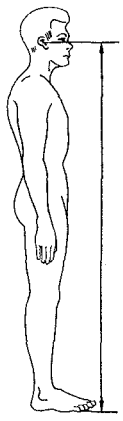
TRAGION HEIGHT

Vertical distance from floor to point tragion —the deepest part of the notch which lies in front of the left ear hole.

N:	678	
Mean:	64.04±.09 in.	162.65±.24 cm.
S.D.:	2.44±.07 in.	6.18±.17 cm.
Range:	57.25–71.25 in.	145–181 cm.
C.V.:	3.80±.10%	3.80±.10%

r: Weight: .45
Stature: .97

%	In.	Cm.
5	59.8	152.0
10	61.0	154.9
20	62.0	157.4
30	62.7	159.2
40	63.3	160.8
50	64.0	162.4
60	64.5	163.9
70	65.2	165.5
80	66.4	168.6
90	67.2	170.7
95	68.1	172.8



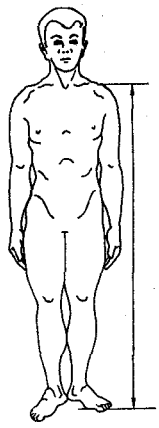
SHOULDER HEIGHT

Distance measured from floor to right acromion while the subject is standing erect, using a wall board.

N:	678	
Mean:	57.81±.10 in.	146.84±.24 cm.
S.D.:	2.59±.07 in.	6.57±.18 cm.
Range:	50.25–65.00 in.	128–165 cm.
C.V.:	4.47±.12%	4.47±.12%

r: Weight: .45
Stature: .86

%	In.	Cm.
5	54.1	137.4
10	55.0	139.8
20	55.7	141.5
30	56.5	143.4
40	57.1	145.1
50	57.8	146.8
60	58.3	148.1
70	58.9	149.6
80	59.7	151.7
90	60.7	154.3
95	61.7	156.7



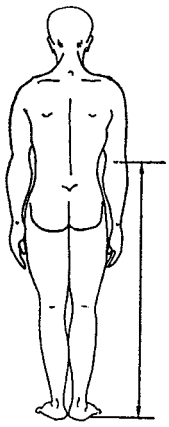
ELBOW HEIGHT

The vertical distance from radiale to the floor.

N:	678	
Mean:	43.97±.08 in.	111.68±.19 cm.
S.D.:	2.03±.05 in.	5.16±.14 cm.
Range:	38.50–49.75 in.	98–126 cm.
C.V.:	4.16±.11%	4.16±.11%

r: Weight: .45
Stature: .87

%	In.	Cm.
5	40.8	103.6
10	41.6	105.7
20	42.6	108.2
30	42.9	109.1
40	43.4	110.3
50	43.9	111.5
60	44.4	112.6
70	44.8	113.9
80	45.5	115.5
90	46.3	117.7
95	47.1	119.6



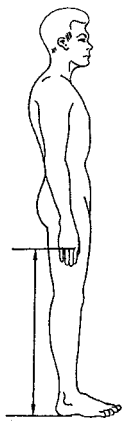
KNUCKLE HEIGHT

Vertical distance from the base of the first phalanx of the third digit to the floor.

N:	678	
Mean:	30.83±.06 in.	78.31±.15 cm.
S.D.:	1.53±.04 in.	3.89±.11 cm.
Range:	27.00–36.25 in.	69–92 cm.
C.V.:	4.97±.14%	4.97±.14%

r: Weight: .43
Stature: .76

%	In.	Cm.
5	28.2	71.7
10	28.7	73.0
20	29.5	74.9
30	29.9	75.9
40	30.3	76.9
50	30.7	78.0
60	31.1	78.9
70	31.5	80.1
80	31.9	81.1
90	32.6	82.8
95	33.2	84.4



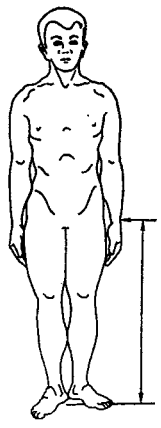
WRIST HEIGHT

The vertical distance from the stylion to the floor.

N:	678	
Mean:	34.92±.06 in.	88.70±.16 cm.
S.D.:	1.67±.04 in.	4.24±.11 cm.
Range:	30.75–40.50 in.	78–103 cm.
C.V.:	4.79±.13%	4.79±.13%

r: Weight: .45
Stature: .83

%	In.	Cm.
5	32.2	81.8
10	32.8	83.3
20	33.5	85.1
30	34.0	86.4
40	34.4	87.4
50	34.9	88.6
60	35.2	89.4
70	35.6	90.4
80	36.1	91.7
90	36.9	93.7
95	37.5	95.2



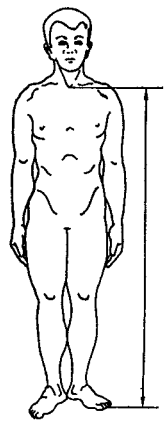
SUPRASTERNAL HEIGHT

Vertical distance from floor to suprasternale, the upper margin of the breast bone.

N:	678	
Mean:	56.59±.09 in.	143.74±.22 cm.
S.D.:	2.26±.06 in.	5.74±.15 cm.
Range:	50.25–63.00 in.	128–160 cm.
C.V.:	4.00±.11%	4.00±.11%

r: Weight: .47
Stature: .93

%	In.	Cm.
5	52.9	134.4
10	53.8	136.7
20	54.6	138.8
30	55.3	140.6
40	55.9	141.9
50	56.5	143.5
60	57.1	145.0
70	57.7	146.5
80	58.4	148.2
90	59.4	150.8
95	60.2	152.8



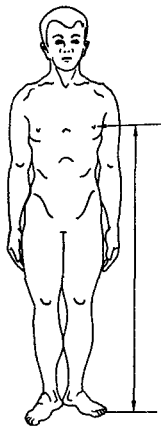
NIPPLE HEIGHT

The vertical distance from the floor to the center of the left nipple.

N:	678	
Mean:	50.43±.08 in.	128.09±.20 cm.
S.D.:	2.04±.06 in.	5.16±.14 cm.
Range:	44.50–56.50 in.	113–144 cm.
C.V.:	4.04±.11%	4.04±.11%

r: Weight: .40
Stature: .93

%	In.	Cm.
5	47.0	119.4
10	47.8	121.5
20	48.6	123.4
30	49.2	124.9
40	49.7	126.3
50	50.2	127.6
60	50.8	128.9
70	51.3	130.4
80	52.1	132.4
90	53.0	134.7
95	53.7	136.3



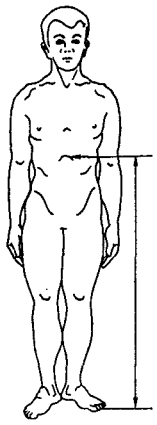
SUBSTERNAL HEIGHT

Vertical distance from floor to substernale (lower tip of breastbone).

N:	678	
Mean:	48.28±.08 in.	122.63±.19 cm.
S.D.:	1.94±.05 in.	4.93±.13 cm.
Range:	43.00–54.25 in.	109–138 cm.
C.V.:	4.02±.11%	4.02±.11%

r: Weight: .42
Stature: .91

%	In.	Cm.
5	45.0	114.3
10	45.8	116.3
20	46.6	118.3
30	47.1	119.7
40	47.6	120.9
50	48.1	122.2
60	48.7	123.6
70	49.2	124.9
80	49.8	126.5
90	50.6	128.6
95	51.4	130.5



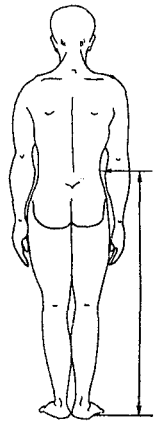
WAIST HEIGHT

The vertical distance from waist line to floor.

N:	678	
Mean:	41.72±.08 in.	105.96±.19 cm.
S.D.:	1.97±.05 in.	5.01±.14 cm..
Range:	36.25–47.75 in.	92–21 cm.
C.V.:	4.73±.13%	4.73±.13%

r: Weight: .30
Stature: .84

%	In.	Cm.
5	38.5	97.9
10	39.1	99.3
20	39.9	101.4
30	40.5	102.8
40	41.2	104.6
50	41.5	105.5
60	42.0	106.8
70	42.6	108.2
80	43.2	109.7
90	44.1	112.0
95	45.0	114.2



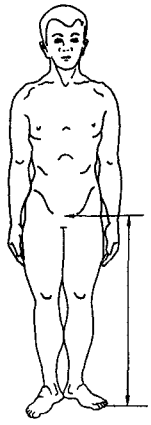
PENALE HEIGHT

Vertical distance from floor to point penale, the junction of the base of the penis and the abdomen.

N:	678	
Mean:	34.26±.07 in.	87.02±.17 cm.
S.D.:	1.73±.05 in.	4.40±.12 cm.
Range:	28.75–40.50 in.	73–103 cm.
C.V.:	5.06±.14%	5.06±.14%

r: Weight: .30
Stature: .82

%	In.	Cm.
5	31.3	79.5
10	32.0	81.2
20	32.7	83.0
30	33.2	84.4
40	33.7	85.6
50	34.1	86.7
60	34.6	87.8
70	35.0	88.9
80	35.6	90.5
90	36.2	92.0
95	37.1	94.1



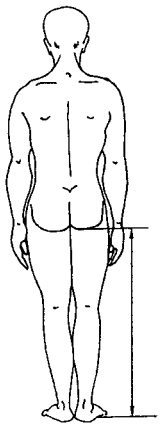
GLUTEAL FURROW HEIGHT

Vertical distance from the lowest point of the transverse buttock crease.

N:	678	
Mean:	31.37±.06 in.	79.69±.16 cm.
S.D.:	1.67±.04 in.	4.24±.11 cm.
Range:	26.50–36.25 in.	67–92 cm.
C.V.:	5.32±.14%	5.32±.14%

r: Weight: .28
Stature: .83

%	In.	Cm.
5	28.8	73.1
10	29.2	74.0
20	29.8	75.6
30	30.4	77.1
40	30.8	78.3
50	31.2	79.3
60	31.6	80.3
70	32.1	81.4
80	32.6	82.8
90	33.4	84.9
95	34.1	86.6



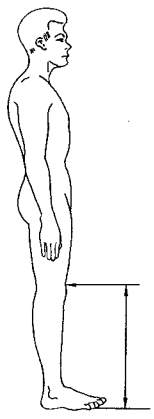
KNEE-CAP HEIGHT

Vertical distance from top of knee cap to floor.

N:	677	
Mean:	20.52±.04 in.	52.12±.10 cm.
S.D.:	1.05±.03 in.	2.68±.07 cm.
Range:	16.75–24.00 in.	42–61 cm.
C.V.:	5.14±.14%	5.14±.14%

r: Weight: .39
Stature: .82

%	In.	Cm.
5	18.8	47.7
10	19.1	48.4
20	19.5	49.5
30	19.8	50.4
40	20.1	51.1
50	20.4	51.8
60	20.7	52.6
70	21.0	53.2
80	21.2	53.9
90	21.7	55.1
95	22.1	56.2



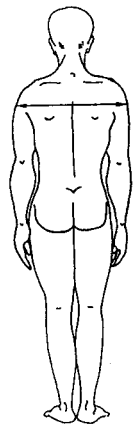
SHOULDER BREADTH

The horizontal distance between the maximum protrusion of the deltoid muscles.

N:	681	
Mean:	18.44±.04 in.	46.83±.11 cm.
S.D.:	1.15±.03 in.	2.91±.08 cm.
Range:	13.50–22.50 in.	34–57 cm.
C.V.:	6.23±.17%	6.23±.17%

r: Weight: .74
Stature: .28

%	In.	Cm.
5	16.8	42.7
10	17.1	43.4
20	17.4	44.3
30	17.7	45.0
40	18.0	45.6
50	18.3	46.4
60	18.5	47.1
70	18.8	47.9
80	19.2	48.8
90	19.8	50.2
95	20.3	51.5



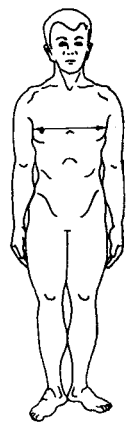
CHEST BREADTH

The maximum transverse diameter of the chest, at the nipple level, during normal breathing.

N:	681	
Mean:	12.89±.04 in.	32.75±.09 cm.
S.D.:	0.91±.02 in.	2.33±.06 cm.
Range:	10.50–17.50 in.	27–44 cm.
C.V.:	7.12±.19%	7.12±.19%

r: Weight: .75
Stature: .29

%	In.	Cm.
5	11.4	28.9
10	11.7	29.8
20	12.0	30.5
30	12.3	31.1
40	12.5	31.7
50	12.7	32.3
60	12.9	32.8
70	13.2	33.4
80	13.4	34.1
90	14.0	35.5
95	14.4	36.6



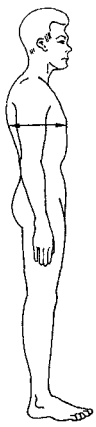
CHEST DEPTH

The anterior-posterior diameter of the chest, taken at the nipple line during normal breathing.

N:	681	
Mean:	9.51±.03 in.	24.16±.07 cm.
S.D.:	0.75±.02 in.	1.90±.05 cm.
Range:	7.00–12.00 in.	18–30 cm.
C.V.:	7.88±.21%	7.88±.21%

r: Weight: .77
Stature: .19

%	In.	Cm.
5	8.3	21.1
10	8.5	21.6
20	8.8	22.3
30	8.9	22.7
40	9.2	23.3
50	9.4	23.7
60	9.5	24.1
70	9.7	24.7
80	10.0	25.3
90	10.4	26.4
95	10.7	27.2



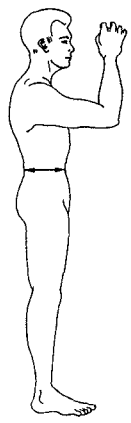
WAIST DEPTH

The maximum anterior-posterior thickness of the waist with the subject standing erect and the abdomen relaxed.

N:	681	
Mean:	8.31±.04 in.	21.12±.10 cm.
S.D.:	0.98±.03 in.	2.49±.07 cm.
Range:	6.25–12.00 in.	16–30 cm.
C.V.:	11.82±.30%	11.82±.30%

r: Weight: .77
Stature: .09

%	In.	Cm.
5	6.8	17.2
10	7.0	17.9
20	7.3	18.6
30	7.6	19.2
40	7.8	20.0
50	8.1	20.6
60	8.3	21.2
70	8.6	21.8
80	9.0	22.9
90	9.5	24.1
95	9.9	25.2



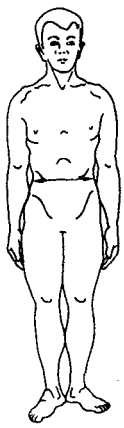
WAIST BREADTH

The maximum transverse diameter of the waist, with the subject standing erect.

N:	681	
Mean:	11.30±.03 in.	28.69±.08 cm.
S.D.:	0.88±.02 in.	2.22±.06 cm.
Range:	9.00–14.75 in.	23–37 cm.
C.V.:	7.76±.21%	7.76±.21%

r: Weight: .82
Stature: .23

%	In.	Cm.
5	9.8	25.0
10	10.1	25.7
20	10.4	26.5
30	10.7	27.2
40	10.9	27.8
50	11.1	28.3
60	11.3	28.8
70	11.5	29.2
80	11.9	30.2
90	12.3	31.2
95	12.7	32.2



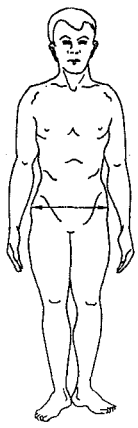
HIP BREADTH

The maximum transverse diameter of the hips, subject standing.

N:	681	
Mean:	13.64±.03 in.	34.66±.07 cm.
S.D.:	0.76±.02 in.	1.92±.05 cm.
Range:	9.75–16.50 in.	25–42 cm.
C.V.:	5.55±.15%	5.55±.15%

r: Weight: .81
Stature: .47

%	In.	Cm.
5	12.3	31.3
10	12.6	32.0
20	12.9	32.7
30	13.1	33.3
40	13.3	33.8
50	13.5	34.2
60	13.7	34.8
70	13.9	35.3
80	14.1	35.9
90	14.5	36.8
95	14.9	37.7



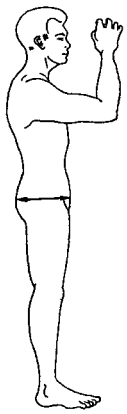
BUTTOCKS DEPTH

The depth of the body at the point of maximum protrusion of the buttocks.

N:	681	
Mean:	9.44±.03 in.	23.99±.09 cm.
S.D.:	0.88±.02 in.	2.22±.06 cm.
Range:	7.50–12.75 in.	19–32 cm.
C.V.:	9.28±.25%	9.28±.25%

r: Weight: .81
Stature: .17

%	In.	Cm.
5	8.0	20.4
10	8.3	21.0
20	8.6	21.7
30	8.8	22.4
40	9.1	23.0
50	9.3	23.5
60	9.5	24.0
70	9.7	24.7
80	10.1	25.5
90	10.5	26.6
95	10.9	27.7



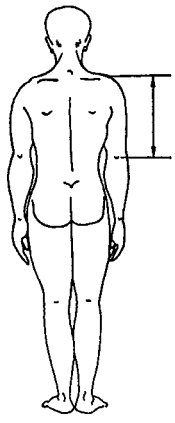
SHOULDER-ELBOW LENGTH

The vertical distance from acromion to the bottom of the elbow.

N:	681	
Mean:	14.29±.03 in.	36.30±.08 cm.
S.D.:	0.86±.02 in.	2.20±.06 cm.
Range:	11.75–16.50 in.	30–42 cm.
C.V.:	5.99±.16%	5.99±.16%

r: Weight: .23
Stature: .65

%	In.	Cm.
5	12.8	32.5
10	13.1	33.2
20	13.4	34.2
30	13.7	34.9
40	14.0	35.5
50	14.2	36.0
60	14.4	36.5
70	14.6	37.1
80	14.8	37.7
90	15.2	38.7
95	15.6	39.5



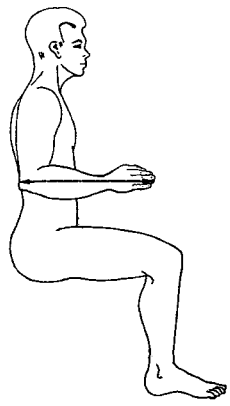
FOREARM-HAND LENGTH

The distance from the most posterior point of the elbow to the tip of the longest finger.

N:	681	
Mean:	18.88±.03 in.	47.95±.09 cm.
S.D.:	0.89±.02 in.	2.26±.06 cm.
Range:	17.00–22.25 in.	43–57 cm.
C.V.:	4.71±.13%	4.71±.13%

r: Weight: .39
Stature: .71

%	In.	Cm.
5	17.4	44.1
10	17.7	44.9
20	18.0	45.8
30	18.3	46.5
40	18.6	47.1
50	18.7	47.6
60	19.0	48.2
70	19.2	48.7
80	19.5	49.5
90	19.9	50.5
95	20.2	51.4



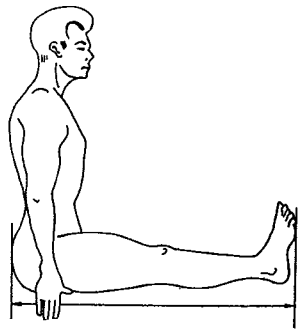
BUTTOCKS-LEG LENGTH

With the subject seated and right leg extended, the distance from the base of the right heel to the most dorsal point of the right buttock.

N:	681	
Mean:	42.68±.07 in.	108.41±.18 cm.
S.D.:	1.93±.05 in.	4.89±.13 cm.
Range:	37.75–49.00 in.	96–124 cm.
C.V.:	4.51±.12%	4.51±.12%

r: Weight: .48
Stature: .77

%	In.	Cm.
5	39.5	100.3
10	40.1	101.8
20	41.0	104.1
30	41.6	105.7
40	42.1	106.8
50	42.5	108.0
60	43.0	109.2
70	43.5	110.6
80	44.2	112.4
90	45.1	114.6
95	45.8	116.3



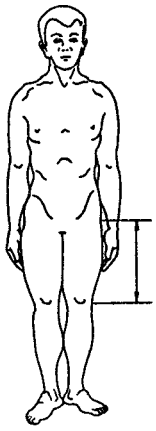
FEMUR LENGTH

With the subject standing, the distance between the superior margin of the greater trochanter and the most distal point of the lateral femoral condyle.

N:	681	
Mean:	18.44±.04 in.	46.82±.09 cm.
S.D.:	0.91±.02 in.	2.31±.06 cm.
Range:	16.00–21.25 in.	41–54 cm.
C.V.:	4.93±.13%	4.93±.13%

r: Weight: .47
Stature: .69

%	In.	Cm.
5	16.8	42.6
10	17.1	43.5
20	17.5	44.5
30	17.8	45.2
40	18.1	45.9
50	18.4	46.6
60	18.6	47.2
70	18.8	47.8
80	19.1	48.5
90	19.4	49.4
95	19.8	50.2



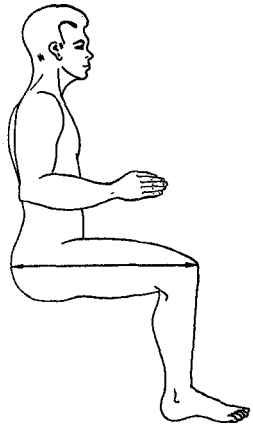
BUTTOCKS-KNEE LENGTH

With subject seated, the horizontal distance from the most posterior point of the right buttock to the front of the kneecap.

N:	680	
Mean:	23.73±.04 in.	60.27±.10 cm.
S.D.:	1.10±.03 in.	2.79±.08 cm.
Range:	20.75–28.00 in.	53–71 cm.
C.V.:	4.6±.13%	4.6±.13%

r: Weight: .47
Stature: .71

%	In.	Cm.
5	22.0	55.9
10	22.3	56.6
20	22.6	57.5
30	23.0	58.5
40	23.3	59.2
50	23.6	59.8
60	23.8	60.6
70	24.1	61.3
80	24.5	62.2
90	25.0	63.5
95	25.5	64.8



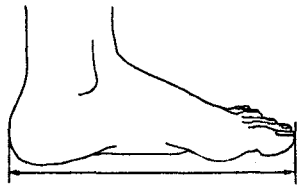
FOOT LENGTH

Back of heel to tip of longest toe.

N:	678	
Mean:	10.56±.02 in.	26.82±.05 cm.
S.D.:	0.46±.01 in.	1.16±.03 cm.
Range:	9.25–12.25 in.	23–31 cm.
C.V.:	4.35±.12%	4.35±.12%

r: Weight: .44
Stature: .66

%	In.	Cm.
5	9.7	24.6
10	9.8	25.0
20	10.0	25.5
30	10.2	25.8
40	10.3	26.2
50	10.4	26.5
60	10.6	26.8
70	10.7	27.1
80	10.8	27.5
90	11.0	28.0
95	11.2	28.4



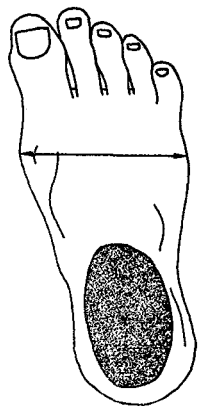
FOOT BREADTH

Breadth of the foot as measured between the dital extremities of the first and fifth metatarsale.

N:	312	
Mean:	3.87±.01 in.	9.83±.03 cm.
S.D.:	.21±.01 in.	.53±.02 cm.
Range:	3.50–4.50 in.	9–11 cm.
C.V.:	5.40±.22%	5.40±.22%

r: Weight: .48
Stature: .35

%	In.	Cm.
5	3.50	8.9
10	3.51	8.9
20	3.56	9.0
30	3.62	9.2
40	3.67	9.3
50	3.78	9.6
60	3.79	9.6
70	3.86	9.8
80	3.93	10.0
90	4.02	10.2
95	4.15	10.5



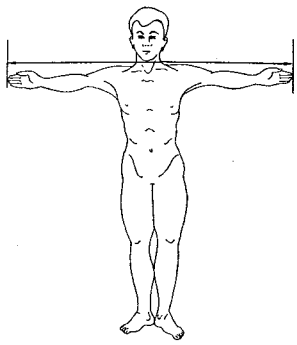
ARM SPAN

Horizontal distance between tips of longest fingers of right and left hands, with arms extended laterally.

N:	677	
Mean:	71.33±.12 in.	181.16±.29 cm.
S.D.:	2.99±.08 in.	7.60±.20 cm.
Range:	62.50–81.00 in.	159–206 cm.
C.V.:	4.19±.11%	4.19±.11%

r: Weight: .40
Stature: .79

%	In.	Cm.
5	168.5	66.4
10	171.1	67.4
20	174.3	68.6
30	176.8	69.6
40	178.9	70.4
50	180.7	71.1
60	182.6	71.9
70	184.9	72.8
80	187.6	73.9
90	190.7	75.1
95	193.6	76.2



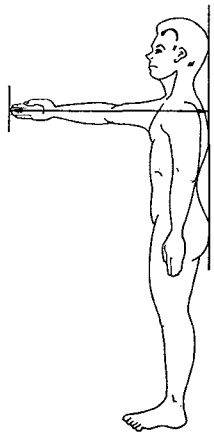
ARM REACH FROM WALL

The subject stands erect with shoulders firmly against the wall and extends his left arm horizontally, with fingers extended. The distance between the tip of the third finger and the wall is measured.

N:	681	
Mean:	32.60±.06 in.	82.80±.16 cm.
S.D.:	1.60±.04 in.	4.07±.11 cm.
Range:	26.50–37.75 in.	67–96 cm.
C.V.:	4.91±.13%	4.91±.13%

r: Weight: .38
Stature: .67

%	In.	Cm.
5	30.0	76.3
10	30.5	77.5
20	31.1	79.0
30	31.6	80.3
40	32.1	81.4
50	32.5	82.5
60	32.8	83.4
70	33.2	84.4
80	33.7	85.6
90	34.6	88.0
95	35.2	89.5



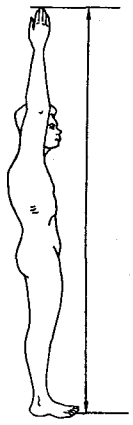
VERTICAL REACH STANDING

The subject stands erect and raises the right hand.

N:	280	
Mean:	88.25±.22 in.	224.14±.55 cm.
S.D.:	3.64±.11 in.	9.24±.28 cm.
Range:	67.00–97.50 in.	170–248 cm.
C.V.:	4.12±.12%	4.12±.12%

r: Weight: .42
Stature: .86

%	In.	Cm.
5	82.3	209.0
10	84.0	213.4
20	85.1	216.2
30	86.1	218.8
40	87.2	221.5
50	88.2	224.0
60	89.1	226.3
70	90.3	229.3
80	91.1	231.4
90	92.9	236.0
95	93.6	237.6



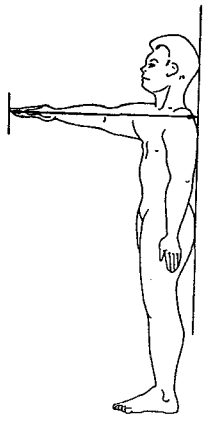
MAXIMUM REACH FROM WALL

The subject stands with his back to the wall, thrusting his right shoulder as far forward as possible with his right arm and hand extended horizontally. The distance from the tip of the longest finger to the wall is measured.

N:	681	
Mean:	37.76±.07 in.	95.90±.18 cm.
S.D.:	1.90±.05 in.	4.83±.13 cm.
Range:	30.75–43.50 in.	78–110 cm.
C.V.:	5.04±.14%	5.04±.14%

r: Weight: .39
Stature: .68

%	In.	Cm.
5	34.6	88.0
10	35.3	89.8
20	36.0	91.5
30	36.5	92.8
40	37.1	94.3
50	37.6	95.6
60	38.1	96.7
70	38.6	98.2
80	39.2	99.6
90	40.1	101.8
95	40.9	103.9

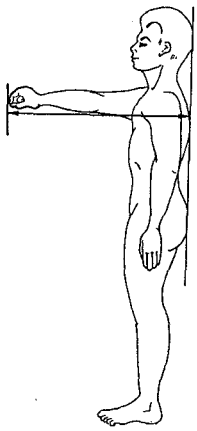


FUNCTIONAL REACH

The position is the same as the previous measurement except that forefinger and thumb are opposed and the distance from the wall to the tip of the thumb is recorded.

N:	681	
Mean:	34.36±.07 in.	87.26±.18 cm.
S.D.:	1.80±.05 in.	4.56±.12 cm.
Range:	28.00–39.50 in.	71–100 cm.
Stature:	5.22±.14%	5.22±.14%

r: Weight: .37
Stature: .64



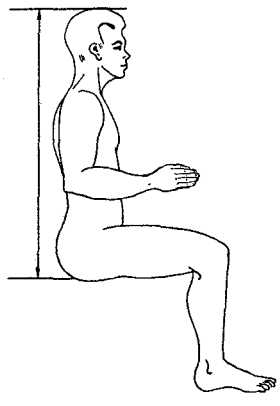
%	In.	Cm.
5	31.4	79.8
10	32.1	81.5
20	32.7	82.9
30	33.2	84.4
40	33.8	85.8
50	34.2	87.0
60	34.6	88.0
70	35.2	89.4
80	35.7	90.8
90	36.5	91.6
95	37.2	94.6

SITTING HEIGHT

With the subject sitting erect, the vertical distance from the seat level to vertex (highest point on the head with the head in the ear-eye plane).

N:	681	
Mean:	36.20±.05 in.	91.95±.12 cm.
S.D.:	1.29±.04 in.	3.27±.09 cm.
Range:	33.00–40.00 in.	84–102 cm.
C.V.:	3.55±.10%	3.55±.10%

r: Weight: .47
Stature: .75



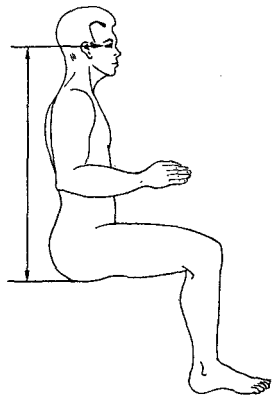
%	In.	Cm.
5	33.9	86.2
10	34.4	87.5
20	35.0	89.0
30	35.4	90.0
40	35.8	90.8
50	36.1	91.6
60	36.4	92.4
70	36.7	93.3
80	37.1	94.2
90	37.8	95.9
95	38.4	97.5

SITTING EYE HEIGHT

With the subject sitting erect, and the head in the ear-eye plane, the vertical distance from the right pupil to seat level.

N:	681	
Mean:	32.11±.05 in.	81.56±.12 cm.
S.D.:	1.28±.04 in.	3.24±.09 cm.
Range:	28.50–35.75 in.	72–91 cm.
C.V.:	3.97±.11%	3.97±.11%

r: Weight: .45
Stature: .68



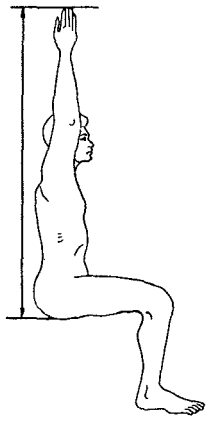
%	In.	Cm.
5	30.0	76.1
10	30.5	77.4
20	31.0	78.7
30	31.4	79.6
40	31.7	80.5
50	32.0	81.4
60	32.3	82.0
70	32.6	82.8
80	33.0	83.8
90	33.6	85.5
95	34.2	86.7

VERTICAL ARM REACH SITTING

The subject sits erect and extends the right arm vertically. The distance from seat level to the tip of the longest finger is recorded.

N:	240	
Mean:	55.06±.14 in.	139.83±.36 cm.
S.D.:	2.24±.10 in.	5.68±.26 cm.
Range:	40.00–60.50 in.	124–154 cm.
C.V.:	4.06±.19%	4.06±.19%

r: Weight: .49
Stature: .76



%	In.	Cm.
5	51.6	131.0
10	52.3	132.9
20	53.0	134.5
30	53.6	136.3
40	54.4	138.0
50	55.0	139.8
60	55.5	141.1
70	56.1	142.6
80	56.7	143.9
90	57.8	146.8
95	59.0	149.9

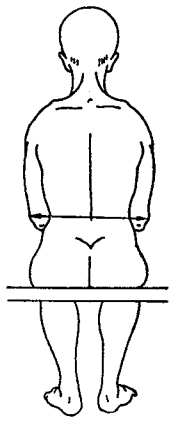
ELBOW-ELBOW BREADTH

The maximum horizontal distance between the lateral surface of the elbows.

N:	681	
Mean:	17.60±.06 in.	44.72±.15 cm.
S.D.:	1.54±.05 in.	3.90±.12 cm.
Range:	14.00–24.75 in.	36–63 cm.
C.V.:	8.73±.24%	8.73±.24%

r: Weight: .74
Stature: .18

%	In.	Cm.
5	15.2	38.7
10	15.7	39.8
20	16.2	41.2
30	16.7	42.3
40	17.0	43.1
50	17.4	44.1
60	17.7	45.0
70	18.1	45.9
80	18.6	47.2
90	19.5	49.5
95	20.3	51.5



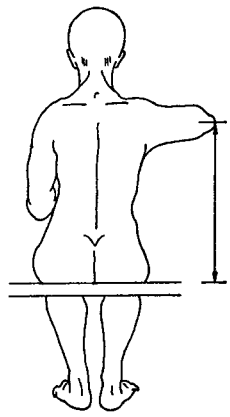
ELBOW CLEARANCE OUT (Vert.)

The subject sits erect and extends the right upper arm laterally. The vertical distance from the tip of the elbow to the seat level is recorded.

N:	680	
Mean:	26.21±.18 in.	66.56±.47 cm.
S.D.:	4.83±.13 in.	12.28±.33 cm.
Range:	15.00–41.00 in.	38–104 cm.
C.V.:	18.44±.52%	18.44±.52%

r: Weight: .02
Stature: .18

%	In.	Cm.
5	19.3	49.0
10	20.4	51.7
20	22.0	55.8
30	23.2	59.0
40	24.3	61.7
50	25.2	64.0
60	26.7	67.8
70	28.1	71.3
80	29.7	75.7
90	33.1	83.9
95	36.1	91.7



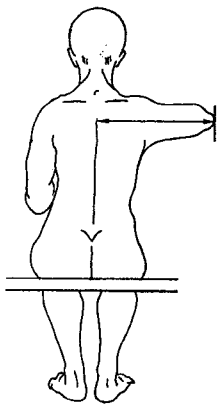
ELBOW CLEARANCE OUT (Horiz.)

The subject's position is identical to that for the previous measurement. The horizontal distance between the tip of the elbow to the mid-line of the back is recorded.

N:	681	
Mean:	19.51±.05 in.	49.55±.12 cm.
S.D.:	1.29±.04 in.	3.27±.09 cm.
Range:	15.50–24.50 in.	39–62 cm.
C.V.:	6.60±.18%	6.60±.18%

r: Weight: .30
Stature: .51

%	In.	Cm.
5	17.4	44.2
10	18.0	45.7
20	18.4	46.7
30	18.7	47.5
40	19.0	48.3
50	19.3	48.9
60	19.5	49.6
70	19.8	50.4
80	20.2	51.4
90	20.9	53.0
95	21.4	54.5



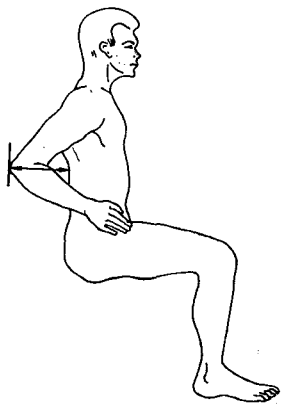
ELBOW CLEARANCE BACK (Horiz.)

The subject sits erect with the right elbow flexed at 90°. The upper arm is then circumducted posteriorly as far as possible and the horizontal distance between the tip of the elbow and the plane of the back is recorded.

N:	679	
Mean:	5.89±.06 in.	14.95±.15 cm.
S.D.:	1.52±.04 in.	3.87±.10 cm.
Range:	1.00–10.00 in.	2–25 cm.
C.V.:	25.88±.74%	25.88±.74%

r: Weight: .02
Stature: .25

%	In.	Cm.
5	3.1	7.8
10	3.8	9.5
20	4.6	11.6
30	5.0	12.7
40	5.4	13.8
50	5.8	14.7
60	6.2	15.7
70	6.6	16.8
80	7.1	18.0
90	7.8	19.7
95	8.1	20.7



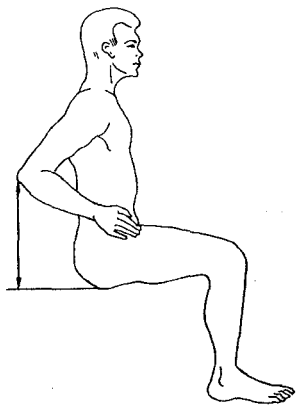
ELBOW CLEARANCE BACK (Vert.)

The subject's position is identical to that of the previous measurement. The vertical distance from the tip of the elbow to the seat level is recorded.

N:	681	
Mean:	24.07±.03 in.	61.14±.08 cm.
S.D.:	8.62±.02 in.	21.89±.06 cm.
Range:	11.00–46.50 in.	28–118 cm.
C.V.:	35.81±.97%	35.81±.97%

r: Weight: .07
Stature: .08

%	In.	Cm.
5	14.2	36.1
10	15.2	38.7
20	17.0	43.2
30	18.2	46.1
40	19.5	49.5
50	20.8	52.9
60	22.4	56.8
70	24.8	62.9
80	35.1	89.2
90	37.8	95.9
95	40.1	101.7



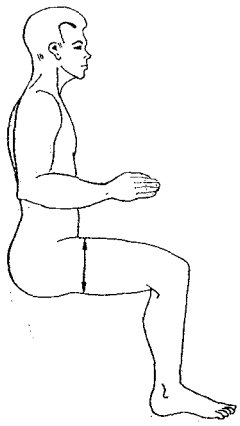
THIGH CLEARANCE

With the subject seated, the vertical distance between the anterior aspect of the thigh, just distal to the inguinal line, and the seat level.

N:	681	
Mean:	5.23±.02 in.	13.30±.05 cm.
S.D.:	.50±.01 in.	1.28±.03 cm.
Range:	3.25–7.50 in.	8–19 cm.
C.V.:	9.63±.26%	9.63±.26%

r: Weight: .79
Stature: .35

%	In.	Cm.
5	4.35	11.0
10	4.52	11.5
20	4.68	11.9
30	4.83	12.3
40	4.96	12.6
50	5.08	12.9
60	5.20	13.2
70	5.34	13.6
80	5.50	14.0
90	5.73	14.5
95	6.00	15.2



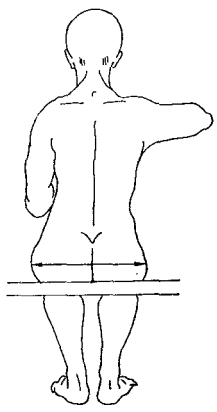
HIP BREADTH SITTING

The maximum transverse diameter of the hips with the subject sitting.

N:	681	
Mean:	14.16±.04 in.	35.96±.09 cm.
S.D.:	0.92±.02 in.	2.34±.06 cm.
Range:	12.00–18.75 in.	30–48 cm.
C.V.:	6.52±.18%	6.52±.18%

r: Weight: .81
Stature: .39

%	In.	Cm.
5	12.8	32.4
10	12.9	32.8
20	13.3	33.7
30	13.5	34.3
40	13.8	34.9
50	13.9	35.4
60	14.2	36.0
70	14.4	36.7
80	14.7	37.4
90	15.2	38.6
95	15.6	39.7



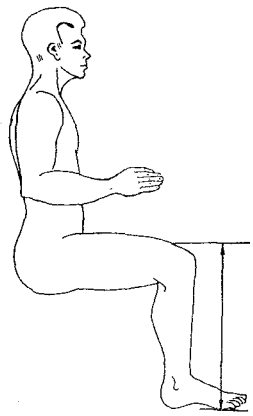
KNEE HEIGHT

With the subject seated, the vertical distance from the floor to the top of the knee.

N:	678	
Mean:	21.74±.04 in.	55.22±.09 cm.
S.D.:	0.96±.03 in.	2.45±.07 cm.
Range:	18.50–25.25 in.	47–64 cm.
C.V.:	4.44±.12%	4.44±.12%

r: Weight: .49
Stature: .82

%	In.	Cm.
5	20.1	51.0
10	20.4	51.9
20	20.8	53.0
30	21.1	53.7
40	21.4	54.3
50	21.6	54.9
60	21.8	55.4
70	22.1	56.1
80	22.4	56.9
90	22.8	57.8
95	23.2	59.0



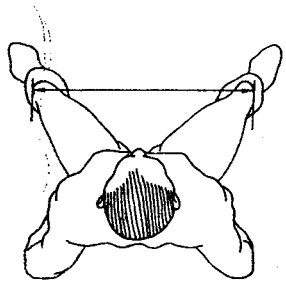
MAXIMUM KNEE SPREAD (Sitting)

The subject sits erect and spreads his knees as far as possible. The distance between the outermost points on each knee is recorded.

N:	681	
Mean:	36.40±.10 in.	92.44±.24 cm.
S.D.:	2.49±.07 in.	6.31±.17 cm.
Range:	27.00–40.25 in.	68–102 cm.
C.V.:	6.83±.18%	6.83±.18%

r: Weight: .26
Stature: .48

%	In.	Cm.
5	32.1	81.6
10	33.1	83.9
20	34.2	86.8
30	35.1	89.1
40	35.8	90.8
50	36.4	92.5
60	37.1	94.2
70	37.6	95.5
80	38.3	97.3
90	39.3	99.9
95	40.0	101.6



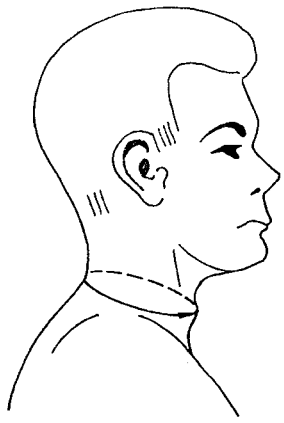
NECK CIRCUMFERENCE

Circumference of the neck perpendicular to its axis on a plane just below the "Adam's Apple".

N:	681	
Mean:	15.11±.03 in.	38.38±.08 cm.
S.D.:	0.85±.02 in.	2.16±.05 cm.
Range:	12.50–18.50 in.	32–47 cm.
C.V.:	5.64±.15%	5.64±.15%

r: Weight: .77
Stature: .17

%	In.	Cm.
5	13.7	34.9
10	13.9	35.3
20	14.3	36.2
30	14.5	36.8
40	14.8	37.5
50	14.9	37.8
60	15.2	38.5
70	15.4	39.1
80	15.7	39.9
90	16.1	40.9
95	16.4	41.7



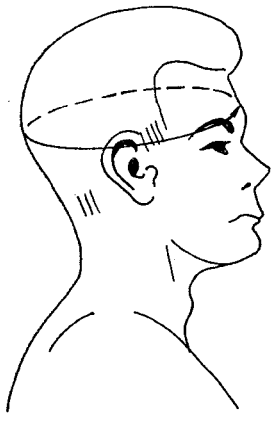
HEAD CIRCUMFERENCE

The maximum horizontal circumference of the head immediately above the brow ridges.

N:	478	
Mean:	22.80±.03 in.	57.90±.07 cm.
S.D.:	0.62±.02 in.	1.58±.05 cm.
Range:	21.00–24.50	53.34–62.23 cm.
C.V.:	2.73±.09%	2.73±.09%

r: Weight: .51
Stature: .33

%	In.	Cm.
5	21.7	55.0
10	21.9	55.5
20	22.1	56.3
30	22.3	56.8
40	22.5	57.2
50	22.7	57.6
60	22.8	58.0
70	23.0	58.3
80	23.2	58.9
90	23.5	59.7
95	23.7	60.3



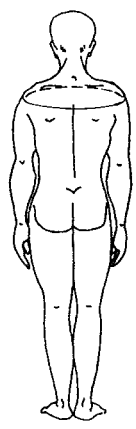
SHOULDER CIRCUMFERENCE

Horizontal circumference of the shoulder measured at the level of maximum lateral protrusion of the deltoid muscles.

N:	681	
Mean:	46.22±.10 in.	117.39±.25 cm.
S.D.:	2.64±.07 in.	6.71±.18 cm.
Range:	40.00–55.25 in.	102–140 cm.
C.V.:	5.72±.16%	5.72±.16%

r: Weight: .89
Stature: .29

%	In.	Cm.
5	42.2	107.1
10	42.8	108.7
20	43.9	111.6
30	44.5	113.1
40	45.2	114.9
50	46.0	116.8
60	46.7	118.5
70	47.3	120.2
80	48.1	122.2
90	49.6	125.9
95	50.9	129.2



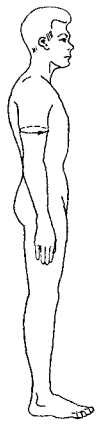
UPPER-ARM CIRCUMFERENCE

Circumference of the upper arm at the greatest diameter of the biceps with the arm relaxed.

N:	681	
Mean:	11.77±.04 in.	29.91±.10 cm.
S.D.:	1.08±.03 in.	2.74±.07 cm.
Range:	9.00–15.25 in.	23–39 cm.
C.V.:	9.18±.25%	9.18±.25%

r: Weight: .76
Stature: .08

%	In.	Cm.
5	10.0	25.5
10	10.3	26.2
20	10.8	27.4
30	11.0	28.1
40	11.3	28.8
50	11.6	29.4
60	11.9	30.2
70	12.2	31.1
80	12.5	31.7
90	13.0	33.1
95	13.5	34.3



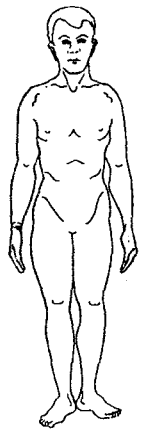
WRIST CIRCUMFERENCE

Circumference of the wrist at a level just proximal to the ulnar styloid process.

N:	680	
Means	6.93±.02 in.	17.60±.04 cm.
S.D.:	0.45±.01 in.	1.14±.03 cm.
Range:	5.75–8.75 in.	15–22 cm.
C.V.:	6.47±.18%	6.47±.18%

r: Weight: .66
Stature: .24

%	In.	Cm.
5	6.1	15.5
10	6.3	16.0
20	6.4	16.3
30	6.6	16.7
40	6.7	17.0
50	6.8	17.2
60	6.9	17.5
70	7.0	17.7
80	7.1	18.2
90	7.4	18.8
95	7.6	19.2



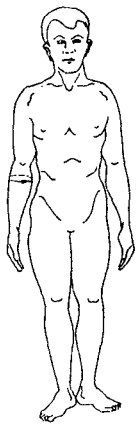
LOWER-ARM CIRCUMFERENCE

With the arm relaxed and extended at the elbow, the maximum circumference of the forearm is recorded.

N:	681	
Mean:	10.80±.03 in.	27.44±.07 cm.
S.D.:	0.73±.02 in.	1.86±.05 cm.
Range:	7.25–13.50 in.	18–34 cm.
C.V.:	6.76±.18%	6.76±.18%

r: Weight: .73
Stature: .19

%	In.	Cm.
5	9.5	24.2
10	9.8	25.0
20	10.1	25.7
30	10.3	26.2
40	10.5	26.6
50	10.6	27.0
60	10.8	27.5
70	11.0	27.9
80	11.3	28.6
90	11.6	29.5
95	11.9	30.3



CHEST CIRCUMFERENCE

Maximum thoracic circumference recorded during normal breathing at the level of the nipples.

N:	681	
Mean:	38.17±.10 in.	95.95±.25 cm.
S.D.:	2.56±.07 in.	6.49±.18 cm.
Range:	32.00–48.00 in.	81–122 cm.
C.V.:	6.70±.18%	6.70±.18%

r: Weight: .85
Stature: .26

%	In.	Cm.
5	34.5	87.6
10	35.0	88.9
20	35.8	91.0
30	36.5	92.7
40	37.3	94.7
50	37.8	96.0
60	38.5	97.7
70	39.2	99.6
80	39.9	101.4
90	41.3	104.9
95	42.9	109.0

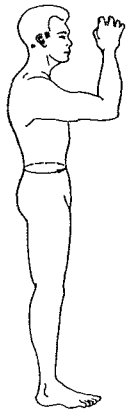
WAIST CIRCUMFERENCE

The horizontal circumference of the waist at its maximum diameter above the iliac crests.

N:	681	
Mean:	32.41±.11 in.	82.32±.28 cm.
S.D.:	2.97±.08 in.	7.53±.20 cm.
Range:	25.00–45.00 in.	63–114 cm.
C.V.:	9.15±.25%	9.15±.25%

r: Weight: .86
Stature: .18

%	In.	Cm.
5	27.9	70.9
10	28.7	73.0
20	29.7	75.5
30	30.5	77.4
40	31.3	79.5
50	32.0	81.4
60	32.8	83.4
70	33.8	85.7
80	34.5	87.6
90	36.2	91.9
95	38.0	96.6



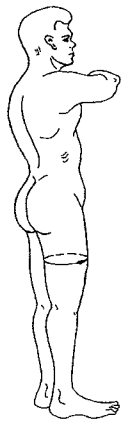
THIGH CIRCUMFERENCE

The circumference of the thigh measured at the juncture of the upper one-third and distal two-thirds.

N:	681	
Mean:	20.24±.06 in.	51.41±.16 cm.
S.D.:	1.65±.04 in.	4.18±.11 cm.
Range:	16.00–26.00 in.	41–66 cm.
C.V.:	8.13±.22%	8.13±.22%

r: Weight: .84
Stature: .17

%	In.	Cm.
5	17.6	44.8
10	18.2	46.2
20	18.8	47.7
30	19.2	48.8
40	19.6	49.8
50	20.0	50.8
60	20.4	51.8
70	20.9	53.0
80	21.4	54.3
90	22.2	56.3
95	23.2	59.0



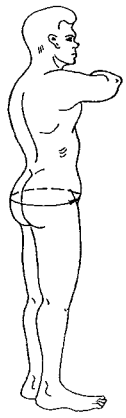
BUTTOCKS CIRCUMFERENCE

In the standing position, the horizontal circumference of the hips at the level of greatest protrusion of the buttocks.

N:	681	
Mean:	38.08±.09 in.	96.73±.24 cm.
S.D.:	2.43±.07 in.	6.17±.17 cm.
Range:	30.00–47.00 in.	76–119 cm.
C.V.:	6.38±.17%	6.38±.17%

r: Weight: .90
Stature: .35

%	In.	Cm.
5	34.6	87.9
10	35.1	89.1
20	35.8	91.0
30	36.5	92.8
40	37.2	94.4
50	37.8	96.1
60	38.4	97.6
70	39.1	99.3
80	39.9	101.3
90	41.0	104.1
95	42.3	107.4



LOWER-THIGH CIRCUMFERENCE

The horizontal circumference of the thigh measured 1 inch above the knee.

N:	681	
Mean:	15.86±.05 in.	40.29±.12 cm.
S.D.:	1.28±.03 in.	3.26±.09 cm.
Range:	12.75–20.00 in.	32–51 cm.
C.V.:	8.10±.22%	8.10±.22%

r: Weight: .83
Stature: .21

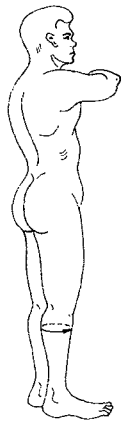
%	In.	Cm.
5	13.8	35.0
10	14.0	35.7
20	14.6	37.0
30	15.00	38.0
40	15.4	39.1
50	15.7	40.0
60	16.0	40.7
70	16.4	41.7
80	16.8	42.8
90	17.3	44.0
95	17.9	45.5

CALF CIRCUMFERENCE

The maximum circumference of the calf.

N:	681	
Mean:	14.42±.04 in.	36.62±.09 cm.
S.D.:	0.96±.03 in.	2.45±.07 cm.
Range:	11.50–17.75 in.	29–45 cm.
C.V.:	6.69±.18%	6.69±.18%

r: Weight: .78
Stature: .19



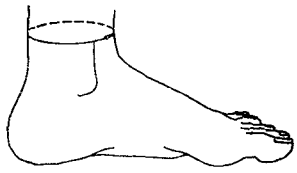
%	In.	Cm.
5	12.8	32.6
10	13.2	33.4
20	13.5	34.3
30	13.8	35.0
40	14.0	35.6
50	14.3	36.2
60	14.5	36.8
70	14.8	37.5
80	15.1	38.3
90	15.5	39.5
95	15.9	40.5

ANKLE CIRCUMFERENCE

The minimal circumference of the ankle at a level immediately proximal to the malleolae.

N:	681	
Mean:	9.13±.02 in.	23.20±.05 cm.
S.D.:	0.55±.02 in.	1.40±.04 cm.
Range:	7.50–11.50 in.	19–29 cm.
C.V.:	6.07±.16%	6.07±.16%

r: Weight: .64
Stature: .33



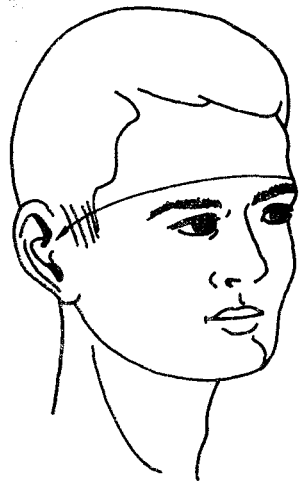
%	In.	Cm.
5	8.1	20.6
10	8.3	21.1
20	8.5	21.7
30	8.7	22.2
40	8.8	22.5
50	9.0	22.8
60	9.1	23.2
70	9.3	23.6
80	9.5	24.1
90	9.7	24.7
95	9.9	25.3

HEAD-EYEBROW ARC

The length of the arc between the points of greatest identation of the temporal crests.

N:	478	
Mean:	13.88±.03 in.	35.26±.07 cm.
S.D.:	0.63±.02 in.	1.60±.05 cm.
Range:	12.00–17.00 in.	30–43 cm.
C.V.:	4.55±.15%	4.55±.15%

r: Weight: .22
Stature: .22



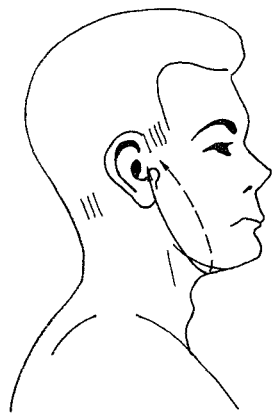
%	In.	Cm.
5	12.8	32.6
10	13.0	33.0
20	13.3	33.7
30	13.4	34.2
40	13.6	34.6
50	13.8	35.0
60	13.9	35.3
70	14.0	35.6
80	14.3	36.3
90	14.5	36.9
95	14.8	37.5

EAR-NECK ARC

The length of the arc from the right to left tragion as measured with the tape passing under the lower jaw and positioned along the juncture of the jaw and the neck.

N:	477	
Mean:	12.51±.02 in.	31.76±.06 cm.
S.D.:	.50±.02 in.	1.28±.04 cm.
Range:	11.00–14.00 in.	28–36 cm.
C.V.:	4.03±.13%	4.03±.13%

r: Weight: .29
Stature: .21



%	In.	Cm.
5	11.6	29.4
10	11.8	29.9
20	12.0	30.4
30	12.1	30.7
40	12.2	31.1
50	12.4	31.4
60	12.5	31.8
70	12.7	32.2
80	12.8	32.6
90	13.1	33.1
95	13.2	33.6

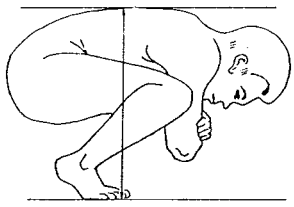
MINIMUM SQUATTING HEIGHT

The subject assumes a squatting position and then tilts his body so that the plane of the back is approximately parallel to the floor. The distance between the plane of the back and the floor is measured.

N:	677	
Mean:	24.92±.08 in.	63.29±.20 cm.
S.D.:	2.04±.06	5.17±.14 cm.
Range:	18.50–33.50 in.	47–85 cm.
C.V.:	8.18±.22%	8.18±.22%

r: Weight: .58
Stature: .36

%	In.	Cm.
5	21.5	54.7
10	22.2	56.5
20	23.1	58.8
30	23.8	60.4
40	24.2	61.6
50	24.8	63.0
60	25.3	64.3
70	25.8	65.6
80	26.5	67.2
90	27.3	69.3
95	28.0	71.1



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