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SELECTED ANTHROPOMETRIC DIMENSIONS OF NAVAL AVIATION PERSONNEL

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and Joseph R. Provost

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Since the previous study of the anthropometric features of naval aircrewmen, the physical and academic requirements for entrance into the flight program have been changed. The present study was undertaken to determine whether these changes combine with changes in the anthropometric features of the population in general to influence certain anthropometric dimensions. Selected anthropometric features of 6534 aviation training candidates were examined. These measures included: weight, stature, sitting height, shoulder width, buttock-knee length, buttock-heel length, per cent of body fat, and lean body weight. Measures of central tendency and dispersion were calculated for each variable, and correlations between variables were obtained. In addition, t tests were used to determine the significance of the differences between mean values obtained by the aviation training candidates and the mean values reported by the Naval Air Development Center and the USAF Aeromedical Laboratory for other populations.

The dimensions of the aviation training candidates in this study differed significantly from those reported in the other samples. Possible reasons for these differences include: growth of the population in general, characteristics of the samples involved, and different anthropometric and academic requirements for acceptance into the aviation training program.

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SUMMARY PAGE

THE PROBLEM

Since the previous study of the anthropometric features of naval aircrewmen was conducted, the physical and academic requirements for entrance into the flight program have been changed. The present study was undertaken to determine if these changes, combined with changes in the anthropometric features of the population in general, have been reflected in the bodily dimensions of the naval aviator population. The following anthropometric measures of 6534 aviation training candidates were examined: weight, stature, sitting height, shoulder width, buttock-knee length, buttock-heel length, per cent body fat, and lean body weight. Measures of central tendency and dispersion were calculated for each variable, and co relations between variables were obtained. In addition, t tests were used to determine the significance of the differences between mean values obtained by these naval aviation training candidates and the mean values reported on other samples by the Naval Air Development Center and the USAF Aeromedical Laboratory.

FINDINGS

The dimensions of the naval aviation training candidates differed significantly from those reported in the other samples. Possible reasons for these differences include: growth of the population in general, characteristics of the samples involved, and different anthropometric and academic requirements for acceptance into the aviation training program.

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INTRODUCTION

In 1964 an anthropometric study of 1549 aircrewmen was conducted by Gifford, Provost, and Lazo (3) of the Naval Air Development Center (NADC)*. The population for this study comprised approximately 10 per cent of the naval aircrewmen then on active duty, and descriptive data for 96 anthropometric dimensions were reported.

Data reported by Newman (5), by Stoudt, Damon, McFarland, and Roberts (8), and by Damon, Stoudt, and McFarland (2) indicated that bodily dimensions of the American population have been changing with time. For example, Damon et al. (2) reported that the average American soldier in WWII was 13 pounds heavier and 0.7 inch taller than his counterpart in WWI. If changes in anthropometric dimensions are to be encountered with time, then these changes must be incorporated into the design of new aircraft systems.

In addition to changes in the anthropometric features of the population in general, changes in standards for acceptance into training have occurred. BUMED Instruction 6110.8 (1) established the following physical standards: candidates for naval flight training must attain a minimum stature of 64 inches and cannot exceed 78 inches provided the sitting height is not less than 32 inches nor more than 41 inches and the buttock-leg length is not less than 36 inches nor more than 50 inches. Marine candidates must meet the sitting height and buttock-leg length requirements cited above; however, they must attain a minimum overall height of 66 inches but cannot exceed the 78-inch maximum.

Since 1965 candidates for naval flight training have been required to have a college degree awarded by an accredited college or university. While this requirement does not apply to Marine Corps entrants to naval flight training, approximately 93 per cent of the recent Marine Corps flight students were college graduates. Stoudt et al. (8) and Damon et al. (2) have reported that college students are taller and lighter than noncollege individuals of the same age group. Newman (5) reported that the limits placed on sitting height in WWII eliminated approximately 5 per cent of the potential aircraft- and armoured-vehicle operator population; however, these same limits would have eliminated between 15 and 20 per cent of the college population. On the basis of the aforementioned findings it is reasonable to expect that a group of recent naval flight students would be taller than the other military groups considered (mostly noncollege graduates).

Characteristics of the sample may also explain differences between the groups. The NADC sample (3) included Navy and Marine Corps aviators, aviation officers, and enlisted aviation personnel (N = 1549). The USAF Aeromedical Laboratory (AML) collected data (4) describing 132 anthropometric features of over 4000 USAF flying personnel from all flight categories (pilots, navigators, bombardiers, observers, gunners). The population examined at the Naval Aerospace Medical Institute (NAMI) included all individuals (for whom records were available) who had entered the flight training program between January 1966 and August 1969 inclusive, and thus enlisted personnel were excluded.

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*At the time of the study the Air Crew Equipment Laboratory was part of the Naval Air Engineering Center.

The purpose of the present study is to describe selected anthropometric features of naval aviation personnel (student naval aviators, SNA's, and student naval flight officers, SNFO's) who entered flight training between January 1966 and August 1969 and to compare the data obtained with those obtained from NADC and from AML. It is expected that differences between the NAMI sample and both the NADC sample (3) and the AML sample (4) may be attributed to: 1) changes in the morphological features of the population as a whole, 2) changes in the physical and academic requirements for admission into the flight training program, and 3) differences in the compositions of the samples examined.

PROCEDURE

METHOD

In 1964 Provost and Gifford (7) reported on their design of an integrated anthropometric measuring device that would permit assessment of select (i.e., relatively unique and operationally important) morphological features of aircrewmen: weight, stature (standing height), sitting height, shoulder width, trunk height, buttock-knee length, buttock-heel length, and functional reach. The device did not require complicated or sophisticated mensuration, and it was felt that it could be utilized with precision by persons with a minimum of training and experience.

BUMED Instruction 6110.8 (1) required that the device be employed in connection with the aviation training entrance physical examination administered at the School of Aviation Medicine (now the Naval Aerospace Medical Institute, NAMI) for all aviation training candidates. These measurements were then reported on the Anthropometric Data Record Form, NAVMED 1460 (11-64). Appropriate identifying information, i.e., name, rank, rate, file, service number, designator, service, age, and date of examination, were also recorded on NAVMED 1460 (11-64). (See Appendix A.)

DATA PROCESSING

The measurements and identifying information specified above were collected from 6534 aviation training candidates (mean age 22.7 years; S.D. 1.24; range 20.00 - 28.33) who commenced training between 1 January 1966 and August 1969. This information was then coded and placed on punched cards, along with accession codes that permit the Aerospace Psychology Department to trace the individual and his concommitant academic and flight grades from the point of introduction into the flight training program until his assignment to a Navy or Marine Corps operational squadron. All the above data constituted the input deck. An output deck was obtained by means of appropriate programs. This output deck contained: 1) the variables specified in the input deck, and 2) selected derived variables--lean body weight and per cent body fat as calculated according to the technique of Pierson and Eagle (6). From this output deck, measures of central tendency and dispersion for each variable and correlations between variables were obtained. Frequency distributions were plotted and percentiles were also obtained (Appendix B). In addition, t tests were used to determine the significance of the differences between the mean values obtained from the NAMI population and the mean values obtained by the previously cited Navy (3) and USAF aircrewmen studies (4).

RESULTS

A preliminary examination of the results revealed a large number of discrepancies associated with the measurement of trunk height and functional reach. These inconsistencies were ultimately traced to unauthorized (bias inducing) modifications of the measuring device. Therefore, the data describing trunk height and functional reach are not included in this report.

A description of the variables measured and the frequency distribution obtained for each variable are presented in Figures 1 through 8. The standard errors associated with the mean, with standard deviation, and with coefficient of variation for each variable are reported in the parenthesis located immediately after the value of interest. Table I presents a comparison of the values associated with the 5th, 50th, and 95th percentiles for the groups measured at NAMI, at NADC, and at AML.

An examination of Table II reveals that the mean value attained by the student naval aviation personnel examined at NAMI differed from the mean value attained by an earlier sample of naval aviation personnel examined by NADC in weight (4.25 lb lighter); stature (0.21 in. taller); sitting height (0.48 in. taller); shoulder width (0.90 in. narrower); buttock-knee length (0.45 in. longer). They were also younger than the NADC sample. Furthermore, the student naval aviation population examined at NAMI were 3.49 pounds heavier, 1.04 inches taller in stature, 0.82 inch taller in sitting height, and had longer buttock-knee lengths (0.92 in.) and buttock-heel lengths (1.16 in.) than the aviation personnel sampled by AML and were also younger. Significant differences ($p < .01$) were found between the means associated with each variable, except for shoulder width, which was identical for the NAMI and the AML samples. While the anthropometric features of the NAMI population were significantly different from those of the other samples, a judgment of the meaningfulness of that significant difference must be made by the user of the data.

Correlations are reported in Table III for these variables. As expected, stature correlated well with segmental and limb lengths, while weight correlated well with breadth- and mass-related factors.

DISCUSSION

The difference in weight between the NAMI and the NADC groups may be in part attributed to the selection process. The American College Health Association study cited by Stoudt et al. (8) reported that college students had an average weight of 3 pounds less than noncollege students of the same age range. Since the majority of the NADC sample were not college graduates (as opposed to the NAMI sample) and had a wider range in weight than the NAMI sample, it is reasonable to expect a higher mean weight for the NADC group.

A similar rationale could explain the differences in stature, sitting height, and buttock-knee length between the NAMI and the NADC groups. In addition to the trend for the population as a whole to become taller, Stoudt et al. (8) reported that college students (from the same age group from which SNA's and SNFO's volunteer) are taller than noncollege students of the same age group.

Table I

Percentile Values of Selected Anthropometric Measures Obtained by NAMI, NADC, and AML*

	NAMI			NADC			AML		
Percentile:	5	50	95	5	50	95	5	50	95
1. Weight (lb)	135.9	165.0	196.4	140.3	171.1	203.6	132.5	161.9	200.8
2. Stature (in.)	65.8	69.7	73.8	66.2	69.9	73.9	65.2	69.1	73.1
3. Sitting height (in.)	34.3	36.3	38.4	34.2	36.3	38.4	33.8	36.0	38.0
4. Shoulder width (in.)	16.0	17.4	19.9	17.3	18.8	20.3	16.5	17.9	19.4
5. Buttock-knee length (in.)	22.1	24.1	26.3	22.5	24.1	25.8	21.9	23.6	25.4
6. Buttock-heel length (in.)	40.2	43.5	46.9				39.4	42.7	46.1
7. Per cent body fat	4.5	11.9	17.8						
8. Lean body weight	124.3	143.9	165.8						

*Empty cells indicate that the measurement was not taken or calculated.

Table II

Means, Standard Deviations, and Ranges of Selected Anthropometric Measures Obtained by NAMI, NADC, and AML*

	NAMI			NADC			AML		
	Mean	S. D.	Range	Mean	S. D.	Range	Mean	S. D.	Range
1. Weight (lb)	167.15	18.38	117.00-244.00	171.40	19.09	109.50-245.50	163.66	20.86	104.00-265.00
2. Stature (in.)	70.15	2.40	62.70- 78.00	69.94	2.33	63.48- 77.25	69.11	2.44	59.45- 77.56
3. Sitting height (in.)	36.76	1.21	31.70- 41.00	36.28	1.25	32.19- 41.62	35.94	1.29	29.92- 40.16
4. Shoulder width (in.)	17.88	0.91	15.00- 21.30	18.78	0.91	14.82- 21.70	17.88	0.91	14.57- 22.83
5. Buttock-knee length (in.)	24.54	1.26	20.40- 29.90	24.09	1.00	20.73- 27.81	23.62	1.06	18.50- 27.56
6. Buttock-heel length (in.)	43.86	2.08	32.50- 50.70				42.70	2.04	35.43- 50.00
7. Per cent body fat	12.10	4.02	0.10- 23.90						
8. Lean body weight	146.29	12.65	109.00-193.00						

* Empty cells indicate that the measurement was not taken or calculated.

Table III

Correlations† Between Anthropometric Measurements Collected on a Group of Student Naval Aviators/Student Naval Flight Officers (N = 6534)

	1	2	3	4	5	6	7	8
1. Weight		.58	.53	.69	.46	.51	.68	.92
2. Stature			.77	.46	.68	.78	-.20	.85
3. Sitting height				.49	.35	.45	-.05*	.71
4. Shoulder width					.31	.35	.41	.66
5. Buttock-knee length						.73	-.06*	.62
6. Buttock-heel length							-.10	.70
7. Per cent body fat								.34
8. Lean body weight								

†All values significant at .01 except those with *.

Differences between the NAMI and the AML group may be in part a function of the number of years that elapsed between data collections. The NAMI data were collected between 1966 and 1969 while the AML data were collected prior to 1950. This represents a gap of at least 16 to 19 years during which the dimensions of the population as a whole were generally increasing. It is reasonable to expect, therefore, that the anthropometric features of the NAMI group would be somewhat larger than those of the AML group. Age at the time of measurement and the different compositions of the populations can also be considered contributory factors.

It was noted in Table II that the mean shoulder widths of the NAMI and AML groups were identical, and both mean widths were smaller than the mean shoulder width of the NADC group. A possible explanation for this apparent reversal of the general trend of increasing body dimensions may lie in the age differences among the groups examined. The NAMI group consisted of individuals (mostly college graduates) who were younger than the cross-section of the naval aviation sample examined by NADC. The NAMI group, therefore, would not have the body fat common to the older population, and the NAMI mean shoulder width would fall closer to the smaller dimensioned sample examined by AML.

PERCENTILE VALUES

%	LB	KG
1	126.8	57.5
2	130.3	59.1
3	132.5	60.1
5	135.9	61.7
10	141.8	64.3
15	146.1	66.3
20	149.6	67.9
25	152.7	69.3
30	155.3	70.5
35	157.9	71.6
40	160.4	72.8
45	162.7	73.8
50	165.0	74.9
55	167.5	76.0
60	170.1	77.2
65	172.7	78.4
70	175.6	79.7
75	178.3	80.9
80	181.7	82.4
85	185.3	84.1
90	190.0	86.2
95	196.4	89.1
97	201.0	91.2
98	203.6	92.4
99	208.6	94.7

All descriptions were adapted from Anthropometry of Flying Personnel - 1950.

Each subject determined his own weight on standard medical type scales.

Mean: 167.15 (.23) lb ; 75.84 (.10) kg

Standard Deviation: 18.38 (.16) lb ; 8.34 (.07) kg

Range: 117 - 244 lb ; 53.09 - 110.71 kg

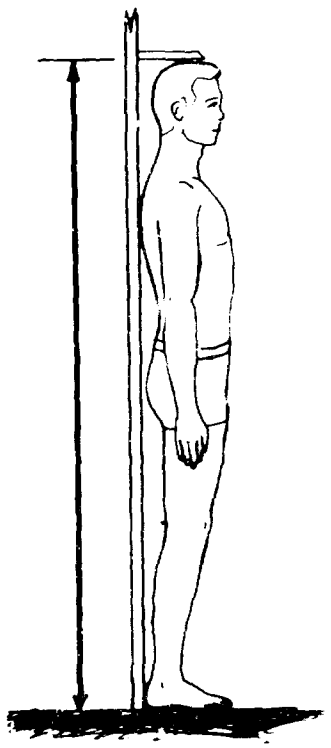
Coefficient of Variation: 11.0 (.10) %

N 6534

Figure 1 Weight

PERCENTILE VALUES

%	IN.	CM
1	64.4	163.7
2	65.0	165.0
3	65.3	166.0
5	65.8	167.2
10	66.6	169.2
15	67.2	170.7
20	67.6	171.8
25	68.0	172.8
30	68.4	173.7
35	68.7	174.5
40	69.0	175.3
45	69.3	176.1
50	69.7	177.0
55	69.9	177.7
60	70.3	178.5
65	70.6	179.4
70	70.9	180.3
75	71.4	181.2
80	71.8	182.3
85	72.2	183.4
90	72.9	185.0
95	73.8	187.5
97	74.3	188.7
98	74.8	189.9
99	75.3	191.4



The subject stands erect with his back, shoulders, and feet firmly positioned against the back of the device. The measurer moves the measuring probe until it touches the scalp firmly. The subject's height is then read on a scale.

Mean: 70.15 (.03) in.; 178.19 (.08) cm.

Standard Deviation: 2.40 (.02) in.; 6.10 (.05) cm.

Range: 62.7 - 78.0 in.; 159.26 - 198.12 cm.

Coefficient of Variation: 3.4 (.03) %

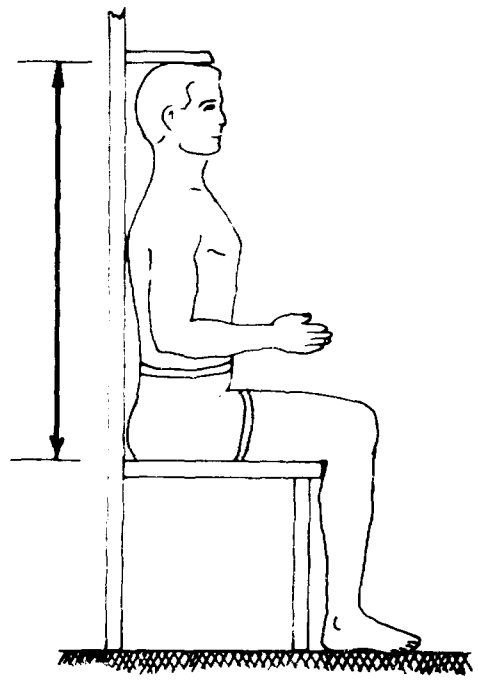
N 6534

Figure 2 Stature (Standing Height)

Values reported in parenthesis in all figures are the Standard Error of the statistic with which they are associated.

PERCENTILE VALUES

	IN	CM
1	33.7	85.6
2	33.9	86.1
3	34.0	86.5
5	34.3	87.2
10	34.8	88.3
15	35.0	89.0
20	35.3	89.6
25	35.5	90.1
30	35.7	90.6
35	35.8	91.0
40	36.0	91.4
45	36.1	91.8
50	36.3	92.2
55	36.5	92.6
60	36.6	93.0
65	36.8	93.4
70	37.0	93.9
75	37.1	94.3
80	37.3	94.8
85	37.6	95.5
90	37.9	96.3
95	38.4	97.4
97	38.6	98.1
98	38.9	98.7
99	39.1	99.4



The subject sits erect beneath the measuring probe. He looks directly forward, with his head, shoulders, back, and buttocks firmly positioned against the back of the seat. His feet rest on the floor of the platform so that his knees are bent at approximately right angles. The measurer moves the measuring probe until the flat surface of the probe makes contact with the highest surface on the subject's head. The measurer then reads the distance on the scale.

Mean: 36.76 (.02) in.; 93.37 (.04) cm.

Standard Deviation: 1.21 (.01) in.; 3.06 (.03) cm.

Range: 31.7 - 41.0; 80.52 - 104.14 cm.

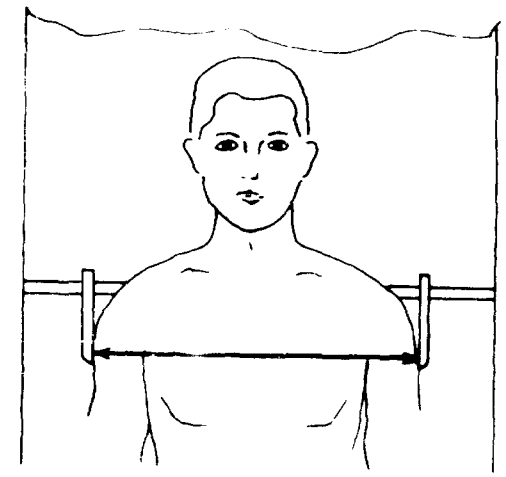
Coefficient of Variation: 3.3 (.03) %

N = 6534

Figure 3 Sitting Height

PERCENTILE VALUES

	IN.	CM
1	15.5	39.3
2	15.6	39.7
3	15.8	40.0
5	16.0	40.7
10	16.3	41.4
15	16.5	42.0
20	16.7	42.3
25	16.8	42.7
30	16.9	43.0
35	17.1	43.3
40	17.2	43.6
45	17.3	44.0
50	17.4	44.3
55	17.6	44.6
60	17.7	45.2
65	17.8	45.5
60	17.9	45.9
75	18.1	45.9
80	18.3	46.4
85	18.4	46.8
90	18.7	47.5
95	19.0	48.2
97	19.3	48.9
98	19.4	49.3
99	19.7	50.1



The subject sits with his upper arms hanging at his sides and his forearms extended horizontally forward. His right deltoid muscle rests against a fixed plate. a sliding plate is then moved until it contacts the subject's left deltoid muscle. The distance between the inner portions of the two plates is then read from a scale which runs between the two plates.

Mean: 17.88 (.01) in.; 45.42 (.03) cm.

Standard Deviation: .91 (.01) in.; 2.30 (.02) cm.

Range: 15.0 - 21.3 in.; 38.10 - 54.10 cm.

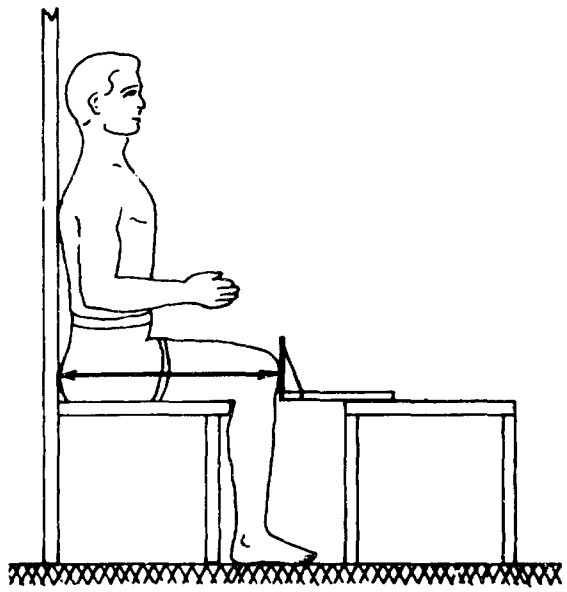
Coefficient of Variation: 5.1 (.05) %

N 6534

Figure 4 Shoulder Width

PERCENTILE VALUES

%	IN.	CM
1	20.8	52.9
2	21.6	54.9
3	21.8	55.4
5	22.1	56.1
10	22.5	57.2
15	22.8	57.9
20	23.0	58.5
25	23.2	59.0
30	23.4	59.5
35	23.6	59.9
40	23.8	60.3
45	23.9	60.8
50	24.1	61.1
55	24.2	61.5
60	24.4	61.9
65	24.5	62.3
70	24.7	62.8
75	24.9	63.3
80	25.2	63.9
85	25.5	64.7
90	25.7	65.4
95	26.3	66.7
97	26.7	67.7
98	26.9	68.4
99	27.4	69.5



The subject remains in the sitting height postiton. A plate mounted on a slide is then positioned against his knee cap. The measurer then reads the distance on a scale.

Mean: 24.54 (.02) in.; 62.33 (.04) cm.

Standard Deviation: 1.26 (.01) in.; 3.21 (.03) cm.

Range: 20.4 - 29.9 in.; 51.82 - 75.95 cm.

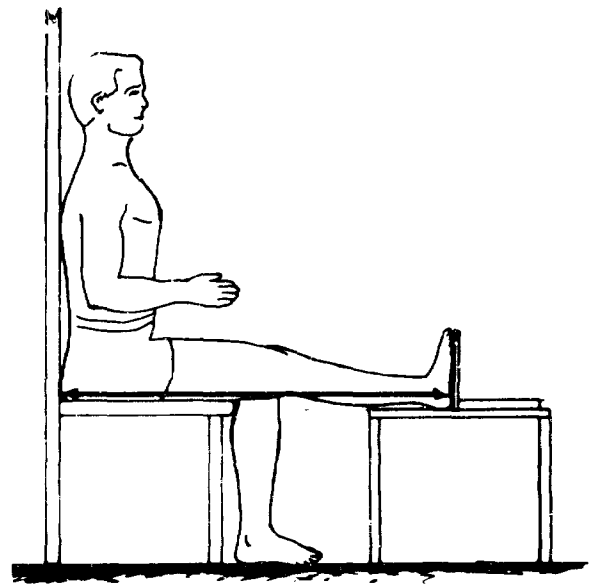
Coefficient of Variation: 5.1 (.05) %

N = 6534

Figure 5 Buttock-Knee Length

PERCENTILE VALUES

%	IN.	CM
1	38.7	98.3
2	39.3	99.9
3	39.7	100.8
5	40.2	102.0
10	41.0	104.1
15	41.3	105.0
20	41.7	105.9
25	42.0	106.7
30	42.3	107.5
35	42.6	108.3
40	42.9	109.0
45	43.2	109.7
50	43.5	110.4
55	43.7	111.0
60	43.9	111.6
65	44.3	112.4
70	44.7	113.4
75	44.9	113.9
80	45.2	114.9
85	45.7	116.0
90	46.2	117.3
95	46.9	119.1
97	47.4	120.3
98	47.8	121.3
99	48.4	122.9



The subject remains in the sitting height position. He extends his right leg as far as possible on the leg bench. The measuring probe is then moved until it comes into contact with the subject's heel.

Mean: 43.86 (.03) in.; 111.39 (.07) cm.

Standard Deviation: 2.08 (.02) in.; 5.28 (.05) cm.

Range: 32.5 - 50.7 in.; 82.55 - 128.78 cm.

Coefficient of Variation: 4.7 (.04) %

N = 6534

Figure 6 Buttock-Heel Length

PERCENTILE VALUES

	%
1	1.8
2	2.9
3	3.5
5	4.5
10	6.2
15	7.2
20	8.2
25	8.9
30	9.6
35	10.2
40	10.8
45	11.3
50	11.9
55	12.4
60	12.9
65	13.5
70	14.1
75	14.6
80	15.3
85	16.1
90	16.7
95	17.8
97	18.2
98	18.5
99	19.0

Per cent Body Fat was calculated according to the technique of Pierson and Eagle.

Mean: 12.10 (.05) %

Standard Deviation: 4.02 (.04) %

Range: 0.1 - 23.9%

Coefficient of Variation: .33 (.003) %

N = 6534

Figure 7 Per Cent Body Fat

PERCENTILE VALUES

%	LB	KG
1	118.1	53.6
2	120.3	54.6
3	122.0	55.4
5	124.3	56.4
10	128.3	58.2
15	131.0	59.4
20	133.3	60.5
25	135.3	61.4
30	137.2	62.3
35	139.0	63.1
40	140.7	63.8
45	142.3	64.6
50	143.9	65.3
55	145.6	66.1
60	147.4	66.9
65	148.9	67.6
70	150.7	68.4
75	152.7	69.3
80	155.1	70.4
85	158.1	71.7
90	161.2	73.1
95	165.8	75.2
97	168.9	76.6
98	171.1	77.6
99	175.4	79.6

Lean Body Weight was calculated according to the technique of Pierson and Eagle.

Mean: 146.29 (.16) lb : 66.38 (.07) kg.

Standard Deviation: 12.65 (.11) lb : 5.74 (.05) kg.

Range: 109 - 193 lb , 49.64 - 87.66 kg.

Coefficient of Variation: 8.6 (.08) %

N = 6534

Figure 8 Lean Body Weight

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APPENDIX A

Anthropometric Data Record
NAVMED 1460 (11-64)

ANTHROPOMETRIC DATA RECORD
NAVMED 1460 (11-64) (PRINT OR TYPE PLAINLY)

NAME (Last, First, Middle Initial)		RANK/RATE	FILE/SERVICE NO.	DESIGNATOR	SERVICE
AGE	DATE OF EXAMINATION (Day Month Year)	ACTIVITY CONDUCTING EXAMINATION			

ANTHROPOMETRIC DATA

MEASUREMENTS

1. WEIGHT *Taken to nearest pound on standard scale with subject in underwear.*	POUNDS
2. HEIGHT *Vertical distance from floor to top of head with subject standing erect in bare feet.*	INCHES
3. SITTING HEIGHT *Vertical distance from seat surface to top of head with subject sitting erect.*	INCHES
4. SHOULDER WIDTH *Distance across shoulders between greatest protusion of deltoid muscles.*	INCHES
5. TRUNK HEIGHT *Vertical distance from seat surface to right shoulder with subject sitting erect.*	INCHES
6. BUTTOCK-KNEE LENGTH *Distance from back of right buttock to front of kneecap with subject sitting erect.*	INCHES
7. BUTTOCK-LEG LENGTH *Distance from back of right buttock to heel of foot with subject sitting erect.*	INCHES
8. FUNCTIONAL REACH *Horizontal distance from back of right shoulder to tips of thumb and forefinger pressed together.*	INCHES

SIZE CODE

SITTING HEIGHT CODE (From Item 3 Above)	HEIGHT CODE (From Item 2 Above)
A-32.0-34.9 INCHES	a-64.0-67.9 INCHES
B-35.0-37.5 INCHES	b-68.0-71.9 INCHES
C-37.6-38.5 INCHES	c-72.0-74.9 INCHES
D-38.6-41.0 INCHES	d-75.0-78.0 INCHES

IN BLOCK BELOW ENTER SITTING HEIGHT CODE FIRST USING A CAPITAL LETTER

FOLLOWED BY HEIGHT CODE USING A SMALL LETTER EXAMPLE - A, b.

SIZE CODE

DISTRIBUTION

1. ORIGINAL - *To be retained in health record*
2. COPY - *Forward with SF88 or SF600 to BUMED CODE 511 Washington, D.C. 20390*
3. COPY - *Send to Commanding Officer Naval Air Engineering Center (AICFL) Phila., Pa. 19112*

SIGNATURE (Of Examining Medical Officer/Flight Surgeon)

APPENDIX B

Frequency Distributions of Age and Eight Selected Variables Describing the 6534 Student Naval Aviators/Student Naval Flight Officers Examined in this Report

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
240.0	6	0.00122	0.00122	
252.0	699	0.10698	0.10820	XXXXXXXXXXXX
264.0	2762	0.42271	0.53092	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
276.0	1788	0.27365	0.80456	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
288.0	761	0.11647	0.92103	XXXXXXXXXXXXX
300.0	325	0.04974	0.97077	XXXXXX
312.0	124	0.01898	0.98975	XX
324.0	40	0.00612	0.99587	X
336.0	21	0.00321	0.99908	
348.0	6	0.00092	1.00000	

AGE IN MONTHS

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
117.0	1	0.00015	0.00015	
119.0	3	0.00046	0.00061	
121.0	5	0.00077	0.00138	X
123.0	16	0.00245	0.00383	XXX
125.0	20	0.00306	0.00689	XXX
127.0	23	0.00352	0.01041	XXXX
129.0	30	0.00459	0.01500	XXXXX
131.0	52	0.00796	0.02296	XXXXXXX
133.0	62	0.00949	0.03245	XXXXXXXXX
135.0	78	0.01194	0.04438	XXXXXXXXXXXX
137.0	82	0.01255	0.05693	XXXXXXXXXXXX
139.0	116	0.01775	0.07469	XXXXXXXXXXXXXXXXX
141.0	114	0.01745	0.09213	XXXXXXXXXXXXXXXX
143.0	130	0.01990	0.11203	XXXXXXXXXXXXXXXXXX
145.0	154	0.02357	0.13560	XXXXXXXXXXXXXXXXXXXXX
147.0	187	0.02862	0.16422	XXXXXXXXXXXXXXXXXXXXXXXX
149.0	185	0.02831	0.19253	XXXXXXXXXXXXXXXXXXXXXXXX
151.0	182	0.02785	0.22039	XXXXXXXXXXXXXXXXXXXXXXX
153.0	236	0.03612	0.25650	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
155.0	258	0.03949	0.29599	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
157.0	241	0.03688	0.33287	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
159.0	250	0.03826	0.37114	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
161.0	284	0.04346	0.41460	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
163.0	273	0.04178	0.45638	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
165.0	299	0.04576	0.50214	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
167.0	256	0.03918	0.54132	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
169.0	255	0.03903	0.58035	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
171.0	238	0.03642	0.61677	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
173.0	256	0.03918	0.65595	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
175.0	223	0.03413	0.69008	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
177.0	253	0.03872	0.72880	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
179.0	215	0.03290	0.76171	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
181.0	199	0.03046	0.79216	XXXXXXXXXXXXXXXXXXXXXXXXXXX
183.0	170	0.02602	0.81818	XXXXXXXXXXXXXXXXXXXXX
185.0	188	0.02877	0.84695	XXXXXXXXXXXXXXXXXXXXXXX
187.0	152	0.02326	0.87022	XXXXXXXXXXXXXXXXXX
189.0	131	0.02005	0.89027	XXXXXXXXXXXXXXXX
191.0	128	0.01959	0.90986	XXXXXXXXXXXXXXXX
193.0	95	0.01454	0.92440	XXXXXXXXXXX
195.0	107	0.01638	0.94077	XXXXXXXXXXXX
197.0	89	0.01362	0.95439	XXXXXXXXXX
199.0	63	0.00964	0.96403	XXXXXX
201.0	40	0.00612	0.97016	XXXXX
203.0	56	0.00857	0.97873	XXXXXX
205.0	30	0.00459	0.98332	XXXX
207.0	24	0.00367	0.98699	XXX
209.0	25	0.00383	0.99082	XXX
211.0	15	0.00230	0.99311	XX
213.0	15	0.00230	0.99541	XX
215.0	5	0.00077	0.99617	X
217.0	3	0.00046	0.99663	
219.0	6	0.00092	0.99755	X
221.0	3	0.00046	0.99801	
223.0	5	0.00077	0.99878	X
225.0	6	0.00092	0.99969	X
227.0	0	0.00000	0.99969	
229.0	1	0.00015	0.99985	
231.0	0	0.00000	0.99985	
233.0	0	0.00000	0.99985	
235.0	0	0.00000	0.99985	
237.0	0	0.00000	0.99985	
239.0	0	0.00000	0.99985	
241.0	0	0.00000	0.99985	
243.0	1	0.00015	1.00000	

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
62.7	1	0.00015	0.00015	
63.2	2	0.00031	0.00046	
63.7	15	0.00230	0.00275	X
64.2	27	0.00413	0.00689	XX
64.7	46	0.00704	0.01393	XXXX
65.2	73	0.01117	0.02510	XXXXXX
65.7	119	0.01821	0.04331	XXXXXXXXXX
66.2	177	0.02709	0.07040	XXXXXXXXXXXXXXX
66.7	242	0.03704	0.10744	XXXXXXXXXXXXXXXXXXXX
67.2	289	0.04423	0.15167	XXXXXXXXXXXXXXXXXXXXXXXX
67.7	359	0.05494	0.20661	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
68.2	455	0.06964	0.27625	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
68.7	471	0.07208	0.34833	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
69.2	528	0.08081	0.42914	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
69.7	494	0.07560	0.50474	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
70.2	557	0.08525	0.58999	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
70.7	476	0.07285	0.66284	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
71.2	455	0.06964	0.73248	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
71.7	399	0.06107	0.79354	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
72.2	362	0.05540	0.84894	XXXXXXXXXXXXXXXXXXXXXXXXXX
72.7	274	0.04193	0.89088	XXXXXXXXXXXXXXXXXXX
73.2	201	0.03076	0.92164	XXXXXXXXXXXXXX
73.7	161	0.02464	0.94628	XXXXXXXXXXX
74.2	137	0.02097	0.96725	XXXXXXXXXX
74.7	78	0.01194	0.97919	XXXXX
75.2	60	0.00918	0.98837	XXXX
75.7	40	0.00612	0.99449	XXX
76.2	19	0.00291	0.99740	XX
76.7	12	0.00184	0.99923	X
77.2	1	0.00015	0.99939	
77.7	4	0.00061	1.00000	

STATURE
(Standing Height)

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
31.7	1	0.00015	00015	
32.2	2	0.00031	0.00046	
32.7	4	0.00061	0.00107	
33.2	15	0.00230	0.00337	X
33.7	43	0.00658	0.00995	XX
34.2	179	0.02740	0.03734	XXXXXXXX
34.7	331	0.05066	0.08800	XXXXXXXXXXXXXXX
35.2	598	0.09152	0.17952	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
35.7	884	0.13529	0.31481	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
36.2	1014	0.15519	0.47000	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
36.7	1040	0.15917	0.62917	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
37.2	943	0.14432	0.77349	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
37.7	651	0.09963	0.87313	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
38.2	435	0.06657	0.93970	XXXXXXXXXXXXXXXXXXX
38.7	227	0.03474	0.97444	XXXXXXXXXX
39.2	115	0.01760	0.99204	XXXXX
39.7	38	0.00582	0.99786	XX
40.2	12	0.00184	0.99969	X
40.7	2	0.00031	1.00000	

SITTING HEIGHT

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
15.0	12	0.00184	0.00184	
15.5	57	0.00872	0.01056	XX
16.0	246	0.03765	0.04821	XXXXXXXXX
16.5	568	0.08693	0.13514	XXXXXXXXXXXXXXXXX
17.0	1280	0.19590	0.33104	XXXXXXXXXXXXXXXXXXXX)XXXXXXXXXXXXXXXXXXXX
17.5	1270	0.19437	0.52541	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
18.0	1351	0.20676	0.73217	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
18.5	881	0.13483	0.86700	XXXXXXXXXXXXXXXXXXXXXXXXXXX
19.0	565	0.08647	0.95347	XXXXXXXXXXXXXXXXX
19.5	210	0.03214	0.98561	XXXXXXX
20.0	66	0.01010	0.99571	XX
20.5	20	0.00306	0.99878	X
21.0	8	0.00122	1.00000	

SHOULDER WIDTH

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
20.4	5	0.00077	0.00077	
20.9	25	0.00383	0.00459	X
21.4	42	0.00643	0.01102	XX
21.9	151	0.02311	0.03413	XXXXXXX
22.4	306	0.04683	0.08096	XXXXXXXXXXXXX
22.9	561	0.08586	0.16682	XXXXXXXXXXXXXXXXXXXXXXX
23.4	858	0.13131	0.29813	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
23.9	959	0.14677	0.44490	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
24.4	1108	0.16957	0.61448	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
24.9	853	0.13055	0.74503	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
25.4	715	0.10943	0.85445	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
25.9	446	0.06826	0.92271	XXXXXXXXXXXXXXXXX
26.4	251	0.03841	0.96113	XXXXXXXXXX
26.9	120	0.01837	0.97949	XXXXX
27.4	77	0.01178	0.99128	XXX
27.9	34	0.00520	0.99648	X
28.4	8	0.00122	0.99770	
28.9	11	0.00168	0.99939	
29.4	2	0.00031	0.99969	
29.9	2	0.00031	1.00000	

BUTTOCK-KNEE LENGTH

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
32.5	2	0.00031	0.00031	
33.0	1	0.00015	0.00046	
33.5	1	0.00015	0.00061	
34.0	1	0.00015	0.00077	
34.5	0	0.00000	0.00077	
35.0	1	0.00015	0.00092	
35.5	0	0.00000	0.00092	
36.0	2	0.00031	0.00122	
36.5	0	0.00000	0.00122	
37.0	1	0.00015	0.00138	
37.5	3	0.00046	0.00184	
38.0	11	0.00168	0.00352	X
38.5	21	0.00321	0.00673	X
39.0	51	0.00781	0.01454	XXXX
39.5	55	0.00842	0.02296	XXXX
40.0	132	0.02020	0.04316	XXXXXXXXX
40.5	136	0.02081	0.06397	XXXXXXXXX
41.0	322	0.04928	0.11325	XXXXXXXXXXXXXXXXXXXXX
41.5	370	0.05663	0.16988	XXXXXXXXXXXXXXXXXXXXXXXX
42.0	530	0.08111	0.25099	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
42.5	497	0.07606	0.32706	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
43.0	610	0.09336	0.42042	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
43.5	563	0.08616	0.50658	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
44.0	678	0.10376	0.61035	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
44.5	534	0.08173	0.69207	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
45.0	535	0.08188	0.77395	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
45.5	376	0.05755	0.83150	XXXXXXXXXXXXXXXXXXXXXXXXX
46.0	365	0.05586	0.88736	XXXXXXXXXXXXXXXXXXXXXXXX
46.5	250	0.03826	0.92562	XXXXXXXXXXXXXXXX
47.0	208	0.03183	0.95745	XXXXXXXXXXXXXX
47.5	111	0.01699	0.97444	XXXXXXX
48.0	73	0.01117	0.98561	XXXXX
48.5	37	0.00566	0.99128	XXX
49.0	29	0.00444	0.99571	XX
49.5	15	0.00230	0.99801	X
50.0	12	0.00184	0.99985	X
50.5	1	0.00015	1.00000	

BUTTOCK-HEEL LENGTH

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
0.1	11	0.00168	0.00168	XX
0.6	13	0.00199	0.00367	XX
1.1	7	0.00107	0.00474	X
1.6	21	0.00321	0.00796	XXX
2.1	29	0.00444	0.01240	XXXX
2.6	30	0.00459	0.01699	XXXX
3.1	37	0.00566	0.02265	XXXXX
3.6	52	0.00796	0.03061	XXXXXXX
4.1	69	0.01056	0.04117	XXXXXXXXXX
4.6	61	0.00934	0.05051	XXXXXXXXX
5.1	90	0.01377	0.06428	XXXXXXXXXXXXX
5.6	103	0.01576	0.08004	XXXXXXXXXXXXXXX
6.1	109	0.01668	0.09672	XXXXXXXXXXXXXXXX
6.6	147	0.02250	0.11922	XXXXXXXXXXXXXXXXXXXX
7.1	173	0.02648	0.14570	XXXXXXXXXXXXXXXXXXXXXXXX
7.6	121	0.01852	0.16422	XXXXXXXXXXXXXXXX
8.1	188	0.02877	0.19299	XXXXXXXXXXXXXXXXXXXXXXXXX
8.6	222	0.03398	0.22697	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
9.1	229	0.03505	0.26201	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
9.6	239	0.03658	0.29859	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10.1	276	0.04224	0.34083	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
10.6	260	0.03979	0.38062	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11.1	314	0.04806	0.42868	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
11.6	310	0.04744	0.47612	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12.1	287	0.04392	0.52005	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
12.6	297	0.04545	0.56550	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
13.1	337	0.05158	0.61708	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
13.6	312	0.04775	0.66483	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
14.1	254	0.03887	0.70370	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
14.6	286	0.04408	0.74778	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
15.1	243	0.03719	0.78497	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
15.6	231	0.03535	0.82032	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
16.1	213	0.03260	0.85292	XXXXXXXXXXXXXXXXXXXXXXXXXXX
16.6	223	0.03413	0.88705	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
17.1	167	0.02556	0.91261	XXXXXXXXXXXXXXXXXXXXX
17.6	184	0.02816	0.94077	XXXXXXXXXXXXXXXXXXXXXXX
18.1	158	0.02418	0.96495	XXXXXXXXXXXXXXXXXXX
18.6	118	0.01806	0.98301	XXXXXXXXXXXXXXX
19.1	54	0.00826	0.99128	XXXXXXX
19.6	27	0.00413	0.99541	XXXX
20.1	9	0.00138	0.99679	X
20.6	4	0.00061	0.99740	X
21.1	5	0.00077	0.99816	X
21.6	4	0.00061	0.99878	X
22.1	4	0.00061	0.99939	X
22.6	2	0.00031	0.99969	
23.1	1	0.00015	0.99985	
23.6	1	0.00015	1.00000	

% BODY FAT

INTER.	N	PCT	CUM	(X = 1/48TH MODAL FREQ)
109.4	2	0.00031	0.00031	
111.4	2	0.00031	0.00061	
113.4	3	0.00046	0.00107	
115.4	18	0.00275	0.00383	XX
117.4	24	0.00367	0.00750	XXX
119.4	52	0.00796	0.01546	XXXXXX
121.4	66	0.01010	0.02556	XXXXXXXX
123.4	102	0.01561	0.04117	XXXXXXXXXXXX
125.4	131	0.02005	0.06122	XXXXXXXXXXXXXXX
127.4	153	0.02342	0.08463	XXXXXXXXXXXXXXXXX
129.4	232	0.03551	0.12014	XXXXXXXXXXXXXXXXXXXXXXXXXX
131.4	245	0.03750	0.15764	XXXXXXXXXXXXXXXXXXXXXXXXXXX
133.4	297	0.04545	0.20309	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
135.4	337	0.05158	0.25467	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
137.4	333	0.05096	0.30563	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
139.4	372	0.05693	0.36257	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
141.4	396	0.06061	0.42317	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
143.4	409	0.06260	0.48577	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
145.4	398	0.06091	0.54668	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
147.4	401	0.06137	0.60805	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
149.4	378	0.05785	0.66590	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
151.4	343	0.05249	0.71840	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
153.4	324	0.04959	0.76798	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
155.4	254	0.03887	0.80686	XXXXXXXXXXXXXXXXXXXXXXXXXXXX
157.4	215	0.03290	0.83976	XXXXXXXXXXXXXXXXXXXXXXX
159.4	220	0.03367	0.87343	XXXXXXXXXXXXXXXXXXXXXXXX
161.4	195	0.02984	0.90328	XXXXXXXXXXXXXXXXXXXX
163.4	145	0.02219	0.92547	XXXXXXXXXXXXXX
165.4	147	0.02250	0.94796	XXXXXXXXXXXXXX
167.4	83	0.01270	0.96067	XXXXXXXXX
169.4	83	0.01270	0.97337	XXXXXXXXX
171.4	54	0.00826	0.98163	XXXXX
173.4	24	0.00367	0.98531	XXX
175.4	32	0.00490	0.99020	XXXX
177.4	24	0.00367	0.99388	XXX
179.4	13	0.00199	0.99587	XX
181.4	7	0.00107	0.99694	X
183.4	5	0.00077	0.99770	X
185.4	7	0.00107	0.99878	X
187.4	4	0.00061	0.99939	
189.4	1	0.00015	0.99954	
191.4	3	0.00046	1.00000	

LEAN BODY WEIGHT