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PRELIMINARY ANTHROPOMETRIC SURVEY OF CANADIAN FORCES WOMEN

G.A.H. MacDonald

K.A. Sharrard

M.C. Taylor

Defence and Civil Institute of Environmental Medicine
1133 Sheppard Avenue West, P.O. Box 2000
Downsview, Ontario
M3M 3B9

DEPARTMENT OF NATIONAL DEFENCE - CANADA

ABSTRACT

A preliminary survey of the anthropometry of Canadian Forces (CF) females was conducted at CFB Borden in October 1977. A series of 42 body dimensions were measured on 137 women. The data from this initial study are presented, along with comparisons of CF males and females for some anthropometric dimensions which are critical in workspace design.

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PRELIMINARY ANTHROPOMETRIC SURVEY OF CANADIAN FORCES WOMEN

INTRODUCTION

An increasing number of women are joining the Armed Forces in Canada and entering service trades that have been exclusively male occupations. As the equipment and procedures used in the Canadian Forces (CF) have been designed for the male operator, there is some question whether women have the necessary size and physical capabilities to function effectively in all trades.

Previous comprehensive anthropometric studies in Canada have focused on the male population, therefore few data are available for use in the design and evaluation of clothing and equipment for CF women. A survey of the anthropometry of Canadian servicewomen is thus required and should in addition, provide information relevant to the study of the specific work capabilities of women within the CF.

A large scale survey of the anthropometry of CF females is underway. This report presents the findings of the initial phase of the study, conducted at CFB Borden in October 1977. A series of 42 body dimensions were measured on 137 women.

PROCEDURES

Sample

One hundred and thirty-seven women from CFB Borden participated in the study. As CFB Borden is primarily a training base, the data collected are not assumed to represent the entire female population in the CF. The age distribution within the sample and the trade/classification of the subjects, are given in Appendix A.

Equipment

Portable anthropometric measuring equipment used in this survey consisted of the following:

medical scales,
free-standing anthropometer, Siber Hegner 101,
sliding calipers, Siber Hegner 104,
spreading calipers, Siber Hegner 106,
two-metre flexible measuring tape,
measuring bench,
stacking plywood squares (variable height footrest),
foot-measuring box,

triangular measuring blocks,
floor scale,
two wall scales.

For the measurement of arm lengths, a corner was used; the corner being strictly defined as two vertical walls (on which the wall scales were mounted), meeting at 90 degrees. Further description of the equipment used is given by McCann et al. (1975).

Measurements

The 42 dimensions measured were selected to give a set of basic anthropometric data which includes parameters useful in clothing design as well as measurements required for human engineering studies. Detailed descriptions of each measurement, accompanied by sketches, are provided in this report. A glossary is also provided to clarify the terminology and landmarks used (Appendix B).

The measurement team consisted of two DCIEM staff members who had been trained to a level where reliable measurements were assured. The subjects wore only light underclothing (bra and panties) while the measurements were taken. Mass was recorded to the nearest 0.1 kilograms and the other dimensions were measured to the nearest millimetre.

Data Treatment

The data were recorded on data sheets, with the sequence of measurements remaining constant. When a set of measurements for a given subject was not completed, the recorded data were included in the analysis. In the case of obvious recorder error, the particular value was discarded but the other measurements were retained.

A summary of the data was compiled for each of the 42 measurements, including frequency histograms, summary statistics and percentile equivalents. The statistical definitions used are detailed in Appendix B.

RESULTS

The data summaries and frequency histograms for each of the 42 measurements are presented in alphabetical order by measurement name, in Appendix C (pp. 21-105). A written definition and sketch of the dimensions measured are included, along with certain percentile equivalents derived from the raw data. The summary statistics that were calculated for each measurement are range, mean ($\bar{X}$), standard error of the mean (SEM), standard deviation (SD) and its error term (SE (SD)), and coefficients of variation, skewedness and kurtosis. The frequency histograms are shaded to indicate the area of $\pm$ 1-2 standard deviations from the mean ($\bar{X}$).

DISCUSSION

Comparison with Canadian Civilian Women

The present policy of the CF includes the screening of recruits on the basis of weight (mass) and height (stature). The basic weight requirement for females is 46.3 kg (102 lb) minimum, with a maximum of 84.8 kg (187 lb). The minimum height standard is 152.4 cm (5 ft), with no corresponding maximum. This screening procedure prevents some of the extremes of body size from entering the military population.

The mean weight and height of servicewomen in this study were found to be 60.7 kg and 162 cm respectively. Applying the age frequency distribution in this sample to age-related data on Canadian civilian females (Nutrition Canada, 1975), the comparable civilian means were 57.5 kg and 161 cm. In view of the variance reported for the Nutrition Canada data, the 137 military women appear to be similar to their civilian counterparts in terms of weight and height.

Comparison with U.S. Army Women

Differences in the precise definition of the anthropometric measurements used in various surveys, hinders comparison of data from this survey with a comprehensive study recently completed on U.S. army women (Churchill et al., 1977). Only 15 measurements are common to both studies, if the exact location and technique are closely compared. The results of this initial CF survey suggest that Canadian servicewomen are similar to U.S. army females, however a more extensive comparison is required to verify this relationship.

Comparison with Canadian Forces Males

Appendix D presents comparisons between the CF women in this study and CF males (McCann et al., 1975) for some body dimensions which relate to workspace design. Although the small female population in this study is not necessarily representative of CF women, histograms A-E indicate (as might be expected) that women in the CF are significantly smaller than the males. Despite some overlap between the sexes, the 50th percentile female corresponds to the 5th percentile male for a given body dimension. The 95th percentile values for the women correspond to the 50th percentile equivalents for the male population. As the 5th and 95th percentile male body sizes are normally used as the limits for equipment design, a considerable number of women are not being accomodated by current design standards.*

* Current human engineering standards (MIL-STD-1472B) require designs to accomodate 90 percent of the user population size range, however, this is frequently not the case, even for the male user population.

Strength and other work performance parameters are influenced to some degree by body dimensions (Haynes, 1962; Kroemer, 1970), as well as physical training, technique, motivation etc. Therefore the basic anthropometric differences shown in Appendix D may parallel the difficulties some individuals (both male and female) have when performing the physical work required in their jobs.

CONCLUSIONS AND RECOMMENDATIONS

1. Although the limited sample of subjects in this preliminary survey may not be fully representative of CF women, the 50th percentile female appears to correspond with the 5th percentile male for many body dimensions. Therefore a large proportion of servicewomen are not accomodated by existing design standards.

2. This preliminary anthropometric survey should be expanded to provide a representative data base on Canadian Forces women, for use in the design and evaluation of clothing and equipment.

3. Strength and other physical work performance parameters should be examined in conjunction with anthropometry, in an attempt to identify and remedy some of the problems encountered in Canadian Forces job roles.

4. Similarly, the actual range of uses of anthropometric data by equipment designers etc., could usefully be studied, in order to ensure their continued applicability.

5. Technique and measurement definition should be standardized, to facilitate comparisons with anthropometric studies carried out on other populations.

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APPENDICES

APPENDIX A

AGE DISTRIBUTION IN SAMPLE POPULATION

Summary Statistics *

Range: 18 - 39 yrs.

Mean: 21.6 yrs.
SEM: 0.3 yrs.

Standard Deviation: 3.7 yrs
SE (SD): 0.2 yrs.

Coefficient of Variation: 17.2%

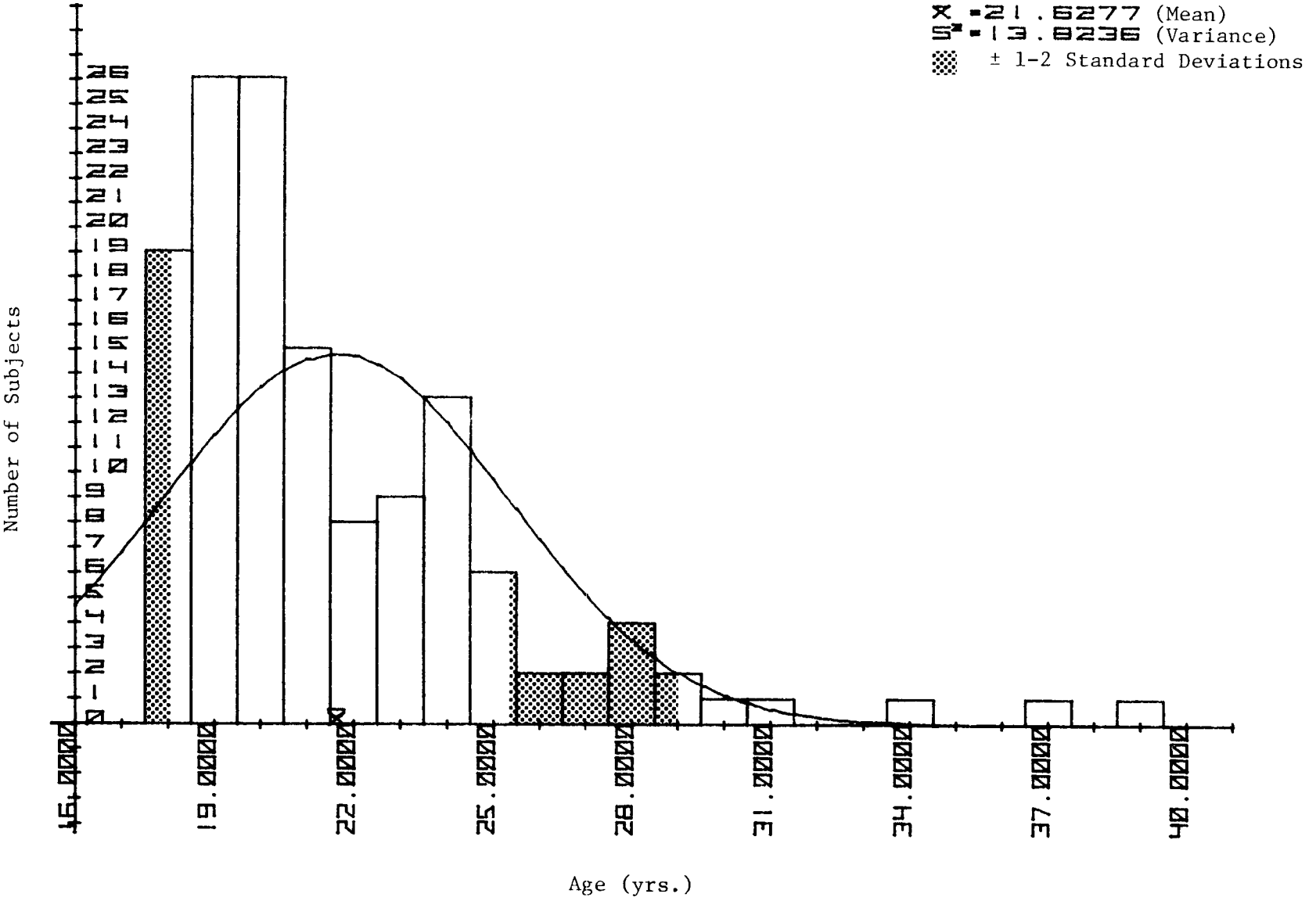
Coefficient of Skewedness: 1.9
Coefficient of Kurtosis: 7.9

Number of Subjects: 137

Percentile Equivalents

years	percentile
18.0	1st
18.0	5th
18.0	10th
18.6	25th
19.9	50th
23.0	75th
25.6	90th
28.1	95th
36.9	99th

* Statistical definitions are outlined on pp. 19 and 20.



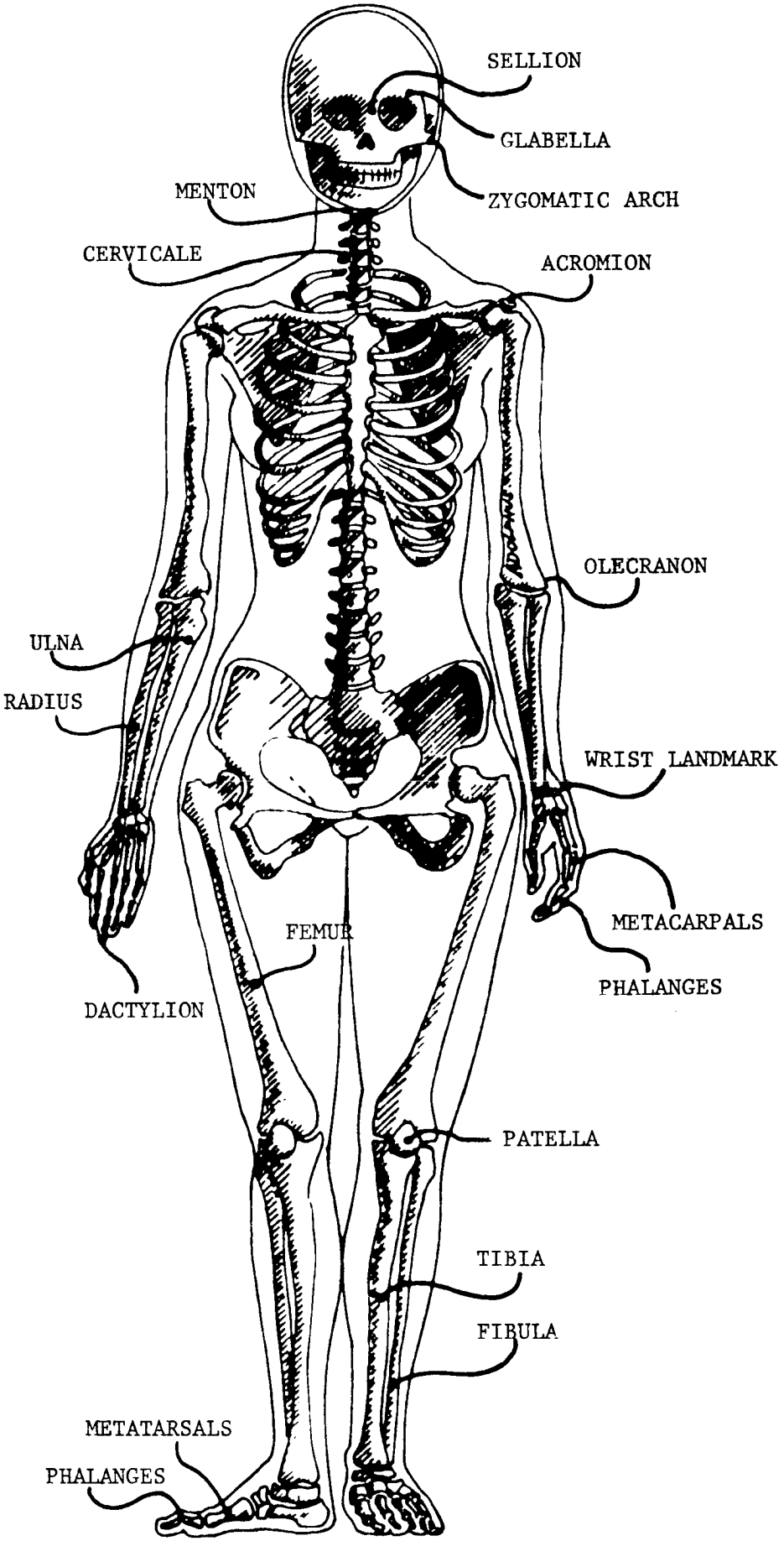
Frequency histogram for age.

CLASSIFICATION/TRADE DISTRIBUTION IN SAMPLE POPULATION

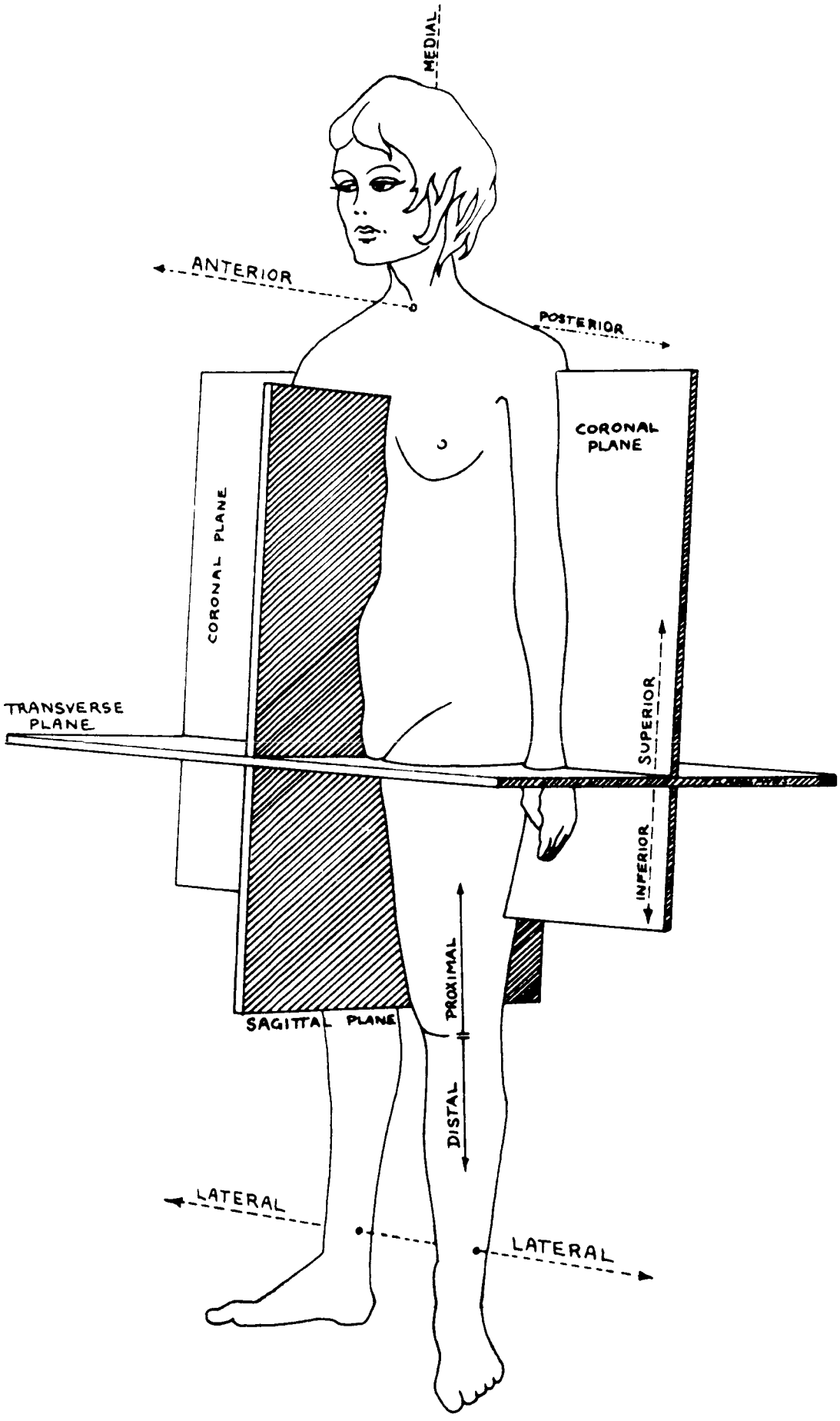
Officers:	* Frequency in Sample Population
Air Traffic Control (63)	1
Air Weapons Control (64)	1
Personnel Support (79)	1
Security (81)	1
Nursing (57)	5
Other Ranks:	
Photographic Technician (131)	9
Air Traffic Control Assistant (162)	5
Air Defence Tehcnician (171)	4
Radio Operator (212)	1
Teletype Operator (212)	4
Radio Technician (221)	1
Terminal Equipment Technician (222)	1
Teletype and Cipher Technician (223)	1
Vehicle Technician (411)	6
Weapons Technician - Land (421)	7
Ammunition Technician (423)	3
Electro-Mechanical Technician (431)	1
Airframe Technician (512)	2
Safety Systems Technician (531)	4
Weapons Technician - Air (571)	5
Medical Assistant (711)	11
Military Policeman (811)	6
Administrative Clerk	12
Accounting and Finace Clerk (841)	5
Physical Education and Recreation Instructor (851)	1
Cook (861)	1
Postal Clerk (881)	1
Supply Technician (911)	14
Traffic Technician (933)	4
Mobile Support Equipment Operator (935)	6

* Thirteen individuals did not specify their trade.

APPENDIX B



Skeletal Reference Points and Landmarks.



Major Anatomical Planes.

GLOSSARY

Abdominal: pertaining to the portion of the body which lies between the rib cage (thorax) and the pelvis.

Abduct: to move a body segment away from the midline of the body or body part to which it is attached.

*Acromial Landmark: the superior aspect of the lateral side of the acromion. This point is located by palpating the lateral extension of the spine of the scapula, which forms the highest point of the shoulder.

Anatomical Position: the standardized body position, described as being that of a standing or erect body which is extended with the feet together, the arms at the sides of the body and the palms of the hands facing forward.

Anterior: pertaining to the front or forward part of the body or body segment, as opposed to posterior.

Biceps Brachii: the large muscle mass on the anterior surface of the upper arm.

Biceps Landmark: the point at which the maximum circumference of the flexed biceps is measured, with the right arm flexed at 90^{o} and the measuring tape held perpendicular to the long axis of the upper arm.

Bustpoint Landmark: the most anterior protrusion of the bra cup.

Cartilaginous: consisting of or of the nature of cartilage (a specialized fibrous connective tissue).

*Cervicale Landmark: the tip of the spinous process of the seventh cervical vertebra, located by palpation of the protrusion of the spinal column at the base of the neck.

Dactylion: the distal tip of the middle finger (medius).

Deltoid Muscle: the large muscle mass on the lateral border of the upper arm, in the shoulder region.

Distal: pertaining to the part of the body or body segment furthest from the median plane or midline of the body, as opposed to proximal.

Dorsiflex: to move the foot such that the angle between the dorsal (upper) surface of the foot and the long axis of the lower leg, decreases.

Extension: a movement in which two adjacent body segments change their positions relative to one another so that the angle formed between them is made to increase in magnitude, as opposed to flexion.

Flexion: a movement in which two adjacent body segments change their positions relative to one another so that the angle formed between them is made to decrease in magnitude, as opposed to extension.

Fossa: the general term which denotes a hollow or depressed area.

Frankfort Plane (McCann et al., 1975): A standard plane for orientation of the head. Established by a line passing through the right tragion (the notch located just above the small cartilaginous flap of flesh in front of the ear), and the lowest point of the right eye socket. Can be approximated by having the subject stand so that his line of sight is horizontal.

Glabella Landmark: the most anterior part of the forehead between the brow ridges.

Gluteal Fold: the indentation formed by the junction of the buttock and the back of the upper leg.

Hyperextension: an extension movement which is continued beyond the anatomical reference position.

Inferior: pertaining to the lower part of the body or body segment, as opposed to superior.

Lateral: pertaining to the part of the body or body segment furthest from the median plane or midline of the body, as opposed to medial.

Line of Sight Horizontal: The Frankfort plane is commonly used as the standard orientation of the head for anthropometric measurements. When this definition is used some variation in actual head position (particularly in natural line of sight) occurs between subjects due to differences in facial structure. Orienting the head by making the subject look straight ahead may help minimize this variation. The head position can be standardized by having the subject look directly at his eyes in a mirror which is held in the vertical plane in front of him.

Medial: pertaining to the part of the body or body segment closest to the median plane or midline of the body, as opposed to lateral.

Menton: the lowest point of the tip of the chin, in the midsagittal plane.

Metacarpal-Phalangeal Joints II and V: the midpoint of the joints, where the second and fifth fingers join the palm of the hand.

Metatarsal-Phalangeal Joint: the junction of the proximal phalanx of the toe with the metatarsal bones of the instep of the foot.

Midsagittal Plane: the vertical plane which divides the body into essentially equal right and left sections.

Olecranon Process: the proximal bony projection of the ulna, at the elbow.

Omphalion: the midpoint of the umbilicus or navel.

Palpate: to use the fingers to exert light pressure on the body surface in order to locate underlying bony landmarks.

Patella: the bone which forms the anterior surface of the knee joint (kneecap).

Phalanges: the bones of the fingers or toes (singular-phalanx).

Plantar Surface: the under surface or sole of the foot.

Popliteal: the fossa which forms the posterior surface of the knee.

Posterior: pertaining to the back or dorsal surface of the body or body segment, as opposed to anterior.

Pronate: to turn the palm of the hand backward (posteriorly) or downward, by medial rotation of the forearm.

Proximal: pertaining to the part of the body or body segment closest to the median plane or midline of the body, as opposed to distal.

Scapula: the flat triangular bone which forms the back of the shoulder.

Sellion: the point of greatest indentation of the nasal root depression.

Sits Erect: Subject sits on flat surface with weight evenly distributed, shoulders held back, and the torso held straight, but not rigid.

Stands Erect: Subject stands on flat surface, weight distributed equally, shoulders held back and legs fully straightened. This position requires holding the body straight but not rigid.

Supinate: to turn the palm of the hand forward (anteriorly) or upward, by lateral rotation of the forearm.

Superior: pertaining to the upper part of the body or body segment, as opposed to inferior.

Tragion: the point located at the notch just above the small cartilaginous flap of flesh in front of the external ear opening (tragus).

Ulna: the inner and larger bone of the forearm on the side opposite that of the thumb.

Wrist Landmark: the midpoint of the styloid process of the ulna (the small bony protrusion on the little finger side of the wrist).

Zygomatic Arch: the bony arch extending horizontally along the side of the face from the cheekbone nearly to the external ear.

*these points are marked on the subject's body.

STATISTICAL DEFINITIONS

Range:

Measure of dispersion showing smallest and largest values recorded for a specific body dimension.

Mean:

Measure of central tendency, shown on frequency histogram as $\bar{X}$.

$$\bar{X} = \frac{\sum_{i=1}^{N} X_i}{N}$$

X_i = Magnitude of given dimension for any individual.

N = Number of subjects.

Standard Deviation:

Measure of dispersion. Values of ± 1-2 standard deviations from the mean ($\bar{X}$), are shaded on frequency histograms.

$$SD = \sqrt{\frac{\sum_{i=1}^{N} X_i^2 - \frac{\left(\sum_{i=1}^{N} X_i\right)^2}{N}}{N-1}}$$

Variance, $(SD)^2$, is shown on histogram as S^2.

Standard Error of Mean (SEM):

Estimated standard deviation of the distribution of sampling errors of the mean.

$$SEM = \frac{SD}{\sqrt{N}}$$

Standard Error of Standard Deviation (SE(SD)):

$$SE(SD) = 0.7071 \times SEM$$

Coefficient of Variation:

Measure of relative dispersion.

$$V(\text{in } \%) = \frac{SD}{\bar{X}} \times 100$$

Coefficient of Skewedness:

Measure of symmetry.

$$a_3 = \frac{\left(\frac{\sum_{j=1}^{N} (X_j - \bar{X})^3}{N} \right)}{(SD)^3}$$

a_3 negative
- skewed to right

a_3 zero
- symmetrical

a_3 positive
- skewed to left

Coefficient of Kurtosis:

Measure of peakedness

$$a_4 = \frac{\left(\frac{\sum_{j=1}^{N} (X_j - \bar{X})^4}{N} \right)}{(SD)^4}$$

(a_4-3) negative
- platykurtic (flat)

(a_4-3) zero
- normal

(a_4-3) positive
- leptokurtic (peaked)

Percentile Equivalents:

Interpolated graphically between actual data points. The 50th percentile corresponds to the median.

Data are converted from the metric units in which they were measured, to pounds and inches, using the following conversion factors.

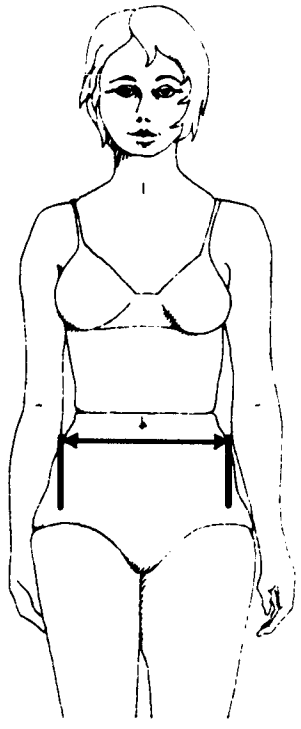
kg X 2.2046 = pounds
cm X .3937 = inches

APPENDIX C

Univariate Statistics

(1) ABDOMINAL BREADTH

Subject stands erect, with heels together and is asked to relax abdominal muscles. The maximum horizontal breadth of the abdomen is measured at the average point of quiet respiration, using the beam calipers.



Summary Statistics

centimetres		inches
26.4 - 41.1	Range	10.4 - 16.2
32.16	Mean	12.66
0.22	SEM	0.09
2.61	Std. Dev.	1.03
0.16	SE (SD)	0.06

Coefficient of Variation: 8.12%

Coefficient of Skewedness: 0.37

Coefficient of Kurtosis: 3.36

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
26.2	1st	10.3
27.6	5th	10.9
28.4	10th	11.2
29.9	25th	11.8
31.7	**50th**	**12.5**
33.5	75th	13.2
34.8	90th	13.7
35.8	95th	14.1
38.6	99th	15.2

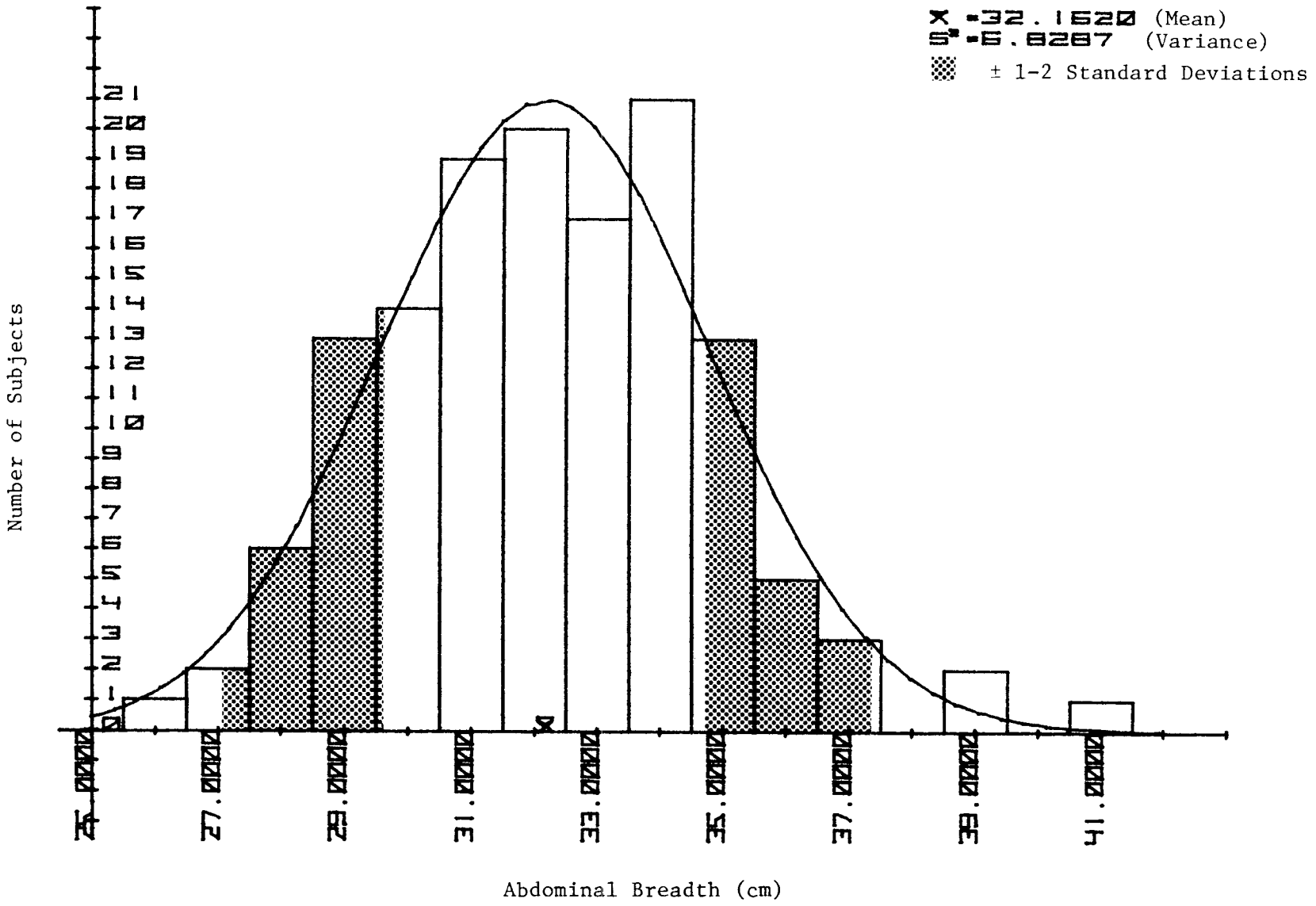
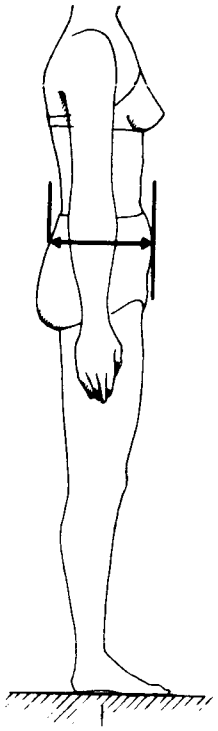


Figure 1: Frequency histogram for abdominal breadth.

(2) ABDOMINAL DEPTH

Subject stands erect, with heels together and is asked to relax abdominal muscles. The maximum horizontal depth of the abdomen is measured at the average point of quiet respiration, using the beam calipers.



Summary Statistics

centimetres		inches
16.4 - 31.0	Range	6.5 - 12.2
22.44	Mean	8.83
0.24	SEM	0.09
2.81	Std. Dev.	1.11
0.17	SE (SD)	0.07

Coefficient of Variation: 12.52%

Coefficient of Skewedness: 0.59

Coefficient of Kurtosis: 3.18

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
16.7	1st	6.6
18.0	5th	7.1
18.8	10th	7.4
20.1	25th	7.9
21.6	**50th**	**8.5**
23.8	75th	9.4
25.9	90th	10.2
27.1	95th	10.7
29.6	99th	11.7

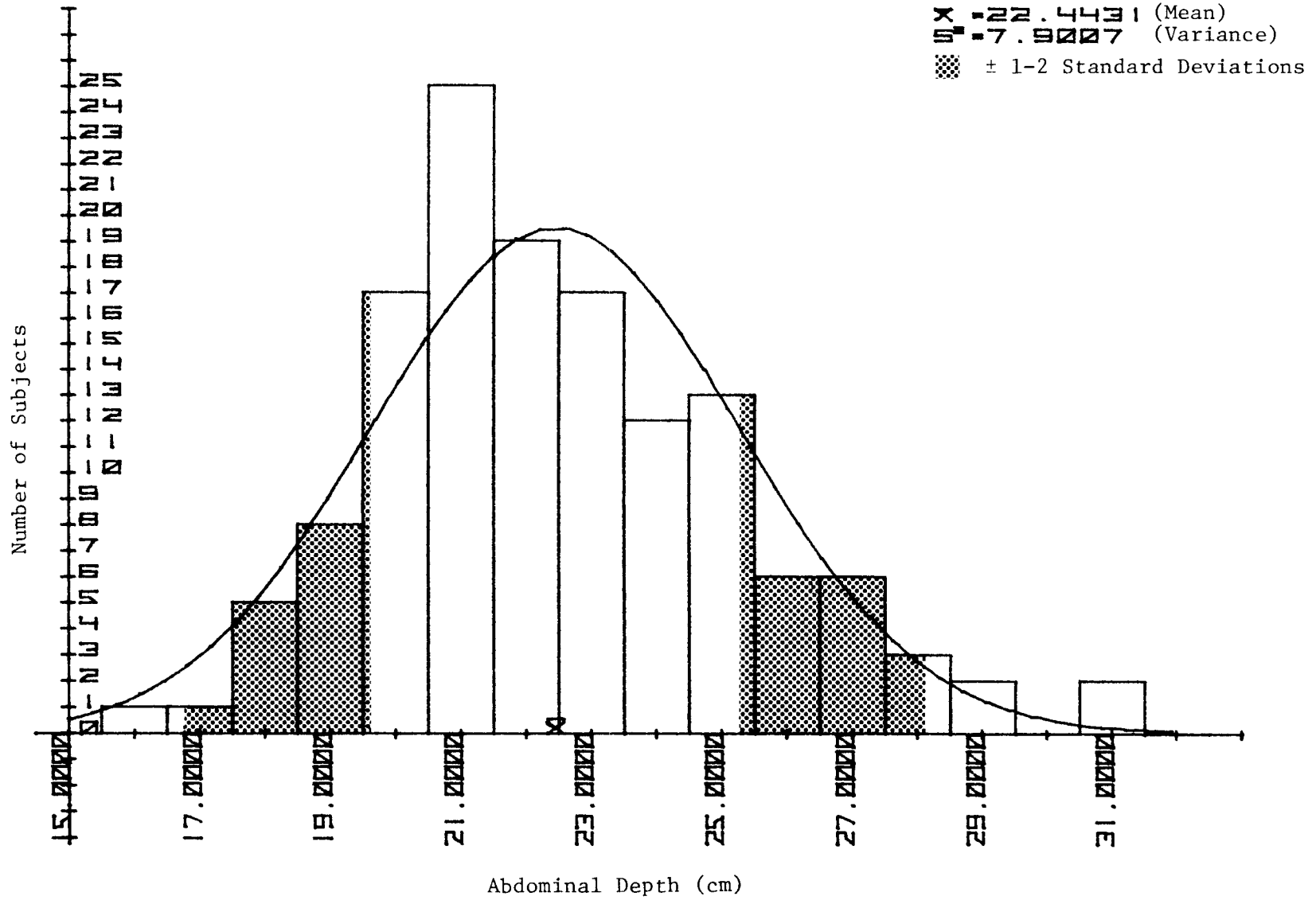
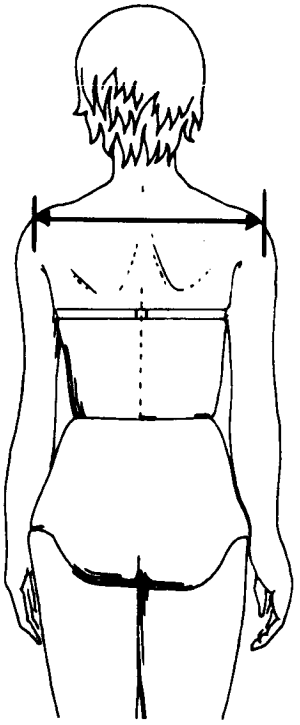


Figure 2: Frequency histogram for abdominal depth.

(3) BIACROMIAL BREADTH

Subject stands erect, with heels together and arms relaxed at the sides. The horizontal distance between the two acromial landmarks is measured with the beam calipers.



Summary Statistics

centimetres		inches
29.8 - 41.7	Range	11.7 - 16.4
36.00	Mean	14.17
0.17	SEM	0.07
1.95	Std. Dev.	0.77
0.12	SE (SD)	0.05

Coefficient of Variation: 0.42%

Coefficient of Skewedness: -0.26

Coefficient of Kurtosis: 3.65

Number of Subjects: 134

Percentile Equivalents

cm	percentile	in
29.9	1st	11.8
32.3	5th	12.7
33.1	10th	13.0
33.3	25th	13.1
35.6	**50th**	**14.0**
36.9	75th	14.5
37.8	90th	14.9
38.7	95th	15.2
40.7	99th	16.0

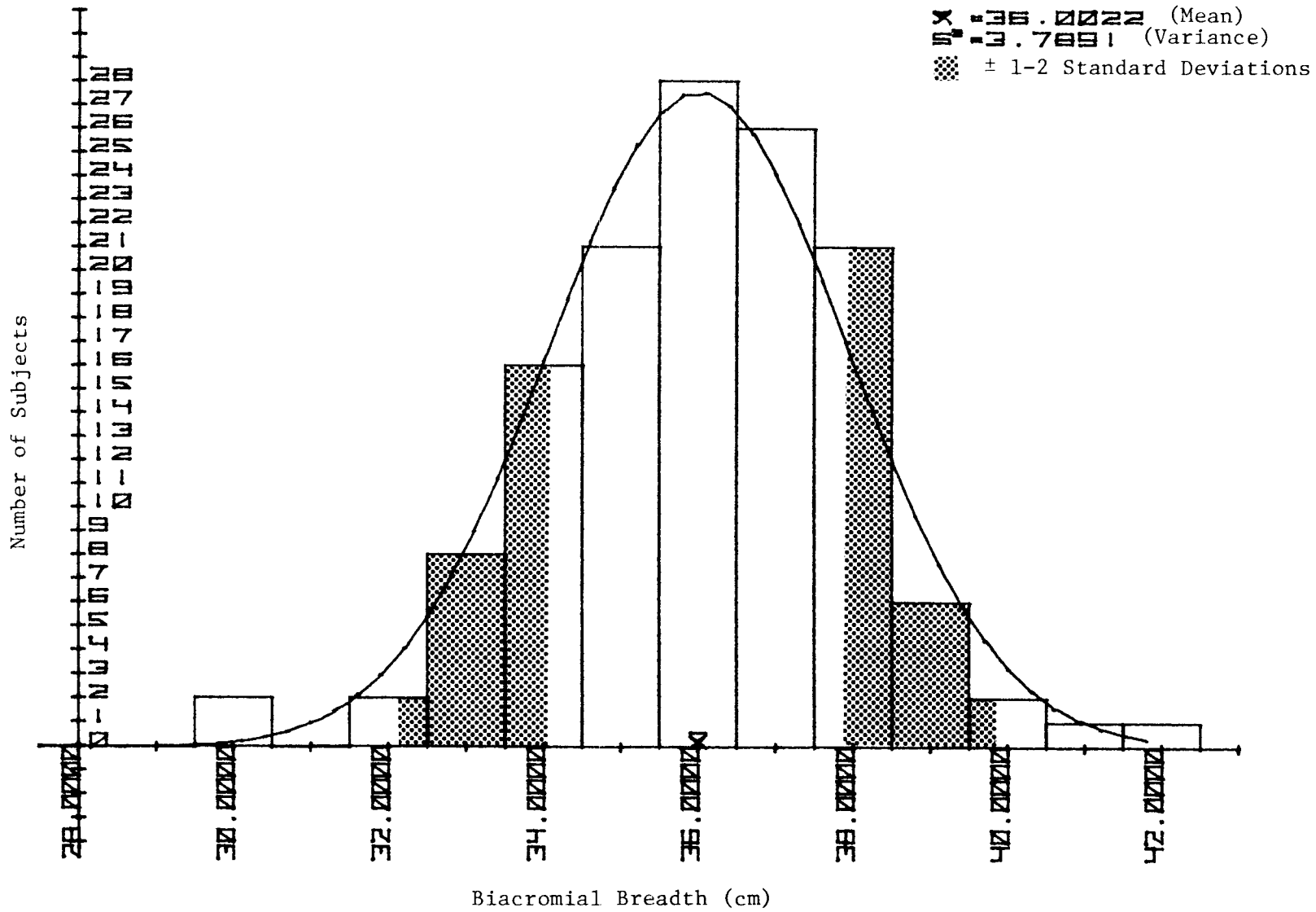


Figure 3: Frequency histogram for biacromial breadth.

(4) BICEPS CIRCUMFERENCE - FLEXED

Subject stands erect, right arm extended horizontally forward, elbow flexed and forearm raised vertically. The fist is tightly clenched and the biceps maximally contracted. With the measuring tape held in a plane perpendicular to the long axis of the right upper arm, the maximum biceps circumference (biceps landmark) is measured.

Summary Statistics

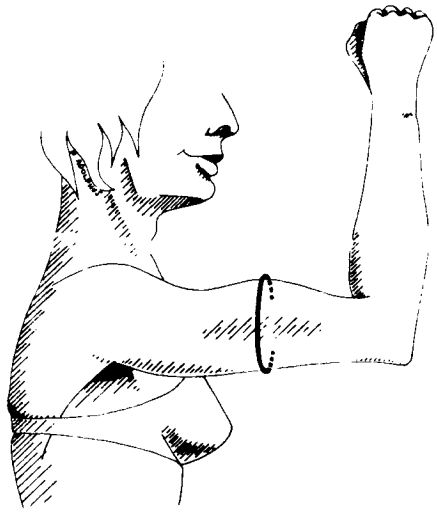
centimetres		inches
23.5 - 33.9	Range	9.3 - 13.3
28.44	Mean	11.20
0.19	SEM	0.07
2.27	Std. Dev.	0.89
0.14	SE (SD)	0.06

Coefficient of Variation: 7.98%

Coefficient of Skewedness: 0.30

Coefficient of Kurtosis: 2.68

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
23.7	1st	9.3
24.7	5th	9.7
25.3	10th	10.0
26.4	25th	10.4
28.0	**50th**	**11.0**
29.3	75th	11.5
31.3	90th	12.3
32.4	95th	12.8
33.5	99th	13.2

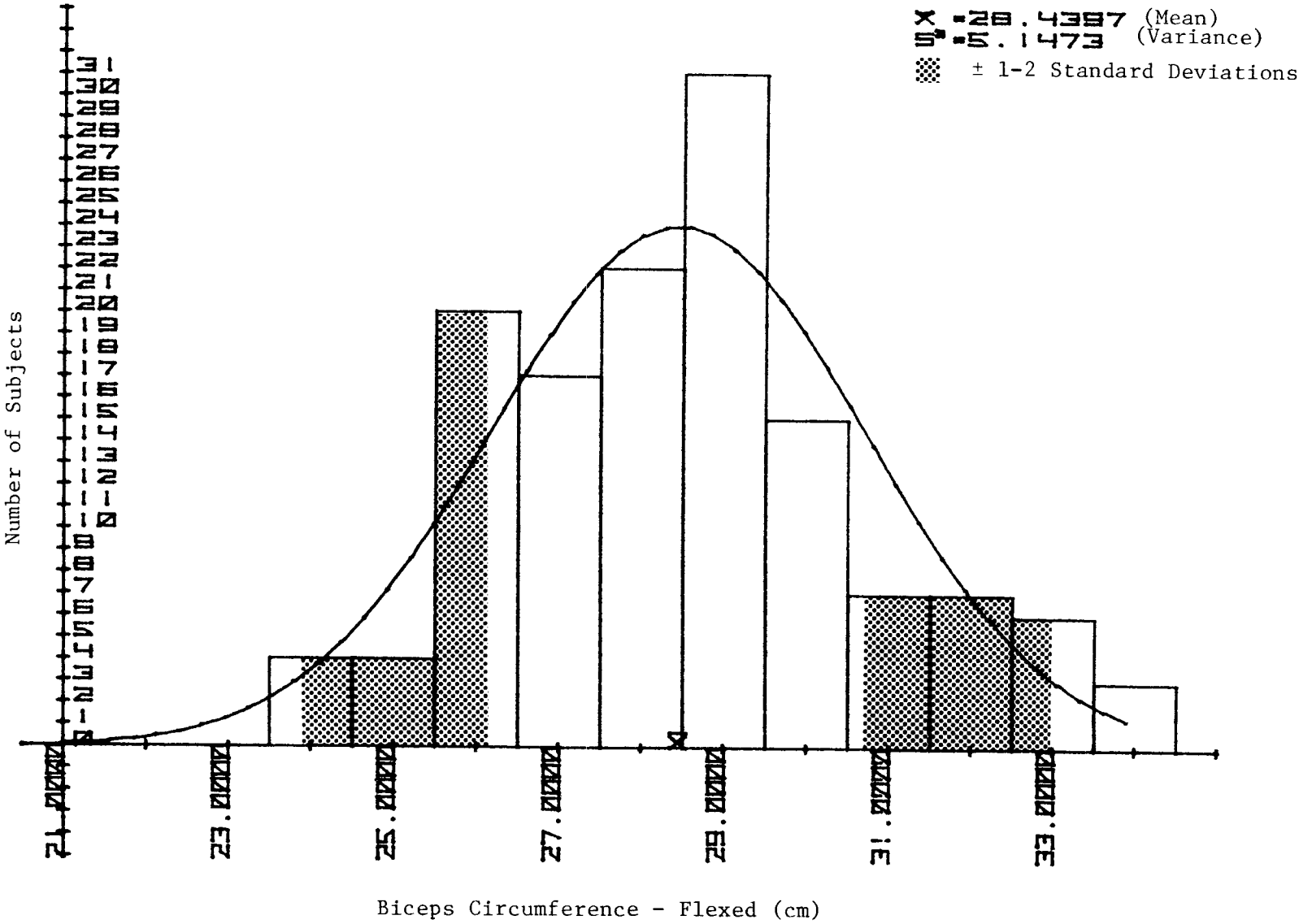


Figure 4: Frequency histogram for biceps circumference-flexed.

(5) BICEPS CIRCUMFERENCE - RELAXED

Subject stands erect, right arm extended horizontally forward and biceps relaxed. With the measuring tape held in a plane perpendicular to the long axis of the right arm, the circumference at the biceps landmark is measured.

Summary Statistics

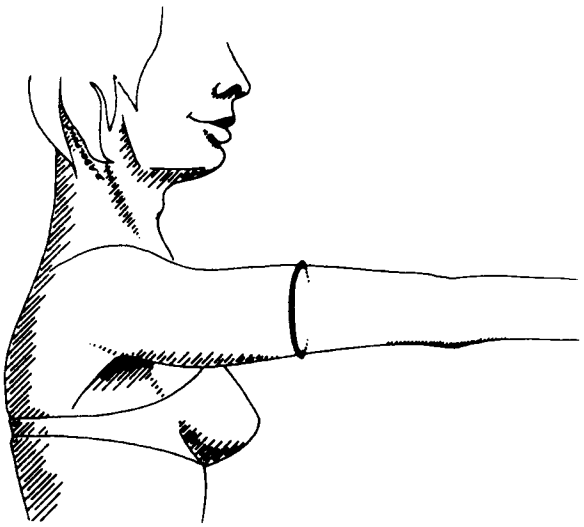
centimetres		inches
22.0 - 32.5	Range	8.7 - 12.8
27.01	Mean	10.63
0.20	SEM	0.08
2.31	Std. Dev.	0.91
0.14	SE (SD)	0.06

Coefficient of Variation: 8.55%

Coefficient of Skewedness: 0.28

Coefficient of Kurtosis: 2.69

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
22.0	1st	8.7
23.0	5th	9.1
23.6	10th	9.3
24.8	25th	9.8
26.5	**50th**	**10.4**
28.1	75th	11.1
30.0	90th	11.8
30.9	95th	12.2
31.9	99th	12.6

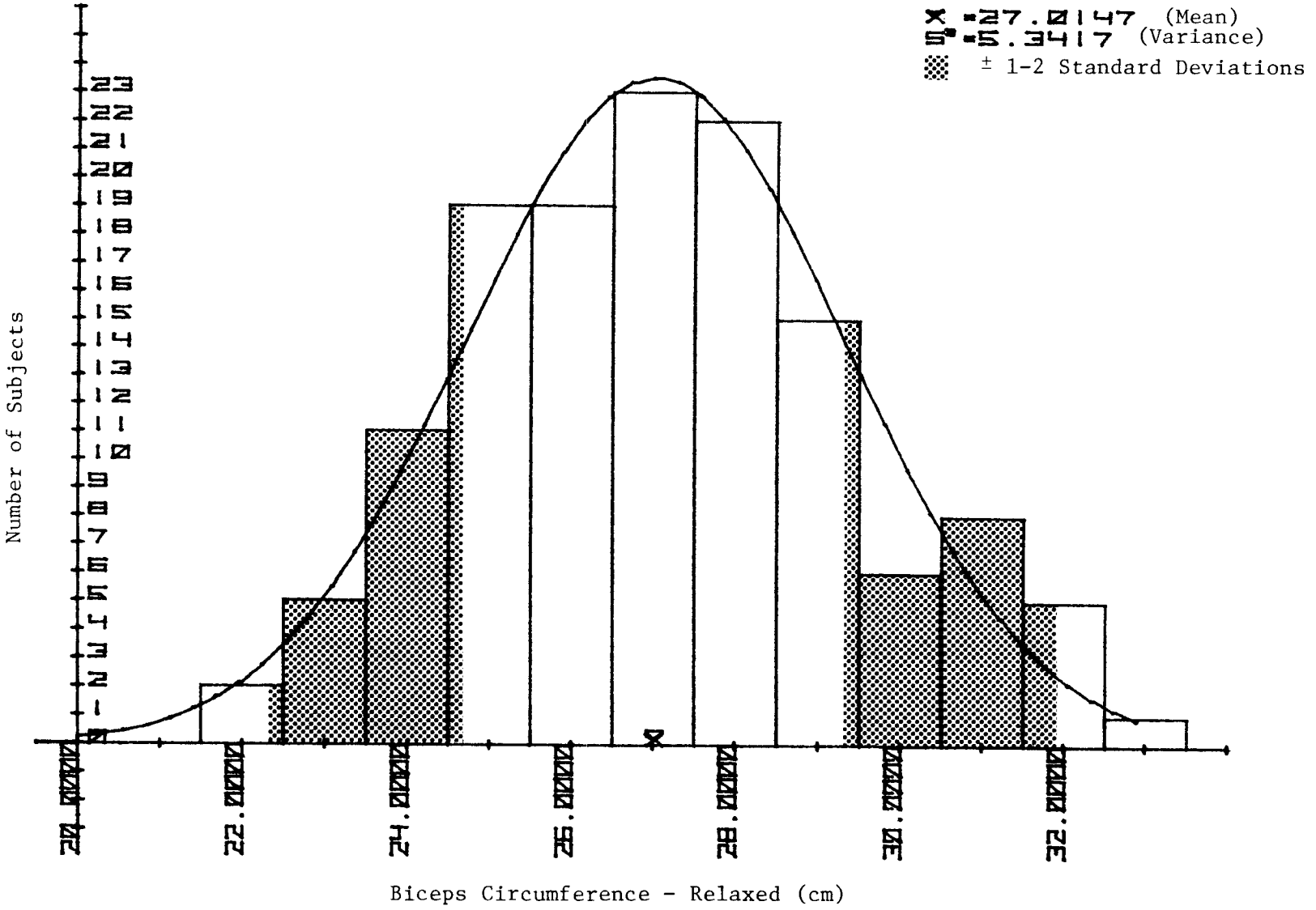
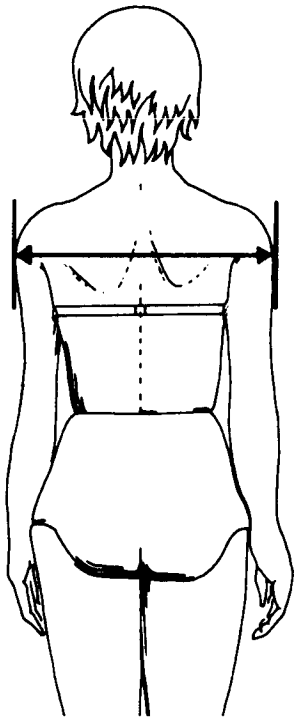


Figure 5: Frequency histogram for biceps circumference - relaxed.

(6) BIDELTOID BREADTH

Subject stands erect, with heels together and arms relaxed at the sides. The horizontal distance between the two deltoid landmarks is measured with the beam calipers.



Summary Statistics

centimetres		inches
33.2 - 48.9	Range	13.1 - 19.3
43.14	Mean	16.98
0.24	SEM	0.10
2.77	Std. Dev.	1.10
0.17	SE (SD)	0.09

Coefficient of Variation: 6.42%

Coefficient of Skewedness: -0.32

Coefficient of Kurtosis: 3.44

Number of Subjects: 134

Percentile Equivalents

cm	percentile	in
34.0	1st	13.4
38.3	5th	15.1
39.4	10th	15.5
40.8	25th	16.1
42.7	50th	16.8
44.7	75th	17.6
46.3	90th	18.2
47.1	95th	18.5
48.4	99th	19.1

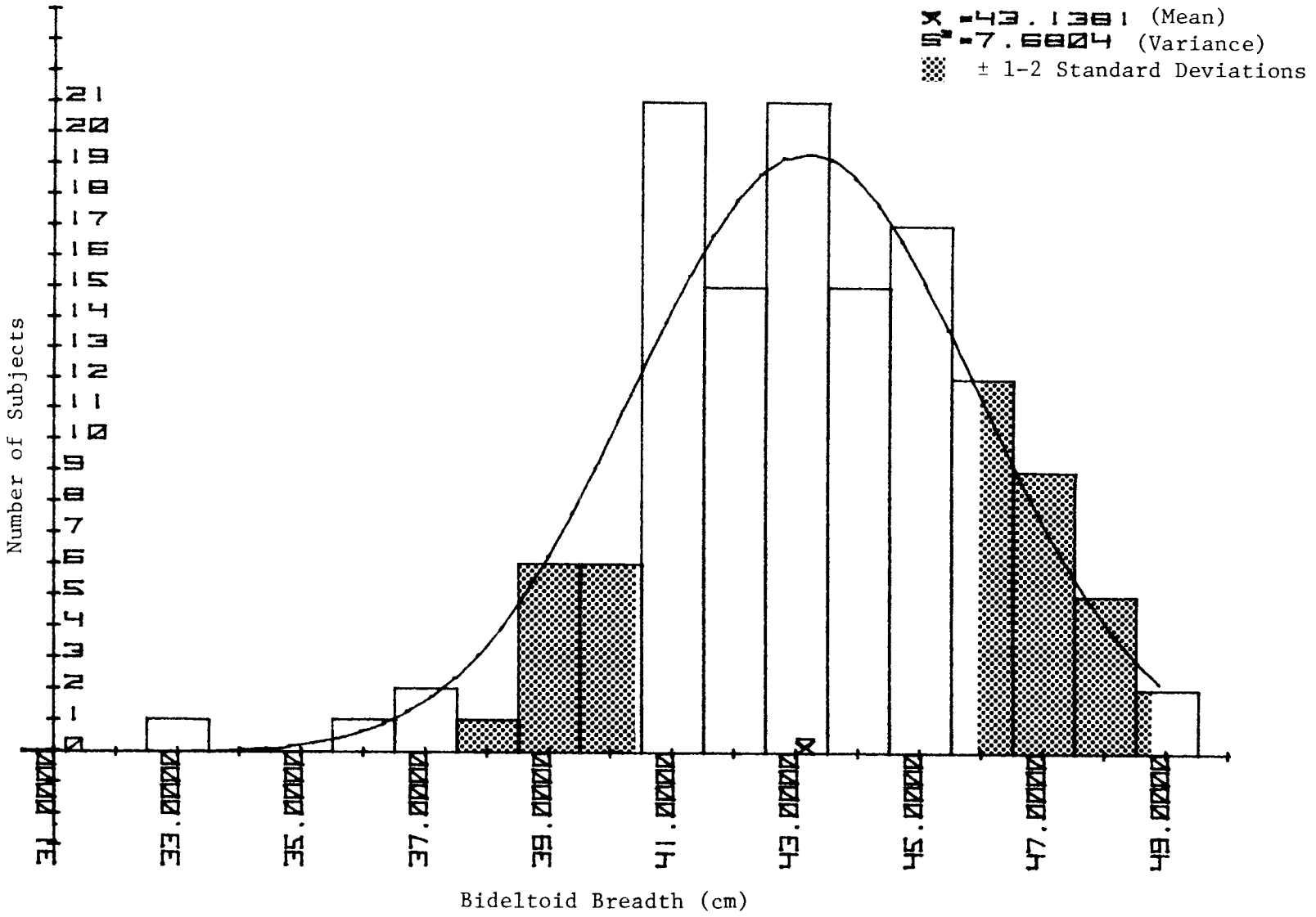
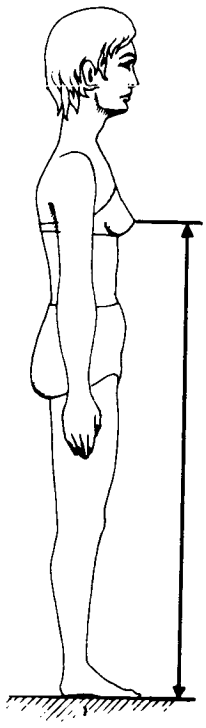


Figure 6: Frequency histogram for bideltoid breadth.

(7) BUSTPOINT HEIGHT

Subject stands erect, with heels together. The vertical distance from the standing surface to the bustpoint landmark is measured with the anthropometer.



Summary Statistics

centimetres		inches
106.9 - 131.2	Range	42.1 - 51.7
118.31	Mean	46.58
0.44	SEM	0.12
5.12	Std. Dev.	2.02
0.31	SE (SD)	0.12

Coefficient of Variation: 4.33%

Coefficient of Skewedness: 0.01

Coefficient of Kurtosis: 2.25

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
107.1	1st	42.2
108.6	5th	42.8
110.8	10th	43.6
113.9	25th	44.8
116.9	50th	46.0
121.4	75th	47.8
123.9	90th	48.8
125.9	95th	49.6
128.7	99th	50.7

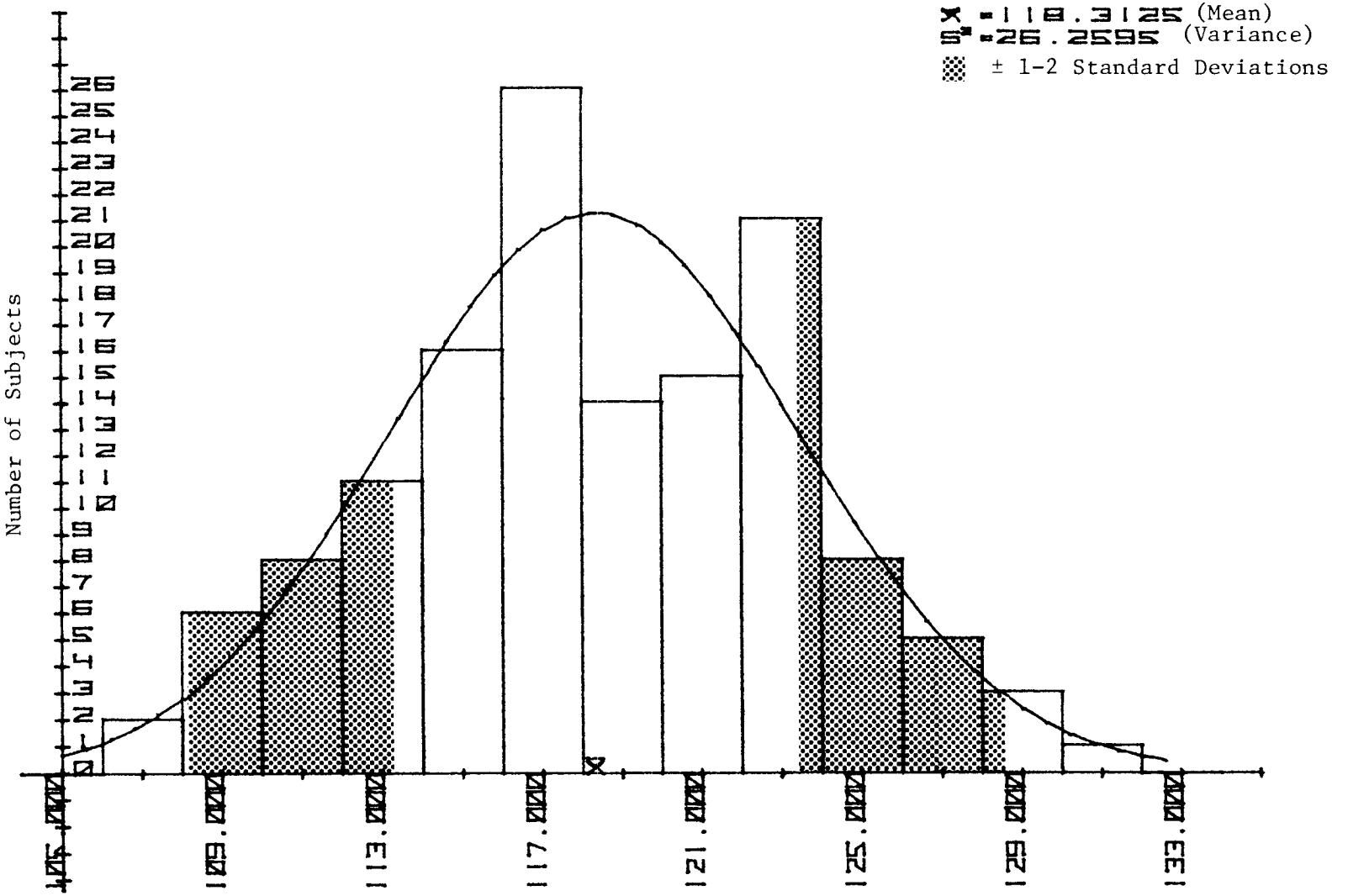
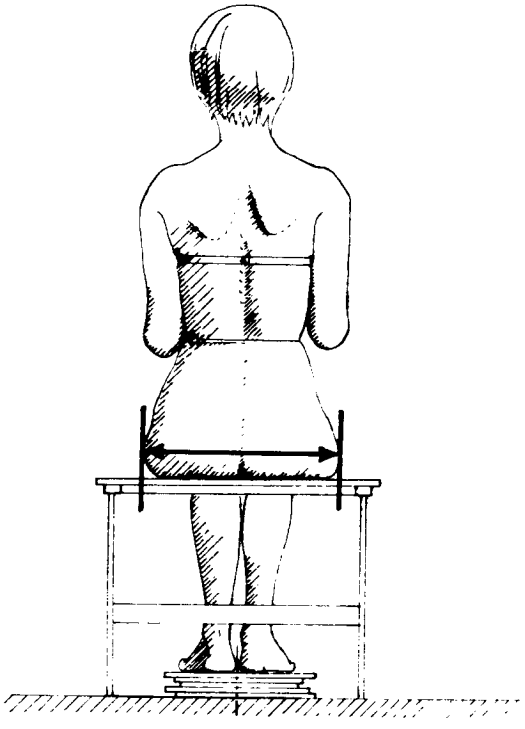


Figure 7: Frequency histogram for bustpoint height.

(8) BUTTOCK BREADTH - SEATED

Subject sits erect on measuring bench, with feet supported so that the thighs are in the horizontal plane and parallel. The lower leg is vertical, with the popliteal in light contact with the front edge of the bench. The beam calipers are held against the buttocks, with the measuring arms extending horizontally forward along the thighs and the maximum horizontal breadth is measured.



Summary Statistics

centimetres		inches
31.4 - 49.2	Range	12.4 - 19.4
36.66	Mean	15.6
0.24	SEM	0.09
2.79	Std. Dev.	1.10
0.17	SE (SD)	0.07

Coefficient of Variation: 7.03%

Coefficient of Skewedness: 0.16

Coefficient of Kurtosis: 3.47

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
31.4	1st	12.4
34.5	5th	13.6
35.9	10th	14.1
37.4	25th	14.7
39.2	50th	15.4
41.1	75th	16.2
42.8	90th	16.9
43.6	95th	17.2
45.8	99th	18.0

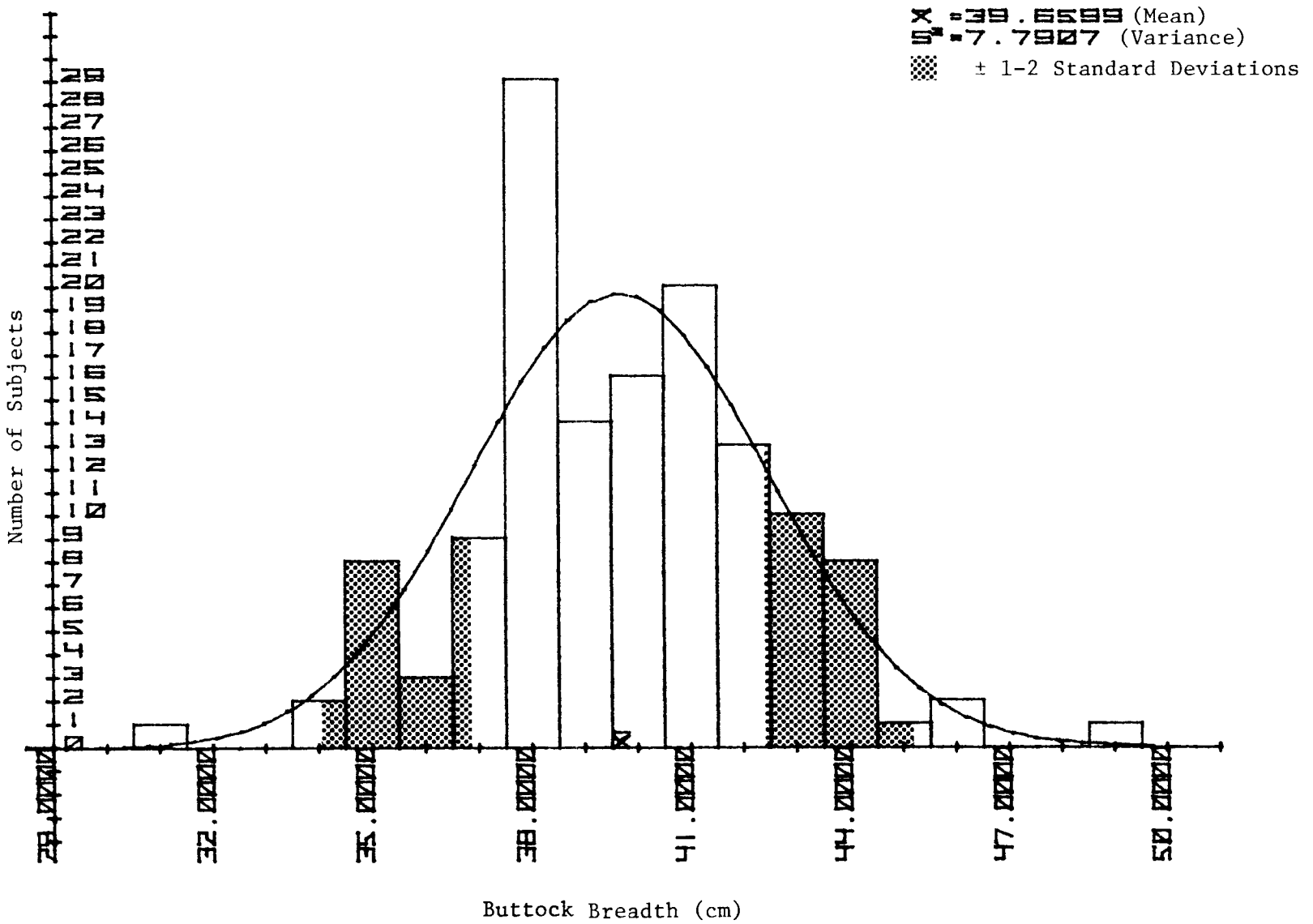


Figure 8: Frequency histogram for buttock breadth-seated.

(9) BUTTOCK-HEEL LENGTH

Subject sits on floor, with back against the wall, right leg extended forward along the floor scale and left leg flexed. Leaning forward and forcing buttocks tightly against the wall, the right knee is fully extended and the right ankle maximally dorsiflexed. A measuring block is placed against the plantar surface of the right foot and the distance from the wall to the block is measured on the floor scale.

Summary Statistics

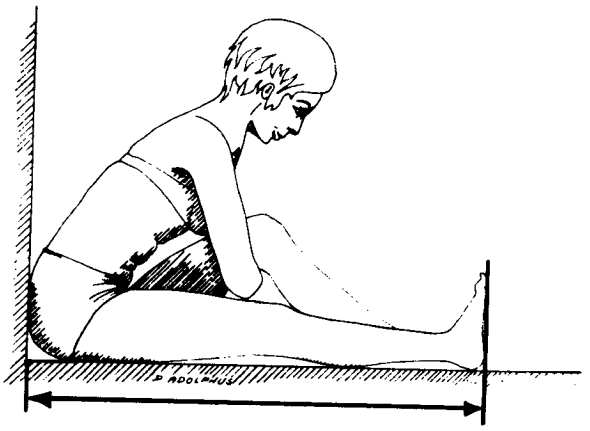
centimetres		inches
89.4 - 114.0	Range	35.2 - 43.3
100.82	Mean	39.69
0.41	SEM	0.16
4.78	Std. Dev.	1.88
0.29	SE (SD)	0.11

Coefficient of Variation: 4.33%

Coefficient of Skewedness: 0.19

Coefficient of Kurtosis: 2.93

Number of Subjects: 137



Percentile Equivalents

cm	percentile	in
90.1	1st	35.5
91.7	5th	36.1
94.2	10th	37.1
96.4	25th	38.0
99.7	50th	39.3
103.0	75th	40.6
105.9	90th	41.7
108.1	95th	42.6
111.6	99th	43.9

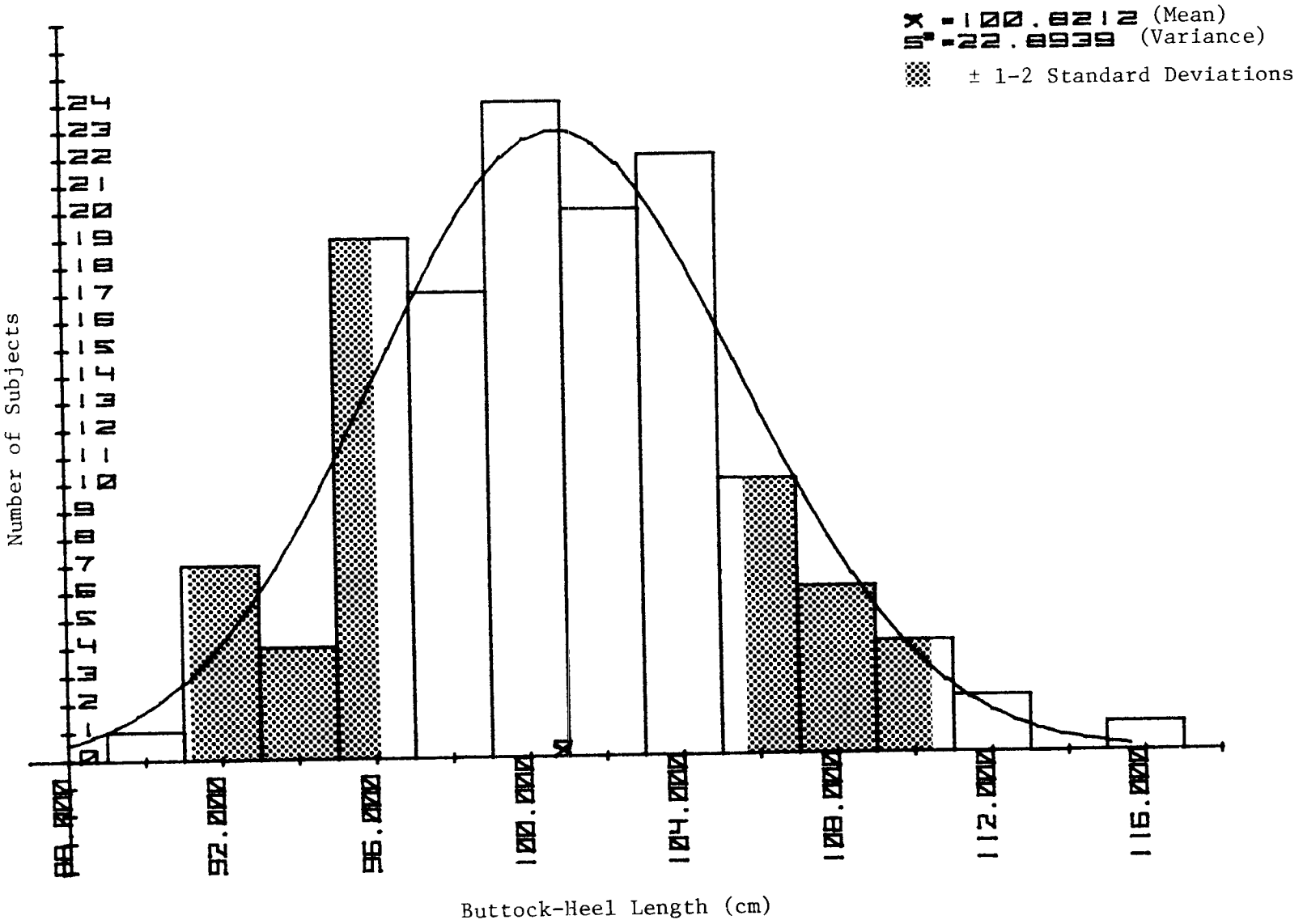
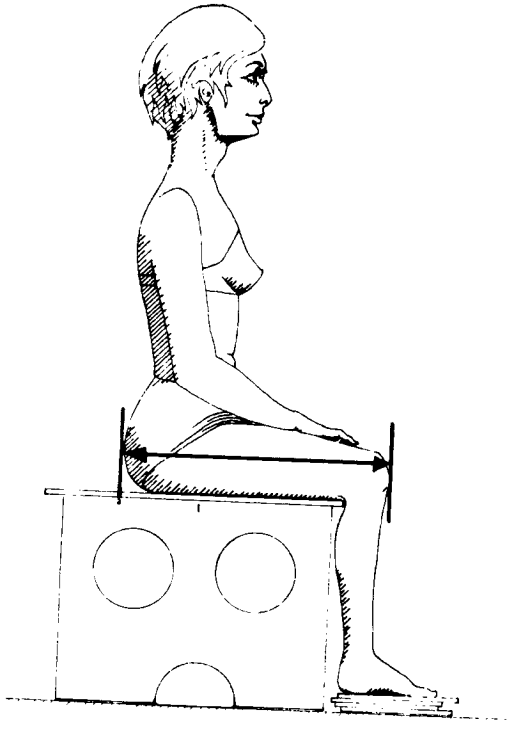


Figure 9: Frequency histogram for buttock-heel length.

(10) BUTTOCK-KNEE LENGTH

Subject sits erect on the measuring bench, with feet supported so that the thighs are in the horizontal plane and parallel. The lower leg is vertical, with the popliteal in light contact with the front edge of the bench. A measuring block is held against the most posterior aspect of the right buttock and the horizontal distance from the block to the most anterior aspect of the right patella is measured with the beam calipers.



Summary Statistics

centimetres		inches
51.3 - 65.7	Range	20.2 - 25.9
57.65	Mean	22.70
0.16	SEM	0.06
2.69	Std. Dev.	1.06
0.16	SE (SD)	0.06

Coefficient of Variation: 4.67%

Coefficient of Skewedness: 0.61

Coefficient of Kurtosis: 3.43

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
51.4	1st	20.2
53.5	5th	21.1
54.2	10th	21.3
55.3	25th	21.8
56.7	50th	22.3
58.7	75th	23.1
60.8	90th	23.9
62.1	95th	24.4
64.9	99th	25.6

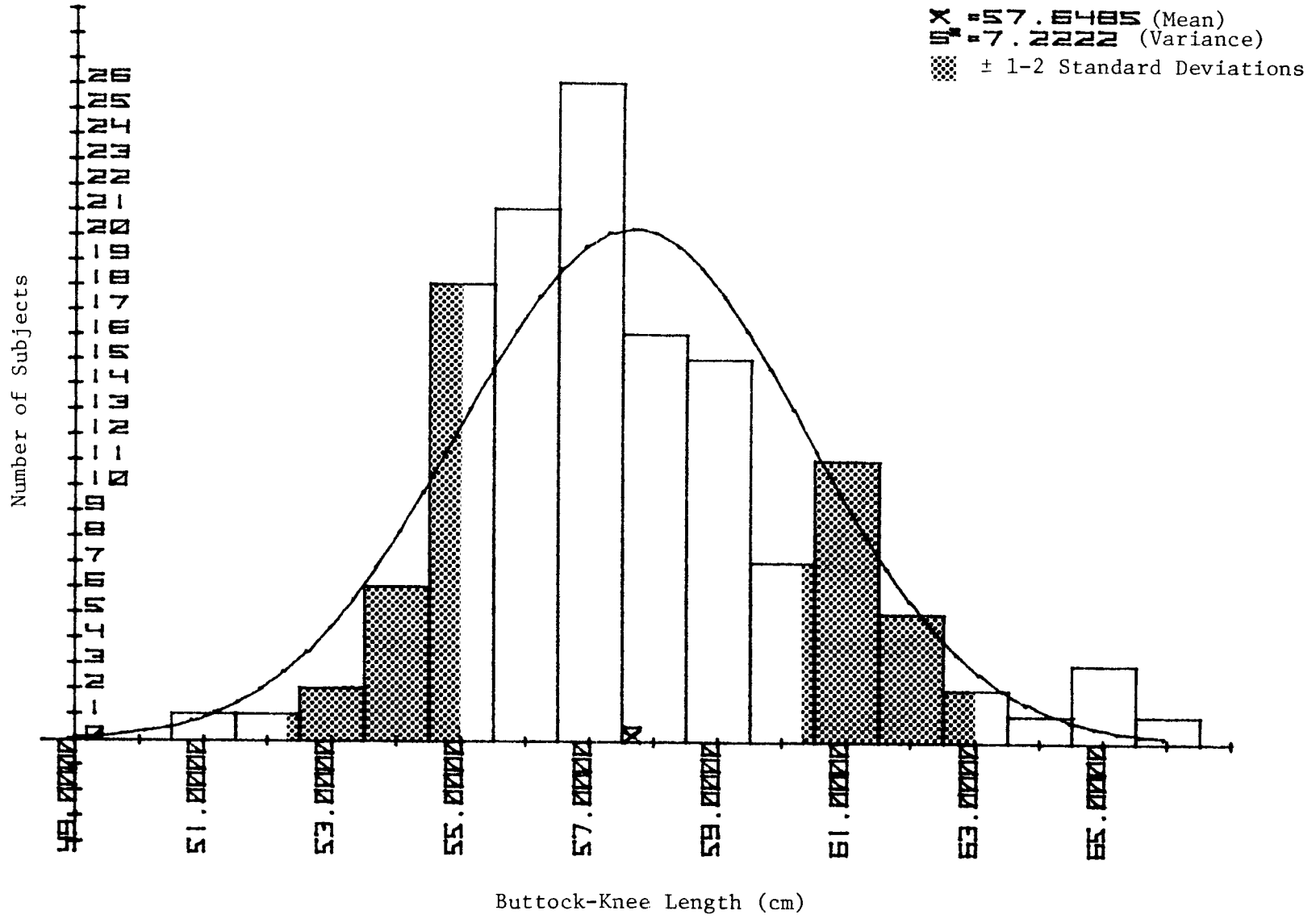
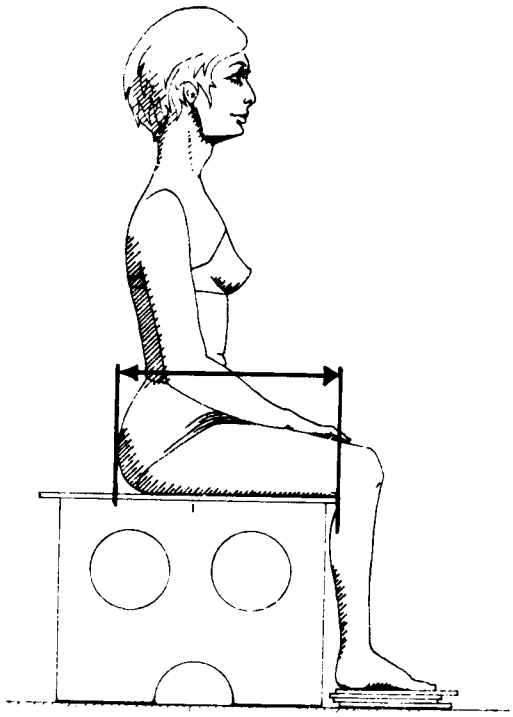


Figure 10: Frequency histogram for buttock-knee length.

(11) BUTTOCK-POPLITEAL LENGTH

Subject sits erect on the measuring bench, with feet supported so that the thighs are in the horizontal plane and parallel. The lower leg is vertical, with the popliteal in light contact with the front edge of the bench. A measuring block is held against the most posterior aspect of the right buttock and the horizontal distance from the front edge of the table to the block is measured on the bench scale.



Summary Statistics

centimetres		inches
40.3 - 52.5	Range	15.9 - 20.7
45.96	Mean	18.09
0.21	SEM	0.08
2.45	Std. Dev.	0.96
0.15	SE (SD)	0.06

Coefficient of Variation: 5.33%

Coefficient of Skewedness: 0.29

Coefficient of Kurtosis: 2.76

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
40.4	1st	15.9
41.7	5th	16.4
42.3	10th	16.7
43.9	25th	17.3
45.3	50th	17.8
47.2	75th	18.6
49.1	90th	19.3
50.0	95th	19.7
51.8	99th	20.4

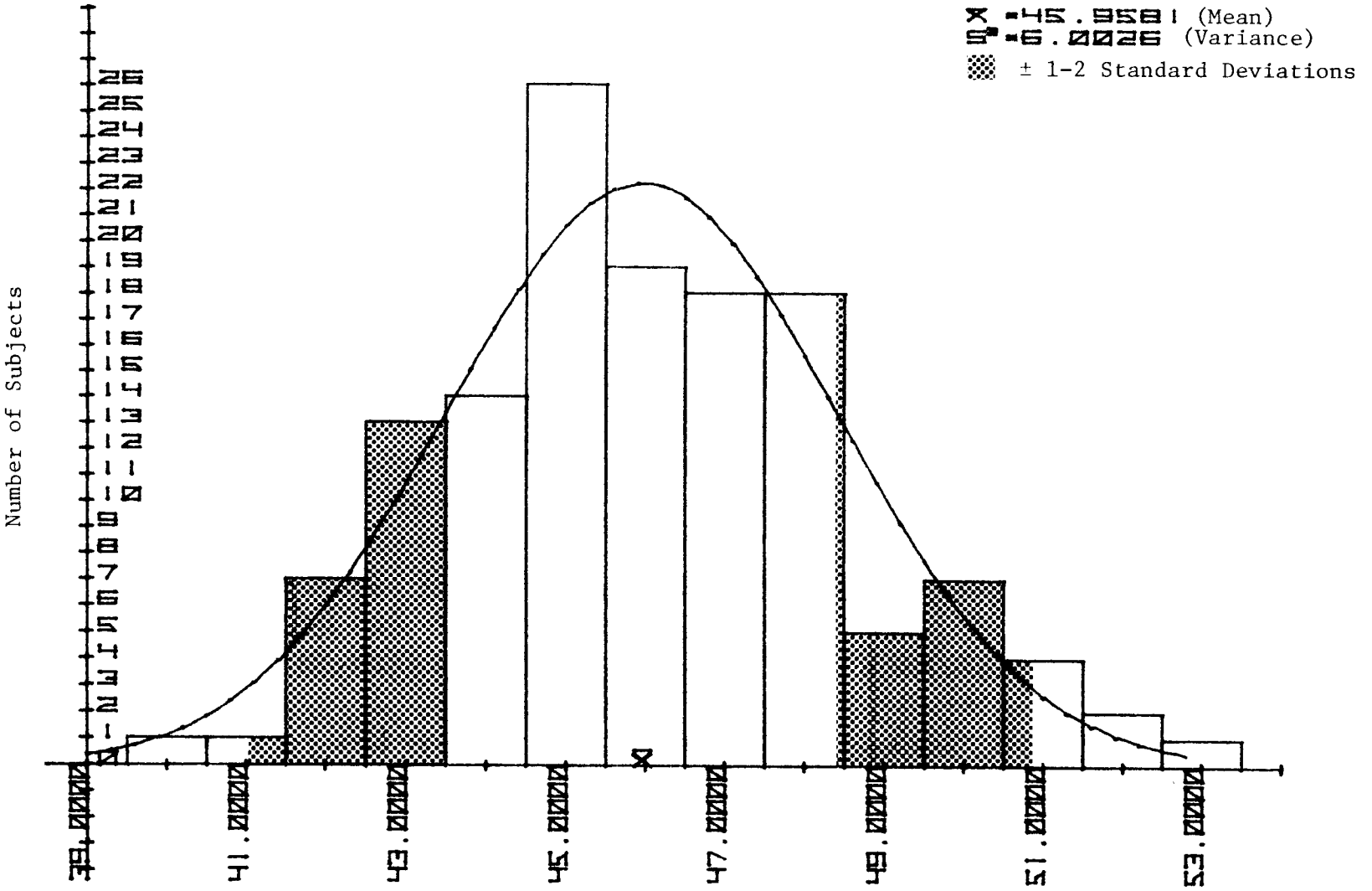
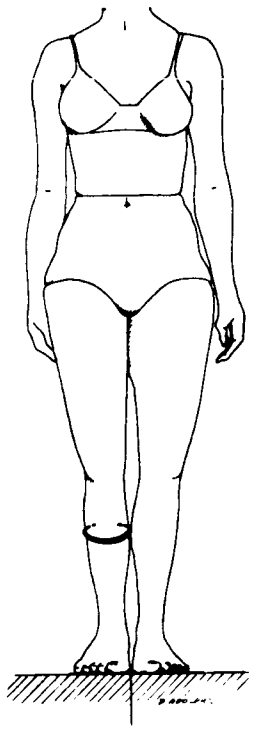


Figure 11: Frequency histogram for buttock-popliteal length.

(12) CALF CIRCUMFERENCE

Subject stands erect, with feet about 10 cm apart. The maximum horizontal circumference of the right calf is measured with the measuring tape.



Summary Statistics

centimetres		inches
29.3 - 41.8	Range	11.5 - 16.5
35.99	Mean	14.17
0.21	SEM	0.08
2.50	Std. Dev.	0.98
0.15	SE (SD)	0.06

Coefficient of Variation: 6.95%

Coefficient of Skewedness: 0.25

Coefficient of Kurtosis: 2.81

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
29.4	1st	11.6
32.0	5th	12.6
32.5	10th	12.8
33.6	25th	13.2
35.3	50th	13.9
37.3	75th	14.7
38.9	90th	15.3
40.3	95th	15.9
41.6	99th	16.4

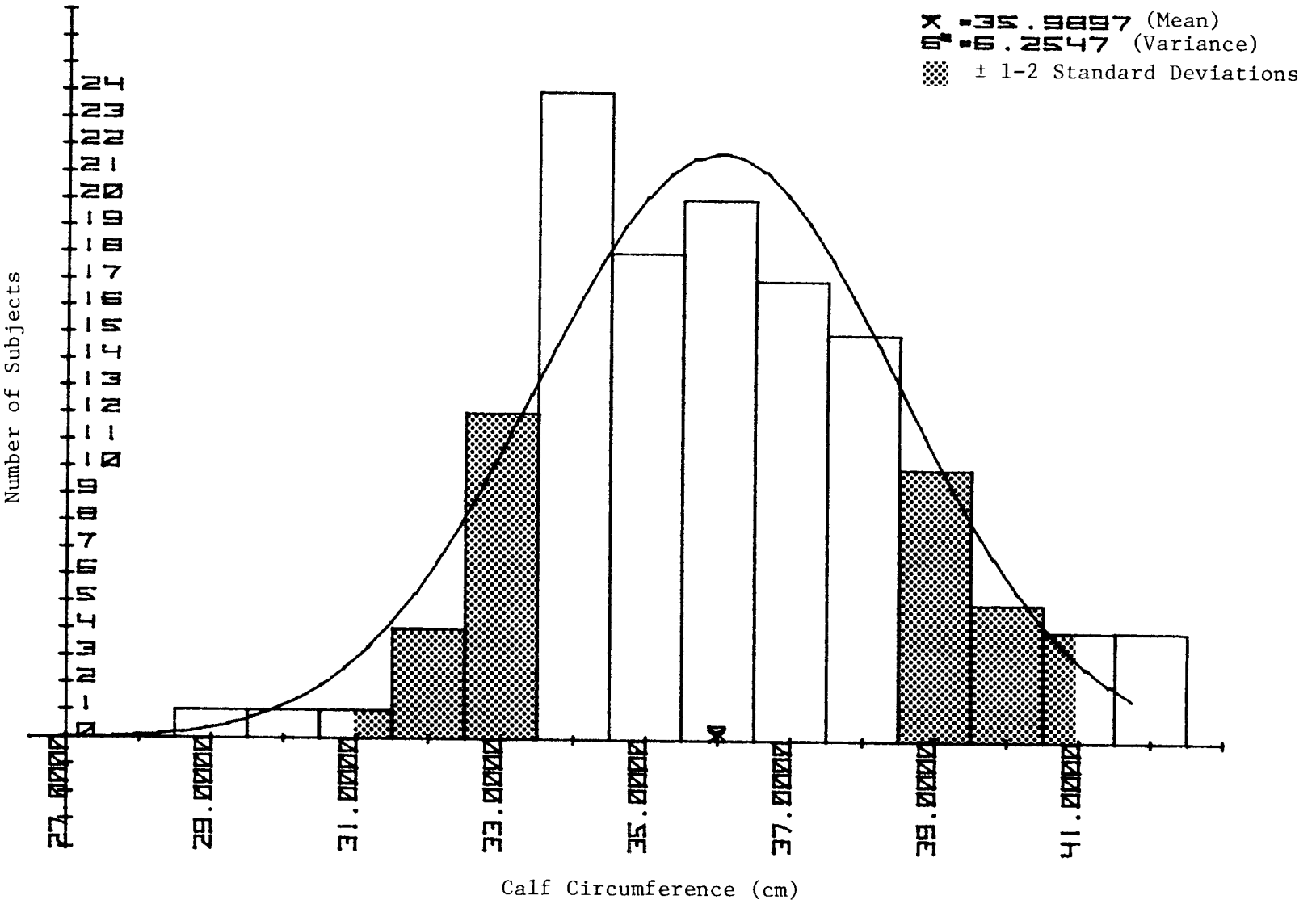
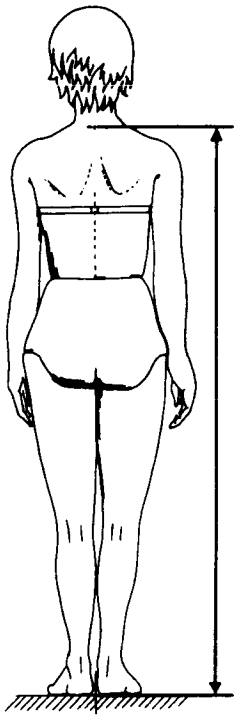


Figure 12: Frequency histogram for calf circumference.

(13) CERVICALE HEIGHT

Subject stands erect, line of sight horizontal and heels together. The vertical distance from the standing surface to the cervicale landmark is measured with the anthropometer.



Summary Statistics

centimetres		inches
126.7 - 153.3	Range	49.9 - 60.4
139.52	Mean	54.93
0.47	SEM	0.19
5.50	Std. Dev.	2.17
0.33	SE (SD)	0.13

Coefficient of Variation: 3.94%

Coefficient of Skewedness: 0.18

Coefficient of Kurtosis: 2.71

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
127.4	1st	50.2
129.9	5th	51.1
132.4	10th	52.1
135.5	25th	53.3
138.6	**50th**	**54.6**
142.8	75th	56.2
146.7	90th	57.8
148.4	95th	58.4
152.4	99th	60.0

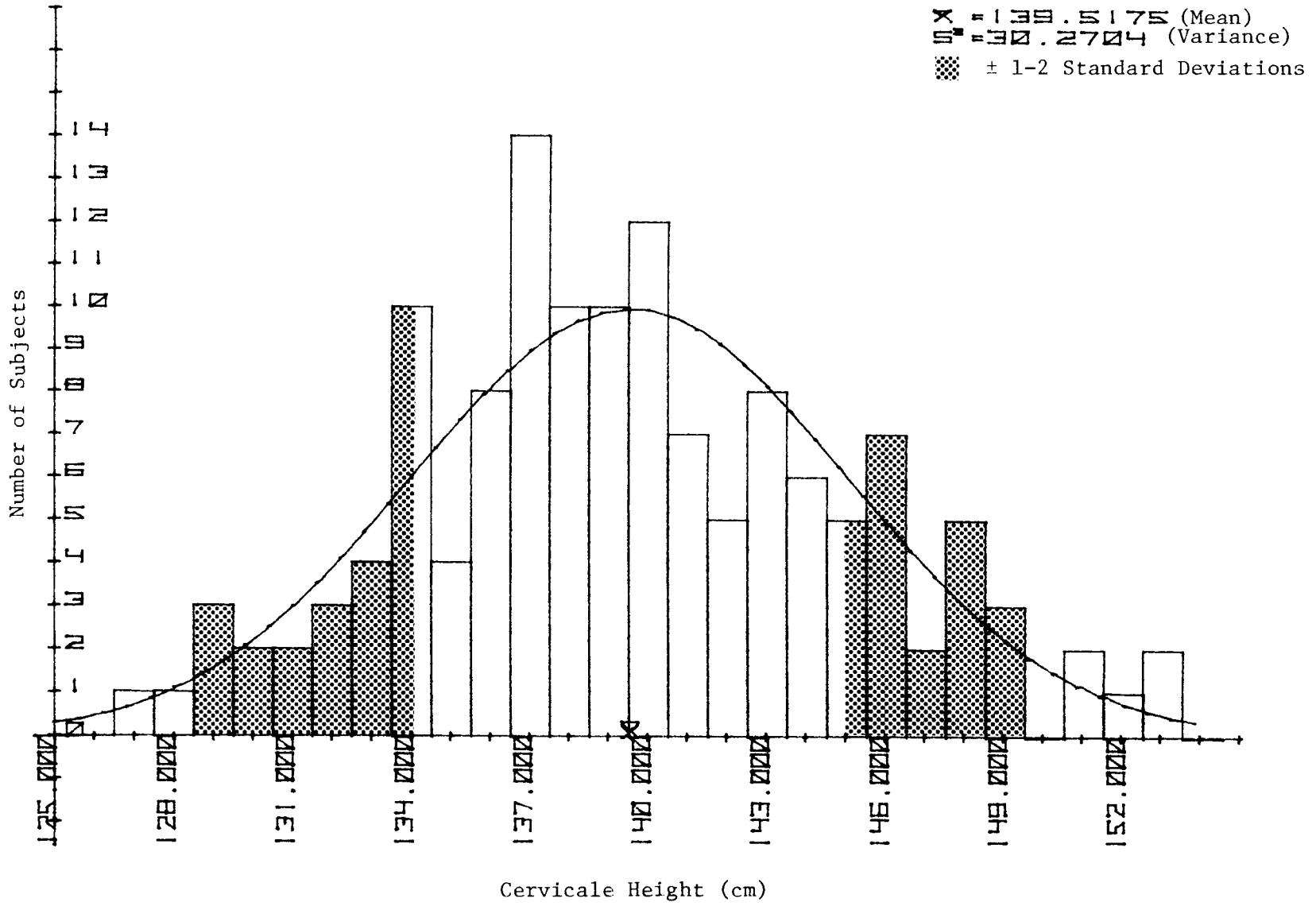
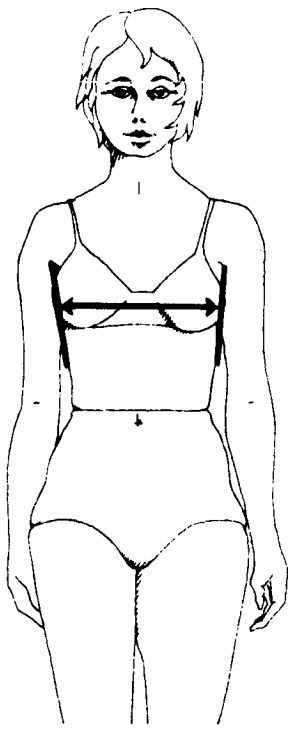


Figure 13: Frequency histogram for cervicale height.

(14) CHEST BREADTH

Subject stands erect, with heels together and arms slightly abducted. The horizontal chest breadth at bustpoint height is measured at the average point of quiet respiration, using the beam calipers.



Summary Statistics

centimetres		inches
25.2 - 35.6	Range	9.9 - 14.0
30.48	Mean	12.00
0.19	SEM	0.07
2.20	Std. Dev.	0.87
0.13	SE (SD)	0.05

Coefficient of Variation: 7.22%

Coefficient of Skewedness: 0.19

Coefficient of Kurtosis: 2.61

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
25.4	1st	10.0
26.5	5th	10.4
27.1	10th	10.7
28.4	25th	11.2
30.1	50th	11.9
31.5	75th	12.4
33.1	90th	13.0
33.8	95th	13.3
35.3	99th	13.9

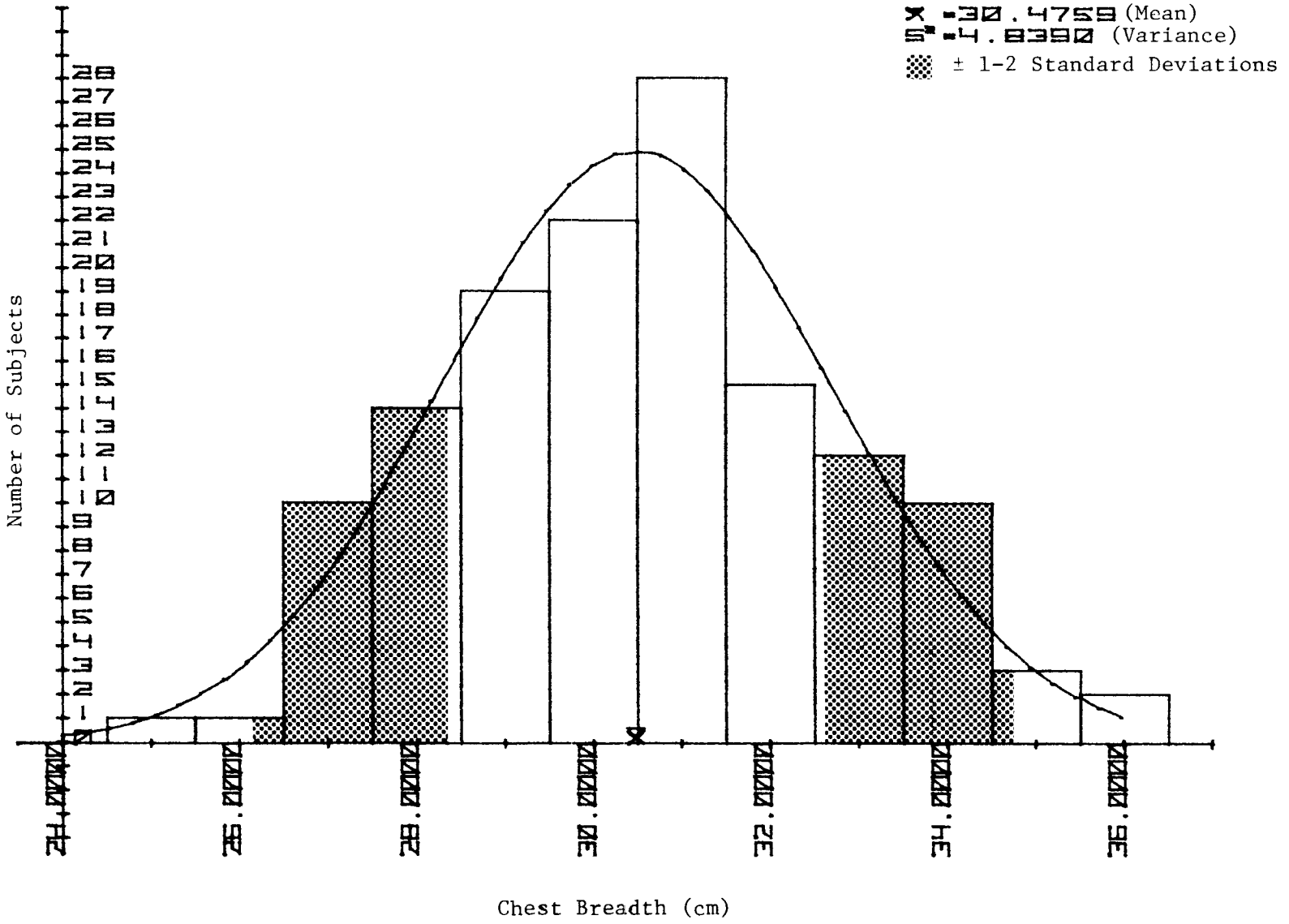
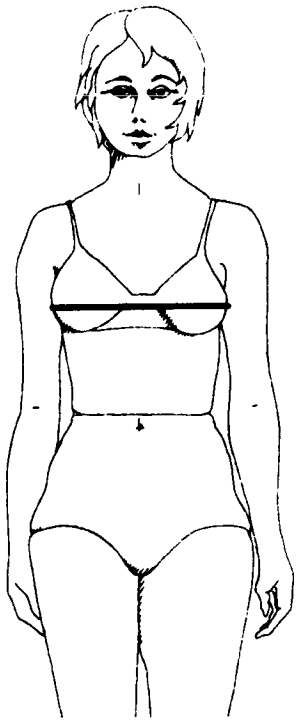


Figure 14: Frequency histogram for chest breadth.

(15) CHEST CIRCUMFERENCE

Subject stands erect, with arms slightly abducted. The measuring tape is held in a horizontal plane and the circumference of the chest at bustpoint height is measured, at the average point of quiet respiration.



Summary Statistics

centimetres		inches
74.5 - 110.1	Range	29.3 - 43.3
92.51	Mean	36.42
0.55	SEM	0.22
6.42	Std. Dev.	2.53
0.55	SE (SD)	0.15

Coefficient of Variation: 6.94%

Coefficient of Skewedness: -0.03

Coefficient of Kurtosis: 2.84

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
75.5	1st	29.7
81.4	5th	32.0
83.4	10th	32.8
86.9	25th	34.2
92.0	50th	36.2
95.8	75th	37.7
99.6	90th	39.2
102.6	95th	40.4
105.8	99th	41.7

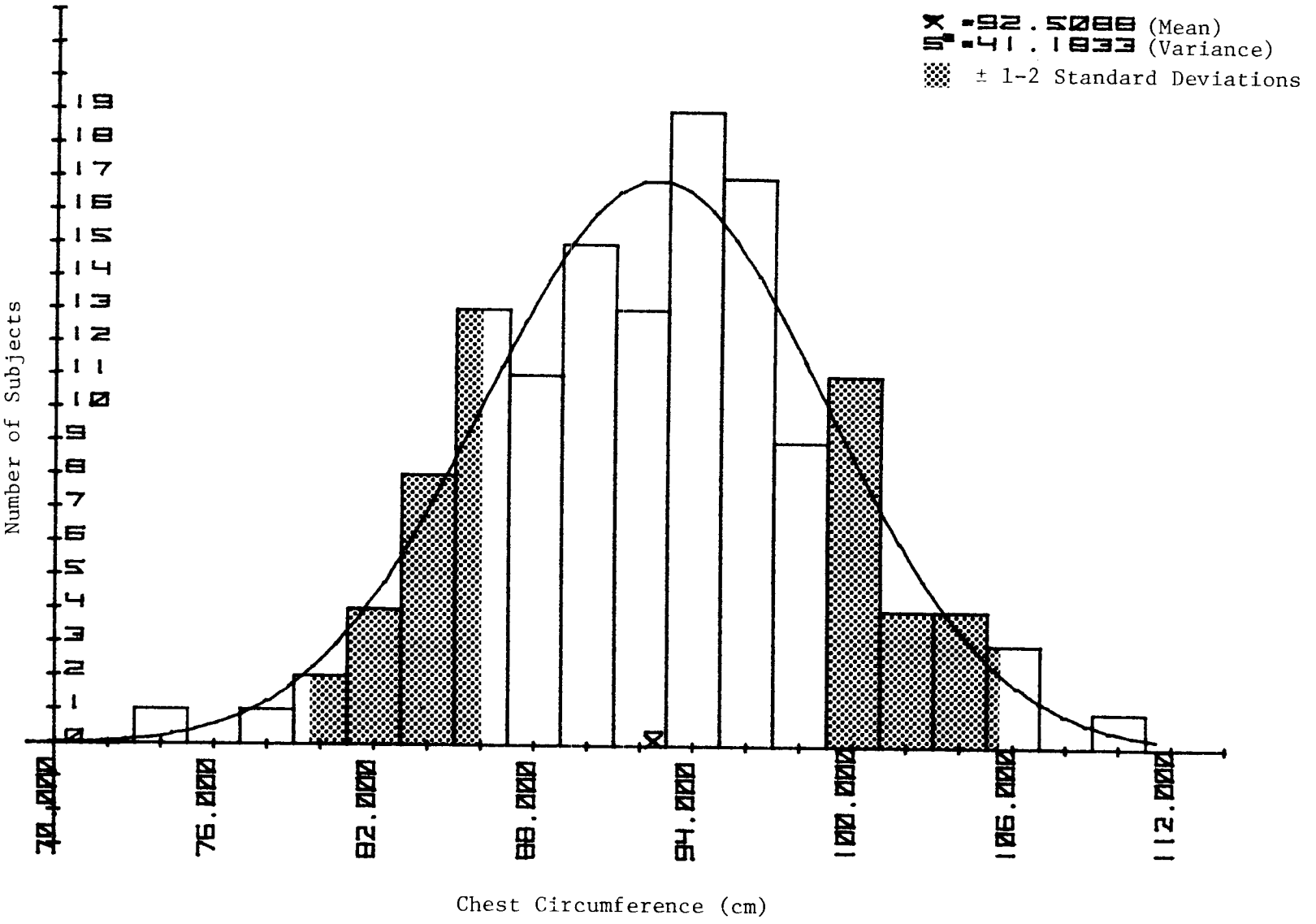
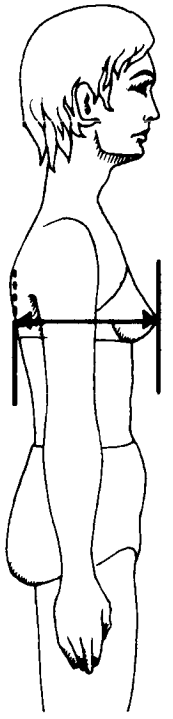


Figure 15: Frequency histogram for chest circumference.

(16) CHEST DEPTH

Subject stands erect, with arms relaxed at the sides and heels together. The horizontal depth of the chest at bustpoint height is measured at the average point of quiet respiration, using the beam calipers.



Summary Statistics

centimetres		inches
19.5 - 30.1	Range	7.7 - 11.9
24.16	Mean	9.51
0.18	SEM	0.07
2.05	Std. Dev.	0.81
0.12	SE (SD)	0.05

Coefficient of Variation: 8.49%

Coefficient of Skewedness: 0.16

Coefficient of Kurtosis: 2.77

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
20.3	1st	8.0
20.4	5th	8.0
21.1	10th	8.3
22.2	25th	8.7
23.6	50th	9.3
25.3	75th	10.0
26.5	90th	10.4
26.9	95th	10.6
28.6	99th	11.3

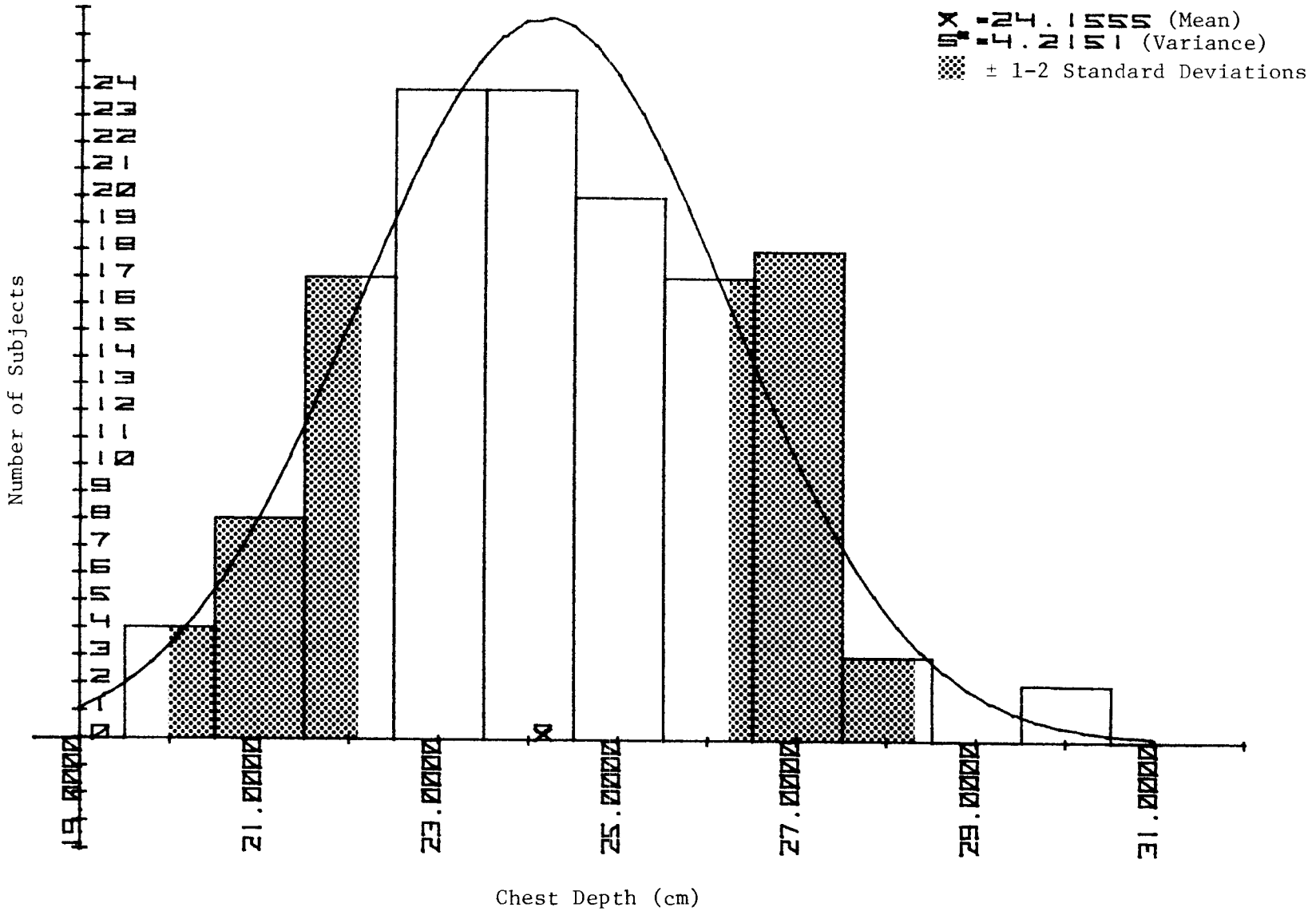
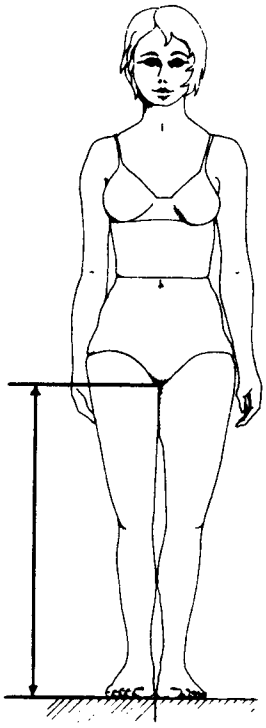


Figure 16: Frequency histogram for chest depth.

(17) CROTCH HEIGHT

Subject stands erect, with heels approximately 10 cm apart. The subject straddles the anthropometer arm and is asked to raise the arm along the right leg, until light contact is made with the crotch. The subject then brings heels together, maintaining contact with the anthropometer arm. The vertical distance from the standing surface to the crotch is measured. One centimetre is added to the measured height to allow for the width of the anthropometer arm.



Summary Statistics

centimetres		inches
66.6 - 86.7	Range	26.2 - 34.1
76.42	Mean	30.09
0.33	SEM	1.52
3.86	Std. Dev.	1.52
0.23	SE (SD)	0.09

Coefficient of Variation: 5.05%

Coefficient of Skewedness: -0.08

Coefficient of Kurtosis: 2.83

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
66.9	1st	26.3
69.2	5th	27.2
70.7	10th	27.8
73.7	25th	29.0
75.8	**50th**	**29.8**
78.6	75th	30.9
80.9	90th	31.9
82.1	95th	32.3
84.8	99th	33.4

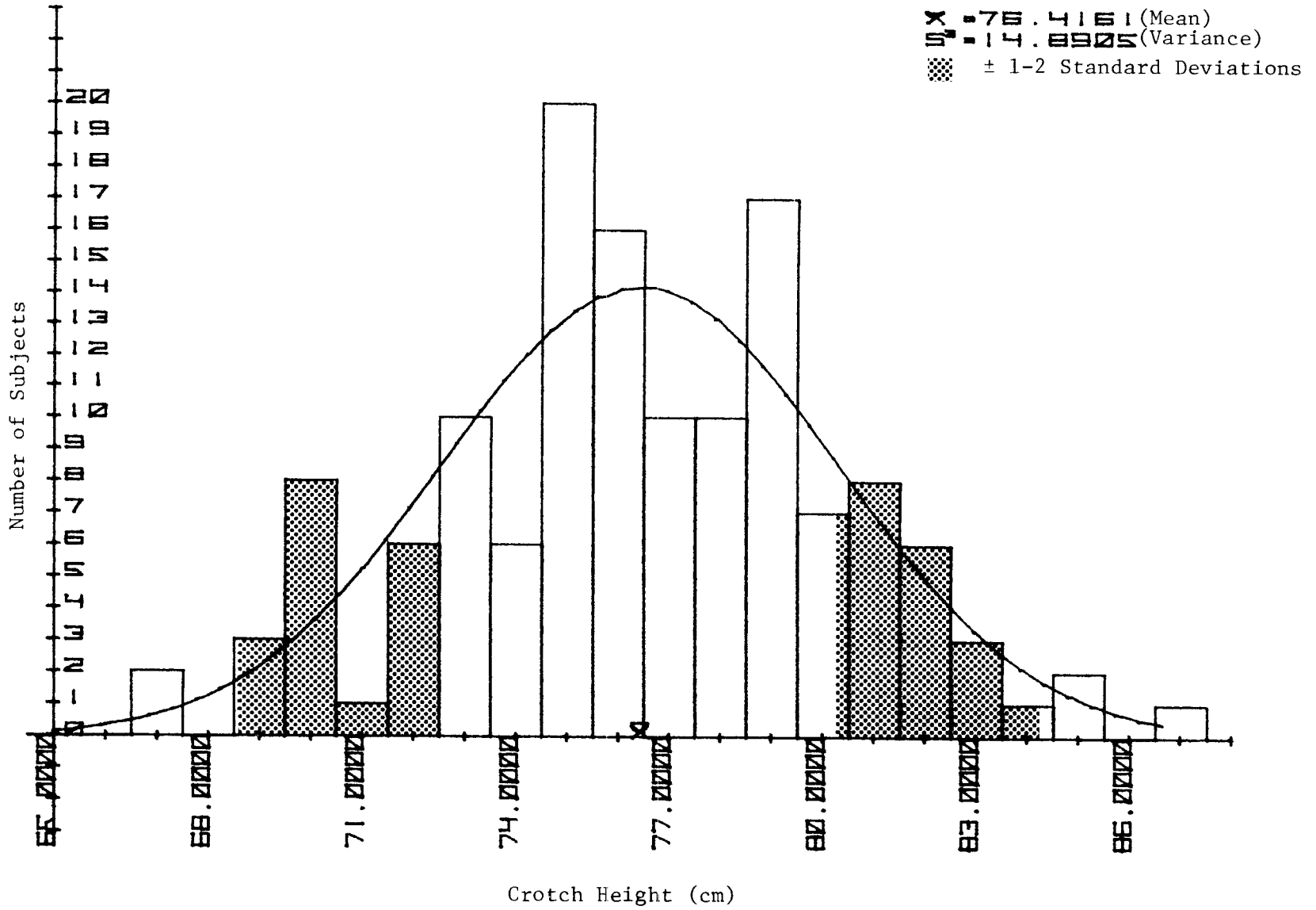


Figure 17: Frequency histogram for crotch height.

(18) FACE BREADTH (BIZYGOMATIC)

Subject stands erect with mouth closed. The maximum horizontal breadth between the zygomatic arches is measured with the spreading calipers.

Summary Statistics

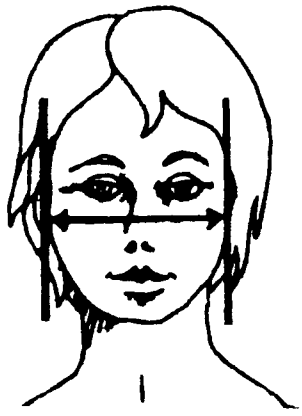
centimetres		inches
12.1 - 14.5	Range	4.8 - 5.7
13.02	Mean	5.13
0.04	SEM	0.02
0.46	Std. Dev.	0.18
0.03	SE (SD)	0.01

Coefficient of Variation: 3.53%

Coefficient of Skewedness: 0.26

Coefficient of Kurtosis: 2.98

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
12.1	1st	4.8
12.2	5th	4.8
12.4	10th	4.9
12.6	25th	5.0
13.0	50th	5.1
13.2	75th	5.2
13.6	90th	5.4
13.8	95th	5.4
14.0	99th	5.5

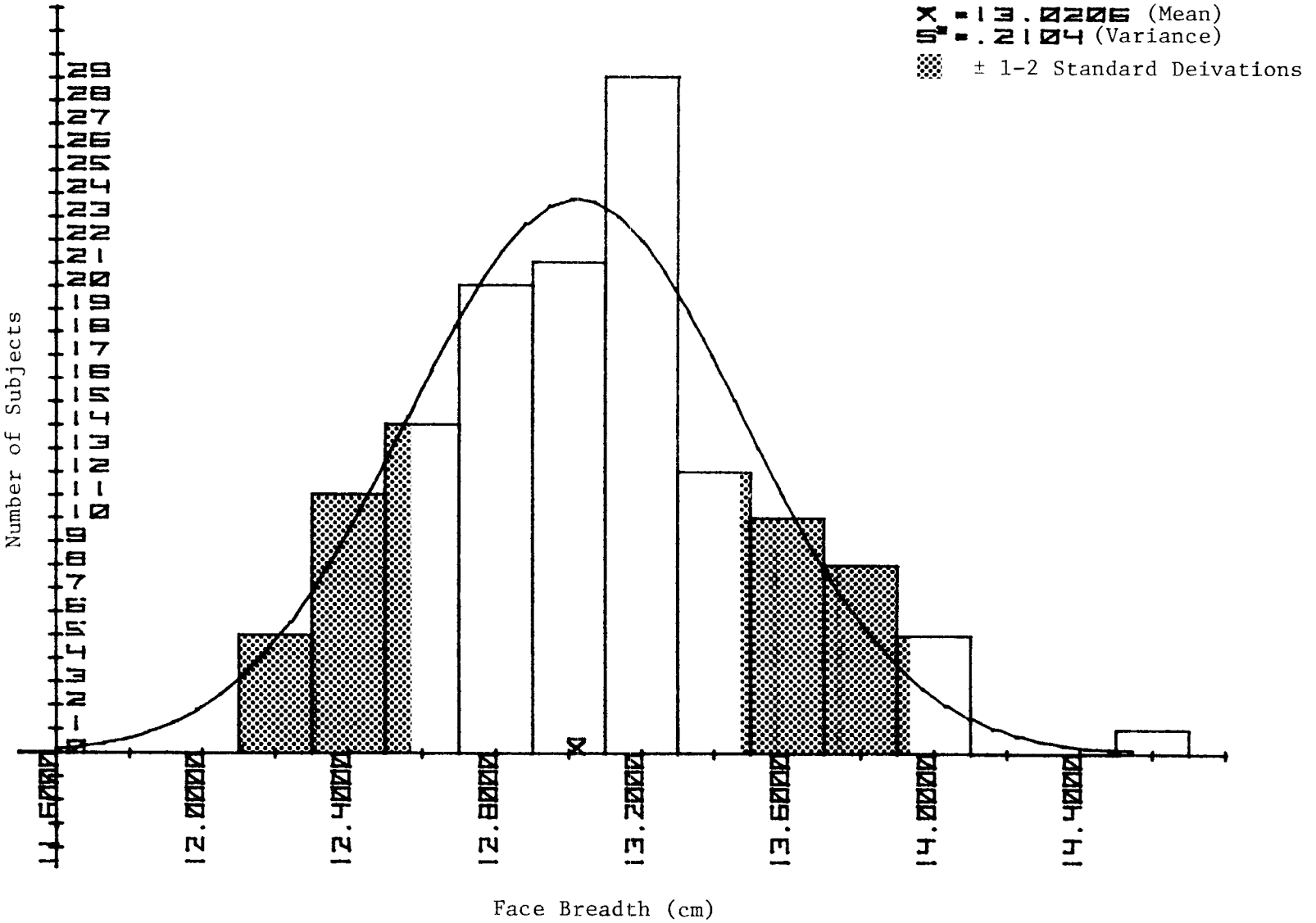


Figure 18: Frequency histogram for face breadth.

(19) FACE LENGTH (SELLION-MENTON)

Subject stands erect, with mouth closed. The distance between the sellion and menton is measured with the sliding calipers.

Summary Statistics

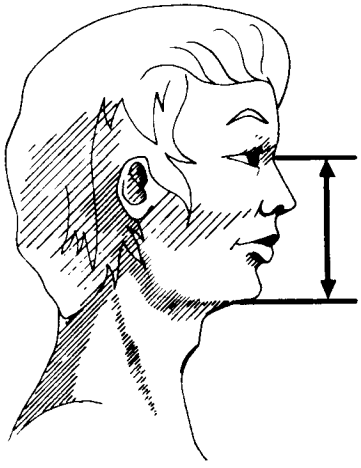
centimetres		inches
9.5 - 13.1	Range	3.7 - 5.2
10.92	Mean	4.30
0.05	SEM	0.02
0.06	Std. Dev.	0.24
0.04	SE (SD)	0.02

Coefficient of Variation: 5.49%

Coefficient of Skewedness: 0.65

Coefficient of Kurtosis: 3.91

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
9.6	1st	3.8
10.0	5th	3.9
10.2	10th	4.0
10.5	25th	4.1
10.8	50th	4.3
11.2	75th	4.4
11.6	90th	4.6
12.1	95th	4.8
12.4	99th	4.9

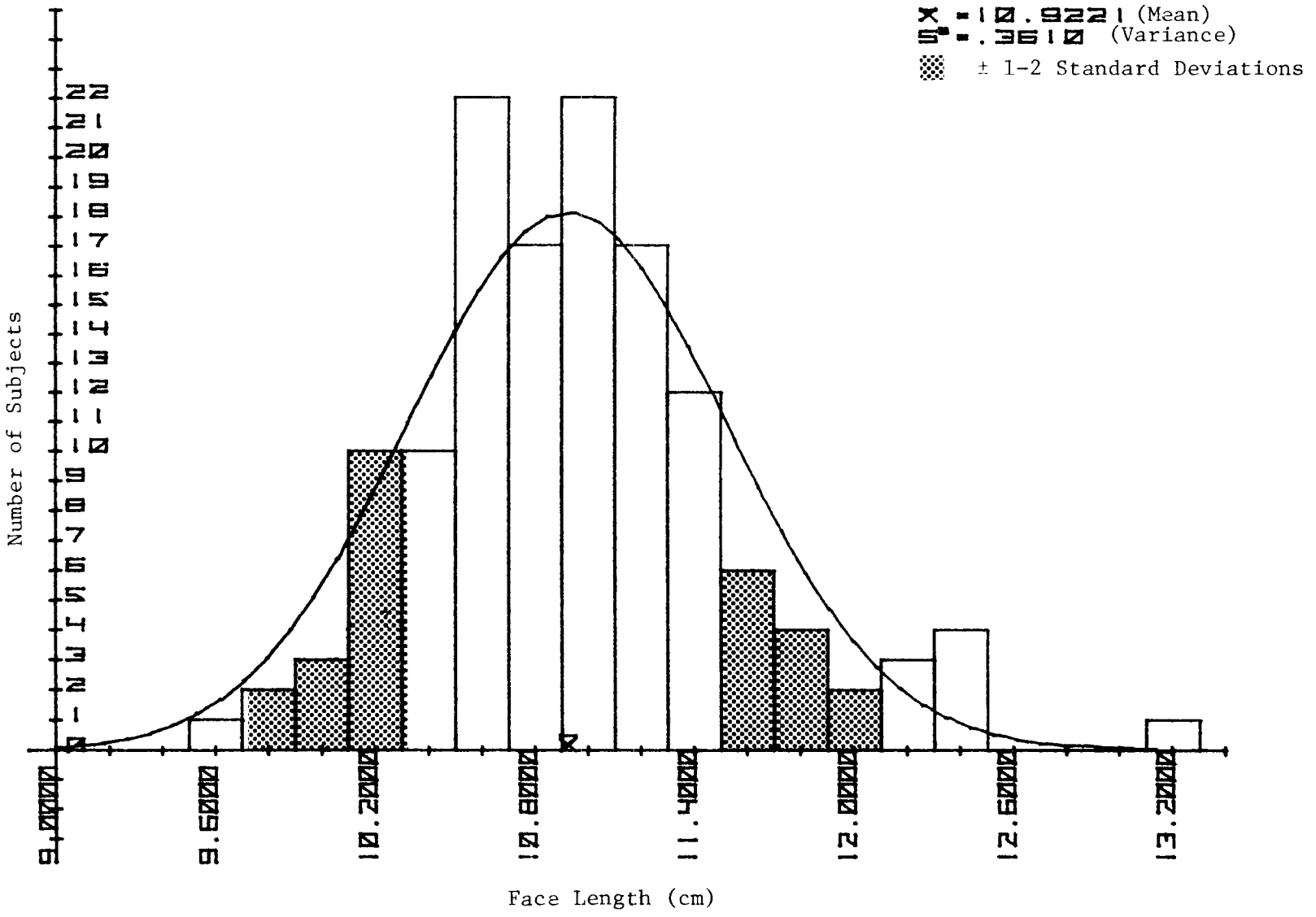
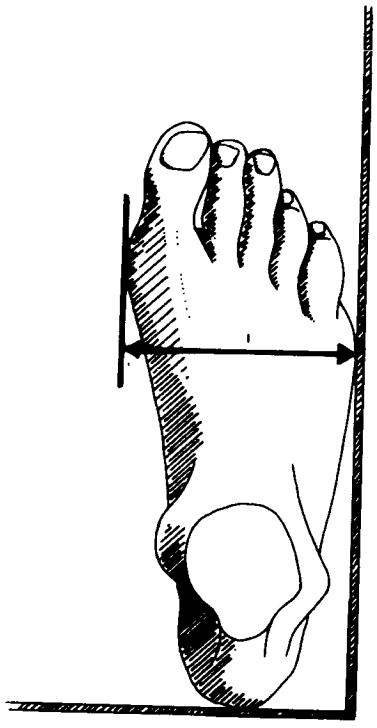


Figure 19: Frequency histogram for face length.

(20) FOOT BREADTH

Subject stands erect, with both feet in the measuring box and about 10 cm apart. The right foot is positioned so that it's long axis is parallel to the side of the box, with the heel touching the rear and the lateral metatarsal-phalangeal joint in light contact with the side of the box. A measuring block is held against the widest part of the foot and the breadth of the right foot is measured on the foot scale.



Summary Statistics

centimetres		inches
7.6 - 14.8	Range	3.0 - 5.8
9.08	Mean	3.57
0.06	SEM	0.02
0.72	Std. Dev.	0.28
0.04	SE (SD)	0.02

Coefficient of Variation: 7.93%

Coefficient of Skewedness: 3.67

Coefficient of Kurtosis: 30.80

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
7.7	1st	3.0
8.2	5th	3.2
8.4	10th	3.3
8.6	25th	3.4
8.9	**50th**	**3.5**
9.4	75th	3.7
9.7	90th	3.8
9.8	95th	3.9
10.3	99th	4.1

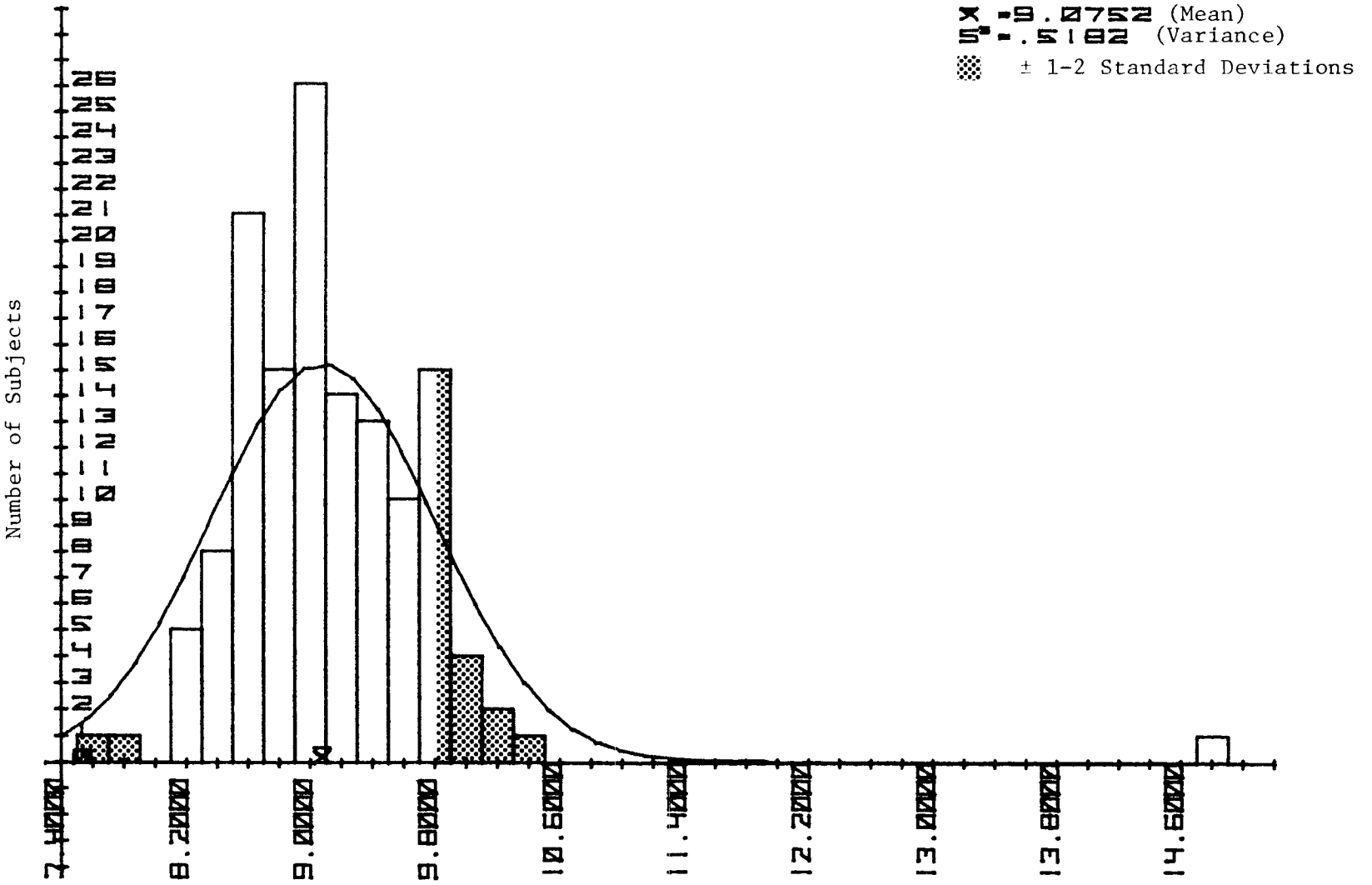


Figure 20: Frequency histogram for foot breadth.

(21) FOOT LENGTH

Subject stands erect, with both feet in the measuring box and about 10 cm apart. The right foot is positioned so that its long axis is parallel to the side of the box, with the heel touching the rear and the lateral metatarsal-phalangeal joint in light contact with the side of the box. A measuring block is held against the tip of the most distal phalanx and the length of the right foot is measured on the foot scale.

Summary Statistics

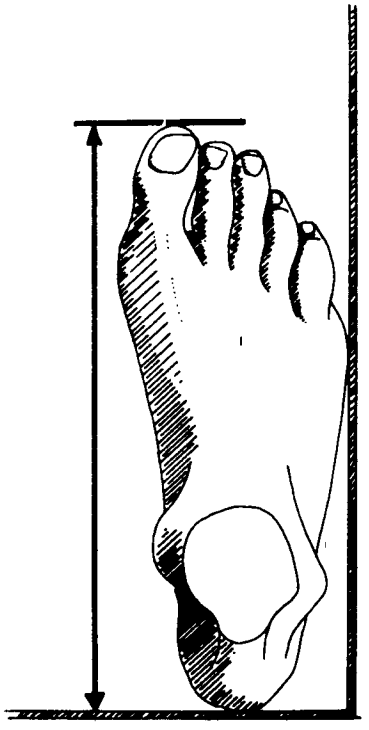
centimetres		inches
15.3 - 28.8	Range	6.0 - 11.3
23.77	Mean	9.36
0.14	SEM	0.06
1.68	Std. Dev.	0.66
0.10	SE (SD)	0.04

Coefficient of Variation: 7.07%

Coefficient of Skewedness: -1.70

Coefficient of Kurtosis: 10.77

Number of Subjects: 137



Percentile Equivalents

cm	percentile	in
15.7	1st	6.2
21.3	5th	8.4
21.9	10th	8.6
22.8	25th	9.0
23.6	50th	9.3
24.5	75th	9.7
25.2	90th	9.9
25.6	95th	10.1
26.9	99th	10.6

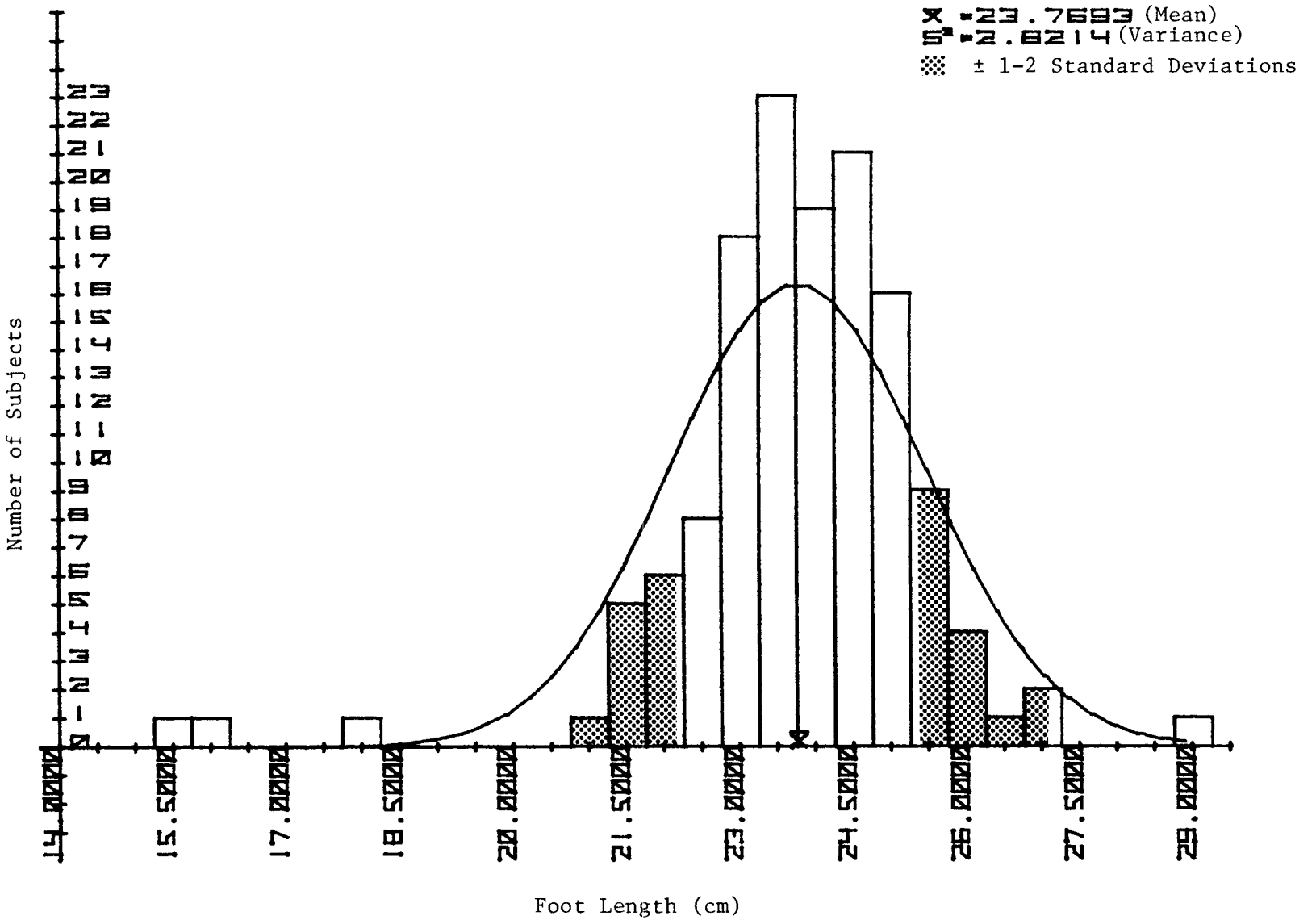


Figure 21: Frequency histogram for foot length.

(22) FOREARM CIRCUMFERENCE - FLEXED

Subject stands erect, right arm extended horizontally forward, elbow flexed and forearm raised vertically. The fist is tightly clenched and the forearm muscles maximally contracted. With the measuring tape held in a plane perpendicular to the long axis of the right forearm, the maximum forearm circumference is measured.

Summary Statistics

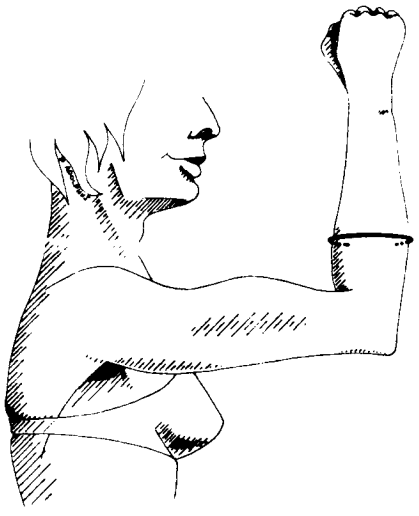
centimetres		inches
21.2 - 29.8	Range	8.3 - 11.7
25.30	Mean	9.96
0.12	SEM	0.05
1.44	Std. Dev.	0.57
0.09	SE (SD)	0.04

Coefficient of Variation: 5.69%

Coefficient of Skewedness: 0.06

Coefficient of Kurtosis: 3.01

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
21.1	1st	8.3
22.7	5th	8.9
23.2	10th	9.1
24.0	25th	9.4
25.0	50th	9.8
26.1	75th	10.3
27.0	90th	10.6
27.4	95th	10.8
28.3	99th	11.1

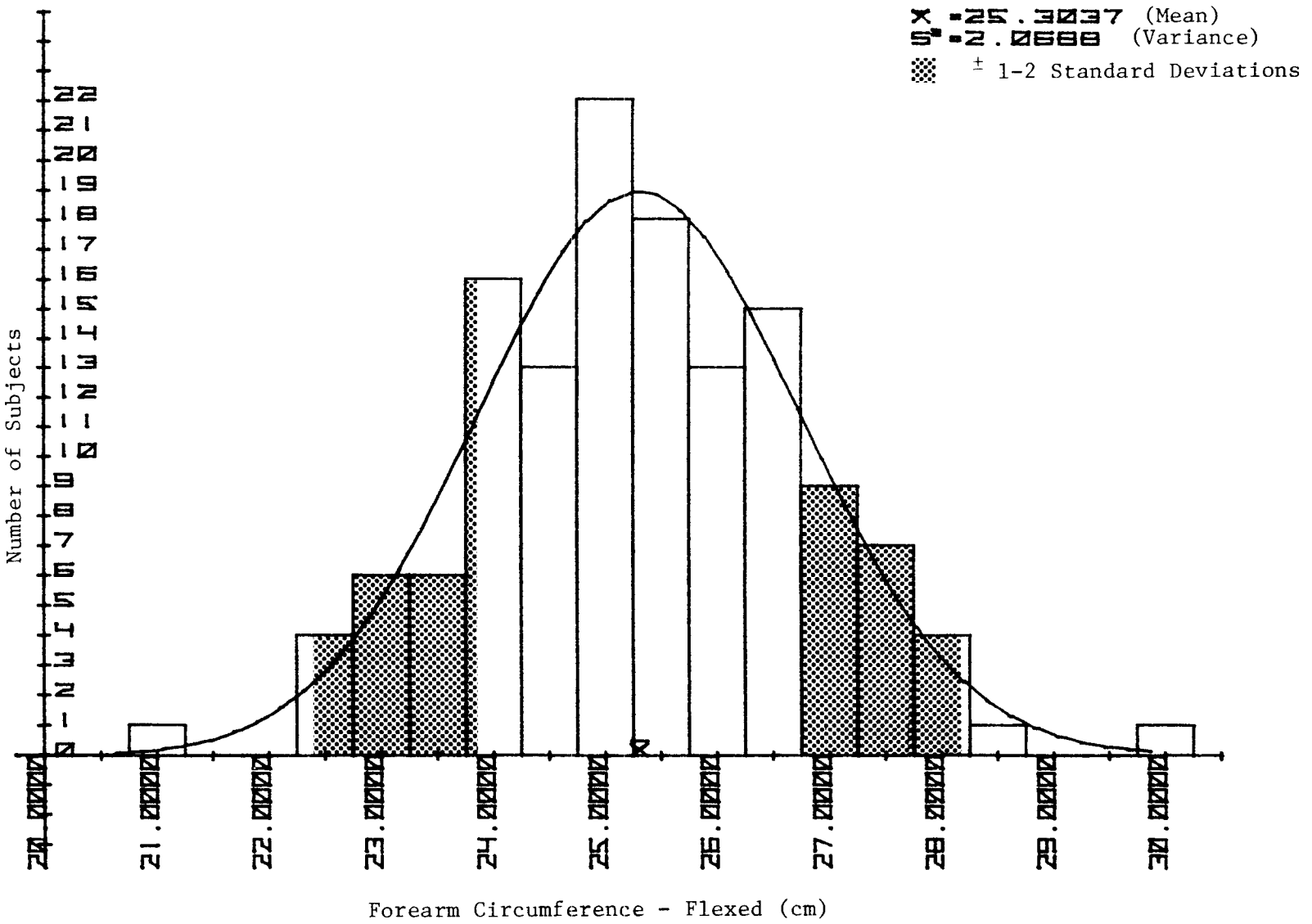
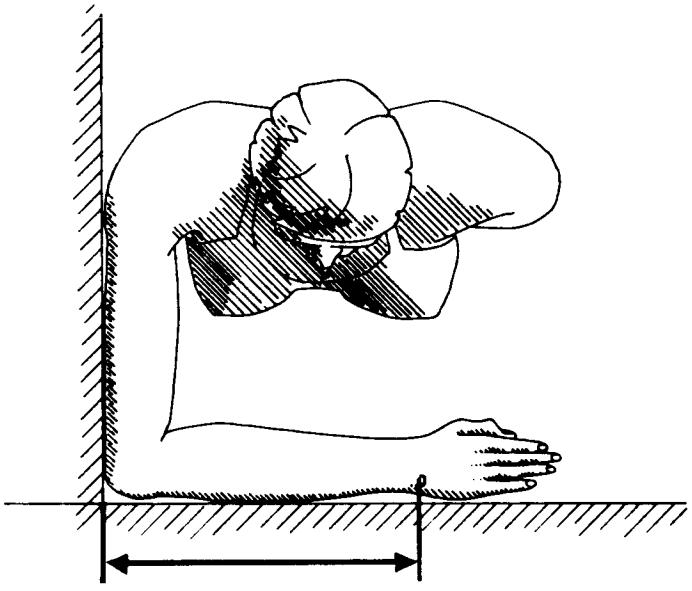


Figure 22: Frequency histogram for forearm circumference -flexed.

(23) FOREARM LENGTH

Subject stands erect beside one wall of the corner and facing the other wall. The right elbow is in the corner with the hand pronated and the upper arm and forearm are held horizontally along the perpendicular walls. The horizontal distance from the corner to the wrist landmark is measured on the wall scale.



Summary Statistics

centimetres		inches
22.2 - 29.4	Range	8.7 - 11.6
24.45	Mean	10.02
0.13	SEM	0.05
1.47	Std. Dev.	0.58
0.09	SE (SD)	0.04

Coefficient of Variation: 5.78%

Coefficient of Skewedness: 0.06

Coefficient of Kurtosis: 2.90

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
22.1	1st	8.7
22.8	5th	9.0
23.3	10th	9.2
24.2	25th	9.5
25.4	50th	10.0
26.1	75th	10.3
27.1	90th	10.7
28.1	95th	11.1
29.2	99th	11.5

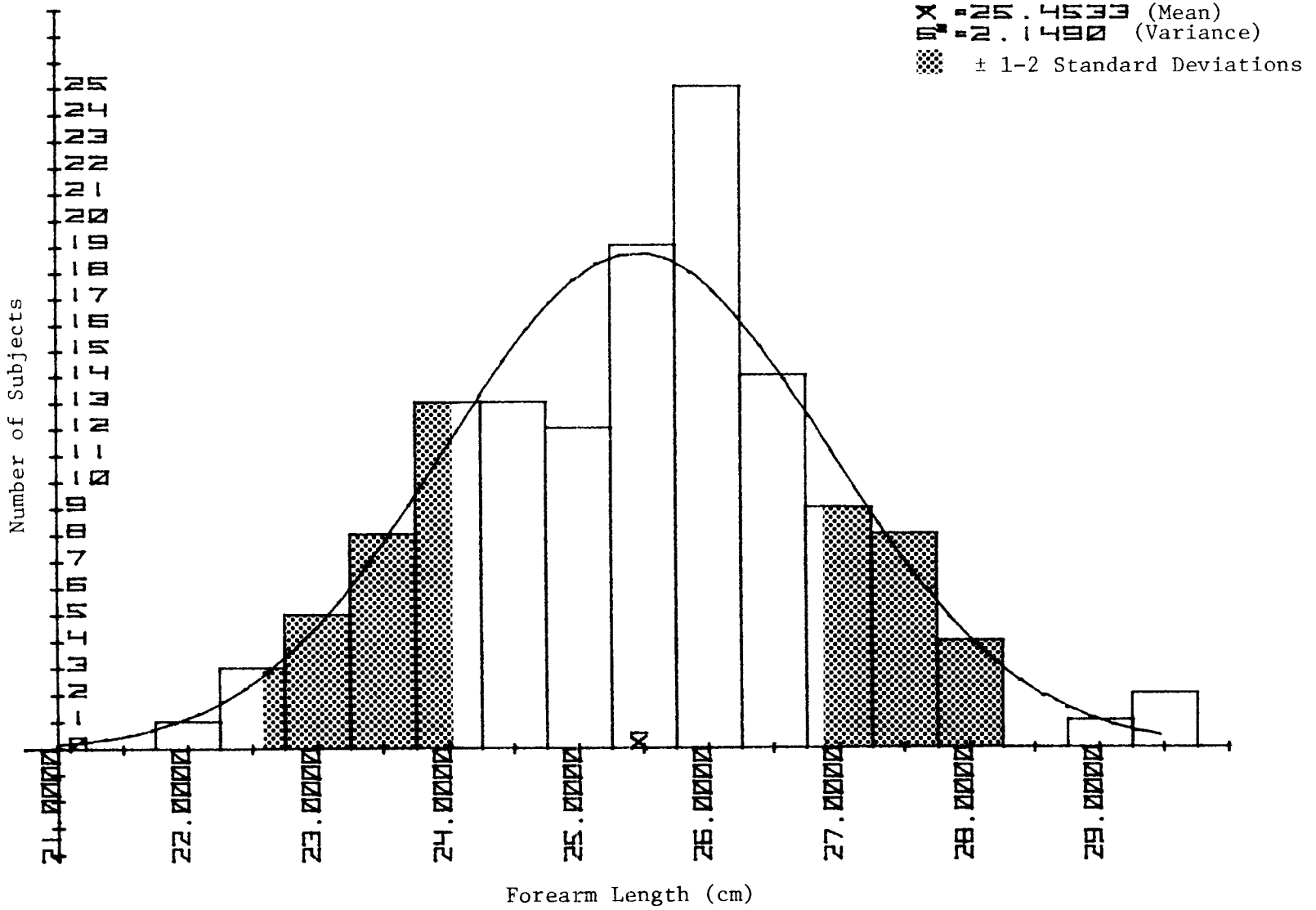
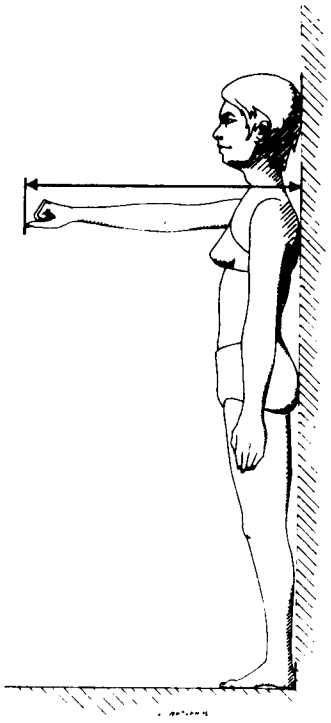


Figure 23: Frequency histogram for forearm length.

(24) FUNCTIONAL REACH

Subject stands erect, with back against one wall of the corner and right arm extended horizontally forward along the other wall. The right hand is pronated and fingers clenched to form a fist. The thumb is then fully extended below the fist, in horizontal line with the forearm. The heels, buttocks and shoulders are held firmly against the wall and a measuring block is held against the top of the extended thumb. The horizontal distance from the back wall to the block is measured on the wall scale.



Summary Statistics

centimetres		inches
62.5 - 78.5	Range	24.6 - 30.9
70.15	Mean	27.62
0.28	SEM	0.11
3.27	Std. Dev.	1.29
0.20	SE (SD)	0.08

Coefficient of Variation: 4.66%

Coefficient of Skewedness: 0.29

Coefficient of Kurtosis: 2.78

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
62.7	1st	24.7
65.7	5th	25.9
66.0	10th	26.0
67.3	25th	26.5
69.5	50th	27.4
71.9	75th	28.3
73.9	90th	29.1
75.7	95th	29.8
77.8	99th	30.6

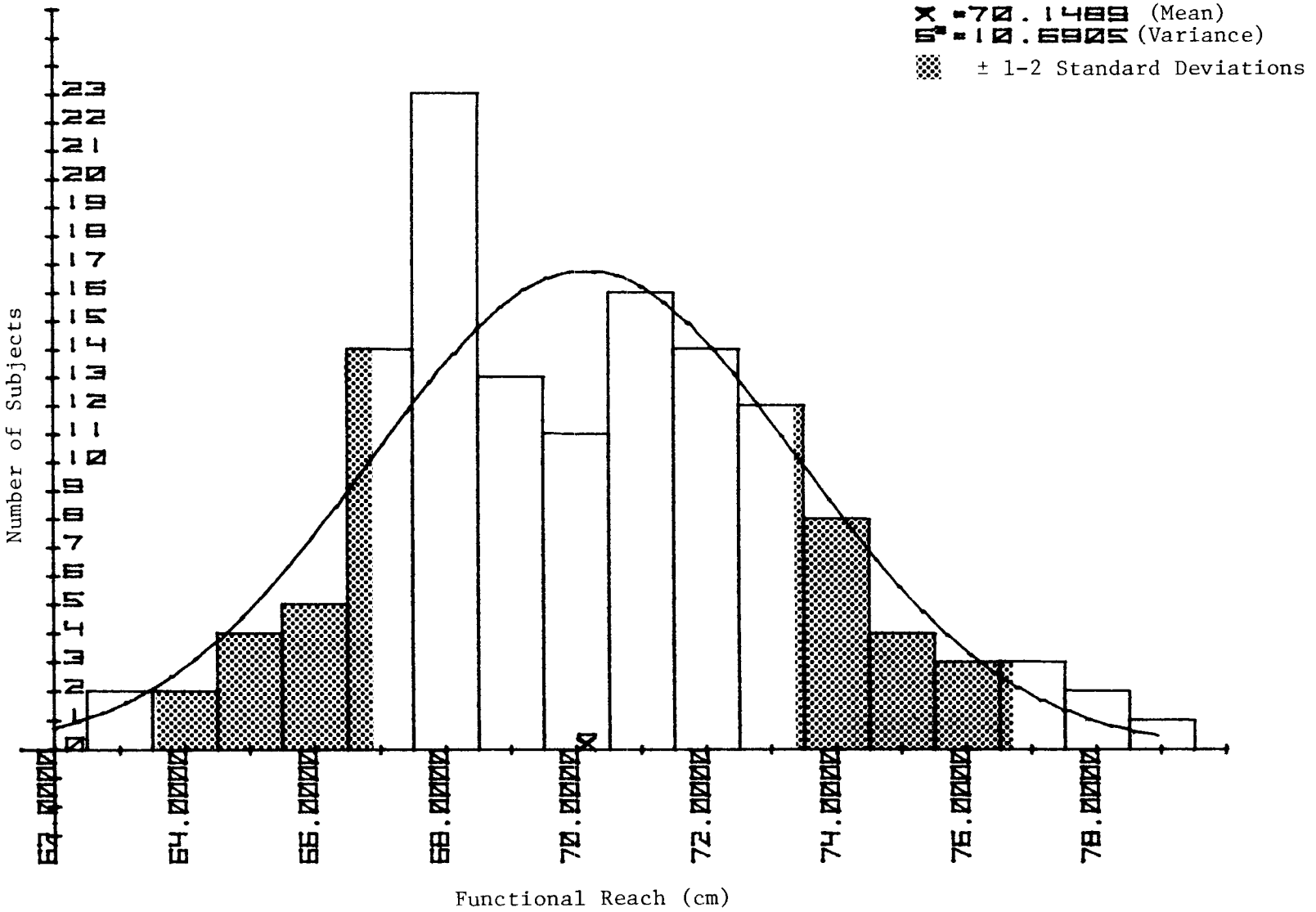
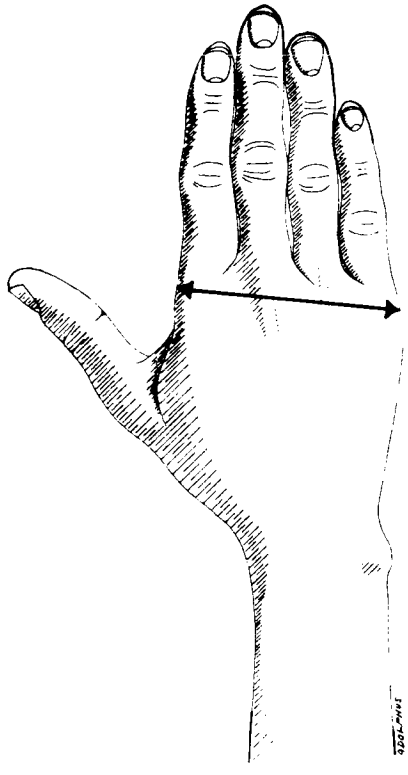


Figure 24: Frequency histogram for functional reach.

(25) HAND BREADTH

The subject's right hand is pronated and rests lightly on a table, fingers together and straight (but not hyperextended) and thumb held apart. The breadth of the hand between the second and fifth metacarpal-phalangeal joints is measured, using the sliding calipers.



Summary Statistics

centimetres		inches
7.1 - 9.0	Range	2.8 - 3.5
8.01	Mean	3.15
0.03	SEM	0.01
0.38	Std. Dev.	0.15
0.02	SE (SD)	0.01

Coefficient of Variation: 4.74%

Coefficient of Skewedness: 0.17

Coefficient of Kurtosis: 2.81

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
7.1	1st	2.8
7.3	5th	2.9
7.5	10th	3.0
7.7	25th	3.0
7.9	50th	3.1
8.2	75th	3.2
8.5	90th	3.3
8.6	95th	3.4
8.9	99th	3.5

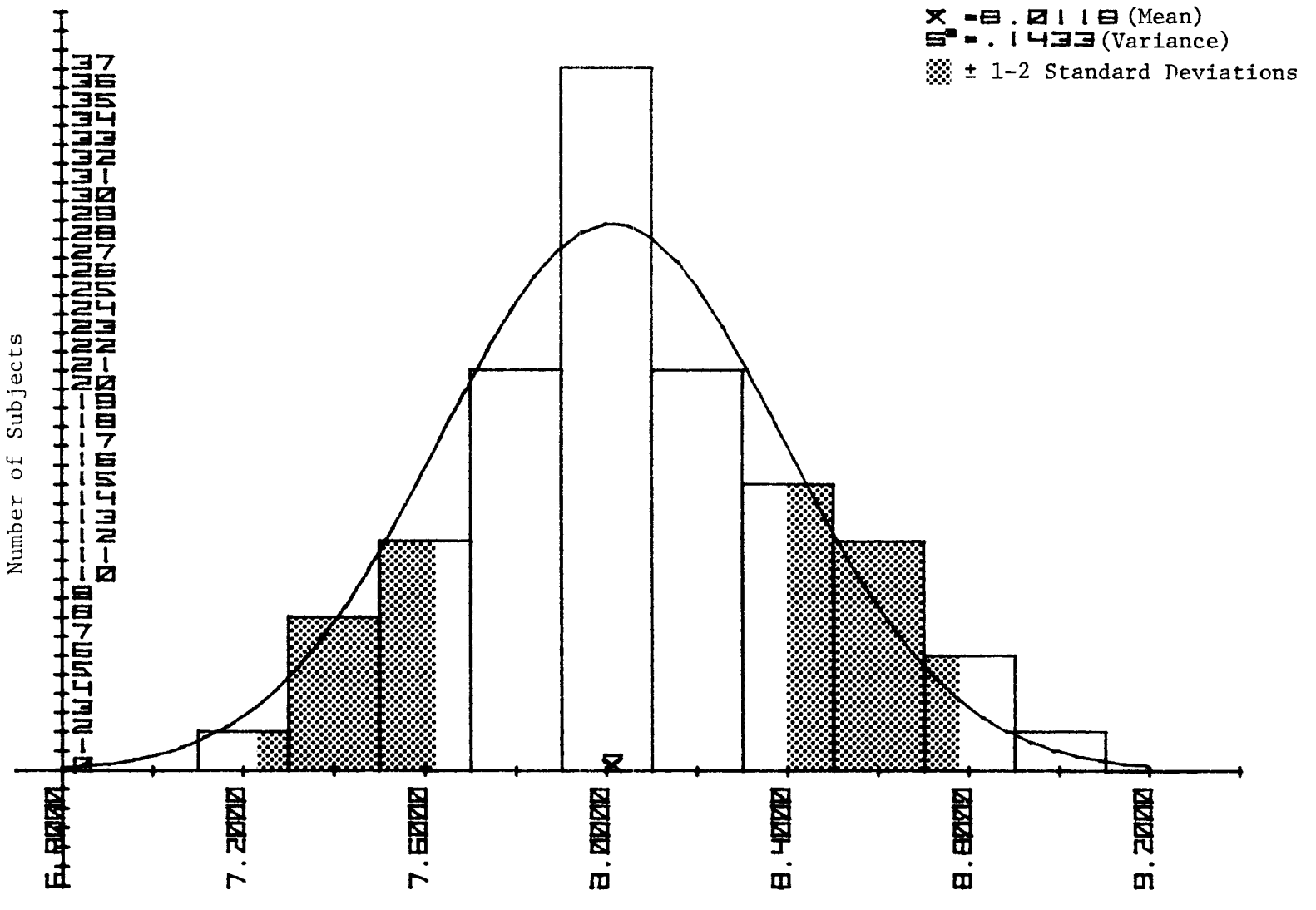
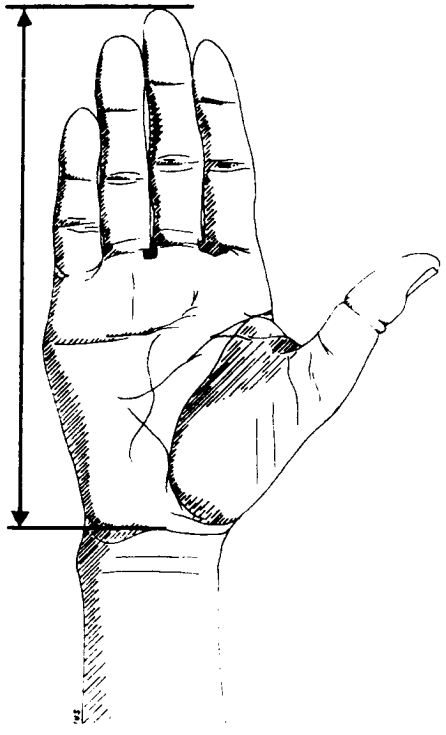


Figure 25: Frequency histogram for hand breadth.

(26) HAND LENGTH

The subject's right hand is supinated and rests lightly on a table, with fingers together and straight (but not hyperextended). With the bar of the sliding calipers held parallel to the long axis of the hand, the distance from the dactylion to the distal wrist crease is measured.



Summary Statistics

centimetres		inches
15.2 - 20.6	Range	6.0 - 8.1
17.38	Mean	6.84
0.08	SEM	0.03
0.89	Std. Dev.	0.35
0.05	SE (SD)	0.02

Coefficient of Variation: 5.12%

Coefficient of Skewedness: 0.36

Coefficient of Kurtosis: 3.42

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
15.2	1st	6.0
15.9	5th	6.3
16.1	10th	6.3
16.6	25th	6.5
17.2	50th	6.8
17.8	75th	7.0
18.5	90th	7.3
18.8	95th	7.4
19.3	99th	7.6

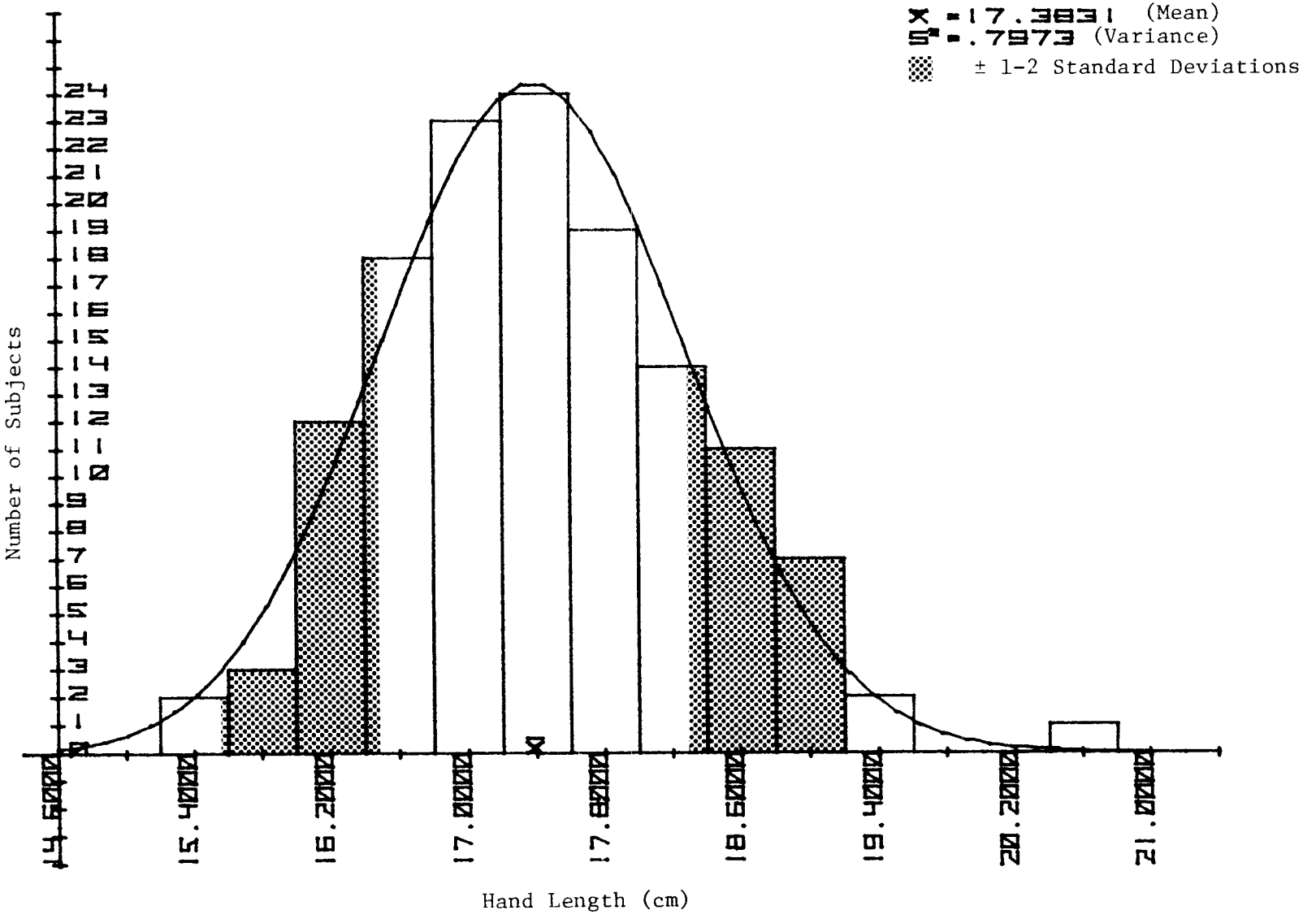


Figure 26: Frequency histogram for hand length.

(27) HEAD CIRCUMFERENCE

Subject stands erect, with line of sight horizontal. The horizontal circumference of the head is measured, with the measuring tape held just above the glabella landmark.

Summary Statistics

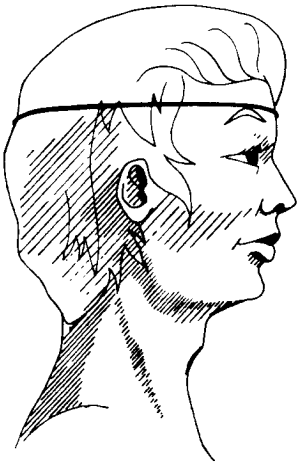
centimetres		inches
50.8 - 59.3	Range	20.0 - 23.3
55.38	Mean	21.80
0.13	SEM	0.05
1.48	Std. Dev.	0.58
0.09	SE (SD)	0.04

Coefficient of Variation: 2.67%

Coefficient of Skewedness: 0.15

Coefficient of Kurtosis: 2.83

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
51.4	1st	20.2
53.2	5th	20.9
53.4	10th	21.0
54.0	25th	21.3
55.1	50th	21.7
56.2	75th	22.1
57.2	90th	22.5
57.7	95th	22.7
58.6	99th	23.1

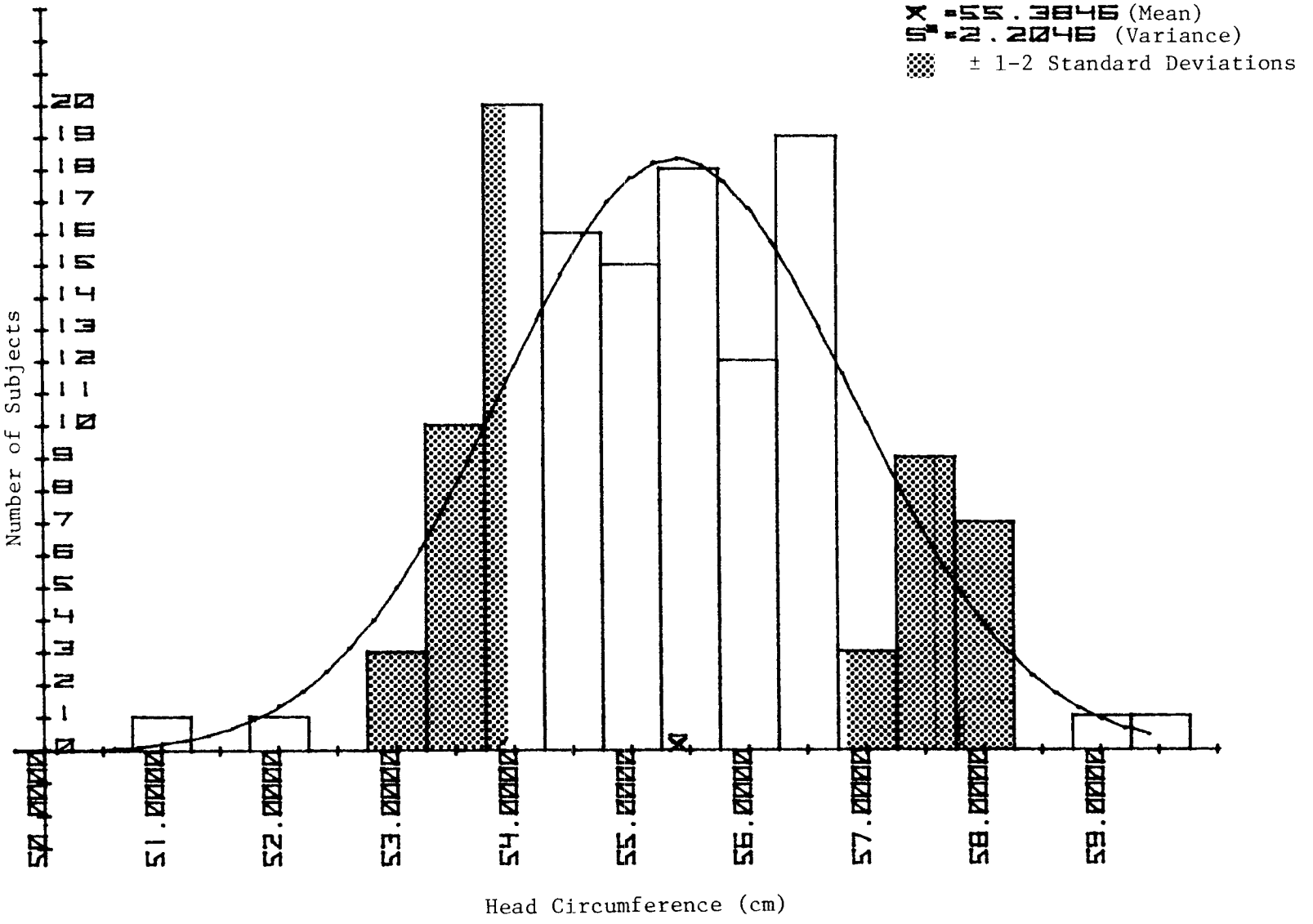
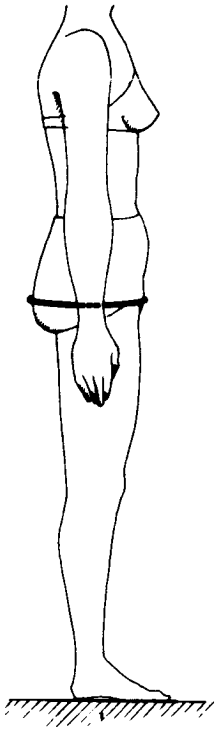


Figure 27: Frequency histogram for head circumference.

(28) HIP CIRCUMFERENCE

Subject stands erect, with heels together. The measuring tape is held in a plane perpendicular to the long axis of the trunk and the circumference of the hips at the maximum protrusion of the buttocks is measured.



Summary Statistics

centimetres		inches
82.0 - 113.0	Range	32.3 - 44.5
97.20	Mean	38.3
0.52	SEM	0.02
6.03	Std. Dev.	2.37
0.37	SE (SD)	0.15

Coefficient of Variation: 6.20%

Coefficient of Skewedness: 0.30

Coefficient of Kurtosis: 2.87

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
82.5	1st	32.5
87.4	5th	34.4
88.9	10th	36.1
91.6	25th	36.1
95.7	50th	37.7
100.5	75th	39.6
104.2	90th	41.0
106.8	95th	42.0
111.8	99th	44.0

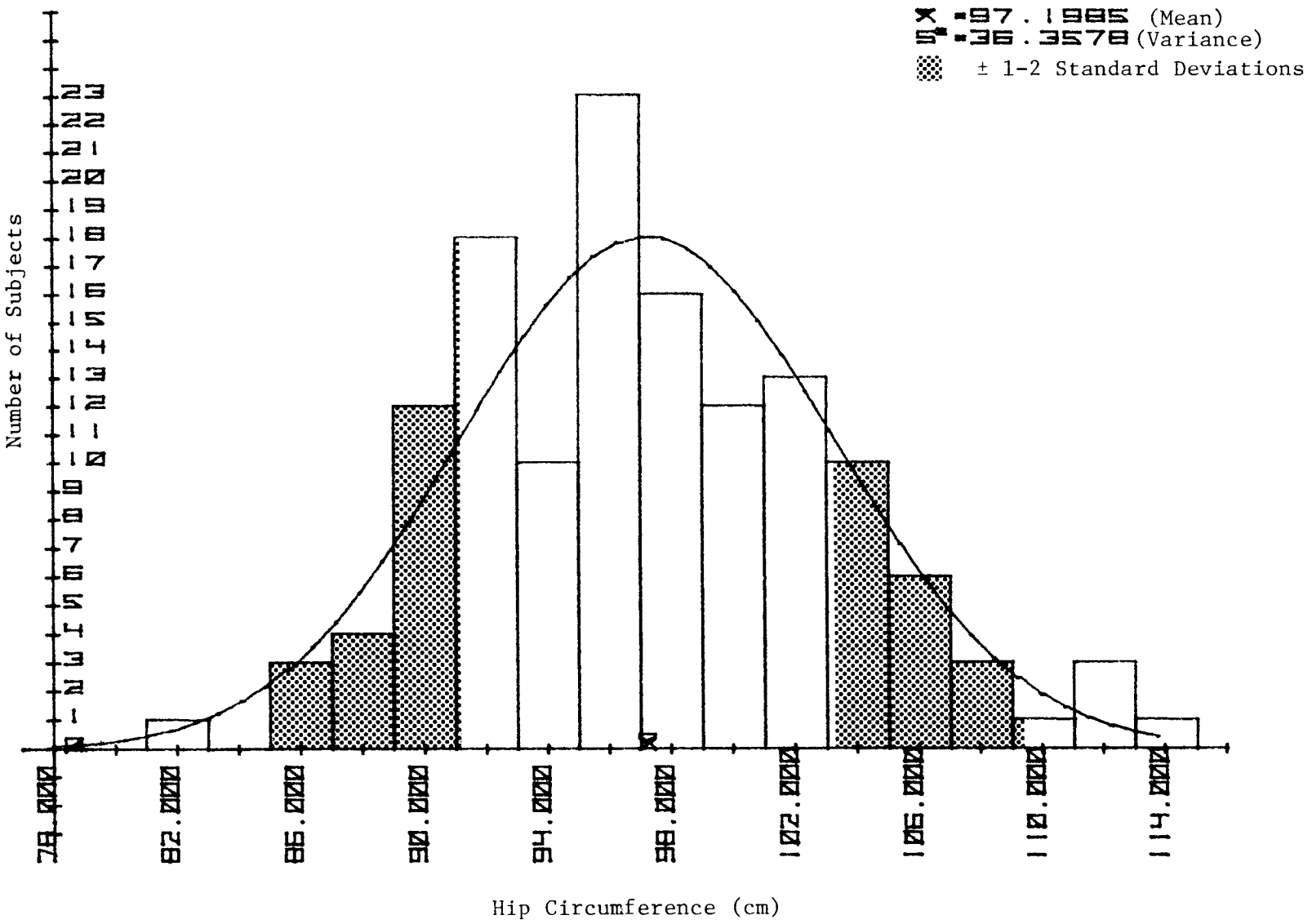
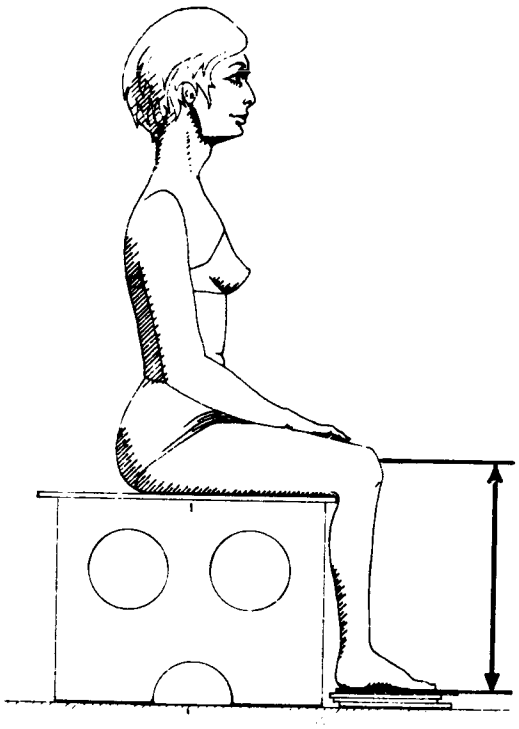


Figure 28: Frequency histogram for hip circumference.

(29) KNEE HEIGHT

Subject sits erect on the measuring bench, with feet supported so that the thighs are in the horizontal plane and parallel. The lower leg is vertical, with the popliteal in light contact with the front edge of the bench. The vertical distance from the foot surface to the superior aspect of the right patella is measured with the anthropometer.



Summary Statistics

centimetres		inches
43.6 - 55.2	Range	17.2 - 21.7
48.86	Mean	19.24
0.21	SEM	0.08
2.48	Std. Dev.	0.98
0.15	SE (SD)	0.06

Coefficient of Variation: 5.08%

Coefficient of Skewedness: 0.16

Coefficient of Kurtosis: 2.65

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
43.7	1st	17.2
44.7	5th	17.5
45.3	10th	17.8
46.8	25th	18.4
48.3	**50th**	**19.0**
50.0	75th	19.7
51.7	90th	20.4
52.4	95th	20.6
54.3	99th	21.4

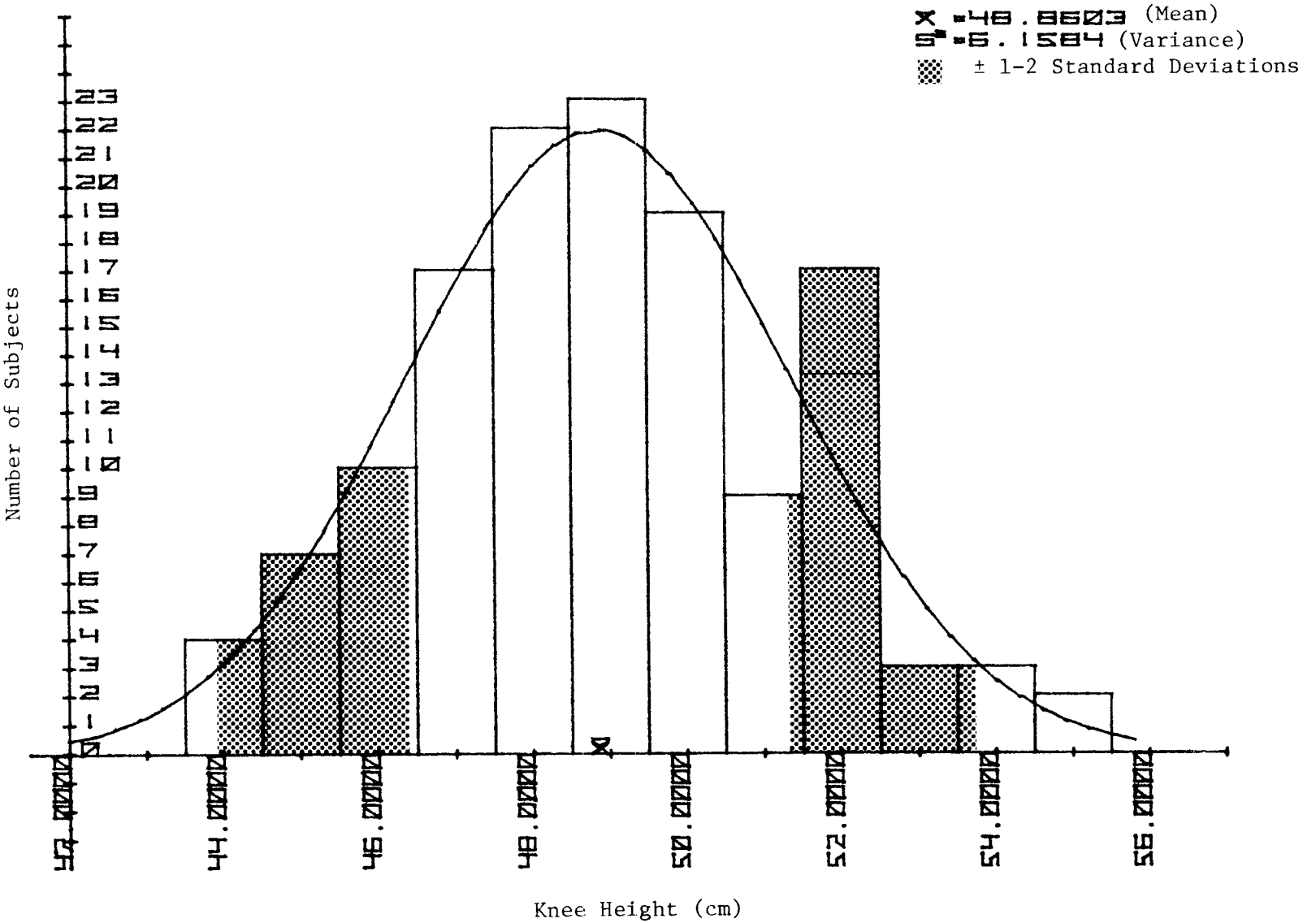
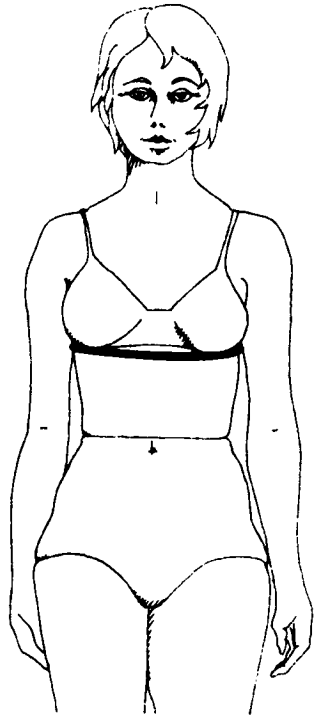


Figure 29: Frequency histogram for knee height.

(30) LOWER CHEST CIRCUMFERENCE

Subject stands erect, with arms slightly abducted. With the measuring tape held in a horizontal plane, the circumference of the chest just below the cups of the bra is measured, at the average point of quiet respiration.



Summary Statistics

centimetres		inches
64.5 - 93.5	Range	25.4 - 36.8
78.30	Mean	30.83
0.45	SEM	0.18
5.26	Std. Dev.	2.07
0.32	SE (SD)	0.13

Coefficient of Variation: 6.72%

Coefficient of Skewedness: 0.28

Coefficient of Kurtosis: 2.82

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
64.7	1st	25.5
70.1	5th	27.6
71.2	10th	28.0
73.6	25th	29.0
76.7	**50th**	**30.2**
81.2	75th	32.0
84.3	90th	33.2
86.1	95th	33.9
89.7	99th	35.3

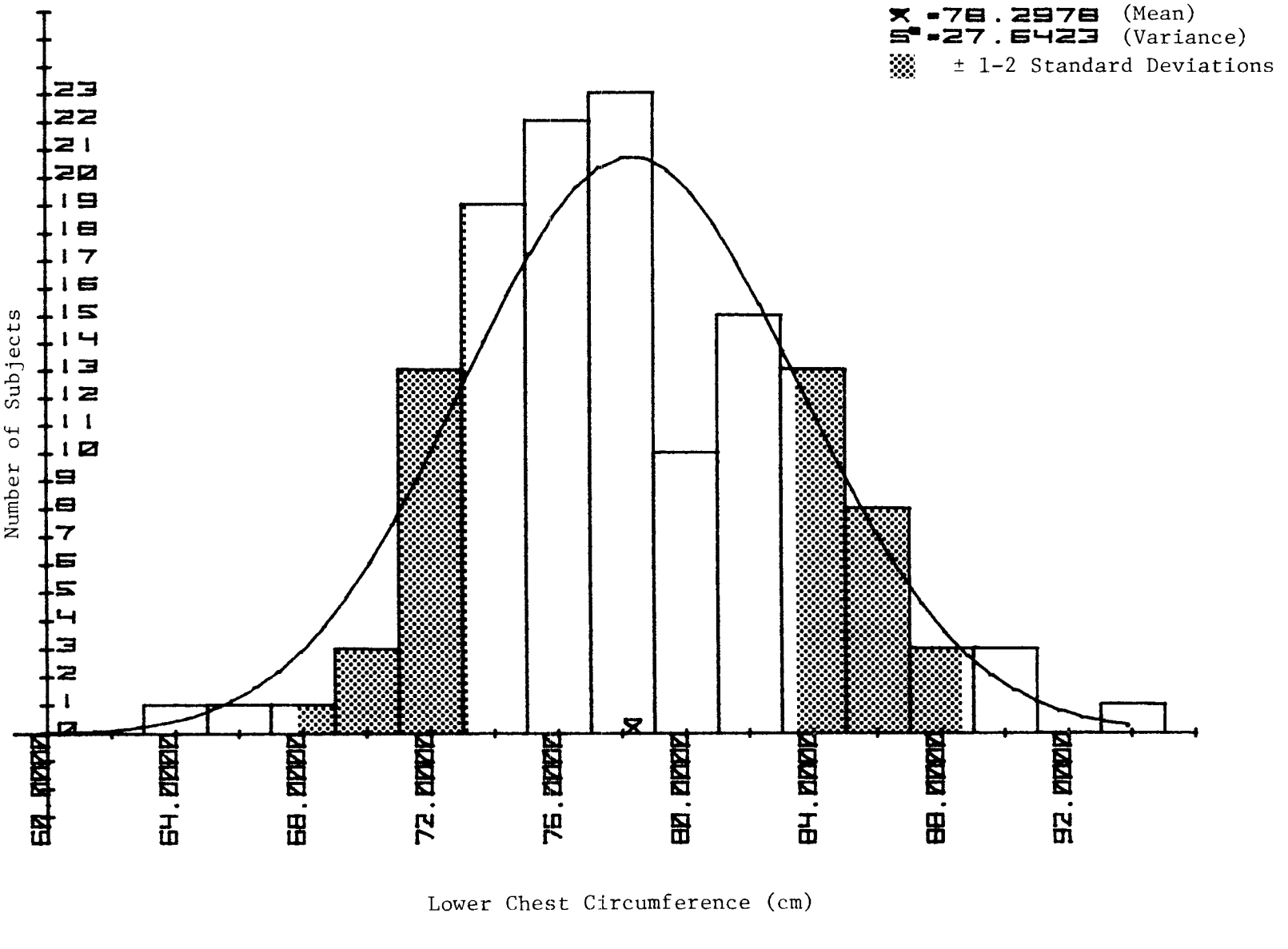
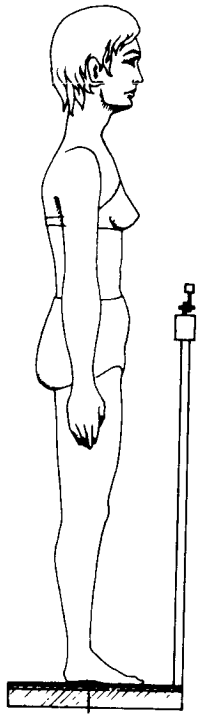


Figure 30: Frequency histogram for lower chest circumference.

(31) MASS

Subject stands erect on medical scales. Mass is recorded to the nearest 0.1 kilograms.



Summary Statistics

kilograms		pounds
40.2 - 82.3	Range	88.6 - 181.
61.70	Mean	136.02
0.69	SEM	1.52
8.13	Std. Dev.	17.92
0.49	SE (SD)	1.08

Coefficient of Variation: 13.18%

Coefficient of Skewedness: 0.26

Coefficient of Kurtosis: 2.69

Number of Subjects: 137

Percentile Equivalents

kg	percentile	lb
42.3	1st	93.3
48.8	5th	107.6
50.5	10th	111.3
54.8	25th	120.8
60.7	50th	133.8
66.4	75th	146.4
73.0	90th	160.9
75.2	95th	165.8
80.5	99th	177.5

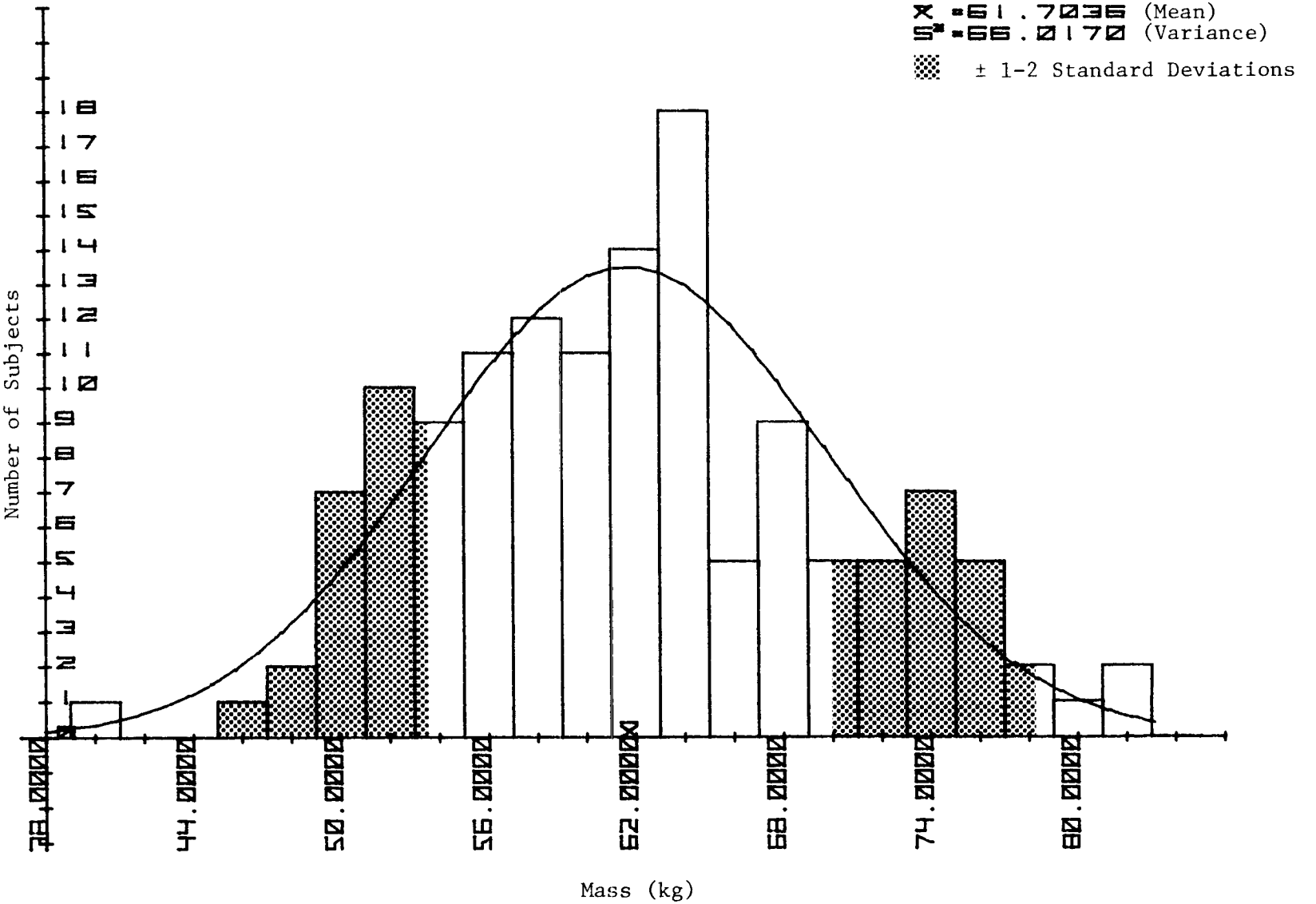
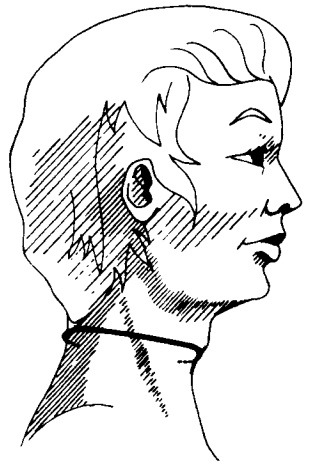


Figure 31: Frequency histogram for mass.

(32) NECK CIRCUMFERENCE

Subject stands erect, with line of sight horizontal. The measuring tape is held in a plane perpendicular to the long axis of the neck. The circumference of the neck just below the bulge of the thyroid cartilage ("Adams apple") is measured.



Summary Statistics

centimetres		inches
28.0 - 38.8	Range	11.0 - 15.3
33.68	Mean	13.26
0.14	SEM	0.06
1.62	Std. Dev.	0.64
0.10	SE (SD)	0.04

Coefficient of Variation: 4.81%

Coefficient of Skewedness: 0.16

Coefficient of Kurtosis: 4.18

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
28.5	1st	11.2
31.1	5th	12.2
31.6	10th	12.4
32.5	25th	12.8
33.4	50th	13.1
34.3	75th	13.5
35.5	90th	14.0
36.4	95th	14.3
37.3	99th	14.7

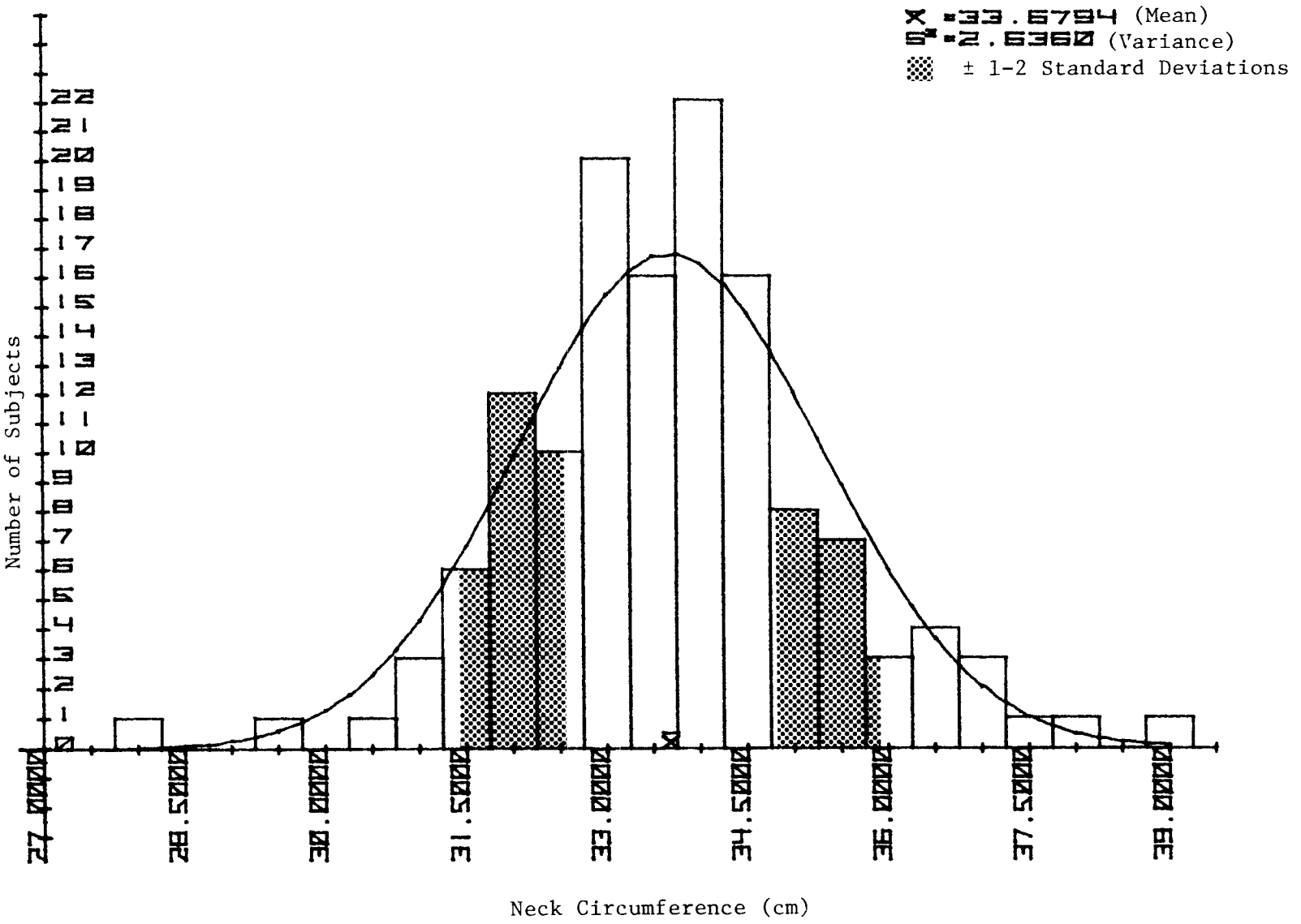
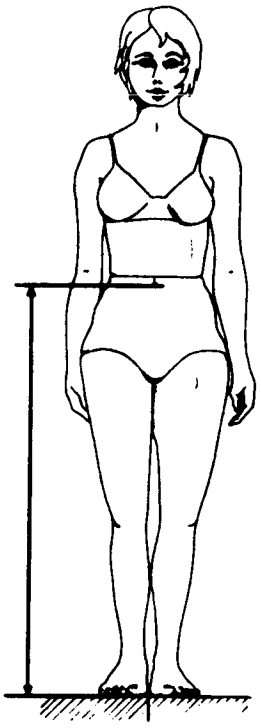


Figure 32: Frequency histogram for neck circumference.

(33) OMPHALION HEIGHT

Subject stands erect, with heels together. The vertical distance from the standing surface to the omphalion is measured with the anthropometer.



Summary Statistics

centimetres		inches
86.0 - 107.6	Range	33.9 - 42.4
97.54	Mean	38.40
0.39	SEM	0.15
4.58	Std. Dev.	1.80
0.28	SE (SD)	0.11

Coefficient of Variation: 4.70%

Coefficient of Skewedness: 0.01

Coefficient of Kurtosis: 2.67

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
87.5	1st	34.4
88.6	5th	34.9
91.2	10th	35.9
93.3	25th	36.7
96.4	**50th**	**38.0**
100.2	75th	39.4
102.6	90th	40.4
105.0	95th	41.3
106.6	99th	42.0

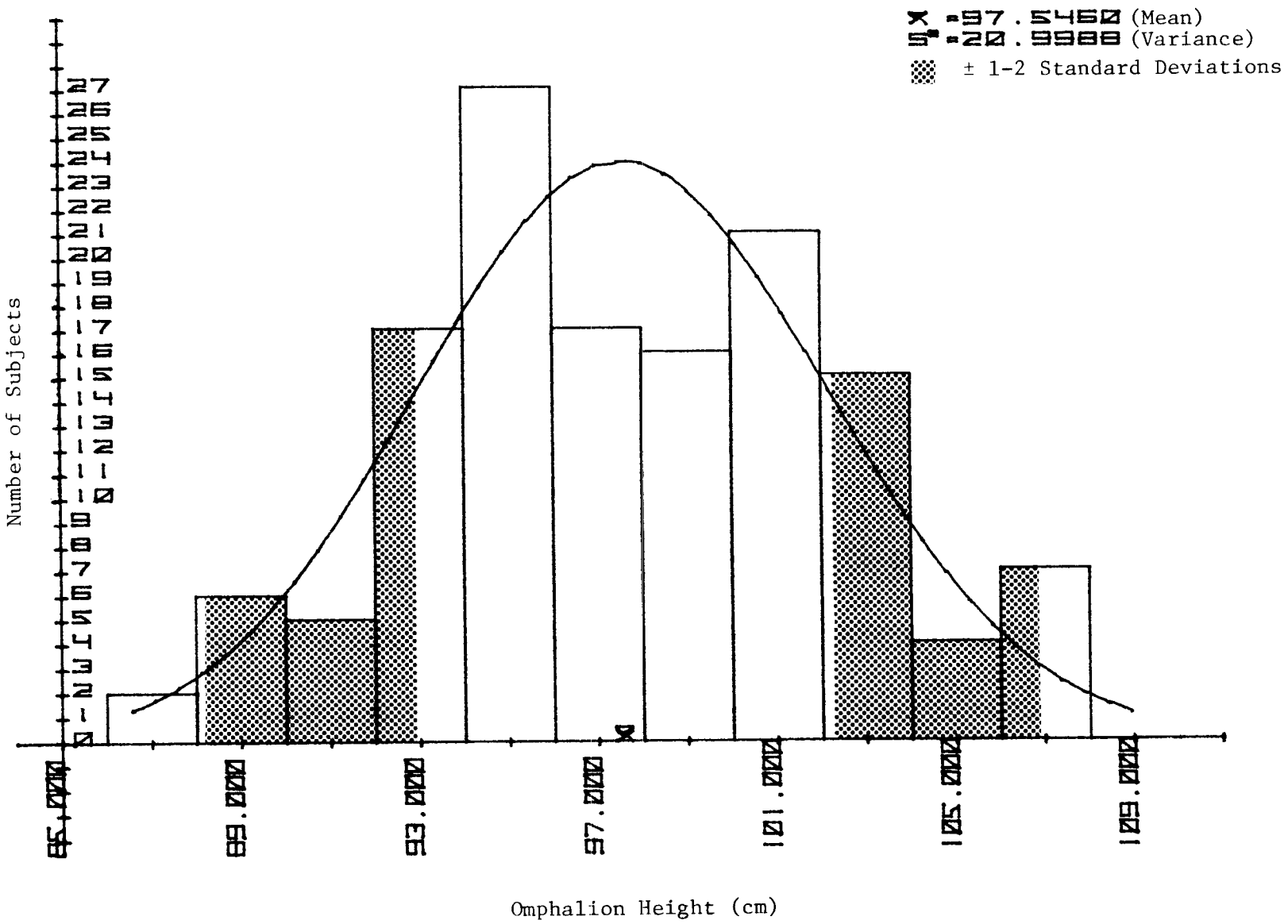
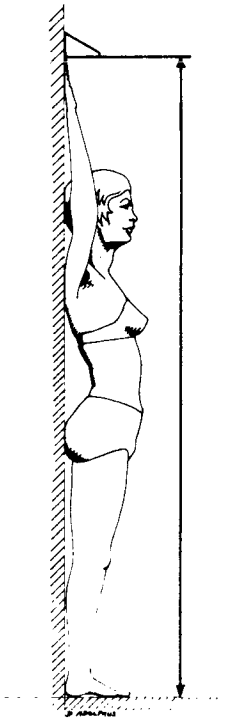


Figure 33: Frequency histogram for omphalion height.

(34) OVERHEAD REACH

Subject stands erect, with heels together and buttocks and shoulders against the wall. The right arm is extended vertically upward, while the heels remain in contact with the standing surface. With the right arm fully extended, the tips of the phalanges are used to push a measuring block up the wall to a maximum vertical height. The vertical distance from the standing surface to the block is measured with the anthropometer.



Summary Statistics

centimetres		inches
188.1 - 229.2	Range	74.1 - 90.2
208.73	Mean	82.18
0.74	SEM	0.29
8.71	Std. Dev.	3.43
0.53	SE (SD)	0.21

Coefficient of Variation: 11.47%

Coefficient of Skewedness: 0.10

Coefficient of Kurtosis: 2.45

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
188.5	1st	74.2
194.3	5th	76.5
196.7	10th	77.4
201.2	25th	79.2
207.5	**50th**	**81.7**
213.8	75th	84.2
219.2	90th	86.3
221.2	95th	87.1
227.6	99th	89.6

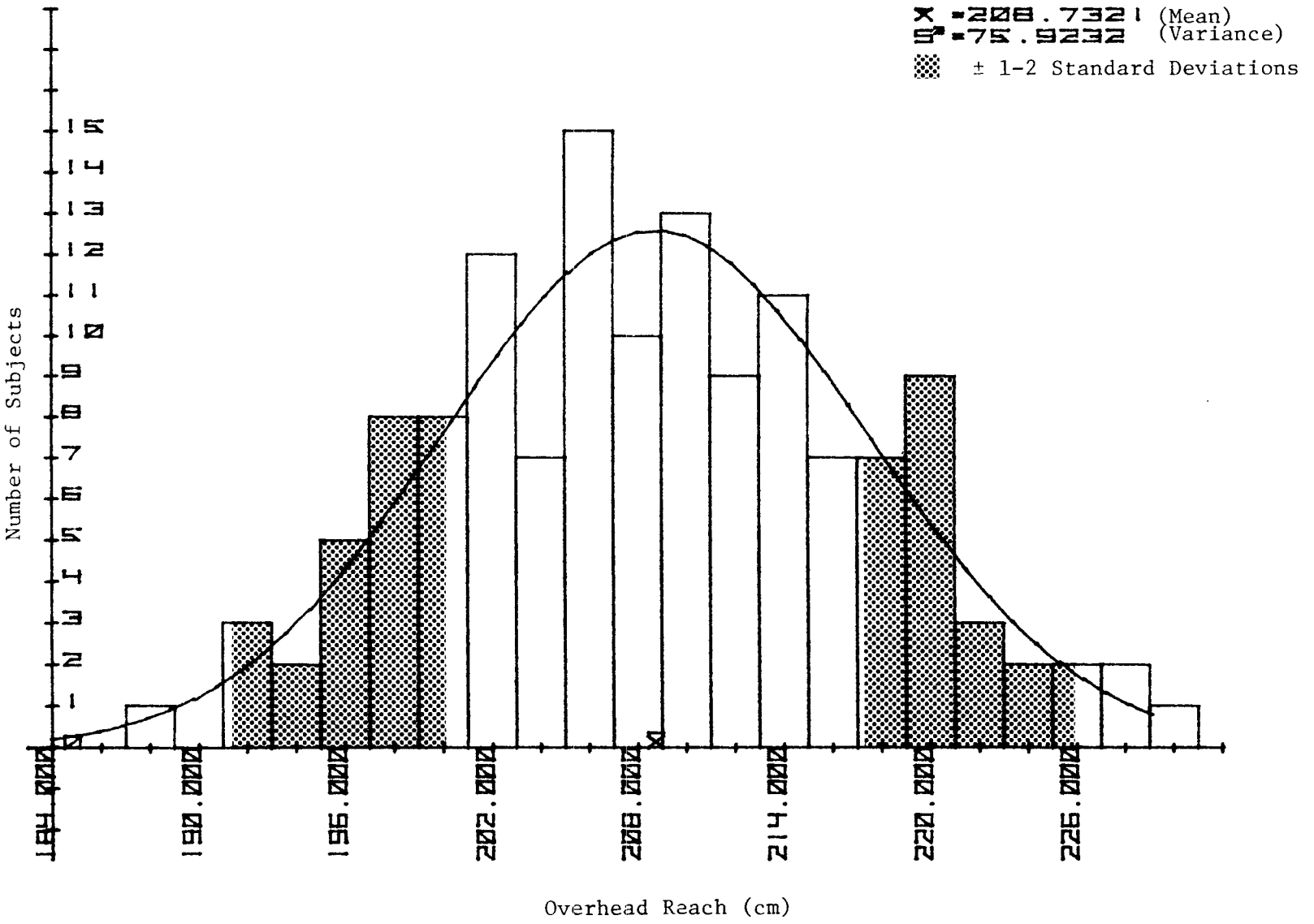
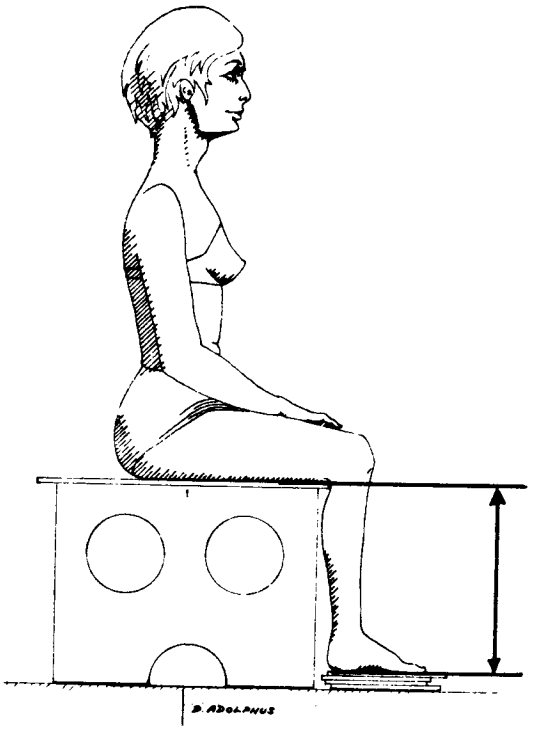


Figure 34: Frequency histogram for overhead reach.

(35) POPLITEAL HEIGHT

Subject sits erect on the measuring bench, with feet supported so that the thighs are in the horizontal plane and parallel. The lower leg is vertical, with the popliteal in light contact with the front edge of the bench. The vertical distance from the foot surface to the sitting surface is measured with the anthropometer.



Summary Statistics

centimetres		inches
24.4 - 43.3	Range	13.5 - 17.0
38.54	Mean	15.17
0.19	SEM	0.07
2.17	Std. Dev.	0.85
0.13	SE (SD)	0.05

Coefficient of Variation: 5.63%

Coefficient of Skewedness: 0.11

Coefficient of Kurtosis: 2.19

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
34.4	1st	13.5
34.6	5th	13.6
35.3	10th	13.9
36.5	25th	14.4
37.9	50th	14.9
39.9	75th	15.7
41.0	90th	16.1
42.0	95th	16.5
42.8	99th	16.9

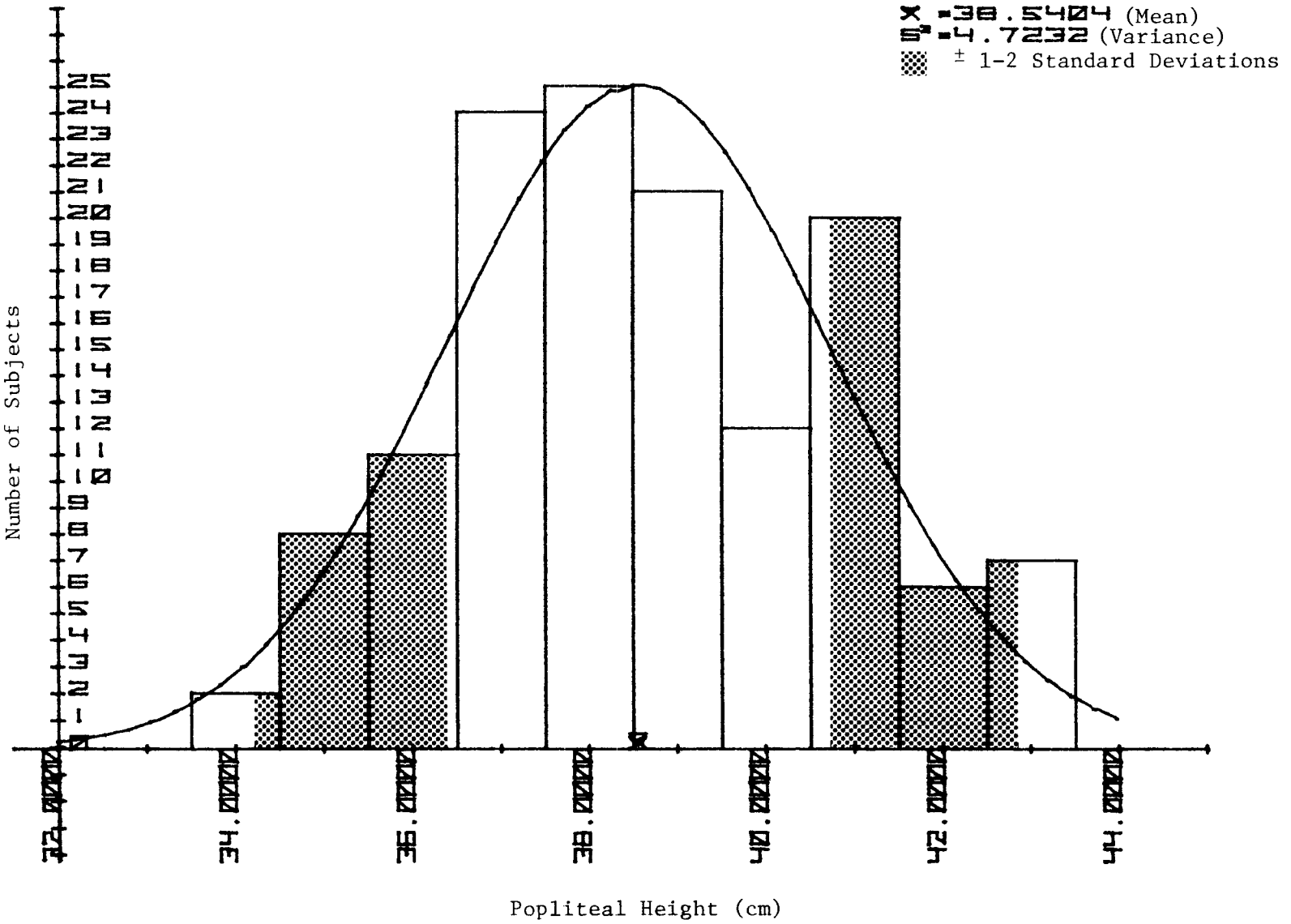
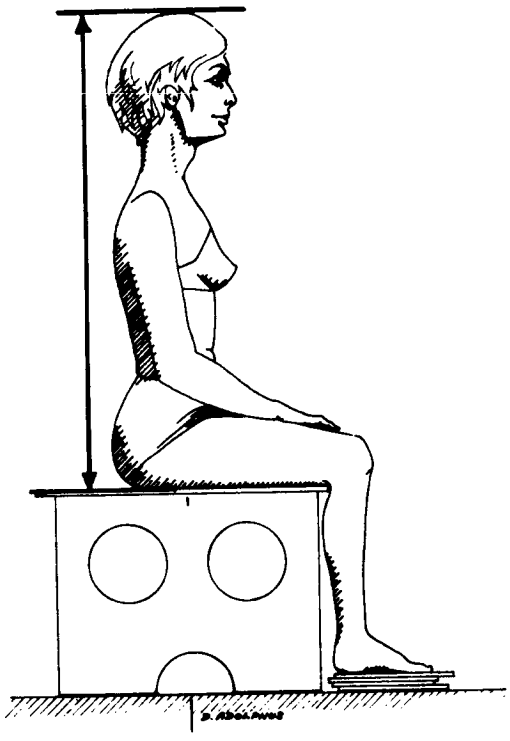


Figure 35: Frequency histogram for popliteal height.

(36) SITTING HEIGHT

Subject sits erect on the measuring bench, line of sight horizontal and feet supported so that the thighs are in the horizontal plane and parallel. With the arm of the anthropometer touching the scalp in the midsagittal plane, the vertical distance from the sitting surface to the top of the head is measured.



Summary Statistics

centimetres		inches
79.1 - 93.6	Range	31.1 - 36.9
86.42	Mean	34.02
0.25	SEM	0.1
2.97	Std. Dev.	1.17
0.18	SE (SD)	0.07

Coefficient of Variation: 3.44%

Coefficient of Skewedness: 0.23

Coefficient of Kurtosis: 2.96

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
79.1	1st	31.1
80.5	5th	31.7
82.1	10th	32.3
84.2	25th	33.1
85.8	**50th**	**33.8**
87.7	75th	34.5
90.2	90th	35.5
91.6	95th	36.1
93.5	99th	36.8

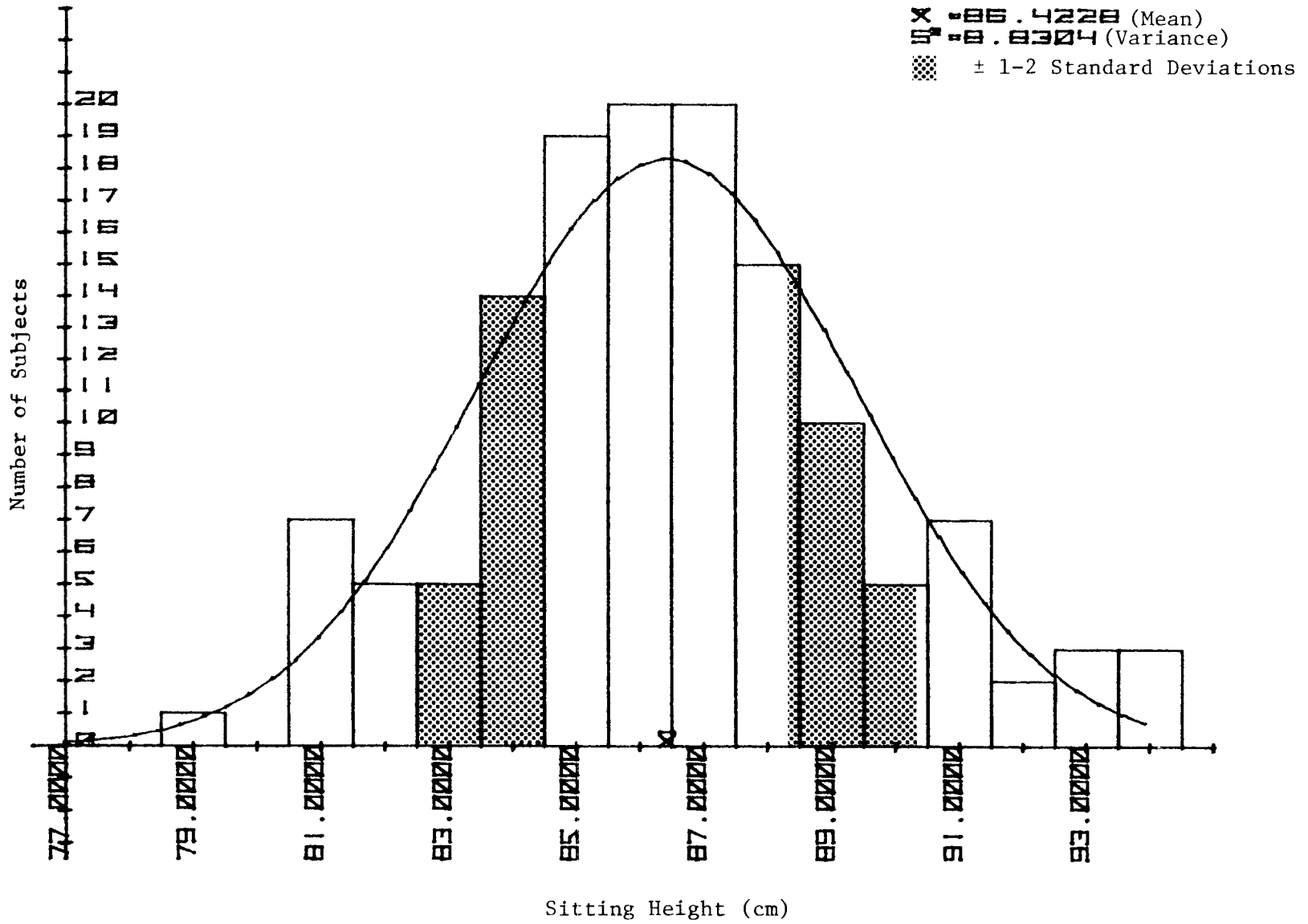
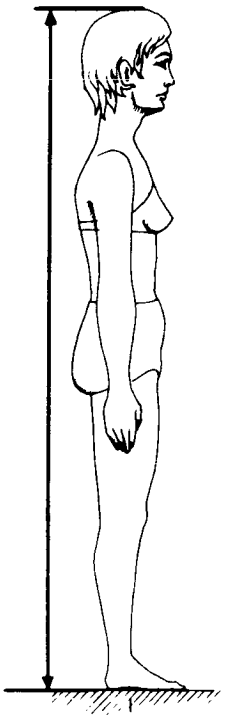


Figure 36: Frequency histogram for sitting height.

(37) STATURE

Subject stands erect, line of sight horizontal and heels together. With the arm of the anthropometer touching the scalp in the midsagittal plane, the vertical distance from the standing surface to the top of the head is measured.



Summary Statistics

centimetres		inches
141.5 - 177.0	Range	55.8 - 69.7
162.67	Mean	64.04
0.52	SEM	0.20
6.12	Std. Dev.	2.41
0.37	SE (SD)	0.15

Coefficient of Variation: 3.76%

Coefficient of Skewedness: -0.13

Coefficient of Kurtosis: 3.09

Number of Subjects: 137

Percentile Equivalents

cm	percentile	in
145.3	1st	57.2
152.4	5th	60.0
154.3	10th	60.7
158.3	25th	62.3
162.0	50th	63.8
166.8	75th	65.7
170.3	90th	67.0
172.5	95th	67.9
174.6	99th	68.7

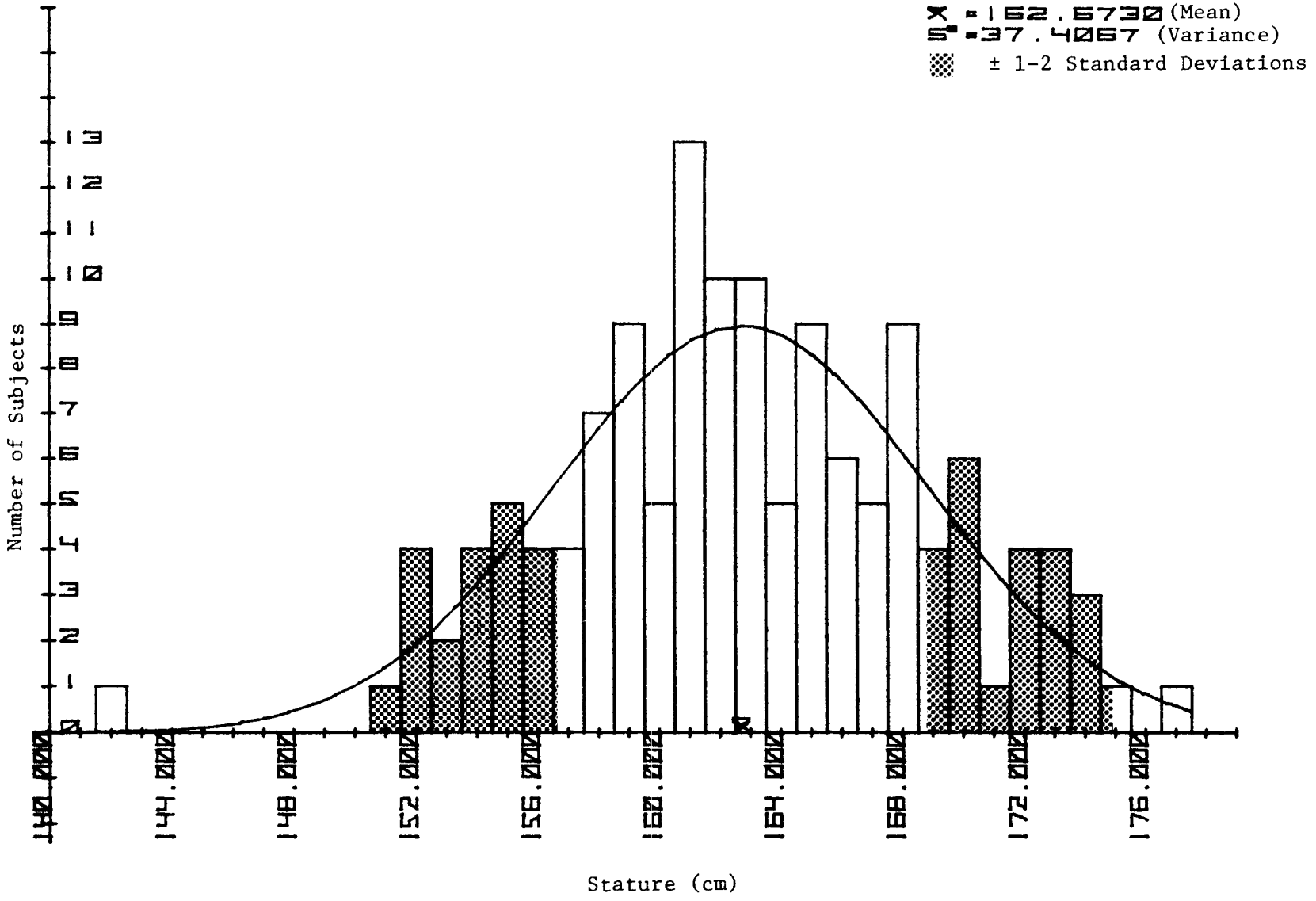


Figure 37: Frequency histogram for stature.

(38) UPPER ARM LENGTH

Subject stands erect in the corner, with back against one wall and right scapula touching the wall. The right arm is extended horizontally forward and the elbow flexed so that the forearm projects horizontally and perpendicular to the side wall. A measuring block is held against the distal edge of the upper arm, at the olecranon process, and the horizontal distance from the wall to the block is measured on the wall scale.

Summary Statistics

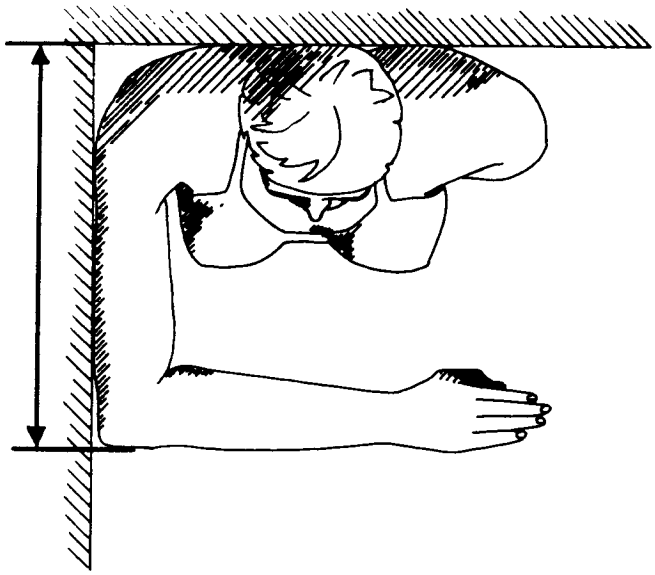
centimetres		inches
29.1 - 43.4	Range	11.5 - 17.1
38.14	Mean	15.02
0.20	SEM	0.08
2.30	Std. Dev.	0.91
0.14	SE (SD)	0.06

Coefficient of Variation: 6.03%

Coefficient of Skewedness: -0.30

Coefficient of Kurtosis: 4.01

Number of Subjects: 136



Percentile Equivalents

cm	percentile	in
30.1	1st	11.9
34.2	5th	13.5
34.8	10th	13.7
36.2	25th	14.3
37.6	50th	14.8
39.4	75th	15.5
40.9	90th	16.1
41.7	95th	16.4
42.7	99th	16.8

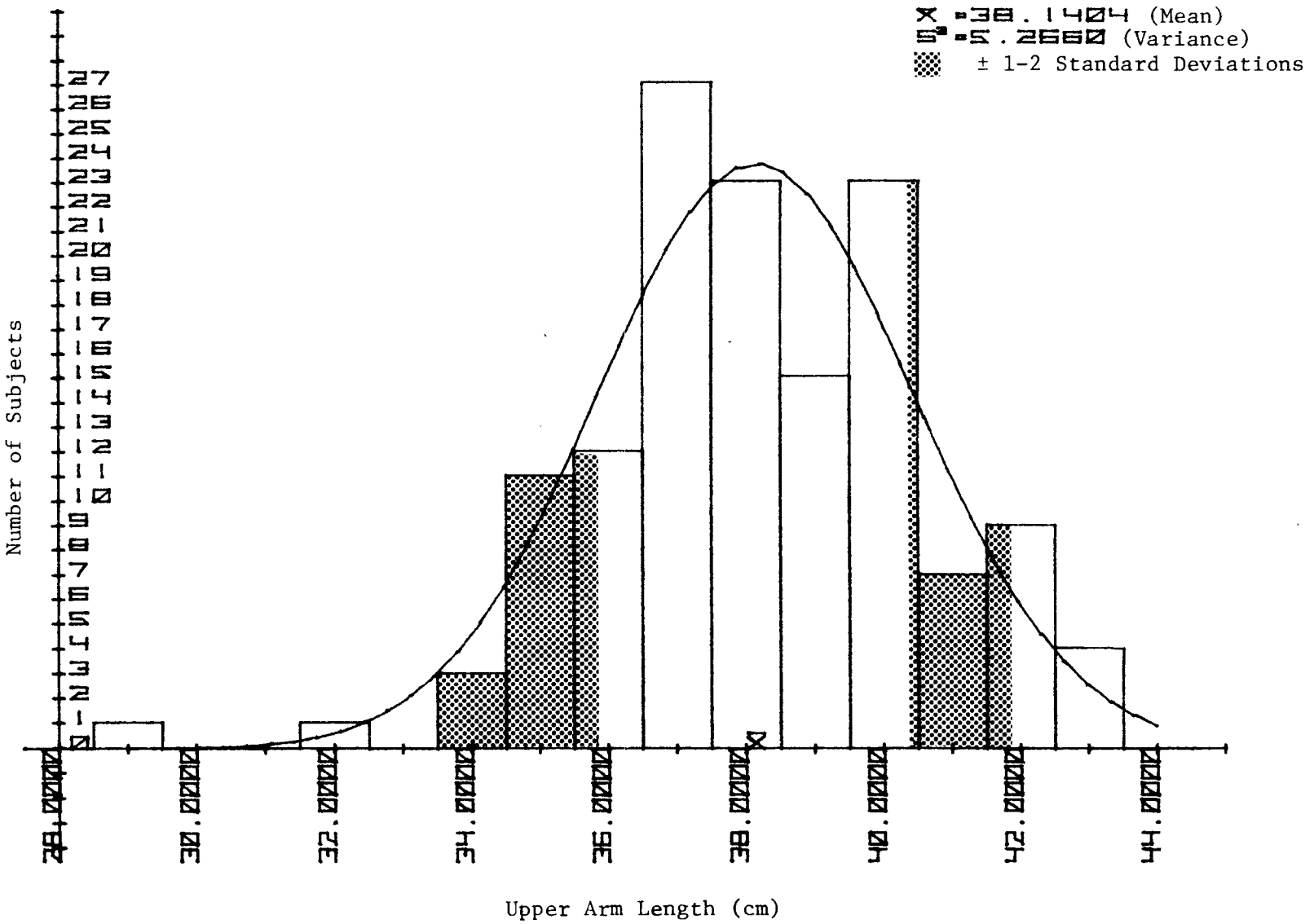
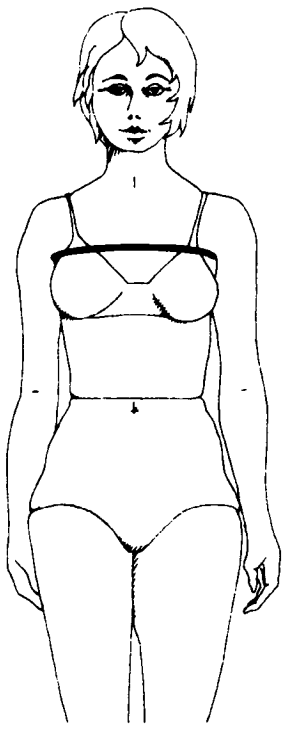


Figure 38: Frequency histogram for upper arm length.

(39) UPPER CHEST CIRCUMFERENCE

Subject stands erect, with arms slightly abducted. The measuring tape is held in a horizontal plane and the circumference of the chest just below the armpits is measured, at the average point of quiet respiration.



Summary Statistics

centimetres		inches
68.0 - 112.2	Range	26.8 - 44.2
87.75	Mean	34.55
0.51	SEM	0.20
5.92	Std. Dev.	2.33
0.36	SE (SD)	0.14

Coefficient of Variation: 6.75%

Coefficient of Skewedness: 0.32

Coefficient of Kurtosis: 5.01

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
69.1	1st	27.2
78.5	5th	30.9
79.7	10th	31.4
85.3	25th	33.6
86.3	50th	34.0
90.7	75th	34.7
94.1	90th	37.0
96.1	95th	37.8
101.3	99th	39.9

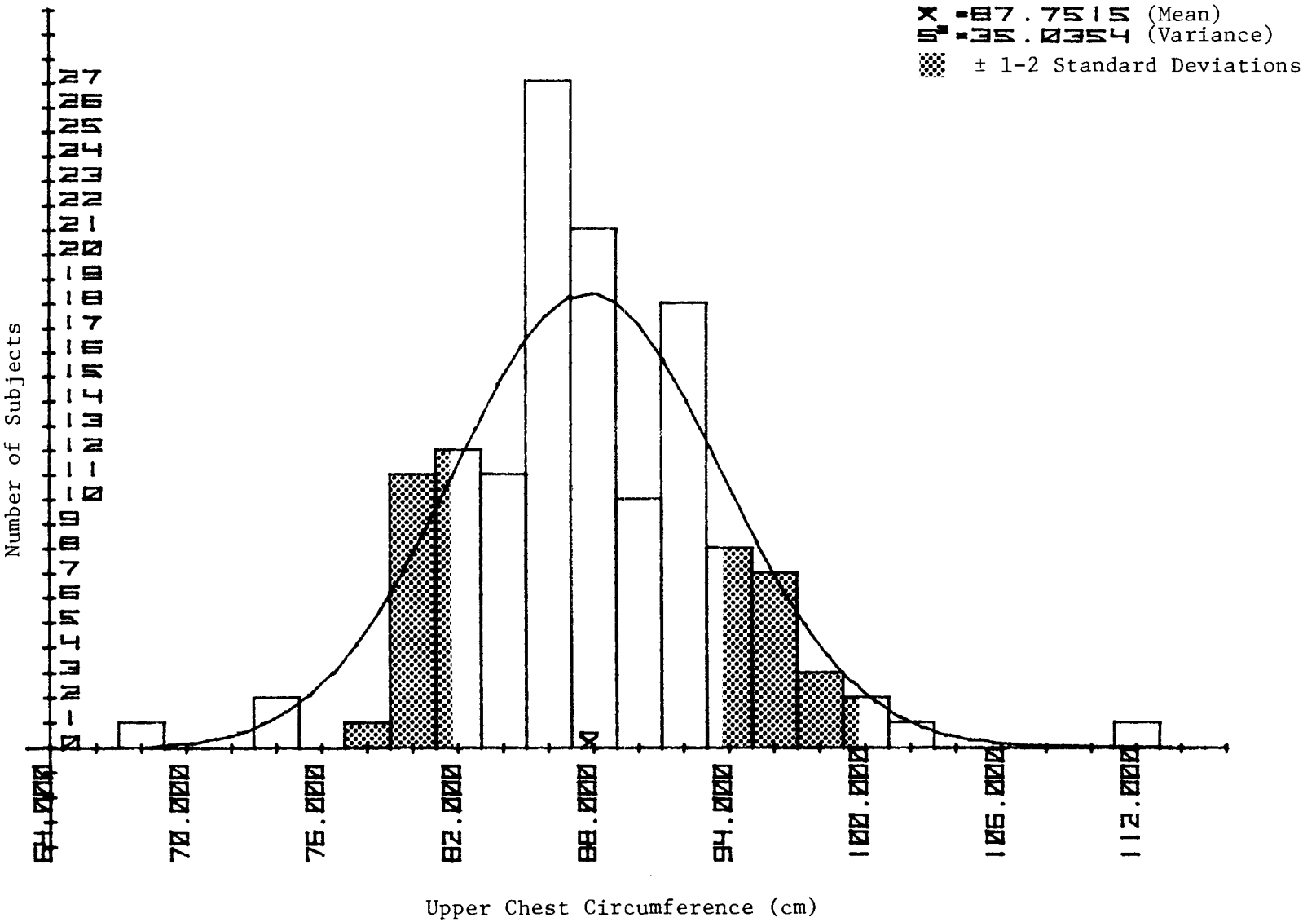
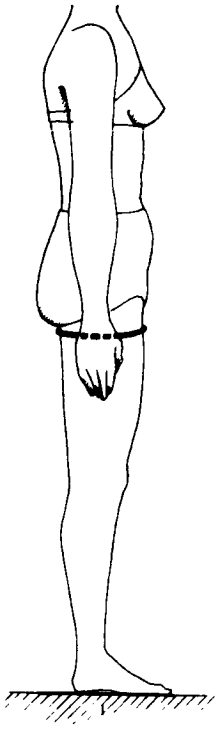


Figure 39: Frequency histogram for upper chest circumference.

(40) UPPER THIGH CIRCUMFERENCE

Subject stands erect, with feet about 10 cm apart. The horizontal circumference of the right thigh is measured, just below the gluteal fold.



Summary Statistics

centimetres		inches
35.2 - 71.0	Range	13.9 - 28.0
58.43	Mean	23.00
0.46	SEM	0.18
5.38	Std. Dev.	2.12
0.33	SE (SD)	0.13

Coefficient of Variation: 9.21%

Coefficient of Skewedness: -1.02

Coefficient of Kurtosis: 6.54

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
35.3	1st	13.9
50.2	5th	19.8
51.4	10th	20.2
54.4	25th	21.4
57.5	50th	22.6
61.1	75th	24.1
63.6	90th	25.0
66.1	95th	26.0
69.3	99th	27.3

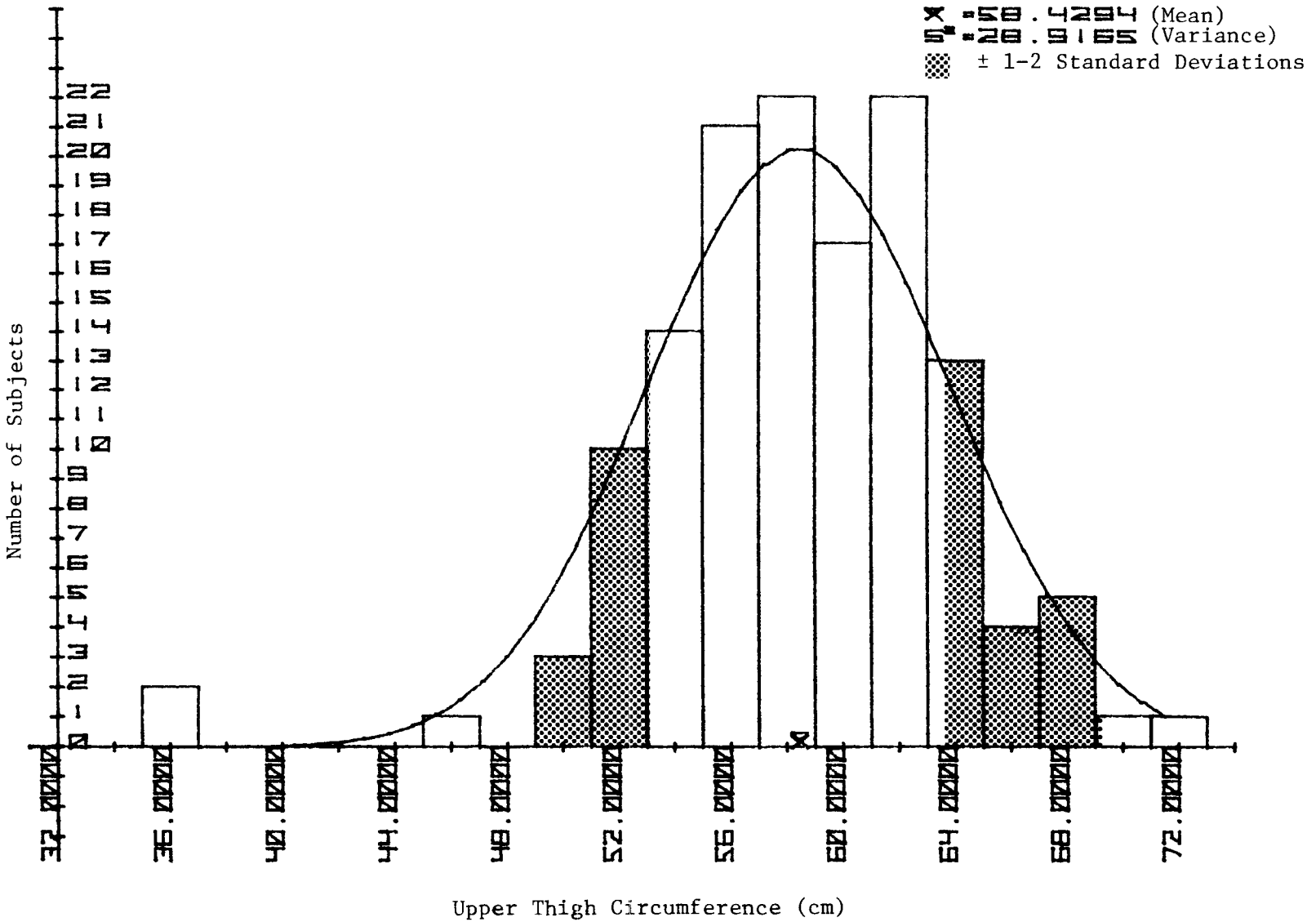
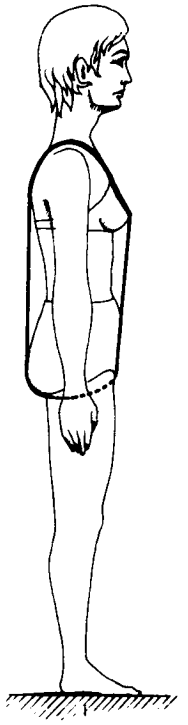


Figure 40: Frequency histogram for upper thigh circumference.

(41) VERTICAL TRUNK CIRCUMFERENCE

Subject stands erect, with feet about 10 cm apart. The measuring tape is passed between the legs, over the right buttock and up the back, to lie over the centre point of the shoulder. The other end of the tape is brought up over the right nipple to complete the circumference. The tape does not follow the body contours. The subject brings heels together and the measurement is made at the average point of quiet respiration.



Summary Statistics

centimetres		inches
141.2 - 167.1	Range	55.6 - 65.8
158.85	Mean	62.54
0.52	SEM	0.20
6.08	Std. Dev.	2.39
0.37	SE (SD)	0.15

Coefficient of Variation: 3.95%

Coefficient of Skewedness: 0.22

Coefficient of Kurtosis: 2.48

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
141.5	1st	55.7
143.1	5th	56.3
145.1	10th	57.1
148.6	25th	58.5
152.7	50th	60.1
156.7	75th	61.7
161.9	90th	63.7
164.0	95th	64.6
165.8	99th	65.3

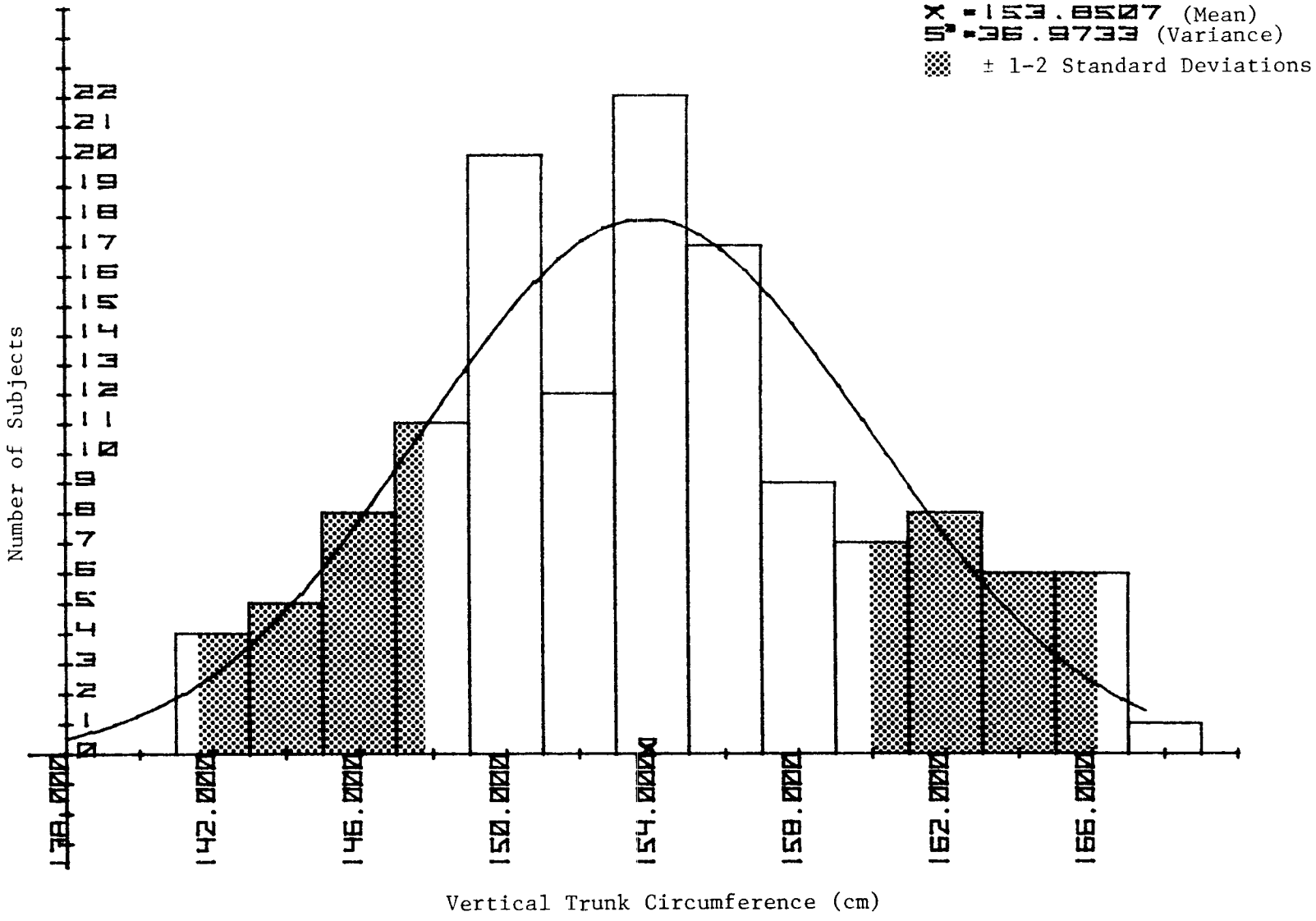
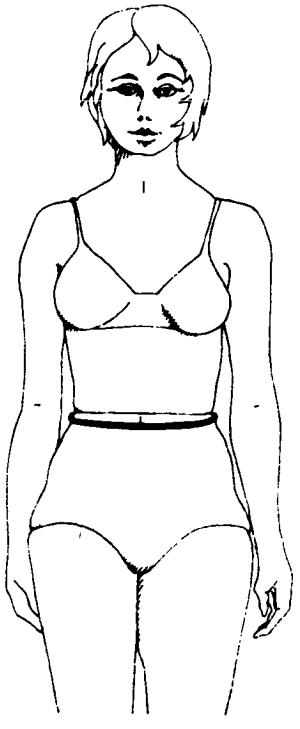


Figure 41: Frequency histogram for vertical trunk circumference.

(42) WAIST CIRCUMFERENCE - OMPHALION

Subject stands erect, with heels together and is asked to relax abdominal muscles. The measuring tape is held in a horizontal plane at the level of the omphalion and the circumference is measured at the average point of quiet respiration.



Summary Statistics

centimetres		inches
61.4 - 101.0	Range	24.2 - 39.8
80.11	Mean	31.50
0.65	SEM	0.26
7.59	Std. Dev.	2.99
0.46	SE (SD)	0.18

Coefficient of Variation: 9.47%

Coefficient of Skewedness: 0.44

Coefficient of Kurtosis: 2.89

Number of Subjects: 136

Percentile Equivalents

cm	percentile	in
62.6	1st	24.6
70.4	5th	27.7
71.7	10th	28.2
73.2	25th	28.8
80.6	50th	33.7
84.0	75th	33.1
89.6	90th	35.3
93.2	95th	36.7
99.3	99th	39.1

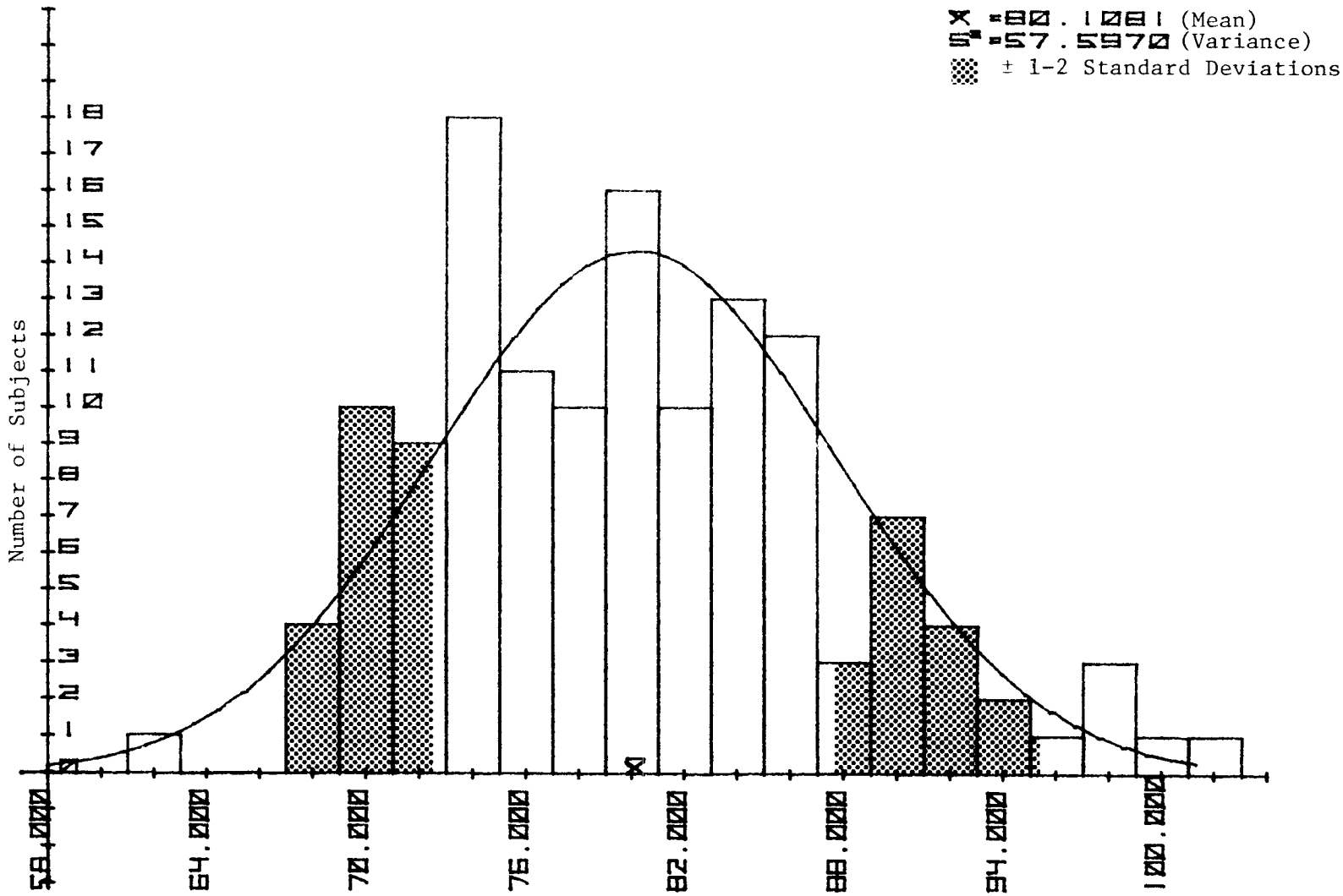


Figure 42: Frequency histogram for waist circumference - omphalion.

APPENDIX D

Comparisons of CF Males and Females

A Comparison of Male/Female Anthropometry - CF Personnel

Percentile	Mass (kg)		Stature (cm)		Sitting Height (cm)		Buttock-Popliteal Length (cm)		Functional Reach (cm)	
	female	male	female	male	female	male	female	male	female	male
1st	42.3	54.0	145.3	159.8	79.1	82.4	40.4	44.3	62.7	69.4
5th	48.8	59.4	152.4	164.8	80.5	84.8	41.7	46.0	65.7	73.2
10th	50.5	62.3	154.3	167.5	82.1	86.0	42.3	47.0	66.0	74.3
25th	54.8	68.3	158.3	170.8	84.2	87.9	43.9	48.2	67.3	76.5
50th	60.7	76.2	162.0	174.7	85.8	90.0	45.3	50.0	69.5	79.0
75th	66.4	84.8	166.8	179.4	87.7	92.7	47.2	51.6	71.9	82.3
90th	73.0	92.1	170.3	183.2	90.2	94.7	49.1	53.2	73.9	85.1
95th	75.2	95.7	172.5	185.2	91.6	95.6	50.0	54.0	75.7	86.4
99th	80.5	109.8	174.6	189.5	93.5	97.9	51.8	55.7	77.8	89.3

(ref. males: McCann et al. 1975, n=565 and ref. females: this study, n=137)

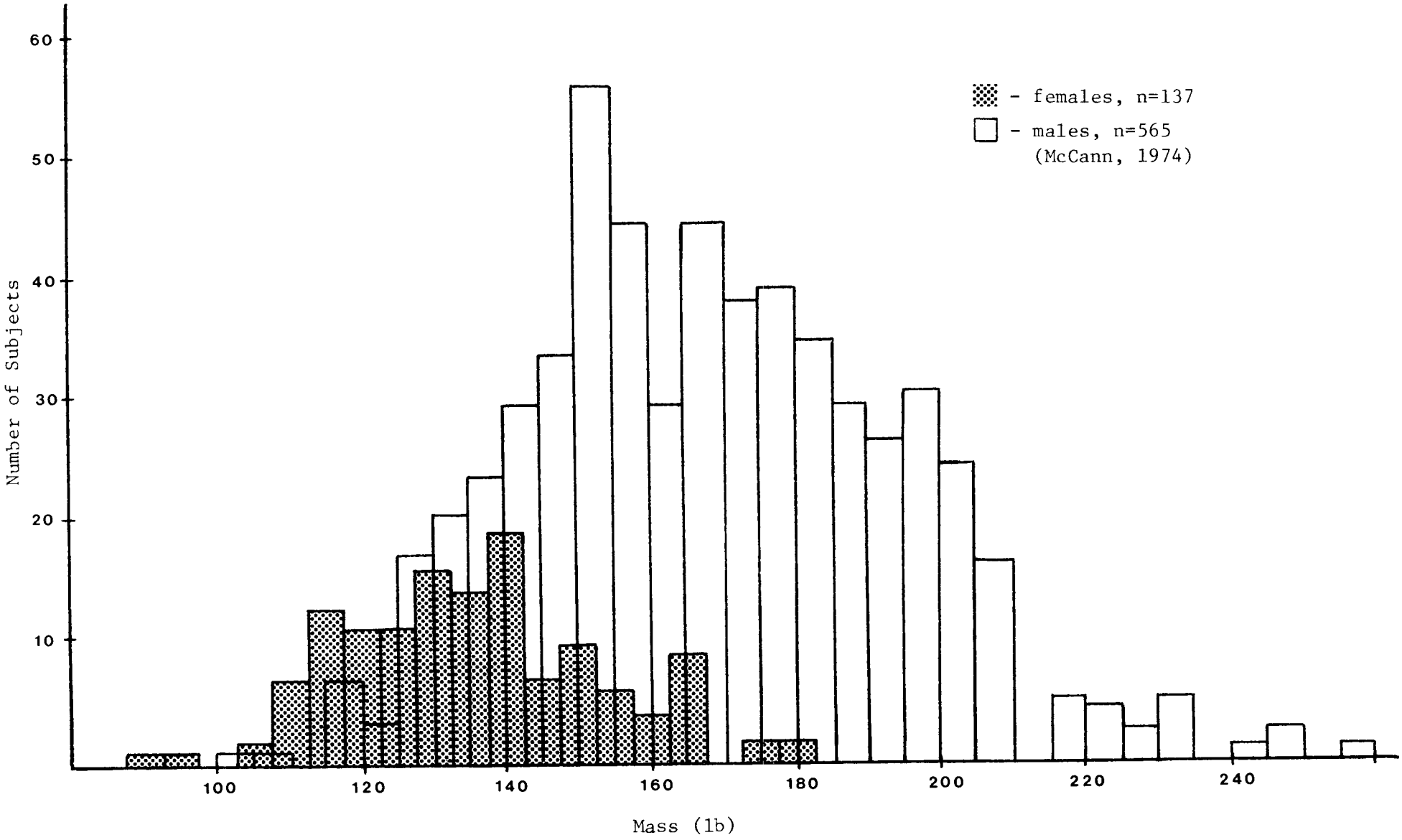


Figure A: A comparison of the mass of the Canadian Forces males and females.

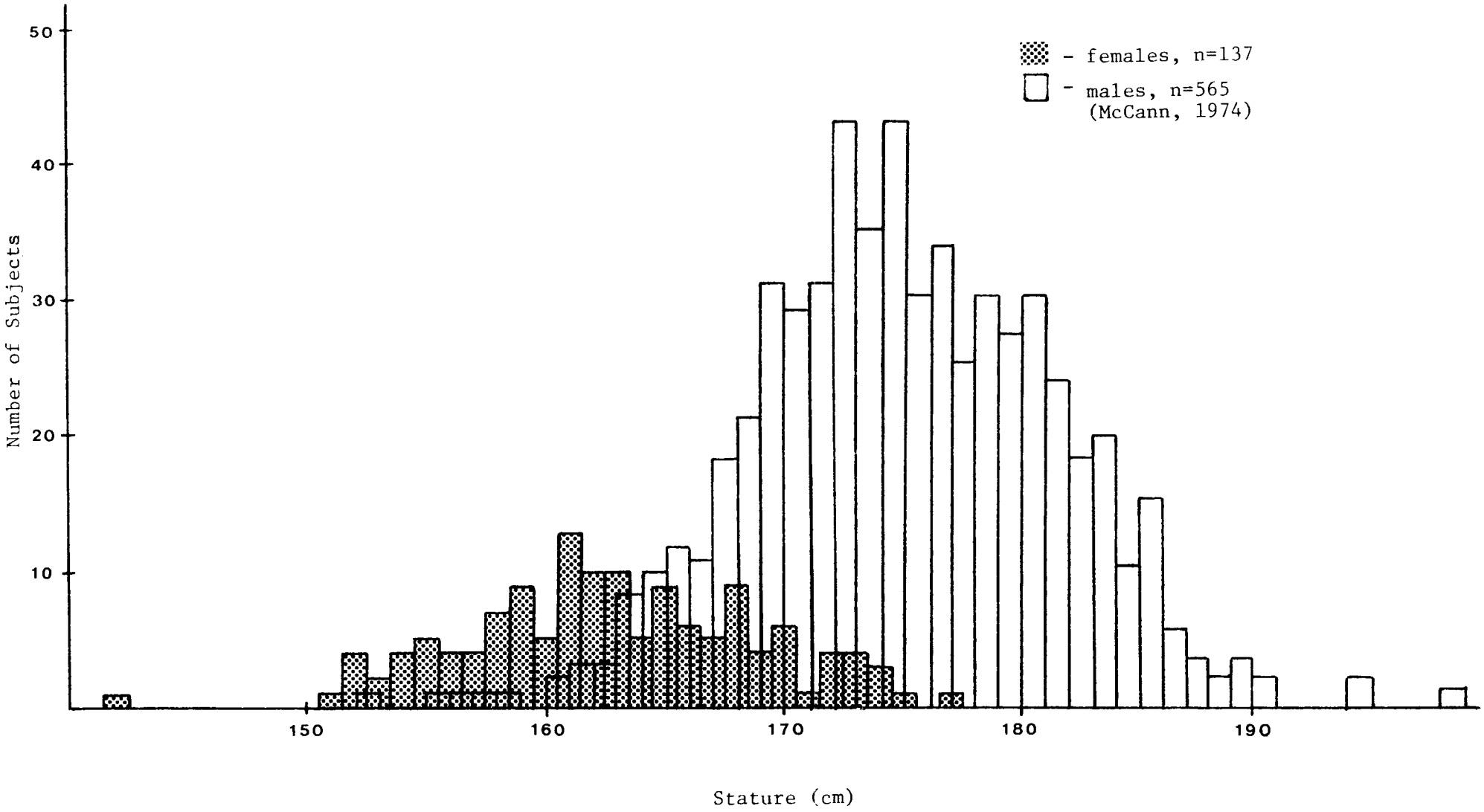


Figure B: A comparison of the stature of the Canadian Forces males and females.

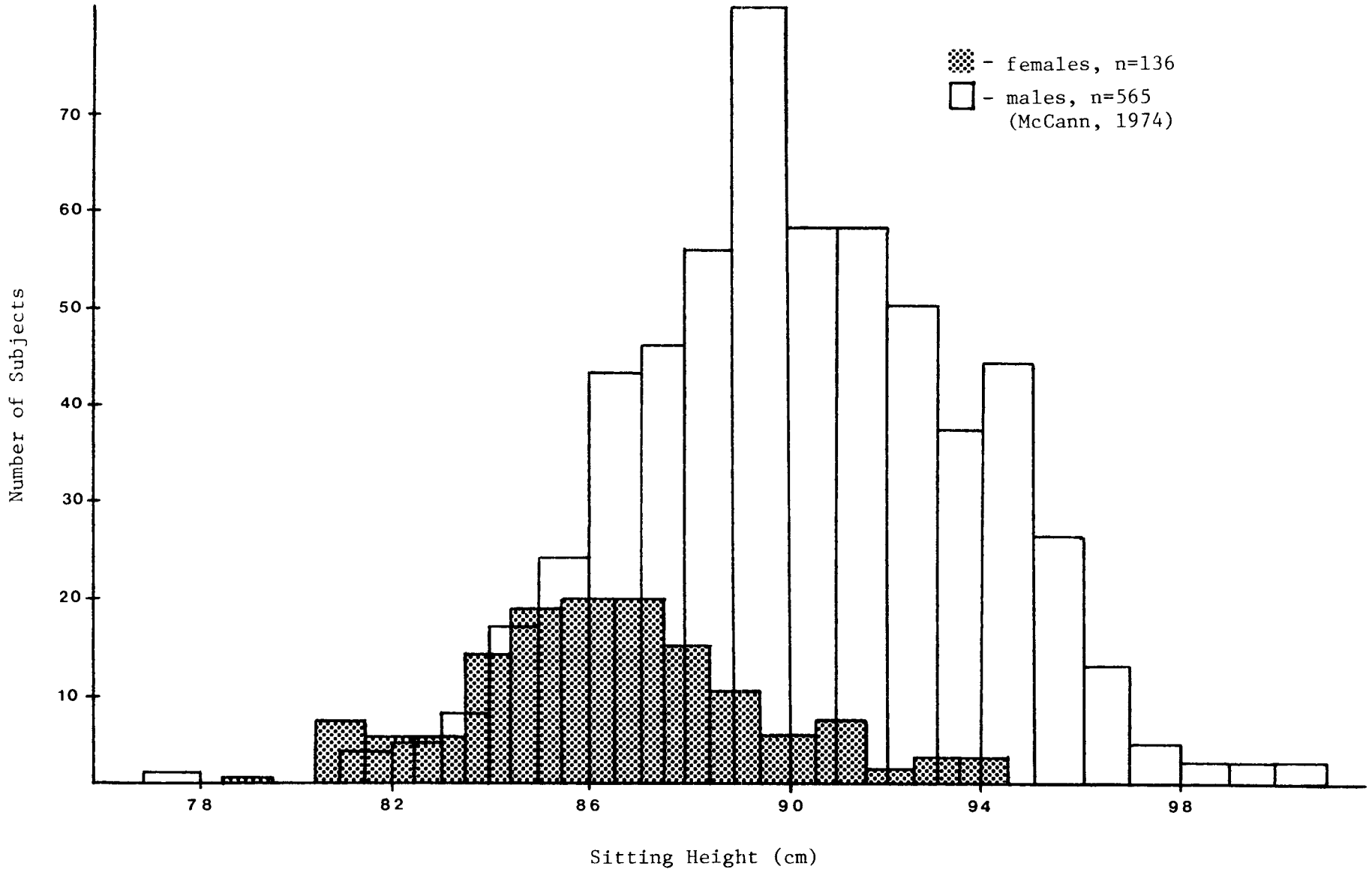


Figure C: A Comparison of the sitting height of the Canadian Forces males and females.

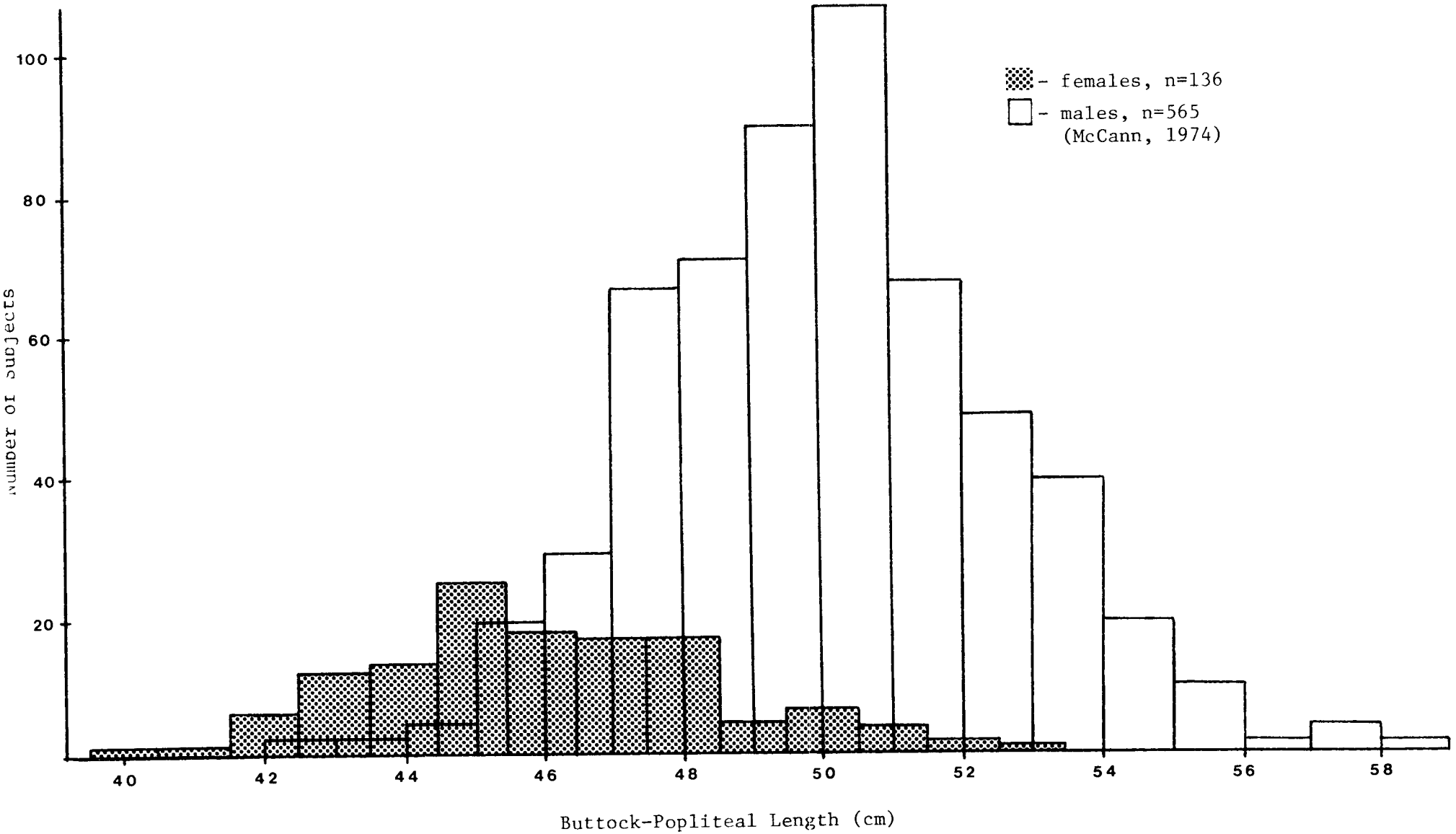


Figure D: A comparison of the buttock-popliteal length of the Canadian Forces males and females.

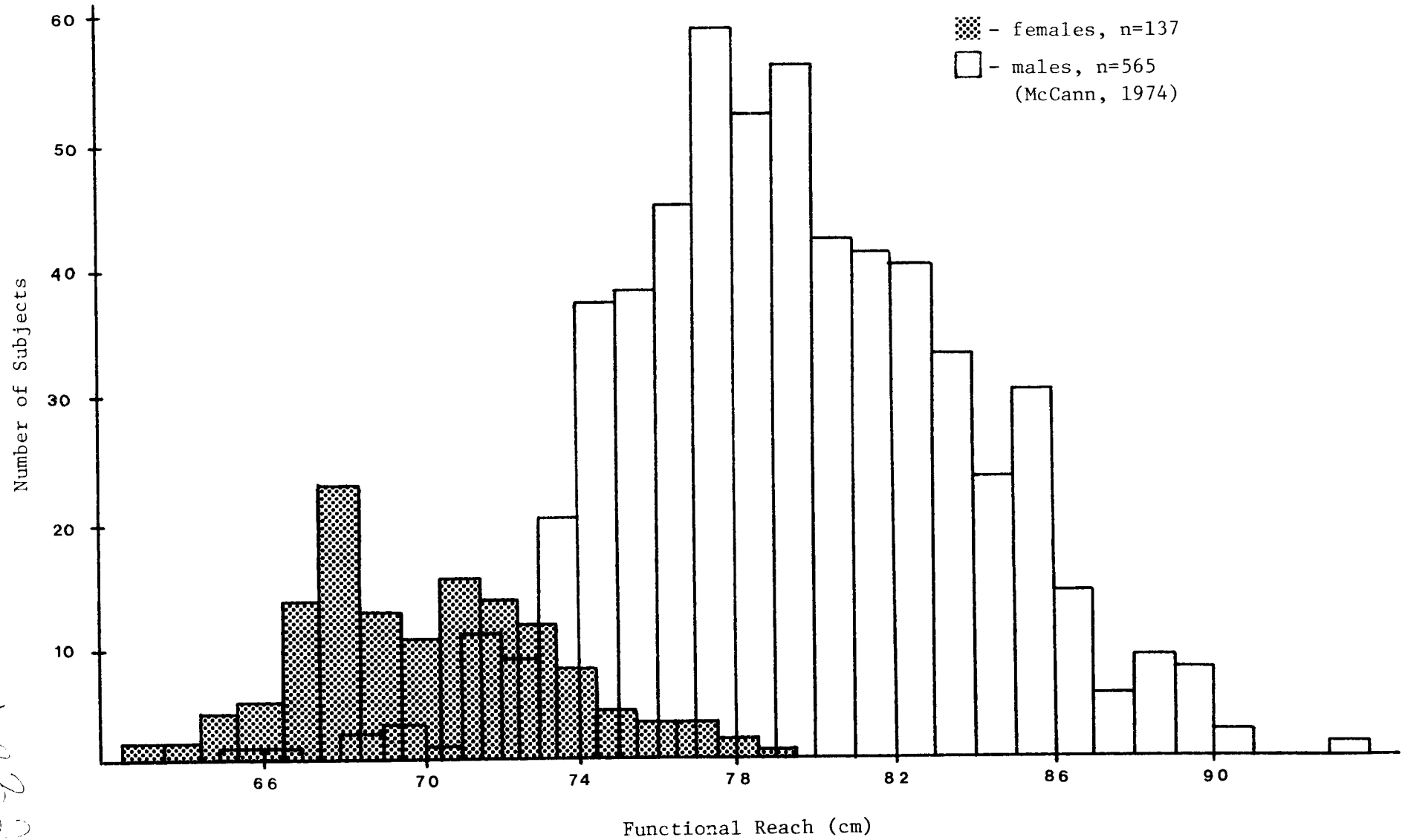


Figure E: A comparison of the functional reach of the Canadian Forces males and females.