Australian Government
Department of Defence
Science and Technology

Revised Anthropometry Guidance for the Royal Australian Navy

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DST-Group-TR-3564

Version 2, 24/07/2020. This version contains corrections to Section 2.3 and Figure 1 regarding the univariate and multivariate examples, and to Figure 2 to correct the illustration of dimensions M09 and M10.

ABSTRACT

In 2015 an Anthropometric Survey of the Royal Australian Navy (ASRAN) was completed providing comprehensive digital and manual anthropometric data on the permanent RAN operational workforce that can be used for the design and evaluation of vessels, equipment and clothing. The ASRAN included the measurement of 1322 Permanent Royal Australian Navy (RAN) personnel (232 females and 1090 males), aged 18–54 years. A total of 87 measurements, comprising of both manual and digital measures, were captured. This document presents the anthropometric percentile data captured and provides information on how to apply the data, as well as information on secular trend, personal equipment and clothing correction factors, and other allowances that should be considered when using the anthropometric data. Boundary manikin data that can assist with multivariate design requirements are also provided. This document supersedes all previous RAN anthropometric data and guidance documents. This report is a revision of the Preliminary Anthropometry Guidance for the RAN.

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January 2019

APPROVED FOR PUBLIC RELEASE

Revised Anthropometry Guidance for the Royal Australian Navy

Executive Summary

Anthropometry is the study and measurement of the human body and body size including lengths, breadths, depths, and circumferences relating to reach, clearance and fit; weight/mass is also typically measured [1, 2]. Application of anthropometric data is critical in matching and designing the physical form and dimensions of compartments, workspaces, systems or equipment to those of the users [2]. In order to maximise crew performance, and meet a duty of care for safe systems of work, anthropometric data should be incorporated into all areas designed for human work, to support human life at sea; and in the development and procurement of all equipment and clothing that crew members come into contact with for any manner of operation, habitation and maintenance purposes [3-5].

In 2015 an Anthropometric Survey of the Royal Australian Navy (ASRAN) was completed providing comprehensive digital and manual anthropometric data on the permanent Royal Australian Navy (RAN) operational workforce that can be used for the design and evaluation of vessels, equipment and clothing. The ASRAN included the measurement of 1322 Permanent RAN personnel (232 females and 1090 males), aged 18–54 years. A total of 87 measurements, comprising of both manual and digital measures were captured.

This document presents the anthropometric percentile data captured in the ASRAN and provides information on how to apply the data and assess designs. Additional information presented includes information on RAN secular trend, personal equipment and clothing correction factors, and other allowances that need to be considered when applying the anthropometric data. A brief overview on multivariate approaches to design is provided, along with boundary manikin data that can assist with multivariate design and evaluation. This document supersedes all previous RAN anthropometric data and guidance documents. This report is a revision of the Preliminary Anthropometry Guidance for the RAN [6].

The main revision changes include updated application guidelines, personal equipment and clothing correction factors, boundary manikin data, additional information on multivariate approach to design, and alignment with the Revised Maritime Physical Accommodation Guidance for the Royal Australian Navy [7].

This document is intended for use by project staff, design engineers, systems engineers, maintainability engineers, operations analysts, human factors specialists, and others engaged in the definition, development, or evaluation of human factors requirements. The procedures and data provided within this document can define, develop and evaluate human factors requirements in the design, construction, modification and evaluation of

current and future RAN systems and equipment in terms of user fit, clearance, reach, vision and/or posture. It is strongly recommended that it is used in consultation with human factors professionals with recent and comprehensive knowledge of anthropometrics.

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Contents

Glossary

ASRAN	Anthropometric Survey of the Royal Australian Navy
BA	Breathing Apparatus
CAD	Computer Aided Design
DHM	Digital Human Modelling
DPNU	Disruptive Pattern Navy Uniform
ISO	International Standard Organization
KMO	Kaiser-Meyer-Olkin
MCBAS	Modular Combat Body Armour System
OCCABA	Open Circuit Compressed Air Breathing Apparatus
PCA	Principle Component Analysis
PECCF	Personal Equipment and Clothing Correction Factors
RAN	Royal Australian Navy

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1. Introduction

1.1. Revision information

This report is a revision of the Preliminary Anthropometry Guidance for the Royal Australian Navy (RAN) [6]. The first version of this document was developed by the University of South Australia on behalf of the Defence Science and Technology (DST) Group, and is heavily based on the Australian Army preliminary anthropometry standard [8] which has been referenced throughout. This revised version has been updated by DST. The main revisions include updated application guidelines, boundary manikin data, and personal equipment and clothing correction factors, as well as additional information on multivariate approach to design, and alignment with the Revised Maritime Physical Accommodation Guidance for the Royal Australian Navy [7]. Note there has been no change made to the percentile data from the previous version.

1.2. Background

Anthropometry is the study and measurement of the human body and body size including lengths, breadths, depths, and circumferences relating to reach, clearance, and fit; weight/mass is also typically measured [1, 2]. Reliable and accurate population specific datasets are produced by regularly measuring relevant body dimensions on a sufficiently large and representative sample of the target individuals using prescribed measurement protocols and trained individuals.

The requirement for updated RAN anthropometry data was outlined in [9] which included guidance from ISO 15535 – General requirements for establishing anthropometric databases [10]. Following funding availability from the Future Submarine and Future Frigate projects, a sample plan was prepared outlining the anthropometric technical and logistical requirements and processes [11]. The University of South Australia formed an anthropometry team who conducted all the measurements [12-14]; all team members were trained to at least level two by the International Society for the Advancement of Kinanthropometry.

In 2015 the Anthropometric Survey of the Royal Australian Navy (ASRAN) was completed providing comprehensive digital and manual anthropometric data on the permanent RAN operational workforce that can be used for the design and evaluation of vessels, equipment, and clothing. The ASRAN data are presented in this document and supersedes all previous RAN anthropometric data. Further information regarding the application of this data in vessel design can also be sought from [7].

1.3. Overview of the ASRAN data

1.3.1. Use of guidance

This document is intended for use by project staff, design engineers, systems engineers, maintainability engineers, operations analysts, human factors specialists, and others engaged in the definition, development, or evaluation of human factors requirements. It is strongly recommended that it is used in consultation with human factors professionals who have recent and comprehensive knowledge of anthropometrics.

Professional advice should be sort in respect to the application of this standard to niche RAN personnel categories that may operate under different selection or training criteria to the typical RAN population. The physical dimensions of such personnel may not fit the statistical distributions presented here. Demographic data can be found in the initial ASRAN report [14].

Care should be taken in respect to application of this standard to female RAN personnel. The small ASRAN female sample size means that the recommended International Standard Organization (ISO) standard confidence and accuracy values [10] for the data have not been met for all dimensions. The sample size required to meet 95% confidence and 1% accuracy varies with each dimension. The greater the variability in a dimension the greater the sample size needed to obtain confidence and accuracy that the percentiles captured estimate the true population. For dimensions such as Eye Height Sitting, Knee Height Sitting, and Stature there are enough females captured in ASRAN for 95% confidence and 1% accuracy in the data. Other dimensions such as Bideltoid Breadth, Hip Breadth Sitting, and Weight, are not reported to the same level of confidence and accuracy given the sample size. For further information see [9].

The ASRAN reference dataset includes a large volume of digitised body scan data, and will soon include range of motion data (impacted by clothing ensembles). Requests for this data can be made to DST, Land Division, Human Systems Integration Team, and DST, Maritime Division, Human Systems and Information Integration Group.

2. Anthropometric Survey of the Royal Australian Navy

The ASRAN included the measurement of 1322 Permanent RAN personnel (232 females and 1090 males), aged 18–54 years. A total of 87 measurements, comprising of both manual and digital measures were captured. The Fleet profile of ASRAN included 1008 Surface Ship personnel, 283 Submarine personnel and 31 Other personnel. The Navy Department profile was broadly representative of the RAN and included Executive (552), Weapons Electrical Engineering (292), Marine Engineering (221), Logistics (190), Aviation (17) and Other (50).

The ASRAN data presented in this document should only be used for the assessment of systems and equipment used by the RAN. Differences between the ASRAN data and other user groups or populations (e.g. other nations or occupations) have not been quantified. Applying these data to other populations should be approached with a degree of caution given the lack of convincing evidence that the body size and shape of the current Permanent RAN personnel are reflective of other populations such as international military personnel, and civilian Australians.

Further information on the ASRAN can be found at [12-14].

2.1. Application of anthropometry

Application of anthropometric data is critical in matching and designing the physical form and dimensions of compartments, workspaces, systems or equipment to those of the users [2]. In order to maximise crew performance and meet a duty of care for safe systems of work, anthropometric data should be incorporated into all areas designed for human work, to support human life at sea; and in development and procurement of all equipment and clothing that crew members come into contact with for any manner of operation, habitability and maintenance purposes [3-5].

The procedures and data provided within this document can define, develop and evaluate human factors requirements in the design, construction, modification and evaluation of current and future RAN systems and equipment in terms of user fit, clearance, reach, vision and/or posture. The procedures and data should be applied to the design of structures, equipment, clothing, systems, subsystems, and facilities for Australian naval Surface Ships and Submarines.

This document provides quantifiable methods to evaluate and verify design prototypes (from conceptual to detailed design), and to define human factors engineering requirements. The data and methods in this document should be applied early in a design or evaluation process. This includes application to static design concepts, computer aided design tools, digital human models, and physical mock-ups in order to de-risk the design process. This document can also be used to identify RAN personnel who align with the limiting dimensions that should participate as part of a representative sample of trial participants in the evaluation of RAN systems.

In addition to the specific univariate data and boundary manikin data provided in this document, comprehensive reference data can be requested from DST Group, Land Division, Human Systems Integration Team, and DST Group, Maritime Division, Human Systems and Information Integration Group for use in more complex and multivariate design approaches.

2.2. Accommodation targets

The default position shall ensure the physical accommodation, compatibility, operability, and maintainability by the 5th – 95th percentile (or central 90%) of both the female and male population. The current best practice is to use female and male limiting data separately[1]. Accommodating the 3rd to 97th percentiles is preferred, and up to the 1st to 99th percentiles (or central 98%) and/or minimum and maximum values where possible, and where safety critical and life support functions require [4, 5, 8, 15-17]. These guidelines reflect the widely accepted levels of accommodation used for design purposes [4, 8, 18, 19].

Deviations from this approach are only to occur at the permission of the procuring organisation and where the implications of excluding gender data, or using combined data is made clear with specific detail on the population that is and is not accommodated. If the minimum 5th to 95th percentiles (or central 90% of the population) cannot be accommodated a risk shall be raised within the projects risk register to be addressed by a team involving human factors professionals to assess and inform the procuring organisation of the risk. Sufficient rationale and evidence should be provided where a design requirement has not been met, outlining the design and procurement attempts that have failed to meet the requirements. Approval to move forward with a design or option that does not meet the requirements shall be obtained by the procuring organisation [5].

Consideration of anthropometric accommodation should also include other intended users outside of the normal population such as Army personnel and their equipment which may need to be accommodated on a Navy vessel.

2.3. Use of data

The recommended process for using anthropometric data, adapted from [20] is:

1. Identify the anthropometric dimension relevant to product design
2. Use anthropometric data representative of the intended users
3. Have clearly defined accommodation targets (see section 2.2)
4. Use statistically valid models of body size variation (see sections 2.3.1 and 2.3.2 on boundary manikins and reference to central population targets)
5. Apply the anthropometric data in a systematic and structured way
6. Apply allowances for secular trend, personal equipment and clothing correction factors, movement, and comfort, as required
7. Establish early and ongoing design and sizing evaluations.

[1] Often a target population guide is to accommodate at a minimum the 5th percentile female to 95th percentile male. The target population is often summarised as such, rather than referring to females and males separately as in most cases the 5th percentile female will capture the 5th percentile male, and the 95th percentile male will capture the 95th percentile female. However there are a few important dimensions for design where females are larger, and males are smaller. As such, for precision and accuracy, female and male data should be examined and used separately unless evidence and rationale is presented for an alternative approach.

This process is best completed in consultation with Human Factors professionals, particularly those with recent expertise in anthropometry to ensure steps 1-7 are applied robustly and accurately.

2.3.1. Univariate statistics (single dimension) / percentile data

Percentile data on each dimension captured is presented in chapter 4. This data is best used when one dimension needs to be considered for a single design point. For example, when determining the height of a structure that has no other constraints, stature is the dimension to consider, and reference to the percentile data can be made. Required allowances such as clothing and equipment (e.g., shoe heights and helmets), secular change, comfort, and movement allowances can be added to the percentile chosen. When there is more than one dimension relevant to a design point the percentile data should not be used or added together, instead a multivariate approach to design is required. For example if designing a doorway, both stature and width (bideltoid breadth or forearm-forearm breadth) are necessary to consider simultaneously. Using 95th percentile male data from ASRAN for stature and bideltoid breadth would only accommodate 90% of that male population, and not close to 95% as might be expected. The more dimensions that are included, the lower the level of accommodation that will occur using 95th percentile data.

2.3.1.1. Summation of anthropometric dimensions

As noted above the summation of anthropometric percentile data will in most situations lead to error in the percent of the population that is intended to be accommodated resulting in unintended design failures. This occurs as individuals will not be at the same percentile across all dimensions. For example when adding 5th percentile female body segments the resulting manikin can be more than 15cm shorter than the actual 5th percentile stature [21]. This also extends to the relationship between anthropometric dimensions and aspects such as joint movement and strength. There are many examples and case studies where design failures have occurred from adding multiple anthropometric percentiles together at once for a design object/arrangement. One such example is the design of an aircraft using 1st percentile female to 99th percentile male data. The design led to 90% of females, 80% of African-American males, and 30% of Caucasian males unable to fly the aircraft [22], for further information see [23-25].

Due to this known error that occurs when adding anthropometric percentile data, this process can only be accepted in two situations. Firstly, when it is known that there is a strong correlation between all the dimensions required for a design object/arrangement. This can require detailed anthropometric data for the target population. Or secondly, in the case of conducting initial checks or suggesting preliminary space claims that is further followed by a more accurate approach which looks at the true body size and shape of individuals. This can often rely on access to raw anthropometric data (instead of just percentiles), which if available can be as quick and efficient as using percentile data.

In design contexts where multiple anthropometric dimensions are simultaneously important for fit, clearance, reach, vision, and posture, an appropriate multivariate approach to design, assessment, and evaluation should be followed.

2.3.2. Multivariate approach (multiple dimensions in design)

A multivariate assessment procedure is to be used to assess design objects/arrangements where multiple anthropometric body dimensions are considered key and are related to each other in the assessment. For example, when manoeuvring through a hatch a person may have to raise and bend their leg, simultaneously bend their torso, and position their arms to enable movement and reach through the hatch.

Multivariate assessments can be used in combination with univariate assessments to initially evaluate certain cut-off criteria. For example, if forward movement through a hatch is required, manoeuvring through the hatch will require a multivariate design approach and assessment, however an initial univariate assessment may find the hatch is not wide enough to accommodate Bideltoid Breadth.

A current common multivariate approach is using Principle Component Analysis (PCA), and the creation of boundary manikin data. This approach involves taking the dimensions of interest and developing manikins that reflect the true and proportional extremes in body shape and size. The values derived can be used to more accurately add dimensions together, and to create representative digital human models that represent the smallest and largest users. This document contains boundary manikin data that can be used for a variety of tasks, see chapter 5.

Other multivariate approaches can include the use of the participant's raw anthropometric data [26], to examine each individuals true body size/shape for a design component. This approach provides a high level of accuracy and precision in design and evaluation. Requests for the raw data can be made to DST Group, Maritime Division, Human Systems and Information Integration. Digital 3D anthropometric data and soon to be available range of motion data, is also available from DST Group, Land Division, Human Systems Integration Team.

Finally, physical mock-ups provide an important last step in adapting, finalising and accepting designs. These procedures should follow any preliminary checks and designs prior to finalising and acceptance of designs or assessments/evaluations as no other method can verify and validate designs as accurately as a physical test [12, 15]. An important component of physical mock-ups is examining the difference in real world posture adaptations that can differ from the measurement protocol in the anthropometry survey.

2.4. Additional allowances

Anthropometric data is typically collected on semi-nude participants, as is the case with the 2015 ASRAN data. As such it is necessary to consider additional allowances for good design, and in some cases subtractions to replicate posture or equipment changes. There are five main considerations: secular trend, personal equipment and clothing correction factors, dynamic movement, general allowances and clearances, and subtractions.

2.4.1. Secular trend

Secular trend refers to the generational changes in dimensions that can occur over time. For example height has been found to be increasing over the last 150 years [27-29]. It is important to consider secular trend where designs are formed many years before equipment/systems/platforms are operational and where they may be in service for many years or decades.

A review of RAN secular trend has been conducted using the 1977 and 2015 RAN anthropometric surveys, matching for occupation, age, and measurement protocol. Matching for such variables enabled 11 dimensions to be compared. The review found that the body dimensions of male RAN personnel increased substantially over time. A summary of this data is presented in Table 1.

The continuation of past secular trends cannot be confirmed without future anthropometric surveys. However given the past increases observed in RAN data it is recommended to consider applying secular trend allowances in design, where the design process or service life of the equipment/system/platform spans a decade or more.

Table 1 Secular trends in absolute body dimensions of male RAN personnel matched by age and occupation between 1977 and 2015 (Adapted from [29])[2]

Measurement	1977 (n=593) x±s	2015 (n=593) x±s	Absolute change in means ± 95% CI	Change p.a. (mm or kg)	Change per decade (mm or kg)
Bideltoid Breadth (mm)	469 ± 24	500 ± 29	31 ± 3	0.82	8.16
Buttock Circumference (mm)	972 ± 59	1024 ± 77	52 ± 8	1.37	13.68
Buttock-Knee Length (mm)	600 ± 26	622 ± 32	21 ± 3	0.55	5.53
Foot Breadth (mm)	100 ± 5	101 ± 6	2 ± 1	0.05	0.53
Head Circumference (mm)	574 ± 16	577 ± 15	3 ± 2	0.08	0.79
Hip Breadth Sitting (mm)	356 ± 21	381 ± 31	26 ± 3	0.68	6.84
Sitting Height (mm)	913 ± 34	941 ± 35	27 ± 4	0.71	7.11
Stature (mm)	1749 ± 66	1796 ± 70	47 ± 8	1.24	12.37
Thigh Clearance (mm)	172 ± 12	182 ± 15	10 ± 2	0.26	2.63
Waist Circumference Omphalion (mm)	867 ± 86	943 ± 112	76 ± 11	2.00	20.00
Weight (kg)	74.8 ± 10.4	87.2 ± 14.0	12.4 ± 1.4	0.33	3.26

[2] n = number of participants in sample; x = mean; s = standard deviation; CI = Confidence Interval; mm = millimeters; kg = kilograms

2.4.2. Personal equipment and clothing correction factors

Personal equipment and clothing correction factors (PECCF) refers to the additional volume that clothing and equipment or other encumbrance normally worn adds to a dimension. For example work boots may add 43mm to a person's stature. Note that ranges of motion, reach envelopes, dexterity, mobility, strength, tactile sensitivity, and grasping capability can also be affected by worn equipment and clothing [30]. Some range of motion data is currently being collected with different RAN ensembles. PECCFs were collected for 22 measurements and three clothing ensembles in the ASRAN, see Table 2. For a description and figure of the clothing ensembles see Appendix A.

Table 2 Personal equipment and clothing correction factors for three ensembles measured in the ASRAN on male personnel only

Dimension (ASRAN code)	Escape Suit			Firefighting Ensemble			Boarding Party		
	Mean	SD	%	Mean	SD	%	Mean	SD	%
Acromion Height, Sitting (M10)	NA	NA	NA	NA	NA	NA	99	±8	16.6
Bideltoid Breadth (M18)	23	±18	4.6	40	±14	8.1	NA	NA	NA
Chest Breadth (M19)	16	±15	5.5	22	±13	7.1	227	±37	73.5
Chest Depth (M20)	54	±29	23.4	182	±10	76.4	129	±17	51.9
Forearm-Forearm Breadth (M22)	78	±31	15	84	±25	15.9	158	±37	31.1
Abdominal Extension Depth, Sitting (M23)	NA	NA	NA	211	±30	87.5	223	±15	89.9
Hip Breadth, Sitting (M24)	NA	NA	NA	NA	NA	NA	106	±31	28.2
Buttock-Knee Length (M25)	NA	NA	NA	NA	NA	NA	152	±19	24.9
Foot Breadth, Horizontal (M27)	6	±5	6.2	15	±4	14.6	16	±6	16.1
Head Circumference (M28)	192	±48	33.3	382	±13	66	316	±19	55
Chest Circumference (M33)	95	±36	9.8	377	±40	38.5	389	±35	39.5
Waist Circumference (Omphalion) (M35)	NA	NA	NA	NA	NA	NA	629	±83	70.3
Buttock Circumference (M36)	254	±15	26.3	146	±33	15.2	70	±23	7
Stature (M38)	20	±7	1.1	94	±11	5.2	76	±12	4.3
Weight (kg) (M40)	NA	NA	NA	NA	NA	NA	20.2	±0.6	24.7
Head Breadth (M41)	6	±4	3.9	89	±7	56.8	68	±4	42
Head Length (M42)	45	±18	22.7	106	±6	53.3	83	±9	41.3
Hand Breadth (M65)	1	±1	1.2	3	±2	3.2	NA	NA	NA
Hand Length (M66)	7	±8	3.5	8	±6	3.9	NA	NA	NA
Foot Length (M71)	38	±8	14	41	±8	15	33	±4	12.3
Hand Depth (M86)	2	±3	3.4	0	±2	0.8	NA	NA	NA
Overhead Fingertip Reach (M90)	NA	NA	NA	NA	NA	NA	-59	±40	-3.4

2.4.3. Dynamic movement

This refers to the additional space required for normal posture and movement when conducting a task. For example when determining the height of a space that people transit through, the motion of walking will require an additional 50-100mm for head clearance. Dynamic movement allowances are often an estimation that should be verified with kinematic investigations to check the geometry of motion, and movement trials with physical designs prior to finalising an appropriate allowance.

2.4.4. General allowances and clearances

Additional allowances to the ones listed above may be needed for reasons of physical comfort (being able to stretch and move more freely), psychological comfort (feeling of more space and openness), and to aid efficient and comfortable ingress/egress. Societal expectations such as proximity to others and personal space can also factor in to this consideration.

2.4.5. Subtractions

Certain subtractions can be considered where, for example, there are expected cushion or mattress compressions, or postural slump in individuals. Due to the varying nature of these potential reductions they are best tested in a physical mock-up with representative users in a realistic context. For example, some cushions or mattresses may soften over time but initially compress very little.

3. Assessment procedure

To determine whether a design is appropriate and acceptable in terms of fit, clearance, reach, vision and/or posture a five step process can be followed [8]. The steps include:

1. Identifying the task(s) to be assessed
2. Identify the key task points (sub-tasks) where risks may be present within each task (these can also be rated on criticality)
3. Identify which of the five assessment aspects (fit, clearance, reach, vision and posture) are relevant to the task being assessed
4. Identify the possible risks corresponding to the five assessment aspects
5. Determine whether the activity is defined by a single or multiple anthropometric dimensions.

Definition of fit, clearance, reach, vision, and posture are outlined in Table 3, as well as performance and safety factors to consider.

Figure 1 provides an illustration of the five step process listed above, with an example. Note the example does not list all the key task points, but a subset for example purposes.

Table 3 Anthropometric assessment types [8], examples modified for context

Assessment Type	Definition	Risks	Example
Fit	Does the system accommodate the specified range of users?	*Performance* – Desired accommodation range not achieved due to users being unable to fit within the system or the equipment does not fit them correctly. *Safety* - Users may compromise their safety to operate the system.	Vertical separation between bunks does not allow the intended range of users to change sleep position, affecting sleep quality.
Clearance	Does the system prevent undesirable contact with the body?	*Performance* - If users are immobilised or restricted then they will be unable to continue working efficiently. If access to controls are impinged, then the user's operational performance will be compromised. *Safety* - injury may be caused by the body striking nearby equipment or getting trapped.	Does the design provide sufficient clearance for maintenance to be conducted efficiently, safely, and without injury?
Reach	Does the system provide suitable placement of controls and/or equipment?	*Performance* – If a control or equipment cannot be reached by the user the system operation will be compromised. *Safety* - If critical safety controls/equipment (e.g. breathing mask points) cannot be reached the risk of injury is increased.	Can the full user population reach and efficiently control and manipulate all valves?
Vision	Does the system allow a suitable eye point to be achieved to provide the user with an appropriate field of view?	*Performance* – Task performance could be compromised if the user does not have optimal field of vision to see all necessary information. *Safety* – If occlusion prevents a hazard being identified or information being retrieved; or the information is poorly positioned, there is an increased risk of ship safety and operator situation awareness.	Is all frequently used information and displays positioned within acceptable fields of view to prevent operators from developing musculoskeletal disorders?
Posture	Does the system allow a safe, comfortable and effective posture to be achieved?	*Performance* - Poor posture increases user fatigue which may reduce performance. *Safety* - Poor posture increases the stress placed on the body and increases the risk of musculoskeletal disorders and injury.	Do the workstations in the control room / operations room allow the user to maintain a comfortable, ergonomic, and effective posture while operating the system?

Note: Posture assessment requires consideration of other variables in addition to anthropometry such as task frequency, the time posture is held, forces applied to/by the body, support of the limbs and joint angles. As such, posture assessment should be performed by a suitably qualified Human Factors Subject Matter Expert (SME).

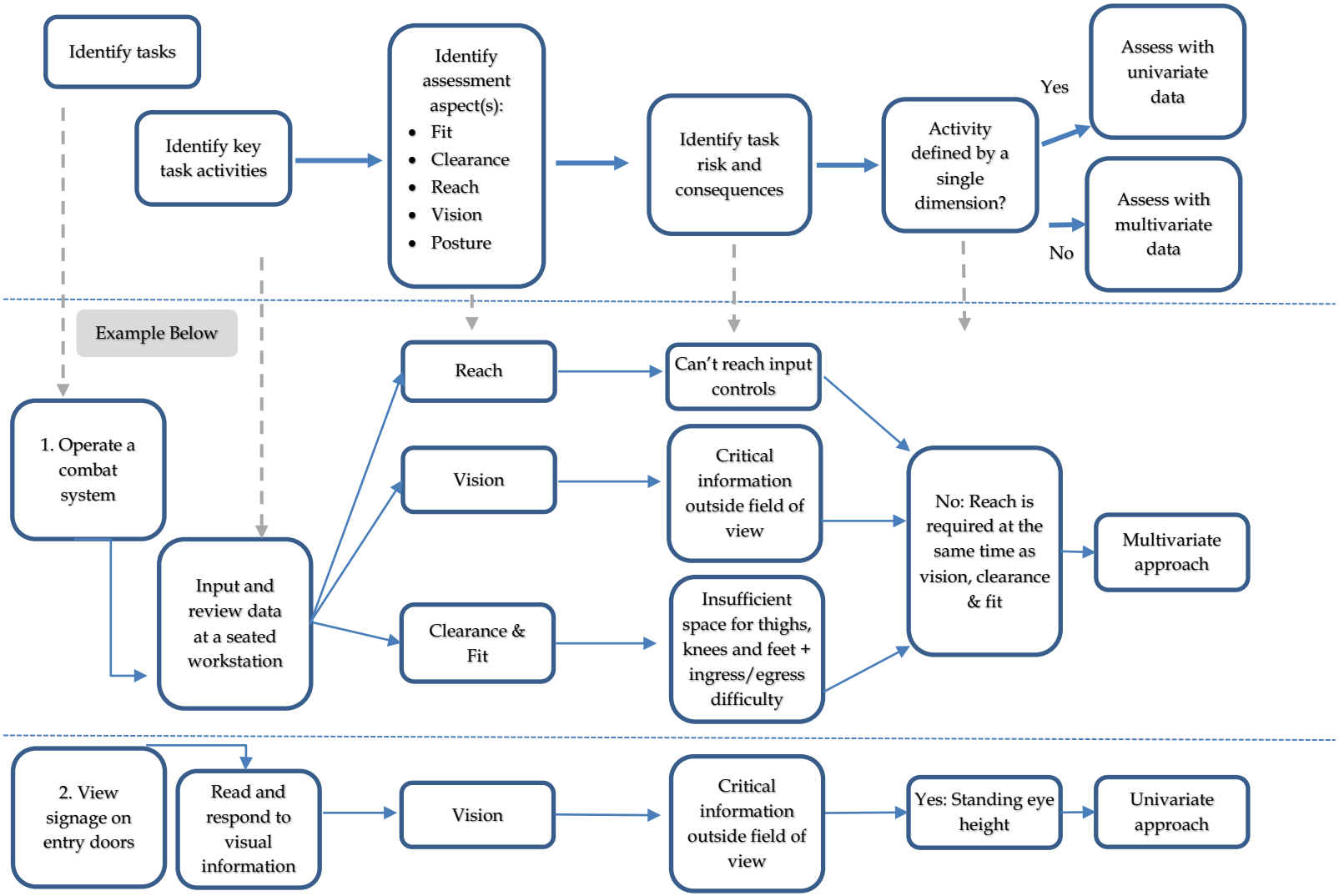


Figure 1 Assessment and decision making process for using univariate or multivariate data (Process from [8], example modified for context)

3.1. Assessment reporting

When conducting an assessment a written report should be provided with sufficient information to enable the assessment to be repeated at a later date using an identical procedure. The following outcomes, adapted from [8], should be included in the report:

- Assessment scenario (including reasons for choice): paper based, software modelling tools, or physical mock-ups
- Task description including key task points, perceived risk and the type of assessment (e.g. clearance)
- The anthropometric dimension(s) considered, and other inputs included (secular trend, PECCF, other allowances)
- Percentage of the population accommodated. If a multivariate approach is required outline what data was used and how values were calculated
- A drawing and/or image of the assessment that shows the measurements taken, including relevant body landmarks used, and postures examined
- Differences between the requirement and the prototype, e.g., additional space allowed, to what degree a prototype is non-compliant to a requirement, any constraints/limitations/caveats with the assessment
- Risk assessment for any assessment failures including the likelihood and consequences associated with each risk.

4. Percentile data / univariate statistics

This section provides summary statistics for all 87 body dimensions measured in the ASRAN. See Table 4 for a list of the dimensions measured and Figure 2 for illustrations of what body parts the dimensions correspond to. All landmarks used during the collection of these measurements are presented in Appendix B and the postures referred to throughout this section are illustrated in Appendix C. Further technical information on the landmark and measurement protocols can be found at [12, 13].

Table 4 Dimensions measured in ASRAN

Physical measurements	Digital measurements
M01 Cervicale Height (mm)	M41 Head Breadth (mm)
M03 Acromion Height (mm)	M43 Menton-Sellion Length (mm)
M04 Suprasternale Height (mm)	M44 Bitragion Submandibular Arc (mm)
M07 Iliocristale Height (mm)	M45 Neck Circumference (mm)
M08 Crotch Height (mm)	M46 Nape-Bustpoint/Thelion Length (mm)
M09 Eye Height, Sitting (mm)	M47 Nape-Waist over Bust (mm)
M10 Acromion Height, Sitting (mm)	M48 Biacromial Breadth (mm)
M11 Elbow Rest Height (mm)	M49 Scye Depth (mm)
M12 Thigh Clearance (mm)	M50 Back Width (mm)
M13 Knee Height, Sitting (mm)	M51 Back Length (mm)
M14 Popliteal Height (mm)	M52 Nape-Waist Centre Back (mm)
M15 Interpupillary Breadth (mm)	M53 Vertical Trunk Circumference (Wide) (mm)
M16 Bizygomatic Breadth (mm)	M54 Crotch Length (Omphalion) (mm)
M18 Bideltoid Breadth (mm)	M55 Waist Circumference Preferred (mm)
M19 Chest Breadth (mm)	M56 Maximum Hip Circumference (mm)
M20 Chest Depth (mm)	M57 Waist-Hip Distance (mm)
M21 Bicristale Breadth (mm)	M58 High Hip (mm)
M22 Forearm-Forearm Breadth (mm)	M59 Hip (mm)
M23 Abdominal Extension Depth, Sitting (mm)	M60 Acromion-Radiale Length (mm)
M24 Hip Breadth, Sitting (mm)	M61 Radiale-Stylion Length (mm)
M25 Buttock-Knee Length (mm)	M62 Sleeve Outseam (mm)
M26 Buttock-Popliteal Length (mm)	M63 Wrist Circumference (mm)
M27 Foot Breadth, Horizontal (mm)	M64 Hand Circumference (mm)
M28 Head Circumference (mm)	M65 Hand Breadth (mm)
M29 Neck Circumference, Base (mm)	M66 Hand Length (mm)
M30 Shoulder Length (mm)	M67 Thigh Circumference (mm)
M31 Biceps Circumference, Flexed (mm)	M68 Knee Circumference (mm)
M32 Forearm Circumference, Flexed (mm)	M69 Calf Circumference (mm)
M33 Chest Circumference (mm)	M70 Ankle Circumference (mm)
M34 Chest Circumference Below Breast (mm)	M71 Foot Length (mm)
M35 Waist Circumference (Omphalion) (mm)	M72 Ball of Foot Length (mm)
M36 Buttock Circumference (mm)	M73 Seat Angle (°)
M37 Thumbtip Reach (mm)	M74 Outside Leg Length (mm)
M38 Stature (mm)	M75 Chest Level (mm)
M39 Sitting Height (mm)	M76 Bust Level (mm)
M40 Weight (kg)	M77 Waist Level Centre Front (mm)
M42 Head Length (mm)	M78 Hip Level (female) (mm)
M86 Hand Depth (mm)	M79 Waist Level Centre Back (mm)
M87 Wrist-Centre Thumbtip Distance (mm)	M80 Seat Level (mm)
M88 Wrist-Centre Grip Distance (mm)	M81 Trochanteric Height (mm)
M89 Ear Length (mm)	M82 Hip Level (male) (mm)
M90 Overhead Fingertip Reach (mm)	M83 Knee Level (mm)
M91Index Finger Breadth Distal (mm)	M84 Ankle Height (mm)
	M85 Torso Length (mm)

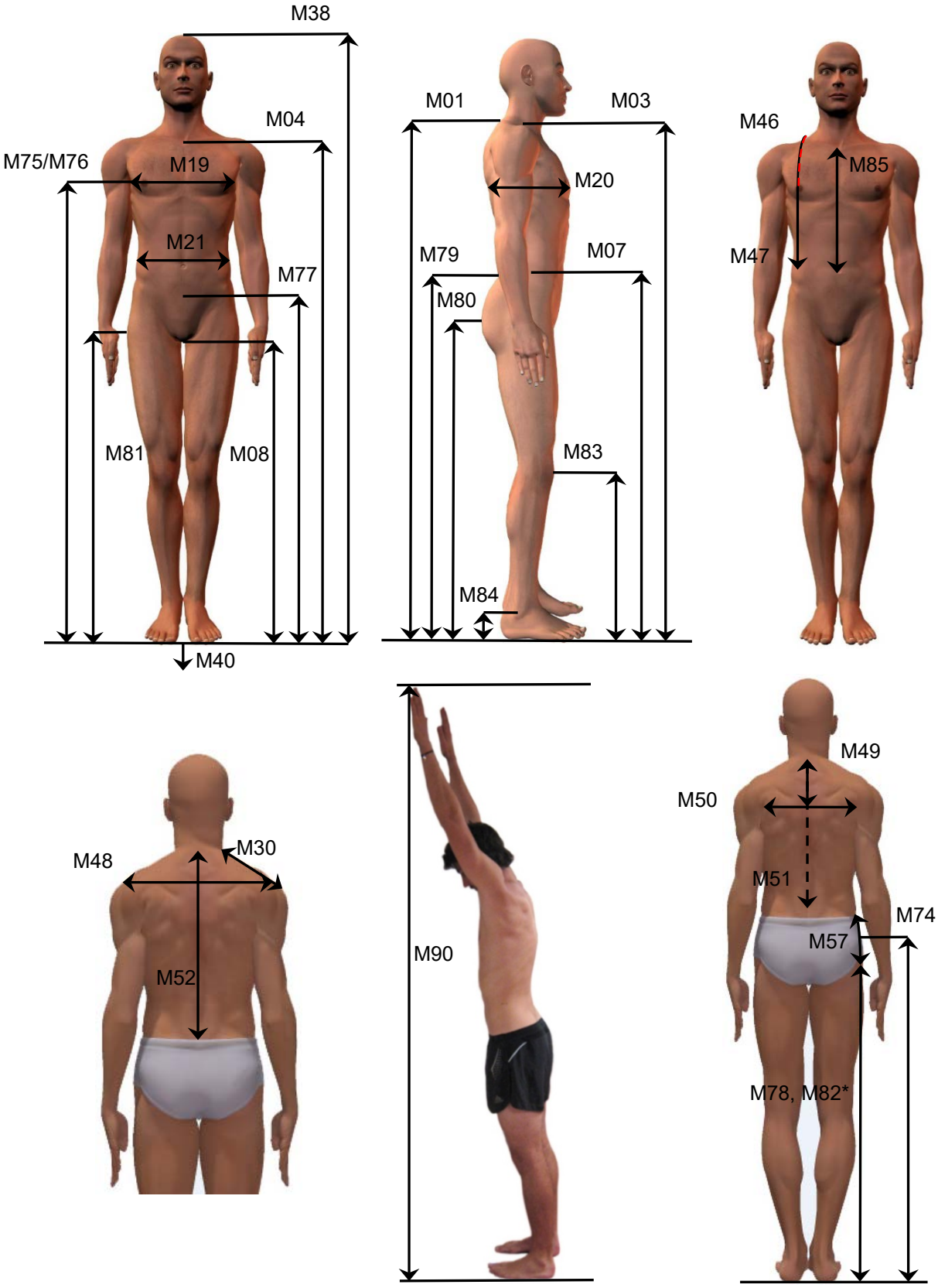


Figure 2 Illustrations of dimensions captured in the ASRAN (8)

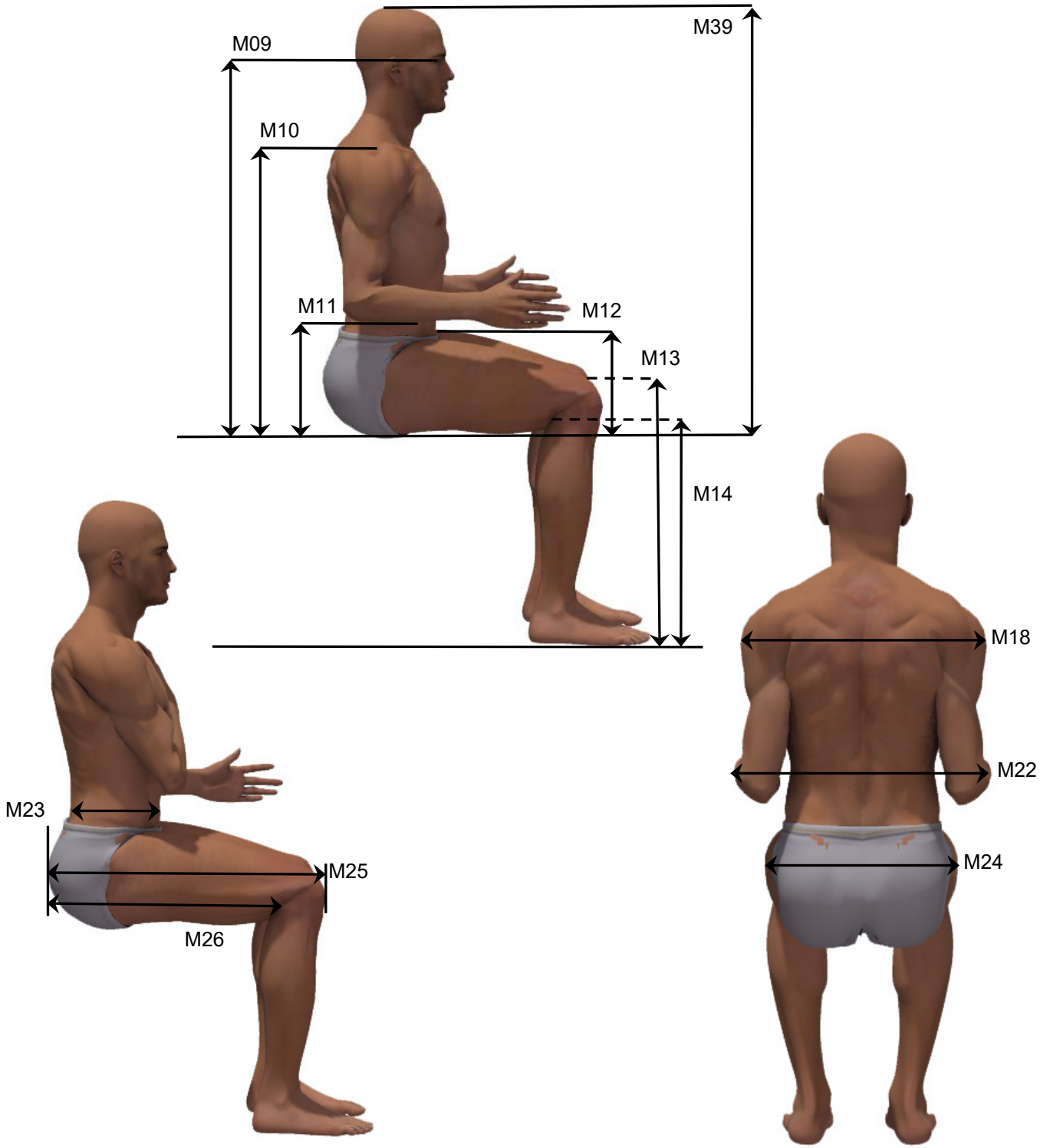


Figure 2 continued

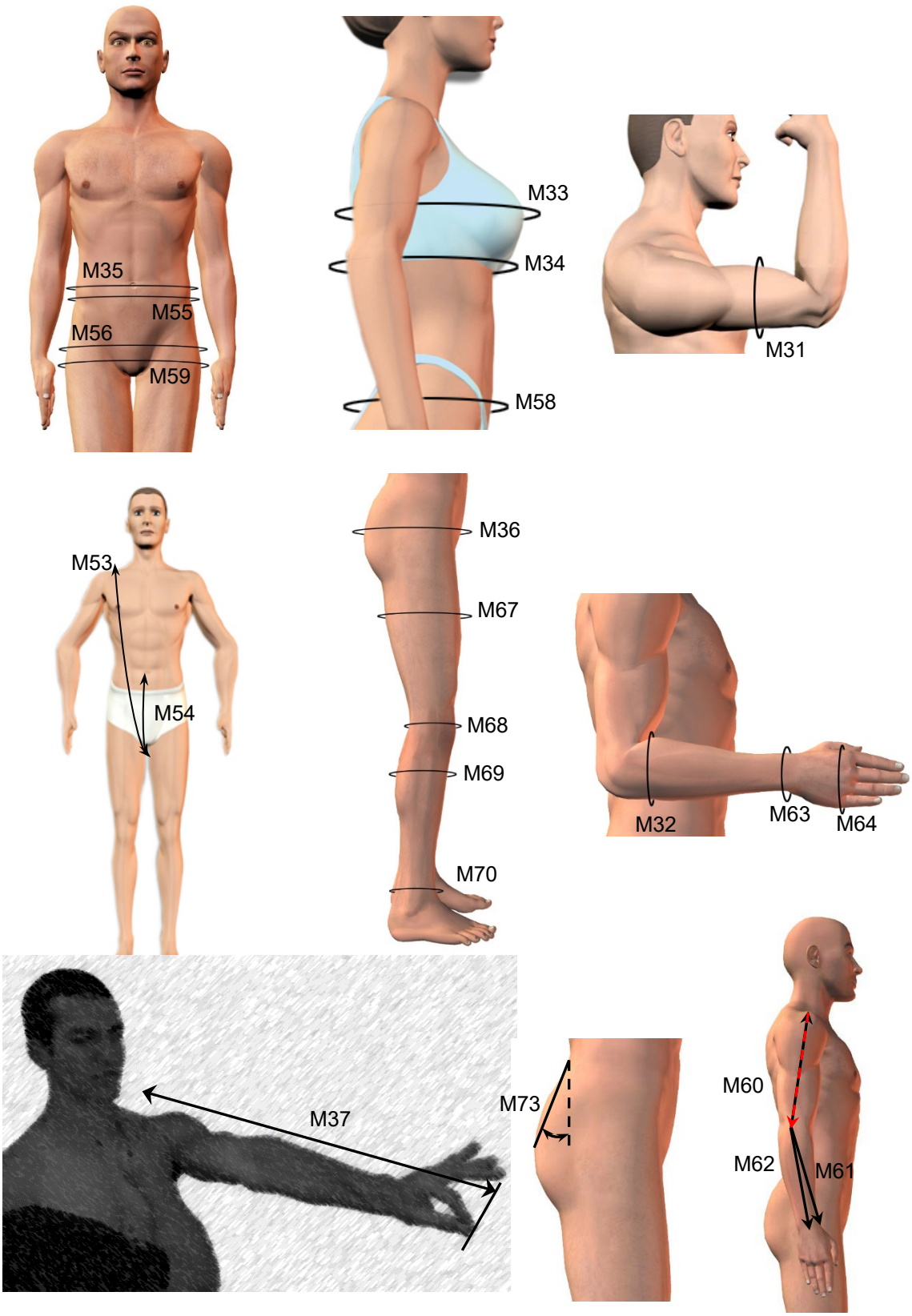


Figure 2 continued

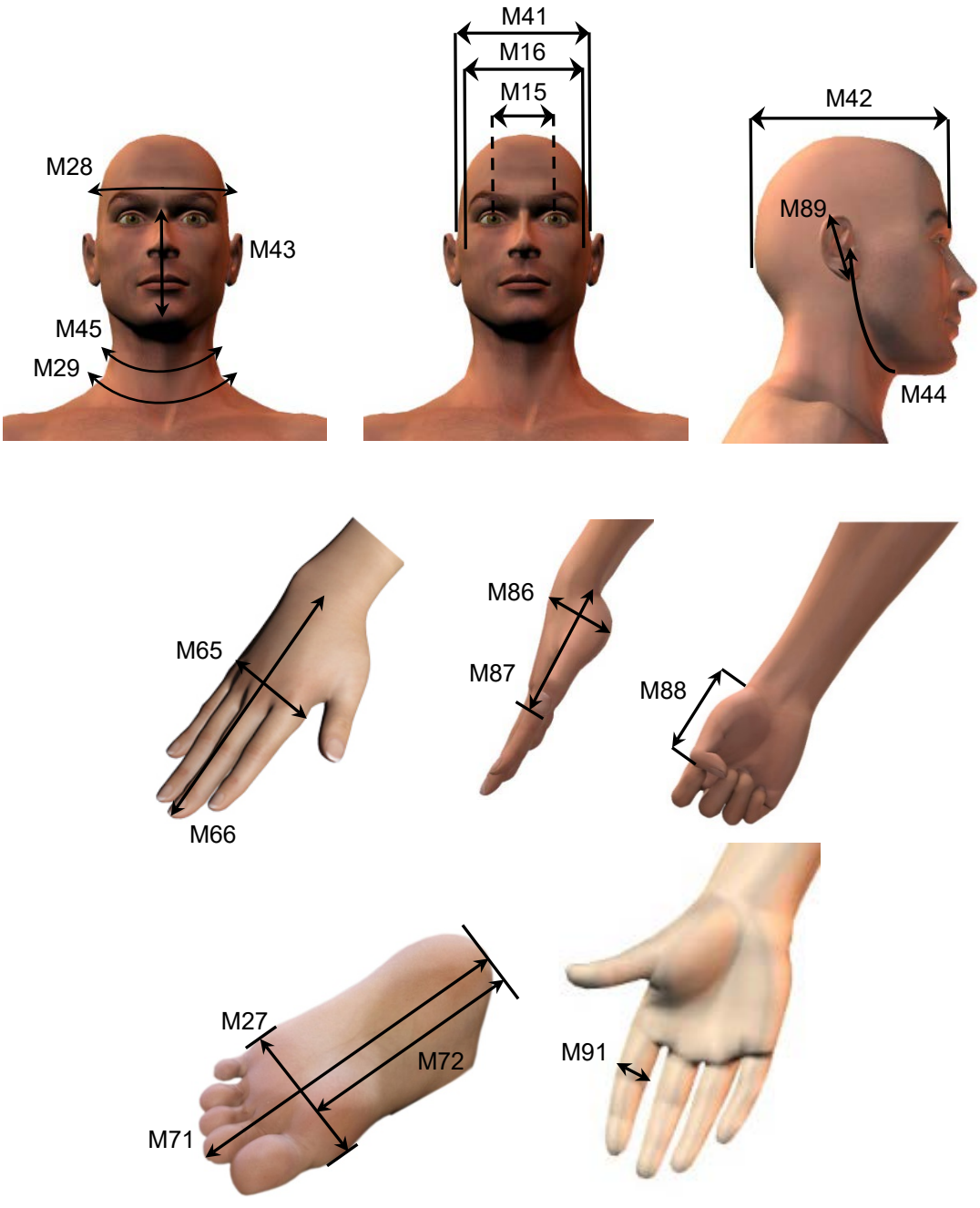
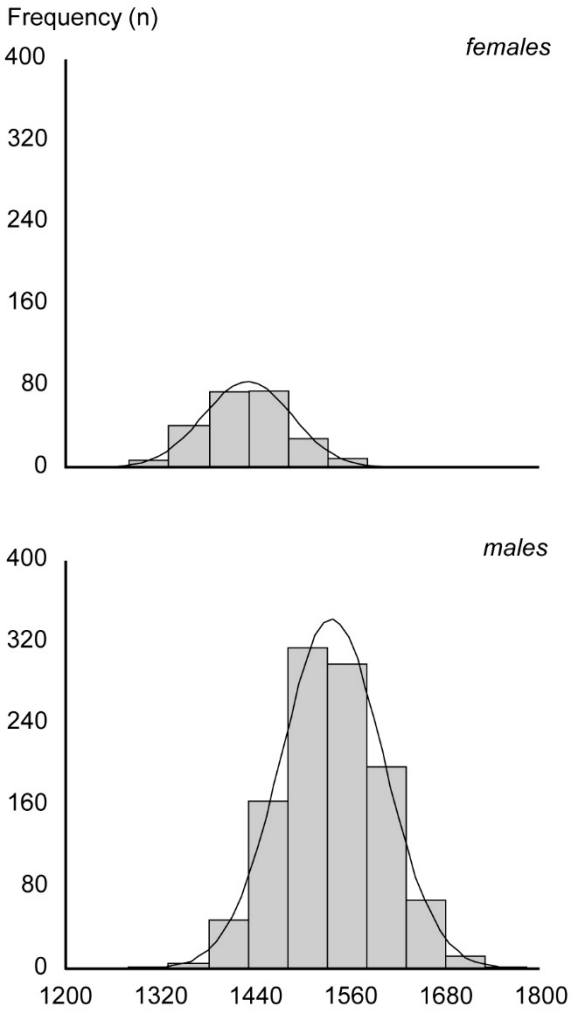


Figure 2 continued

Cervicale Height (M01)

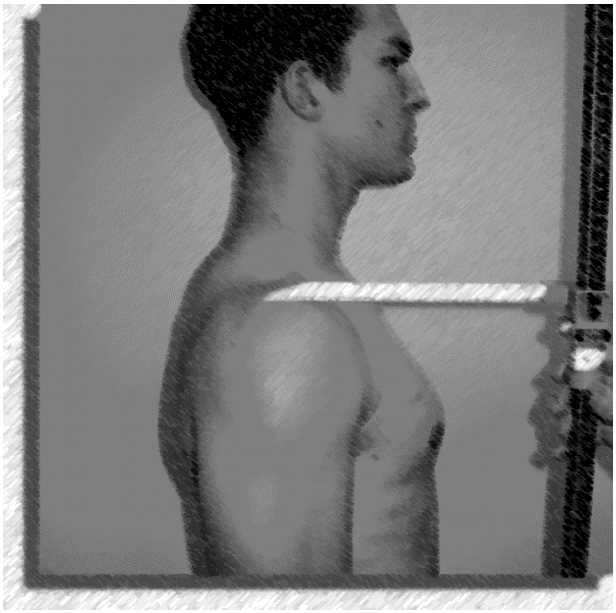
Posture: Anthropometric Standing with the head in the Frankfort Plane.
Definition: Standing surface to Cervicale (mm).

FEMALES	STATISTIC	MALES
232	*n*	1090
1429	*Mean*	1537
3.7	*SE (mean)*	2.0
56	*SD*	65
1602	*Maximum*	1781
1280	*Minimum*	1330
0.222	*Skewness*	0.100
0.270	*Kurtosis*	-0.013
3.9%	*Coefficient of variation*	4.2%
	Percentiles	
1572	P_{99}	1694
1561	P_{98}	1668
1547	P_{97}	1656
1521	P_{95}	1642
1503	P_{90}	1622
1484	P_{85}	1604
1469	P_{80}	1591
1460	P_{75}	1581
1453	P_{70}	1570
1446	P_{65}	1560
1441	P_{60}	1554
1435	P_{55}	1544
1428	P_{50}	1534
1424	P_{45}	1527
1416	P_{40}	1518
1412	P_{35}	1511
1402	P_{30}	1501
1395	P_{25}	1491
1380	P_{20}	1482
1370	P_{15}	1469
1358	P_{10}	1454
1337	P_5	1431
1333	P_3	1424
1320	P_2	1414
1311	P_1	1399

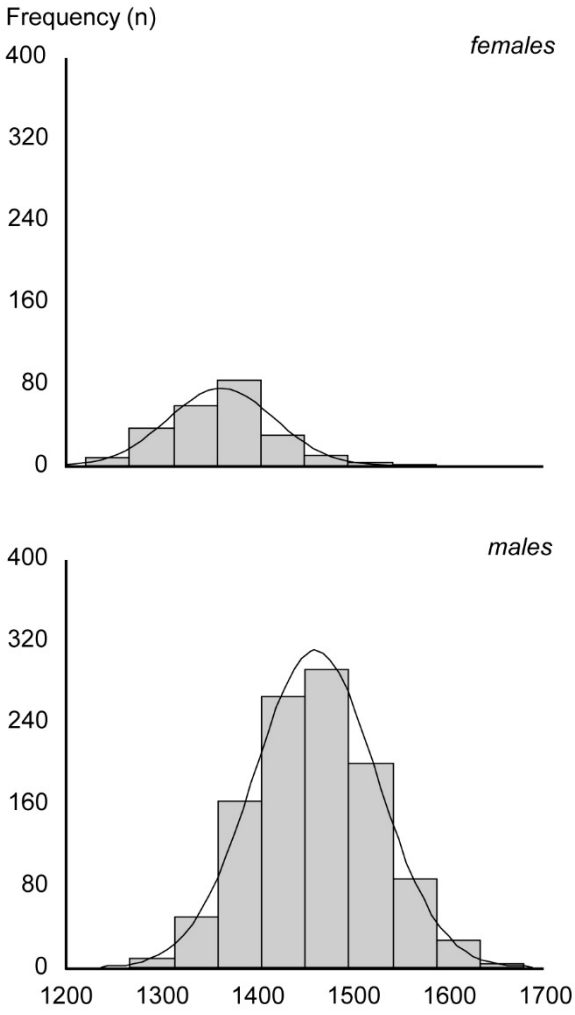


Acromion Height (M03)

Posture: Anthropometric Standing.
Definition: Standing surface to Acromion, Right (mm).

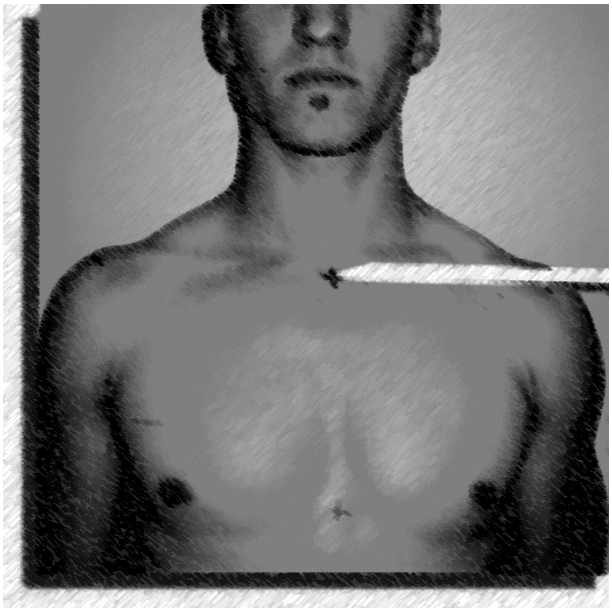


FEMALES	STATISTIC	MALES
232	*n*	1090
1362	*Mean*	1460
3.6	*SE (mean)*	1.9
55	*SD*	64
1557	*Maximum*	1678
1221	*Minimum*	1269
0.286	*Skewness*	0.123
0.417	*Kurtosis*	-0.104
4.1%	*Coefficient of variation*	4.4%
	Percentiles	
1509	P_{99}	1613
1482	P_{98}	1596
1468	P_{97}	1586
1458	P_{95}	1566
1431	P_{90}	1543
1421	P_{85}	1528
1402	P_{80}	1514
1393	P_{75}	1503
1387	P_{70}	1493
1381	P_{65}	1486
1374	P_{60}	1477
1368	P_{55}	1469
1363	P_{50}	1459
1358	P_{45}	1451
1350	P_{40}	1441
1343	P_{35}	1434
1339	P_{30}	1424
1322	P_{25}	1414
1314	P_{20}	1403
1303	P_{15}	1391
1292	P_{10}	1377
1275	P_5	1357
1265	P_3	1344
1260	P_2	1337
1246	P_1	1326

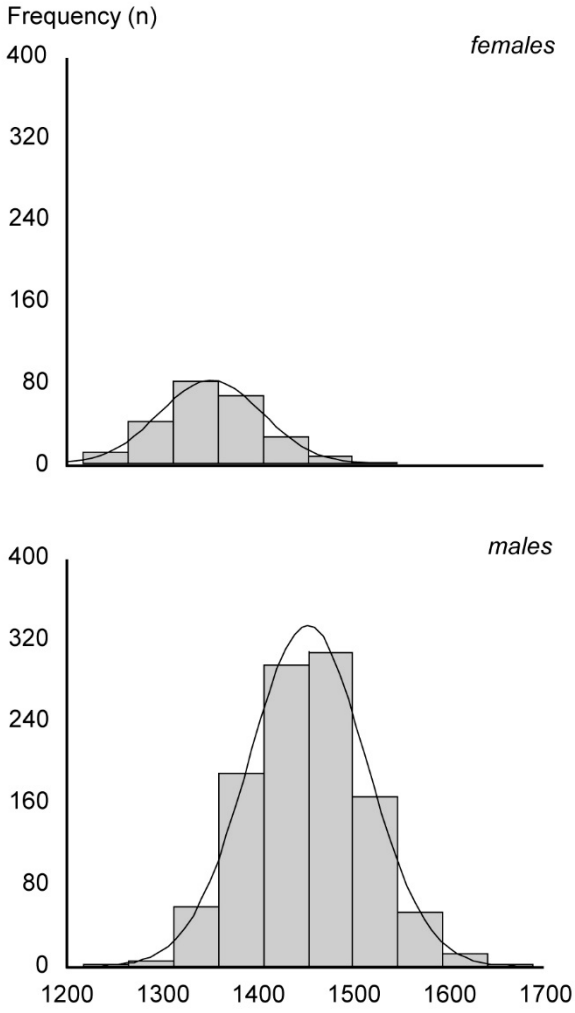


Suprasternale Height (M04)

Posture: Anthropometric Standing.
Definition: Standing surface to Suprasternale (mm).



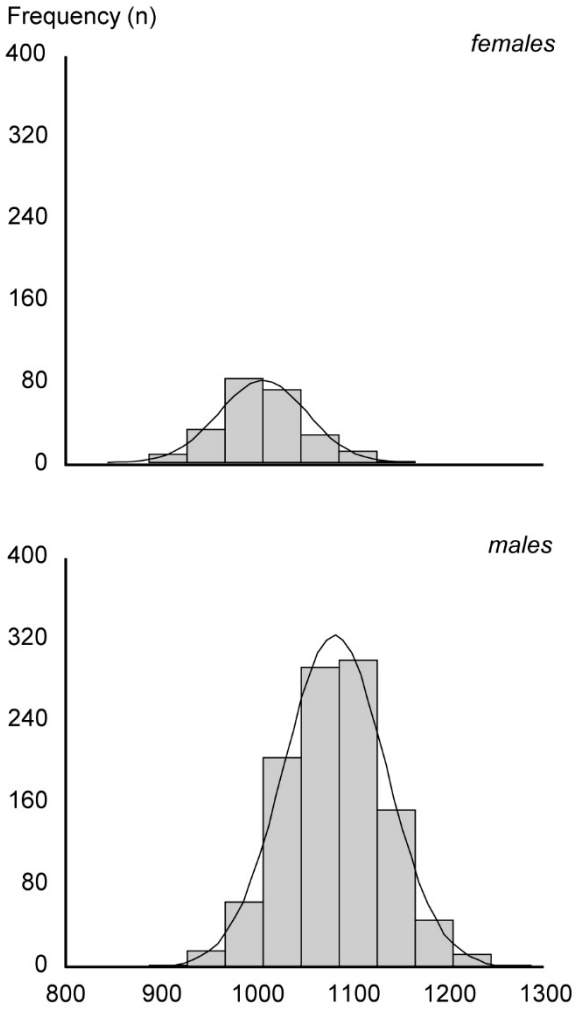
FEMALES	STATISTIC	MALES
232	*n*	1089
1351	*Mean*	1451
3.5	*SE (mean)*	1.9
54	*SD*	61
1538	*Maximum*	1687
1217	*Minimum*	1263
0.258	*Skewness*	0.140
0.427	*Kurtosis*	0.014
4.0%	*Coefficient of variation*	4.2%
	Percentiles	
1489	P_{99}	1603
1470	P_{98}	1577
1456	P_{97}	1567
1441	P_{95}	1551
1418	P_{90}	1530
1404	P_{85}	1515
1390	P_{80}	1502
1384	P_{75}	1492
1377	P_{70}	1482
1370	P_{65}	1475
1364	P_{60}	1468
1356	P_{55}	1460
1349	P_{50}	1451
1343	P_{45}	1441
1339	P_{40}	1435
1330	P_{35}	1425
1322	P_{30}	1417
1317	P_{25}	1408
1303	P_{20}	1398
1295	P_{15}	1387
1288	P_{10}	1373
1268	P_{5}	1354
1252	P_{3}	1343
1246	P_{2}	1335
1231	P_{1}	1320



Iliocristale Height (M07)

Posture: Anthropometric Standing.
Definition: Standing surface to Iliocristale (mm).

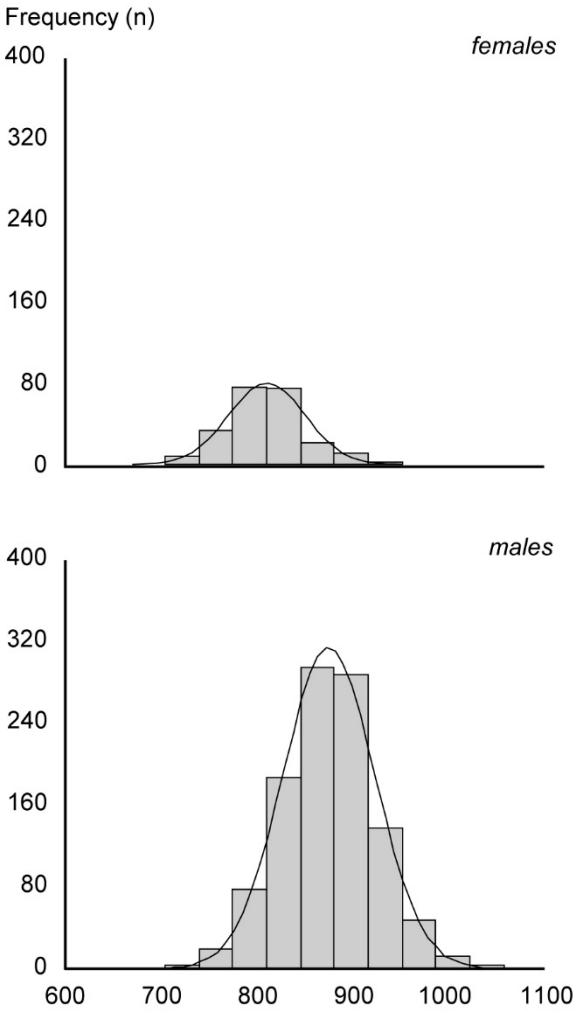
FEMALES	STATISTIC	MALES
232	*n*	1089
1005	*Mean*	1080
3.0	*SE (mean)*	1.6
46	*SD*	53
1151	*Maximum*	1284
887	*Minimum*	921
0.170	*Skewness*	0.093
0.405	*Kurtosis*	0.046
4.6%	*Coefficient of variation*	4.9%
	Percentiles	
1119	P_{99}	1209
1108	P_{98}	1197
1099	P_{97}	1178
1087	P_{95}	1168
1065	P_{90}	1147
1051	P_{85}	1135
1041	P_{80}	1124
1032	P_{75}	1117
1025	P_{70}	1108
1018	P_{65}	1101
1013	P_{60}	1095
1010	P_{55}	1089
1005	P_{50}	1081
1000	P_{45}	1074
994	P_{40}	1065
988	P_{35}	1058
981	P_{30}	1051
975	P_{25}	1043
971	P_{20}	1034
962	P_{15}	1024
950	P_{10}	1014
937	P_5	994
911	P_3	984
903	P_2	974
895	P_1	957



Crotch Height (M08)

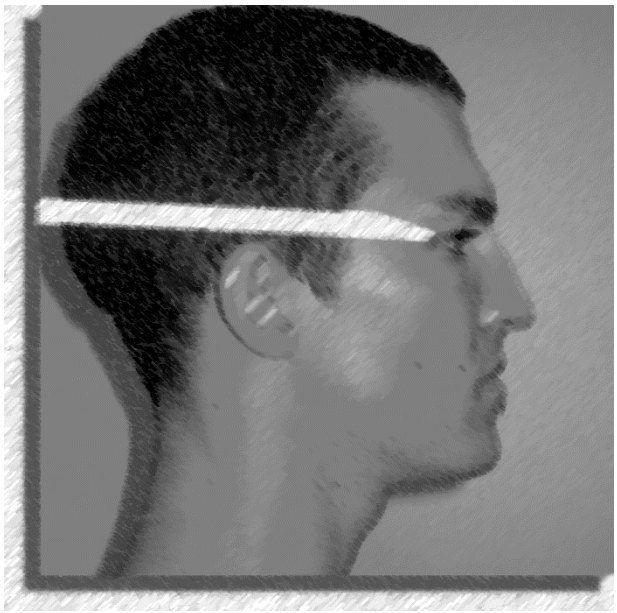
Posture: Anthropometric Standing.
Definition: Standing surface to Crotch (mm).

FEMALES	STATISTIC	MALES
224	*n*	1069
810	*Mean*	874
2.7	*SE (mean)*	1.5
40	*SD*	48
933	*Maximum*	1056
704	*Minimum*	738
0.193	*Skewness*	0.092
0.362	*Kurtosis*	0.259
4.9%	*Coefficient of variation*	5.5%
	Percentiles	
908	P_{99}	992
894	P_{98}	978
891	P_{97}	968
883	P_{95}	953
864	P_{90}	933
845	P_{85}	922
839	P_{80}	913
832	P_{75}	905
827	P_{70}	898
821	P_{65}	893
819	P_{60}	886
813	P_{55}	880
809	P_{50}	875
805	P_{45}	869
802	P_{40}	861
798	P_{35}	855
792	P_{30}	849
786	P_{25}	842
779	P_{20}	835
768	P_{15}	825
761	P_{10}	813
747	P_5	796
735	P_3	784
729	P_2	774
717	P_1	762

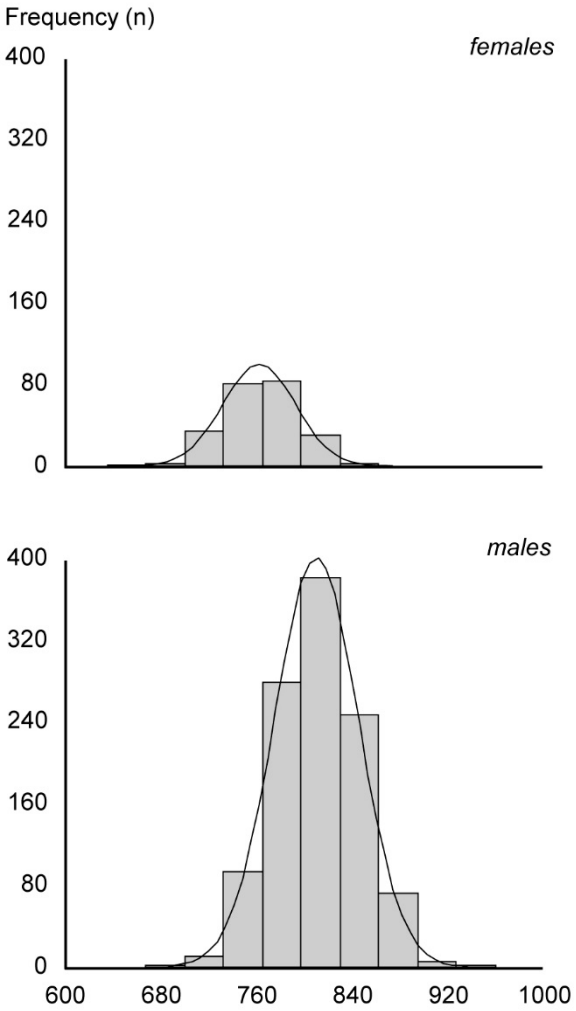


Eye Height, Sitting (M09)

Posture: Anthropometric Sitting with the head in the Frankfort plane.
Definition: Sitting surface to Ectocanthus (mm).

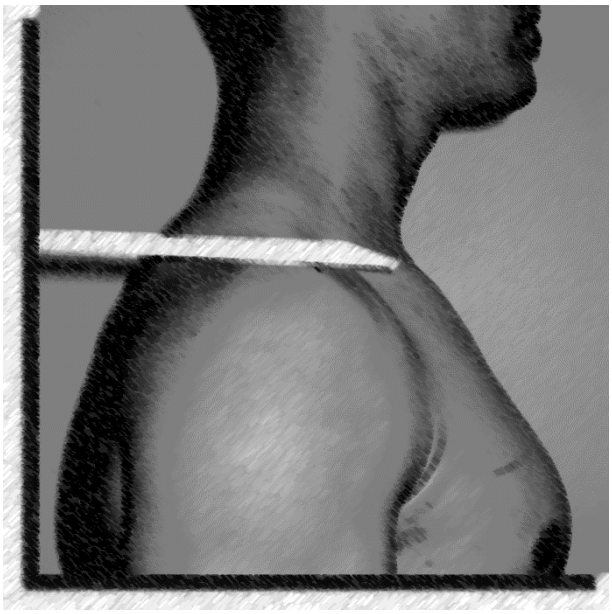


FEMALES	STATISTIC	MALES
232	*n*	1090
761	*Mean*	809
2.0	*SE (mean)*	1.1
30	*SD*	35
833	*Maximum*	959
634	*Minimum*	690
-0.339	*Skewness*	0.053
0.573	*Kurtosis*	0.012
4.0%	*Coefficient of variation*	4.4%
	Percentiles	
824	P_{99}	890
820	P_{98}	878
813	P_{97}	875
808	P_{95}	868
800	P_{90}	854
792	P_{85}	847
787	P_{80}	840
781	P_{75}	834
779	P_{70}	828
775	P_{65}	822
772	P_{60}	818
767	P_{55}	814
763	P_{50}	808
759	P_{45}	804
755	P_{40}	800
750	P_{35}	796
744	P_{30}	790
741	P_{25}	785
738	P_{20}	779
730	P_{15}	774
721	P_{10}	765
710	P_{5}	751
709	P_{3}	742
705	P_{2}	738
692	P_{1}	730

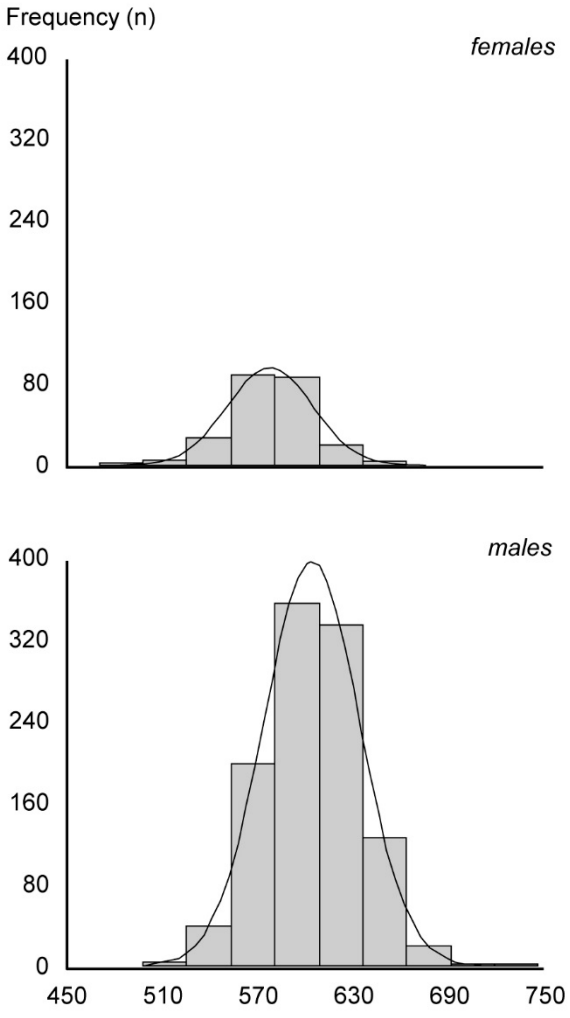


Acromion Height, Sitting (M10)
(PECCF data available)

Posture: Anthropometric Sitting.
Definition: Sitting surface to Acromion, Right (mm).

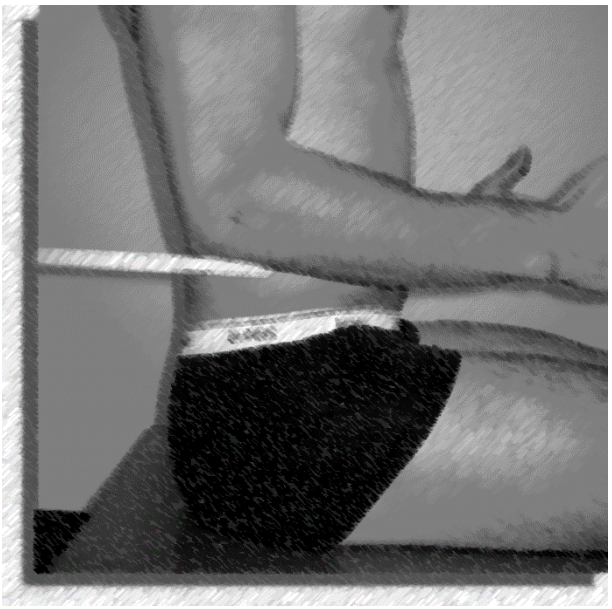


FEMALES	STATISTIC	MALES
232	*n*	1090
577	*Mean*	604
1.8	*SE (mean)*	0.9
27	*SD*	30
647	*Maximum*	746
470	*Minimum*	510
-0.379	*Skewness*	0.144
1.119	*Kurtosis*	0.215
4.6%	*Coefficient of variation*	5.0%
	Percentiles	
636	P_{99}	674
632	P_{98}	664
629	P_{97}	660
621	P_{95}	654
608	P_{90}	641
603	P_{85}	634
599	P_{80}	629
595	P_{75}	625
591	P_{70}	620
588	P_{65}	615
586	P_{60}	611
582	P_{55}	607
579	P_{50}	602
574	P_{45}	599
572	P_{40}	596
568	P_{35}	591
565	P_{30}	587
560	P_{25}	583
556	P_{20}	578
553	P_{15}	573
545	P_{10}	565
539	P_{5}	555
527	P_{3}	548
518	P_{2}	544
510	P_{1}	540

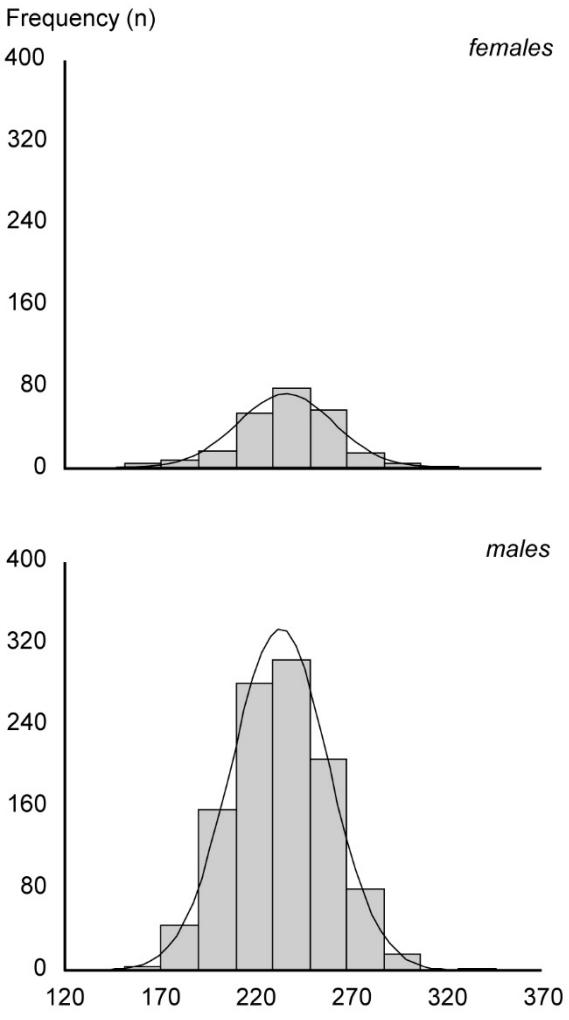


Elbow Rest Height, Sitting (M11)

Posture: Anthropometric Sitting.
Definition: Sitting surface to Olecranon, Bottom (mm).

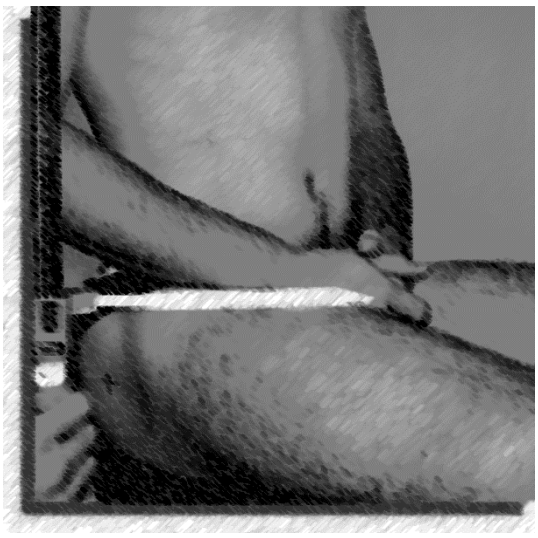


FEMALES	STATISTIC	MALES
232	*n*	1090
235	*Mean*	232
1.6	*SE (mean)*	0.8
25	*SD*	25
307	*Maximum*	345
151	*Minimum*	152
-0.389	*Skewness*	0.084
0.794	*Kurtosis*	0.019
10.6%	*Coefficient of variation*	10.9%
	Percentiles	
290	P_{99}	288
284	P_{98}	283
278	P_{97}	280
274	P_{95}	275
265	P_{90}	266
258	P_{85}	260
254	P_{80}	254
252	P_{75}	250
248	P_{70}	245
246	P_{65}	241
243	P_{60}	238
240	P_{55}	235
236	P_{50}	232
234	P_{45}	229
232	P_{40}	226
229	P_{35}	223
225	P_{30}	220
219	P_{25}	215
215	P_{20}	211
212	P_{15}	205
206	P_{10}	200
193	P_5	191
186	P_3	187
174	P_2	182
165	P_1	176

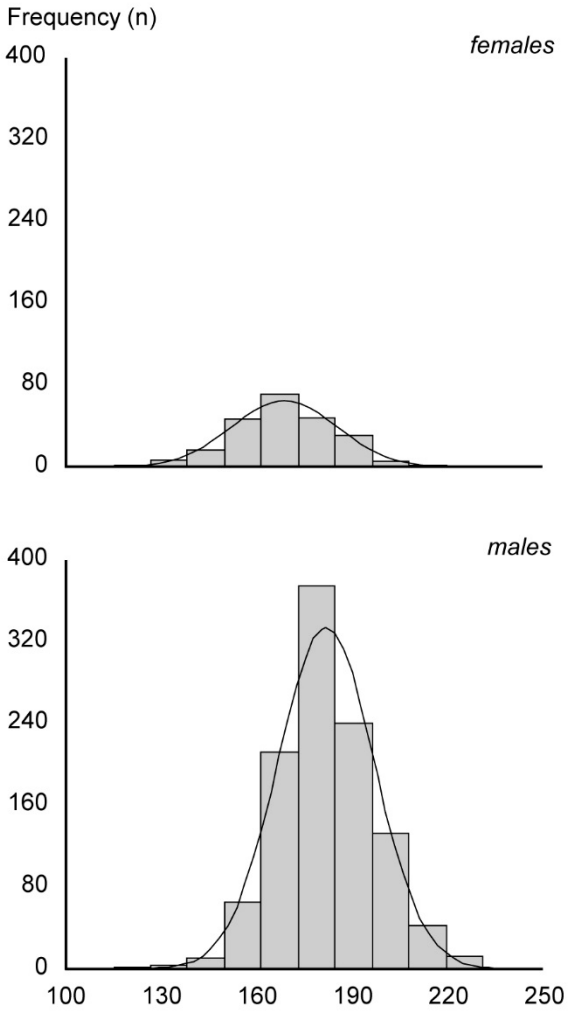


Thigh Clearance (M12)
(Secular trend data available)

Posture: Anthropometric Sitting, with the arms hanging relaxed.
Definition: Sitting surface to Thigh Point, Top (mm).



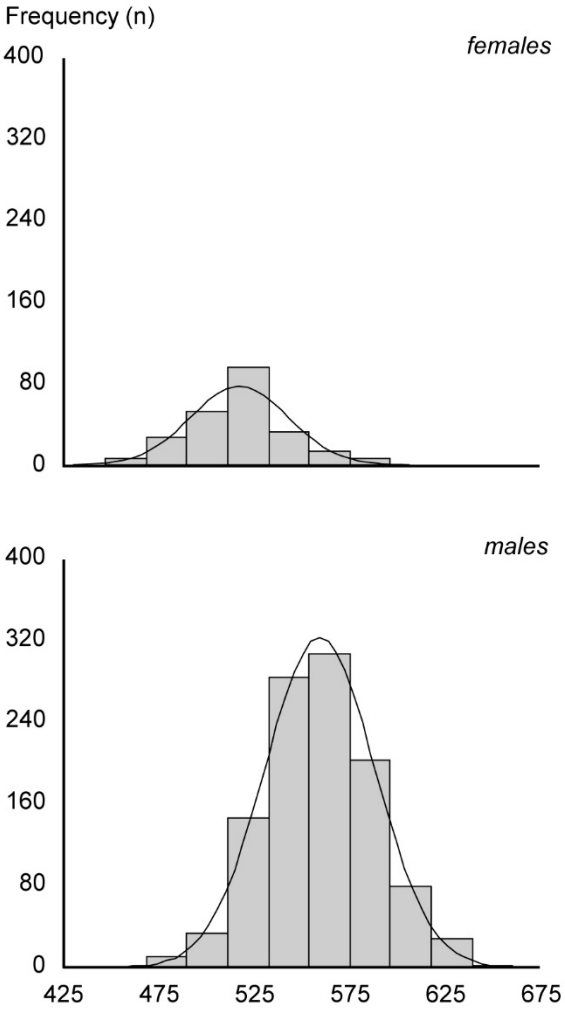
FEMALES	STATISTIC	MALES
232	*n*	1090
168	*Mean*	182
1.1	*SE (mean)*	0.5
17	*SD*	15
223	*Maximum*	231
115	*Minimum*	125
0.123	*Skewness*	0.168
0.695	*Kurtosis*	0.291
9.8%	*Coefficient of variation*	8.3%
	Percentiles	
210	P_{99}	220
204	P_{98}	214
200	P_{97}	212
195	P_{95}	207
192	P_{90}	202
186	P_{85}	198
180	P_{80}	194
178	P_{75}	191
175	P_{70}	189
174	P_{65}	187
171	P_{60}	184
169	P_{55}	183
168	P_{50}	181
166	P_{45}	179
164	P_{40}	177
163	P_{35}	175
160	P_{30}	174
157	P_{25}	172
156	P_{20}	169
154	P_{15}	167
148	P_{10}	163
145	P_{5}	158
137	P_{3}	155
135	P_{2}	153
132	P_{1}	146



Knee Height, Sitting (M13)

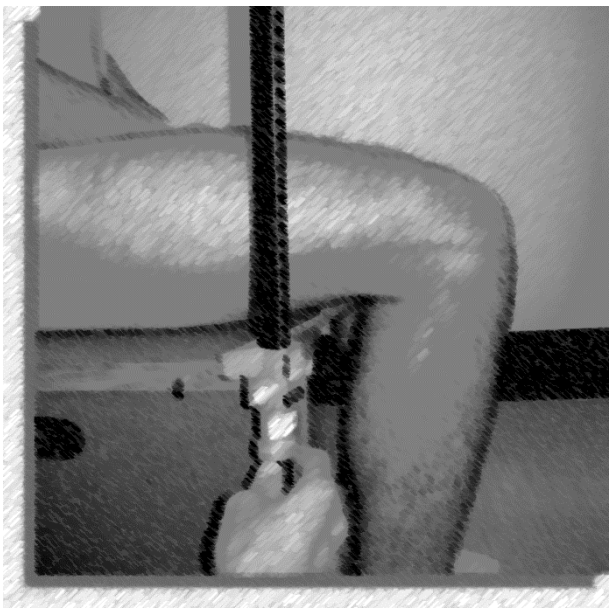
Posture: Anthropometric Sitting, with the arms hanging relaxed.
Definition: Footrest surface to Suprapatella (mm).

FEMALES	STATISTIC	MALES
231	*n*	1090
517	*Mean*	559
1.7	*SE (mean)*	0.9
26	*SD*	29
596	*Maximum*	660
447	*Minimum*	473
0.263	*Skewness*	0.124
0.665	*Kurtosis*	0.133
4.9%	*Coefficient of variation*	5.1%
	Percentiles	
583	P_{99}	631
578	P_{98}	624
573	P_{97}	615
561	P_{95}	606
549	P_{90}	596
540	P_{85}	588
535	P_{80}	583
530	P_{75}	578
527	P_{70}	573
524	P_{65}	569
522	P_{60}	565
519	P_{55}	563
516	P_{50}	559
515	P_{45}	555
512	P_{40}	551
509	P_{35}	547
505	P_{30}	544
502	P_{25}	540
497	P_{20}	536
491	P_{15}	530
484	P_{10}	524
480	P_{5}	514
473	P_{3}	508
467	P_{2}	502
457	P_{1}	492

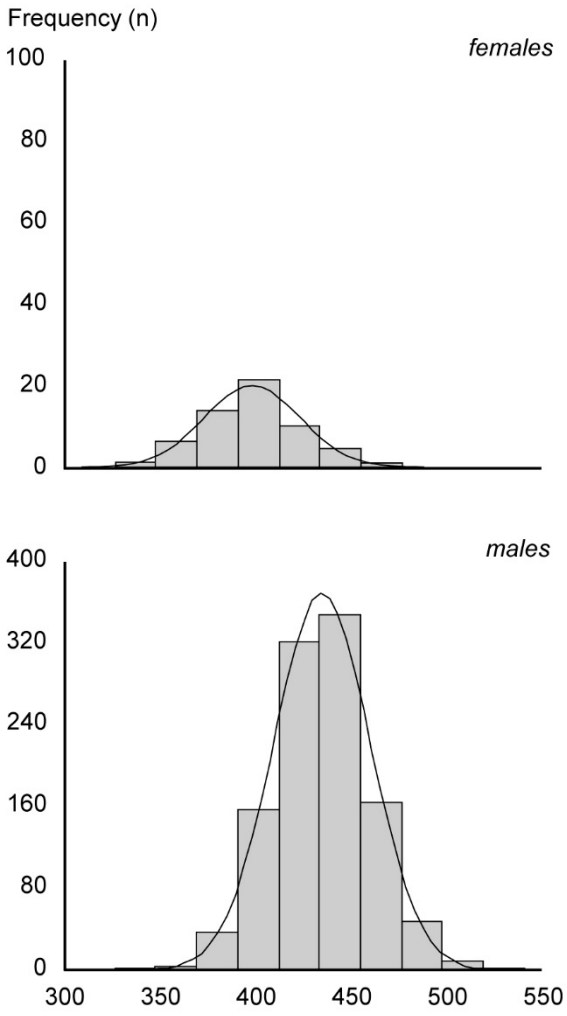


Popliteal Height (M14)

Posture: Anthropometric Sitting, with the arms hanging relaxed.
Definition: Footrest surface to the Dorsal Juncture of Calf and Thigh (mm).

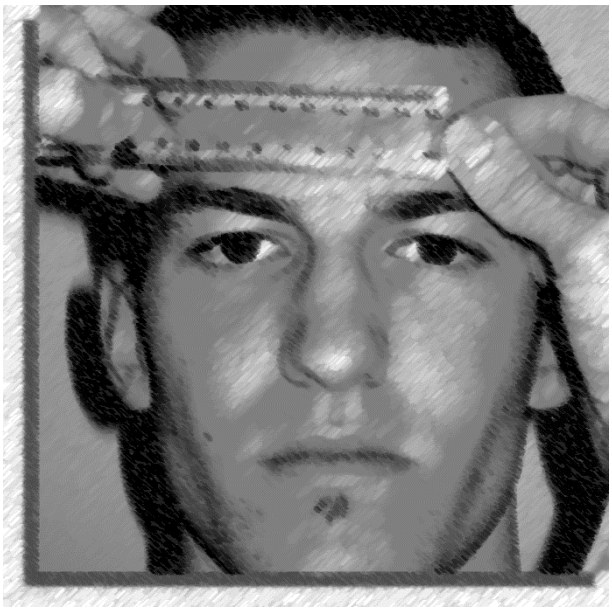


FEMALES	STATISTIC	MALES
232	*n*	1087
398	*Mean*	435
1.6	*SE (mean)*	0.8
25	*SD*	25
461	*Maximum*	541
326	*Minimum*	336
0.084	*Skewness*	0.075
0.090	*Kurtosis*	0.373
6.3%	*Coefficient of variation*	5.8%
	Percentiles	
455	P_{99}	497
454	P_{98}	487
447	P_{97}	483
442	P_{95}	477
432	P_{90}	467
422	P_{85}	461
417	P_{80}	455
414	P_{75}	450
407	P_{70}	447
405	P_{65}	444
402	P_{60}	441
399	P_{55}	438
397	P_{50}	435
396	P_{45}	432
392	P_{40}	429
389	P_{35}	424
386	P_{30}	421
382	P_{25}	418
377	P_{20}	413
372	P_{15}	409
366	P_{10}	403
359	P_5	395
353	P_3	388
348	P_2	381
344	P_1	377

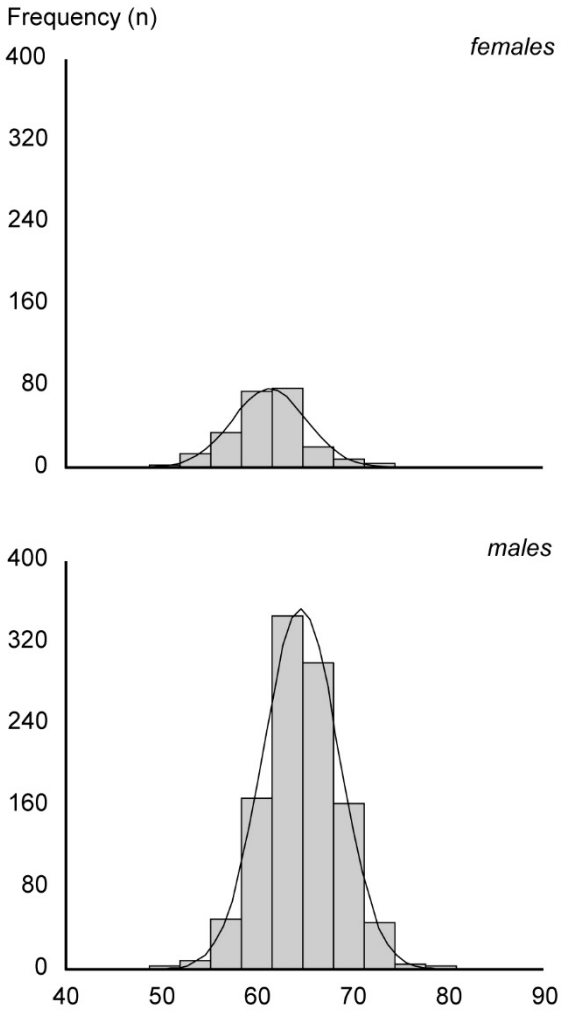


Interpupillary Breadth (M15)

Posture: Sitting.
Definition: Distance between the Centre of the Pupil, Right and the Centre of the Pupil, Left (mm).

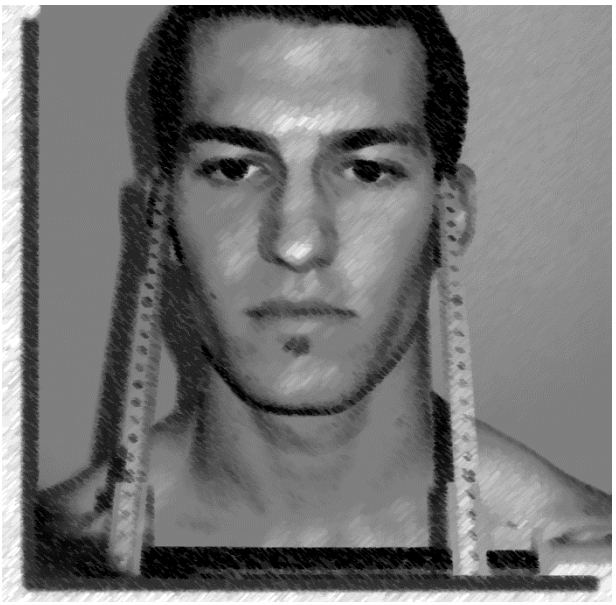


FEMALES	STATISTIC	MALES
232	*n*	1089
61	*Mean*	65
0.3	*SE (mean)*	0.1
4	*SD*	4
73	*Maximum*	81
49	*Minimum*	51
0.109	*Skewness*	0.018
0.813	*Kurtosis*	0.643
6.3%	*Coefficient of variation*	6.1%
	Percentiles	
71	P_{99}	74
71	P_{98}	73
70	P_{97}	72
68	P_{95}	71
65	P_{90}	69
65	P_{85}	68
64	P_{80}	68
63	P_{75}	67
63	P_{70}	67
62	P_{65}	66
62	P_{60}	65
62	P_{55}	65
61	P_{50}	65
61	P_{45}	64
61	P_{40}	64
60	P_{35}	63
59	P_{30}	63
59	P_{25}	62
58	P_{20}	61
58	P_{15}	61
56	P_{10}	60
55	P_5	58
54	P_3	57
54	P_2	56
52	P_1	55

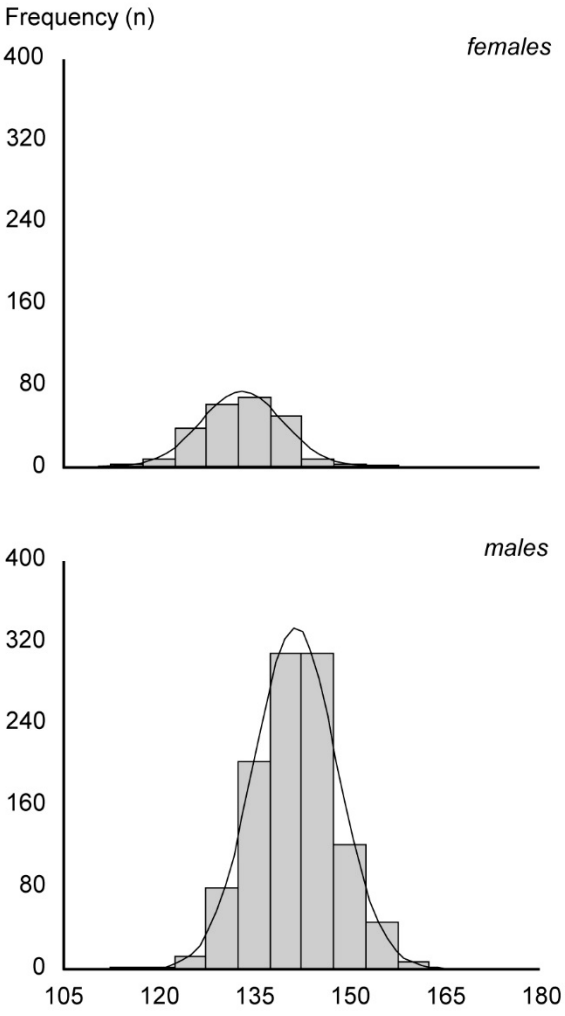


Bizygomatic Breadth (M16)

Posture: Sitting.
Definition: The maximum horizontal breadth between Zygion, Right and Zygion, Left (mm).



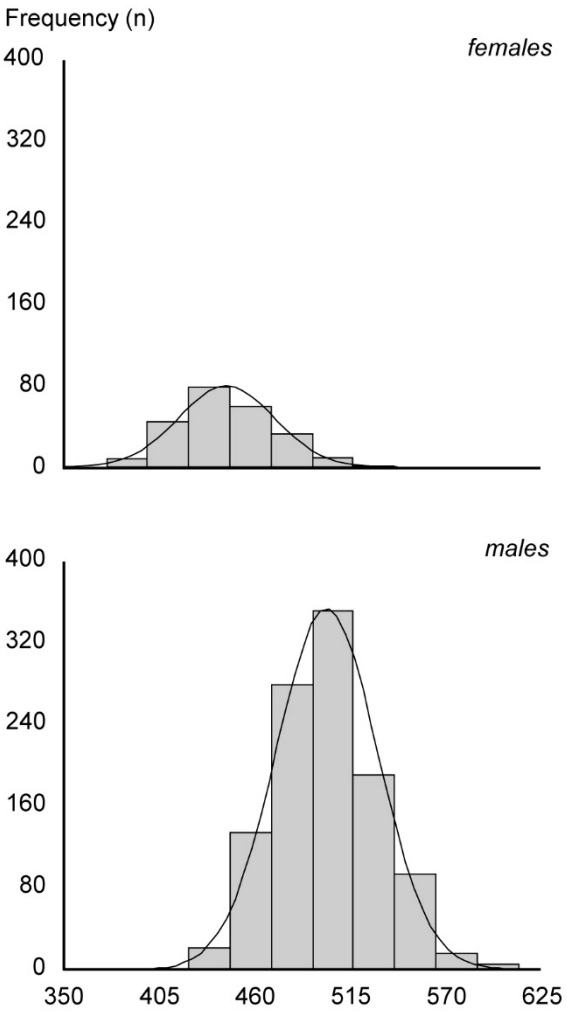
FEMALES	STATISTIC	MALES
232	*n*	1090
133	*Mean*	141
0.4	*SE (mean)*	0.2
6	*SD*	7
155	*Maximum*	163
112	*Minimum*	117
-0.025	*Skewness*	-0.039
0.631	*Kurtosis*	0.093
4.8%	*Coefficient of variation*	4.6%
	Percentiles	
148	P_{99}	156
146	P_{98}	155
143	P_{97}	154
142	P_{95}	153
140	P_{90}	150
139	P_{85}	148
138	P_{80}	147
138	P_{75}	146
137	P_{70}	145
136	P_{65}	144
135	P_{60}	143
134	P_{55}	142
133	P_{50}	142
132	P_{45}	141
132	P_{40}	140
131	P_{35}	139
130	P_{30}	138
129	P_{25}	137
128	P_{20}	136
126	P_{15}	135
125	P_{10}	133
123	P_5	130
122	P_3	129
121	P_2	128
119	P_1	126



Bideltoid Breadth (M18)
(PECCF and secular trend data available)

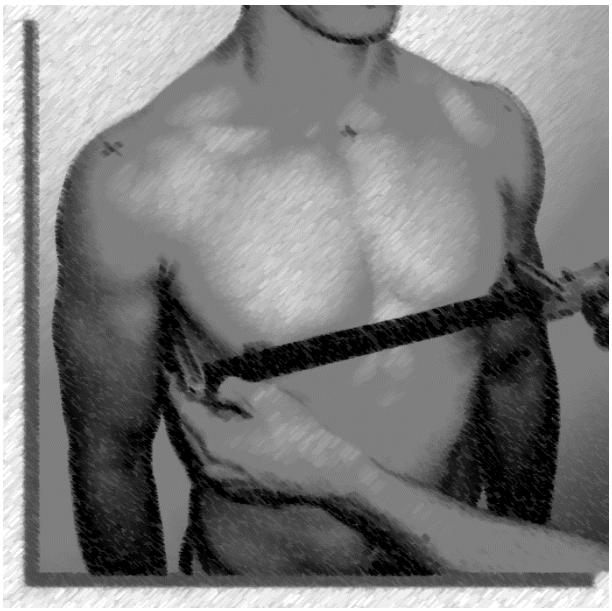
Posture: Anthropometric Sitting.
Definition: The distance between the lateral margins of the upper arms on the deltoid muscles (mm).

FEMALES	STATISTIC	MALES
231	*n*	1090
443	*Mean*	501
1.8	*SE (mean)*	0.9
27	*SD*	29
521	*Maximum*	611
375	*Minimum*	431
0.342	*Skewness*	0.278
-0.210	*Kurtosis*	0.025
6.2%	*Coefficient of variation*	5.8%
	Percentiles	
509	P_{99}	574
506	P_{98}	563
499	P_{97}	557
491	P_{95}	550
480	P_{90}	542
475	P_{85}	532
467	P_{80}	525
461	P_{75}	519
455	P_{70}	515
451	P_{65}	511
449	P_{60}	507
445	P_{55}	503
442	P_{50}	500
439	P_{45}	497
434	P_{40}	493
431	P_{35}	489
427	P_{30}	486
423	P_{25}	481
419	P_{20}	477
414	P_{15}	471
410	P_{10}	464
403	P_5	453
398	P_3	449
395	P_2	446
389	P_1	441

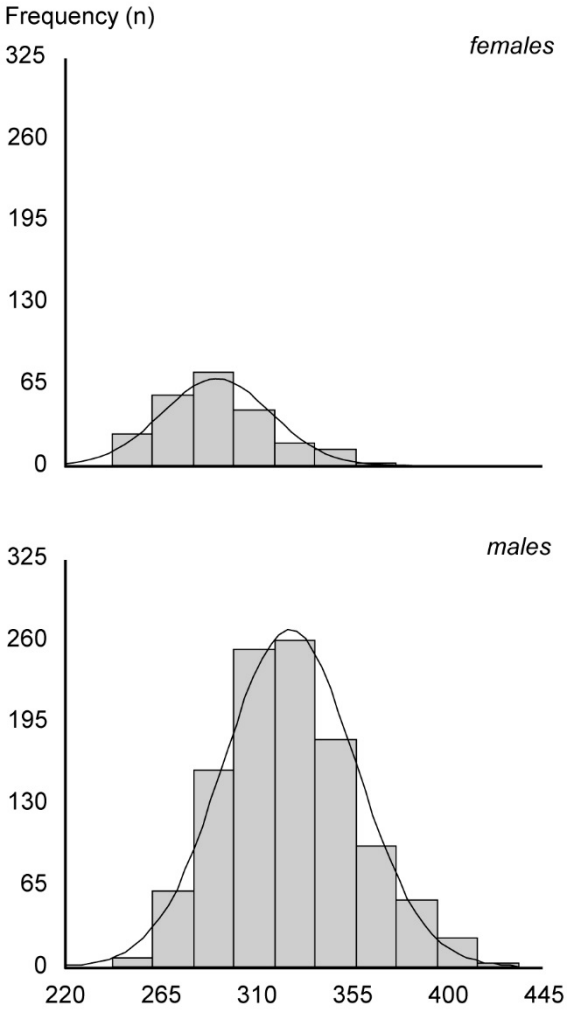


Chest Breadth (M19)
(PECCF data available)

Posture: Anthropometric Standing, with the arms slightly abducted.
Definition: The maximum horizontal breadth at the height of Bustpoint, Right (females) or Thelion, Right (males) (mm).

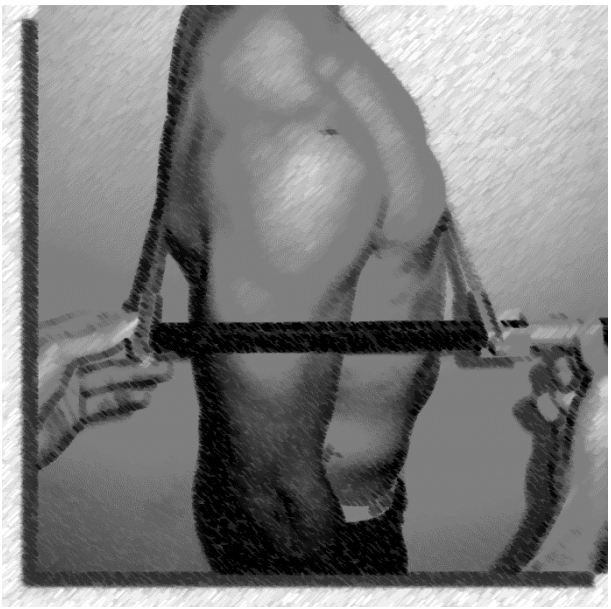


FEMALES	STATISTIC	MALES
232	*n*	1090
291	*Mean*	325
1.7	*SE (mean)*	0.9
26	*SD*	31
373	*Maximum*	433
242	*Minimum*	243
0.605	*Skewness*	0.360
0.162	*Kurtosis*	-0.119
8.8%	*Coefficient of variation*	9.5%
	Percentiles	
356	P_{99}	401
354	P_{98}	397
346	P_{97}	388
341	P_{95}	381
327	P_{90}	367
317	P_{85}	358
309	P_{80}	352
305	P_{75}	345
301	P_{70}	340
298	P_{65}	336
294	P_{60}	332
292	P_{55}	326
289	P_{50}	323
287	P_{45}	320
284	P_{40}	315
281	P_{35}	311
278	P_{30}	306
272	P_{25}	303
267	P_{20}	299
264	P_{15}	293
260	P_{10}	288
254	P_{5}	278
251	P_{3}	273
249	P_{2}	271
247	P_{1}	264

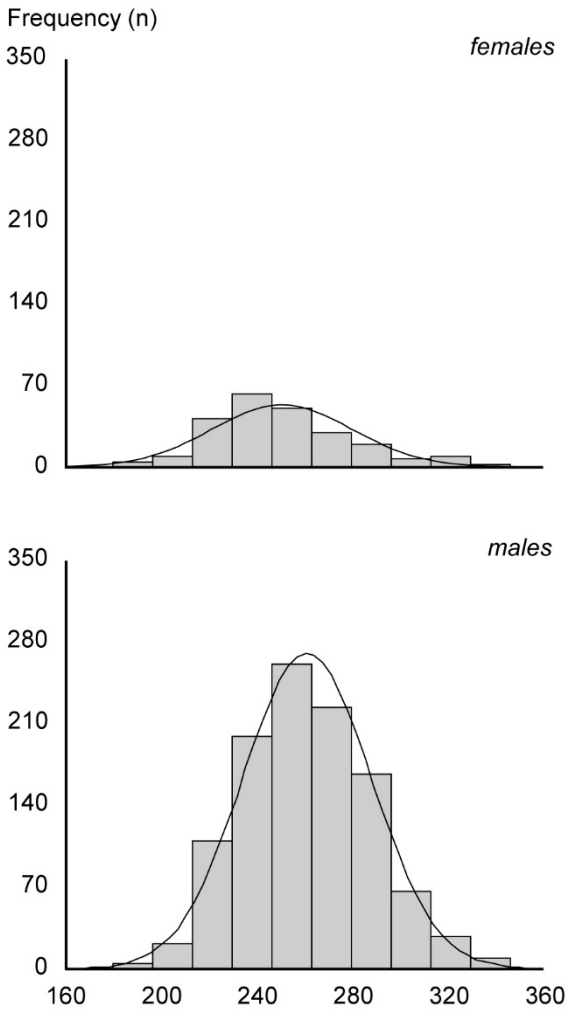


Chest Depth (M20)
(PECCF data available)

Posture: Anthropometric Standing.
Definition: The horizontal distance between the Bustpoint, Right (females) or Thelion, Right (males), and point on the back at the same level (mm).



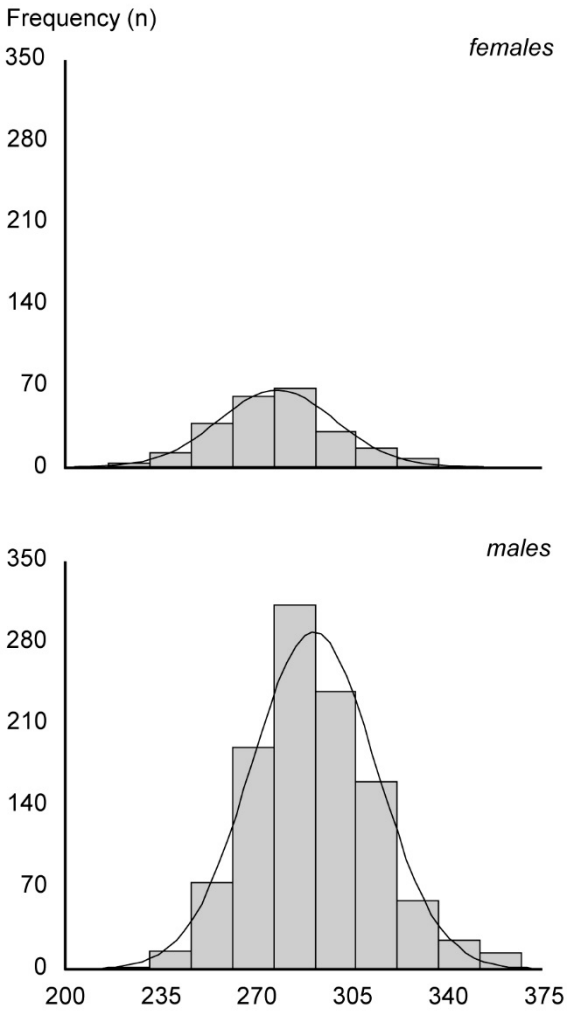
FEMALES	STATISTIC	MALES
232	*n*	1090
250	*Mean*	261
1.9	*SE (mean)*	0.8
29	*SD*	27
335	*Maximum*	346
180	*Minimum*	182
0.650	*Skewness*	0.225
0.326	*Kurtosis*	-0.129
11.7%	*Coefficient of variation*	10.3%
	Percentiles	
325	P_{99}	328
322	P_{98}	318
317	P_{97}	314
311	P_{95}	306
288	P_{90}	296
281	P_{85}	289
272	P_{80}	283
266	P_{75}	279
261	P_{70}	275
256	P_{65}	270
253	P_{60}	267
249	P_{55}	263
246	P_{50}	260
242	P_{45}	256
239	P_{40}	252
236	P_{35}	249
234	P_{30}	246
231	P_{25}	242
226	P_{20}	237
222	P_{15}	232
218	P_{10}	226
211	P_5	219
206	P_3	214
203	P_2	212
193	P_1	207



Bicristale Breadth (M21)

Posture: Anthropometric Standing, with the arms placed across the chest.
Definition: The distance between the most lateral points on the right and left iliac crests, immediately below the Iliocristale landmarks (mm).

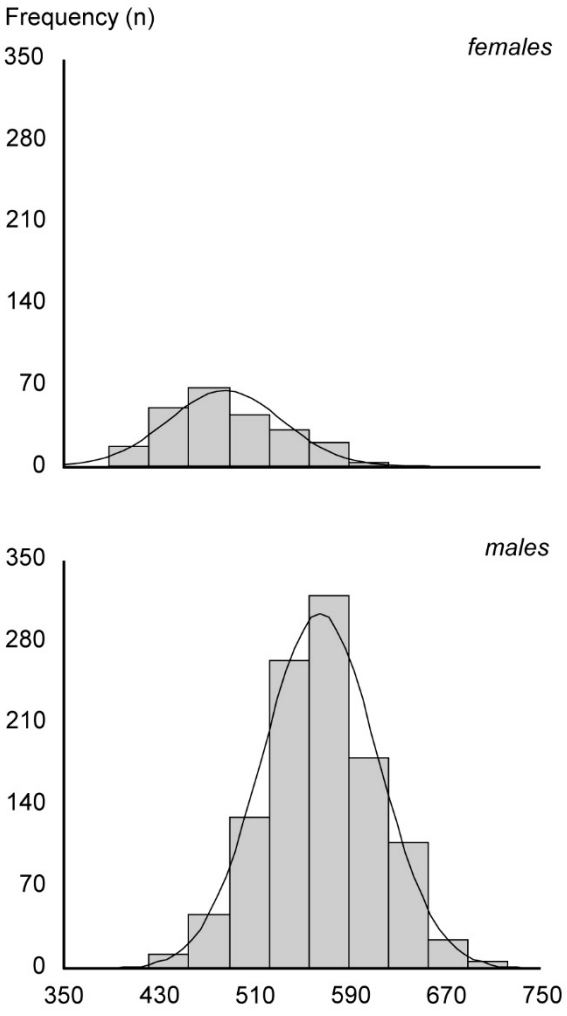
FEMALES	STATISTIC	MALES
232	*n*	1088
278	*Mean*	291
1.4	*SE (mean)*	0.7
21	*SD*	23
335	*Maximum*	367
216	*Minimum*	231
0.140	*Skewness*	0.361
0.130	*Kurtosis*	0.267
7.7%	*Coefficient of variation*	7.8%
	Percentiles	
329	P_{99}	353
324	P_{98}	345
320	P_{97}	339
315	P_{95}	331
306	P_{90}	321
299	P_{85}	314
294	P_{80}	309
290	P_{75}	305
287	P_{70}	301
285	P_{65}	298
282	P_{60}	295
279	P_{55}	292
277	P_{50}	289
275	P_{45}	286
271	P_{40}	284
269	P_{35}	282
268	P_{30}	279
264	P_{25}	276
260	P_{20}	272
256	P_{15}	269
252	P_{10}	264
244	P_{5}	256
238	P_{3}	252
235	P_{2}	249
231	P_{1}	242



Forearm-Forearm Breadth (M22)
(PECCF data available)

Posture: Anthropometric Sitting.
Definition: The maximum horizontal distance between the most lateral points on the right and lateral left forearms (mm).

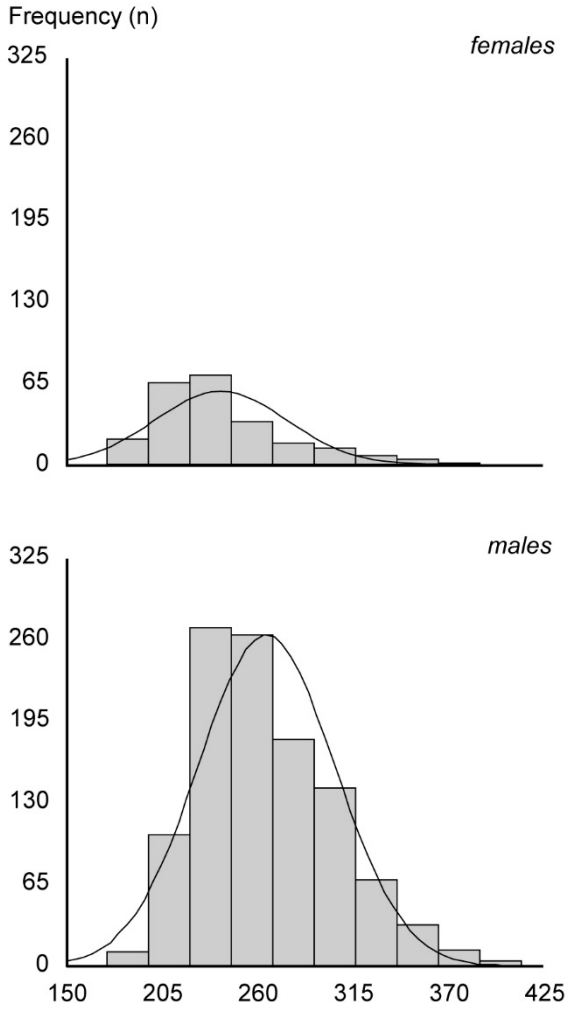
FEMALES	STATISTIC	MALES
232	*n*	1090
485	*Mean*	564
3.1	*SE (mean)*	1.4
48	*SD*	48
621	*Maximum*	722
388	*Minimum*	424
0.315	*Skewness*	0.048
-0.375	*Kurtosis*	0.061
9.9%	*Coefficient of variation*	8.5%
	Percentiles	
593	P_{99}	674
580	P_{98}	667
576	P_{97}	653
567	P_{95}	641
554	P_{90}	627
540	P_{85}	616
528	P_{80}	605
519	P_{75}	597
512	P_{70}	588
501	P_{65}	581
493	P_{60}	574
486	P_{55}	569
480	P_{50}	564
472	P_{45}	558
467	P_{40}	552
464	P_{35}	547
457	P_{30}	539
448	P_{25}	532
443	P_{20}	526
438	P_{15}	516
428	P_{10}	505
411	P_{5}	485
404	P_{3}	472
396	P_{2}	461
391	P_{1}	452



Abdominal Extension Depth, Sitting (M23)
(PECCF data available)

Posture: Anthropometric Sitting with the right hand on the chest.
Definition: The horizontal distance between the Abdominal Point, Anterior, and point on the back at the same level (mm).

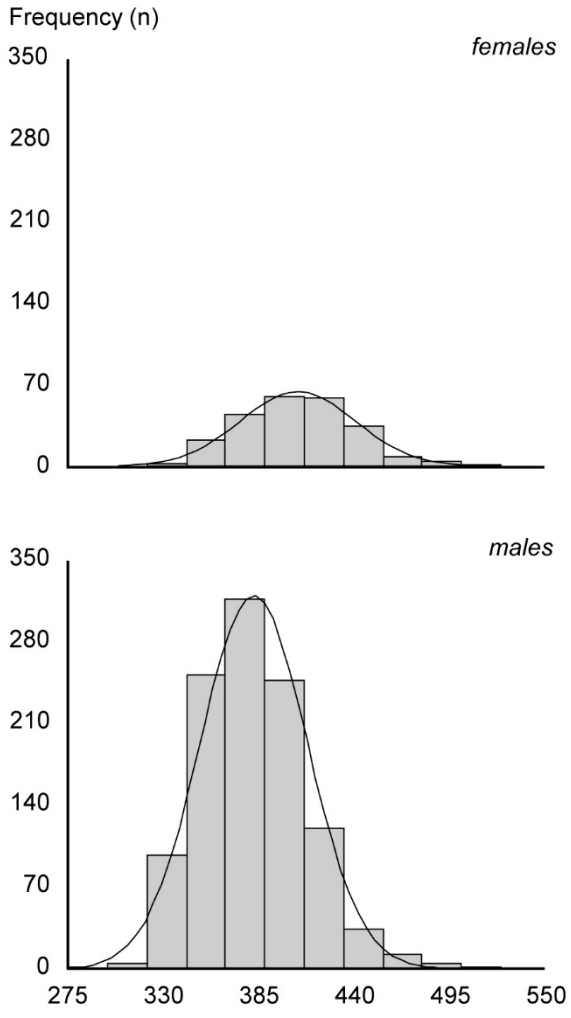
FEMALES	STATISTIC	MALES
232	*n*	1090
238	*Mean*	265
2.5	*SE (mean)*	1.2
38	*SD*	39
378	*Maximum*	411
173	*Minimum*	180
1.109	*Skewness*	0.633
1.096	*Kurtosis*	0.073
15.9%	*Coefficient of variation*	14.9%
	Percentiles	
348	P_{99}	367
340	P_{98}	356
331	P_{97}	346
317	P_{95}	339
293	P_{90}	319
278	P_{85}	307
264	P_{80}	298
255	P_{75}	290
250	P_{70}	283
243	P_{65}	275
239	P_{60}	269
236	P_{55}	264
231	P_{50}	258
224	P_{45}	253
222	P_{40}	248
220	P_{35}	244
214	P_{30}	240
210	P_{25}	235
207	P_{20}	231
202	P_{15}	225
197	P_{10}	220
195	P_5	210
191	P_3	206
187	P_2	202
186	P_1	197



Hip Breadth, Sitting (M24)
(PECCF and secular trend data available)

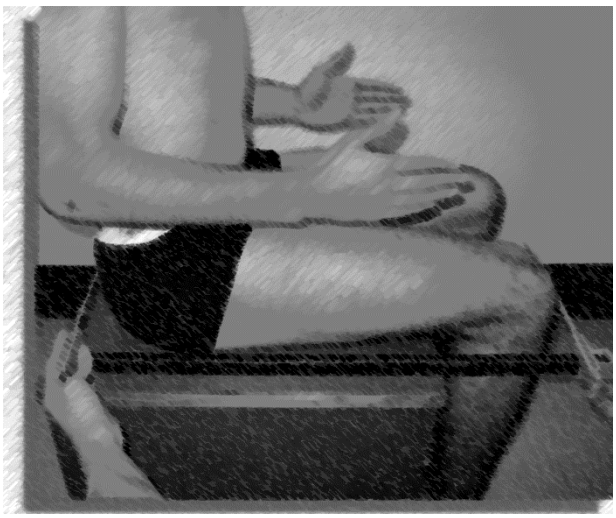
Posture: Anthropometric Sitting, with feet and knees together.
Definition: The maximum breadth of the seated subject at the hip or thigh, whichever is larger (mm).

FEMALES	STATISTIC	MALES
232	*n*	1089
407	*Mean*	382
2.2	*SE (mean)*	0.9
33	*SD*	31
515	*Maximum*	524
324	*Minimum*	298
0.334	*Skewness*	0.585
0.100	*Kurtosis*	0.790
8.1%	*Coefficient of variation*	8.1%
	Percentiles	
496	P_{99}	471
482	P_{98}	452
470	P_{97}	445
460	P_{95}	433
449	P_{90}	422
442	P_{85}	413
435	P_{80}	406
427	P_{75}	402
423	P_{70}	397
420	P_{65}	392
416	P_{60}	388
411	P_{55}	385
405	P_{50}	380
401	P_{45}	376
397	P_{40}	372
394	P_{35}	368
389	P_{30}	363
383	P_{25}	360
377	P_{20}	355
372	P_{15}	350
366	P_{10}	344
358	P_{5}	336
352	P_{3}	332
349	P_{2}	328
346	P_{1}	325

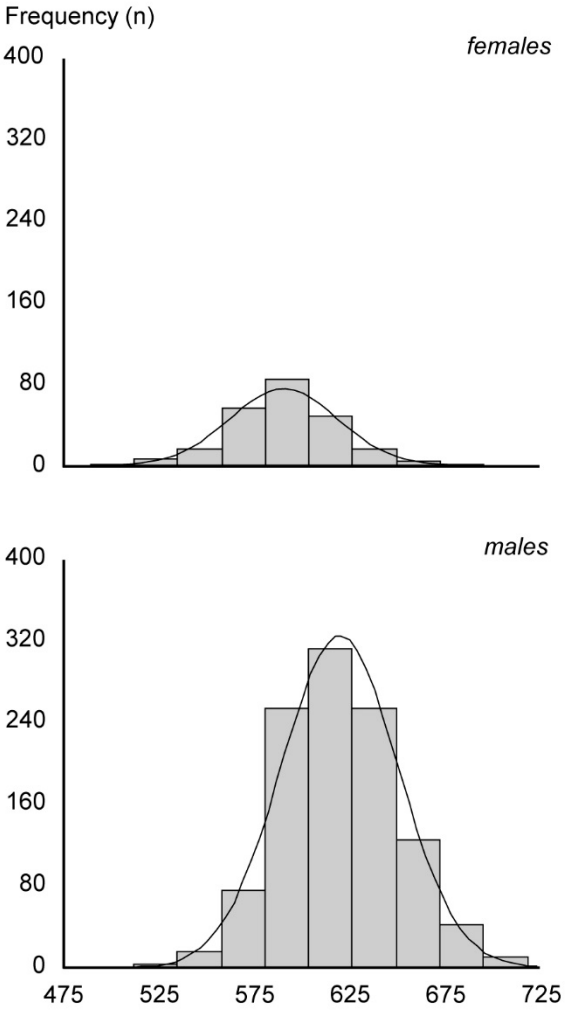


Buttock-Knee Length (M25)
(PECCF data available)

Posture: Anthropometric Sitting.
Definition: The horizontal distance between Buttock Point, Posterior and the Knee Point, Anterior (mm).



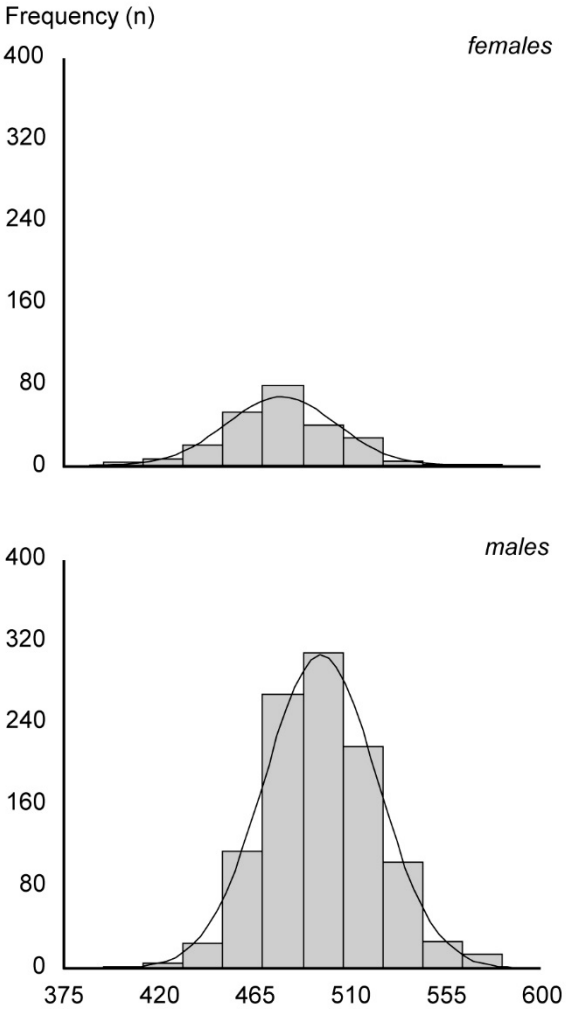
FEMALES	STATISTIC	MALES
232	*n*	1090
590	*Mean*	620
1.9	*SE (mean)*	0.9
28	*SD*	31
675	*Maximum*	718
489	*Minimum*	530
0.057	*Skewness*	0.200
0.658	*Kurtosis*	0.043
4.8%	*Coefficient of variation*	5.0%
	Percentiles	
659	P_{99}	693
650	P_{98}	685
646	P_{97}	682
642	P_{95}	672
625	P_{90}	660
618	P_{85}	652
613	P_{80}	645
606	P_{75}	640
603	P_{70}	635
599	P_{65}	631
595	P_{60}	626
593	P_{55}	622
588	P_{50}	618
585	P_{45}	614
583	P_{40}	610
581	P_{35}	606
578	P_{30}	602
574	P_{25}	598
568	P_{20}	593
563	P_{15}	589
558	P_{10}	583
545	P_5	574
535	P_3	567
531	P_2	559
526	P_1	548



Buttock-Popliteal Length (M26)

Posture: Anthropometric Sitting.
Definition: The horizontal distance between Buttock Point, Posterior and the Dorsal Juncture of Calf and Thigh (mm).

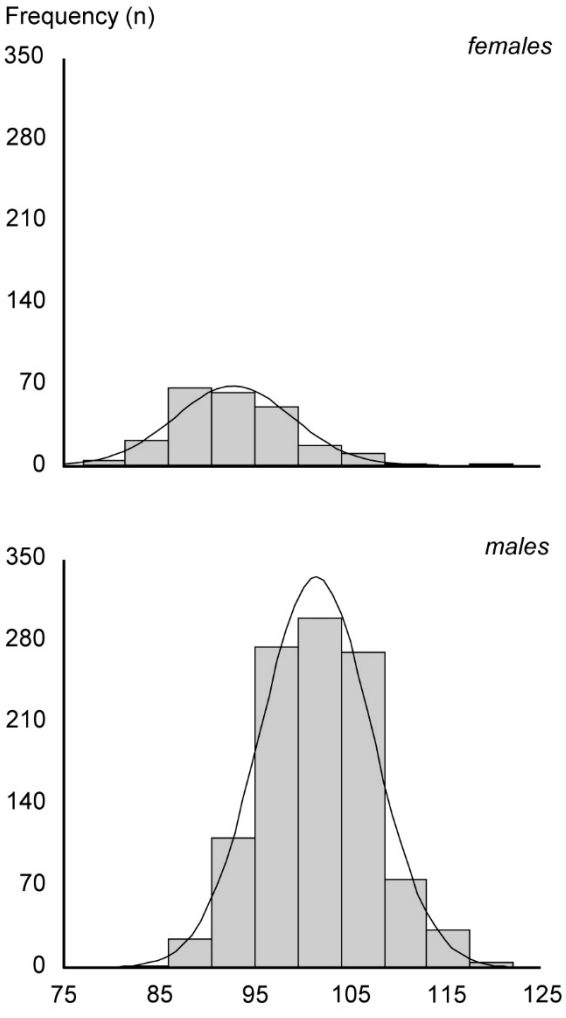
FEMALES	STATISTIC	MALES
231	*n*	1083
480	*Mean*	499
1.7	*SE (mean)*	0.8
26	*SD*	27
569	*Maximum*	586
394	*Minimum*	405
0.038	*Skewness*	0.210
0.747	*Kurtosis*	0.299
5.5%	*Coefficient of variation*	5.4%
	Percentiles	
540	P_{99}	572
533	P_{98}	561
526	P_{97}	552
523	P_{95}	544
514	P_{90}	534
508	P_{85}	526
501	P_{80}	520
495	P_{75}	516
490	P_{70}	512
487	P_{65}	508
485	P_{60}	505
481	P_{55}	501
479	P_{50}	497
476	P_{45}	494
474	P_{40}	491
471	P_{35}	488
466	P_{30}	484
463	P_{25}	480
460	P_{20}	476
454	P_{15}	472
450	P_{10}	466
437	P_5	456
427	P_3	451
423	P_2	446
412	P_1	438



Foot Breadth, Horizontal (M27)
(PECCF and secular trend data available)

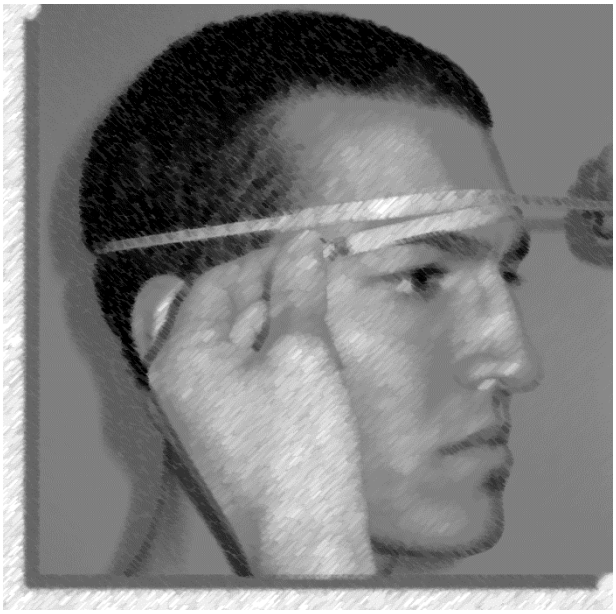
Posture: Anthropometric Standing.
Definition: The maximum horizontal distance between the First Metatarsophalangeal Protrusion and the Fifth Metatarsophalangeal Protrusion (mm).

FEMALES	STATISTIC	MALES
232	*n*	1090
93	*Mean*	101
0.4	*SE (mean)*	0.2
6	*SD*	6
121	*Maximum*	122
77	*Minimum*	84
0.533	*Skewness*	0.137
1.343	*Kurtosis*	-0.103
6.6%	*Coefficient of variation*	5.8%
	Percentiles	
107	P_{99}	116
105	P_{98}	114
105	P_{97}	113
103	P_{95}	111
101	P_{90}	109
99	P_{85}	107
98	P_{80}	106
97	P_{75}	105
96	P_{70}	105
95	P_{65}	104
94	P_{60}	103
93	P_{55}	102
92	P_{50}	101
92	P_{45}	101
91	P_{40}	100
90	P_{35}	99
89	P_{30}	98
89	P_{25}	97
88	P_{20}	96
87	P_{15}	95
85	P_{10}	94
84	P_{5}	92
83	P_{3}	91
82	P_{2}	90
80	P_{1}	89

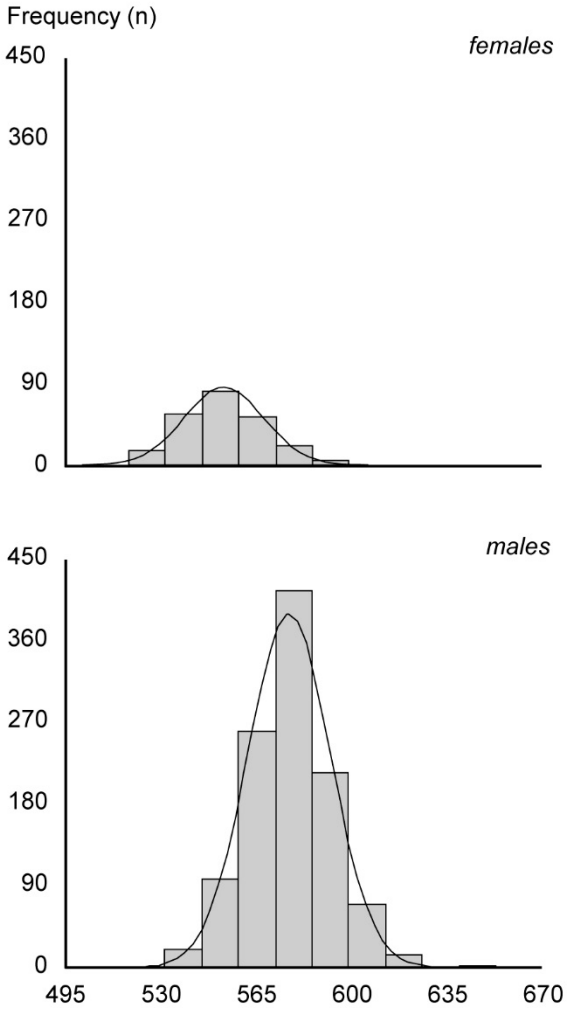


Head Circumference (M28)
(PECCF and secular trend data available)

Posture: Anthropometric Sitting with the head in the Frankfort plane.
Definition: The maximum horizontal circumference above the supraorbital ridges and ears, at the level of Glabella (mm).



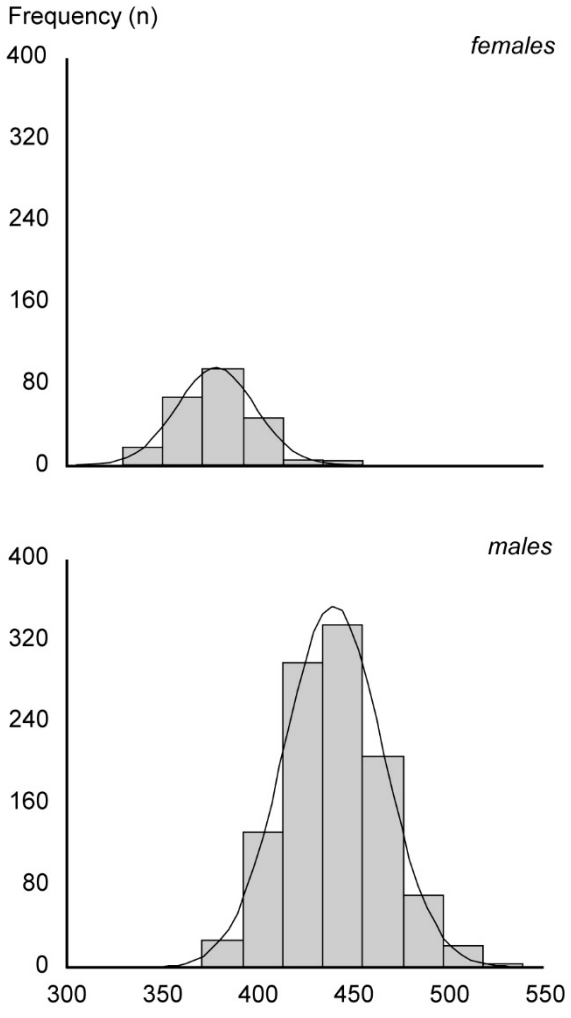
FEMALES	STATISTIC	MALES
232	*n*	1090
553	*Mean*	577
1.0	*SE (mean)*	0.5
15	*SD*	15
591	*Maximum*	653
518	*Minimum*	533
0.270	*Skewness*	0.111
-0.322	*Kurtosis*	0.457
2.6%	*Coefficient of variation*	2.6%
	Percentiles	
589	P_{99}	615
586	P_{98}	608
580	P_{97}	604
577	P_{95}	601
574	P_{90}	596
568	P_{85}	593
566	P_{80}	590
564	P_{75}	587
561	P_{70}	584
558	P_{65}	582
556	P_{60}	580
554	P_{55}	579
551	P_{50}	577
549	P_{45}	575
547	P_{40}	574
546	P_{35}	572
544	P_{30}	570
544	P_{25}	567
541	P_{20}	565
539	P_{15}	562
534	P_{10}	558
531	P_{5}	552
528	P_{3}	548
527	P_{2}	545
524	P_{1}	542



Neck Circumference, Base (M29)

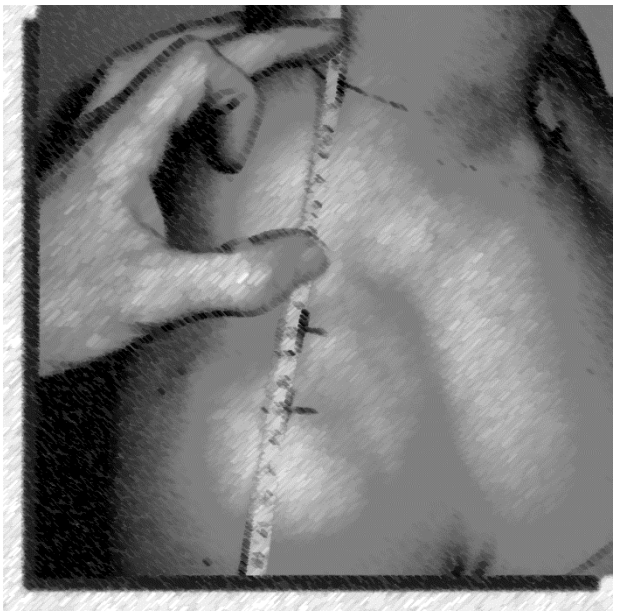
Posture: Anthropometric Standing with the head in the Frankfort plane.
Definition: The circumference at the base of the neck (mm).

FEMALES	STATISTIC	MALES
232	*n*	1090
378	*Mean*	440
1.3	*SE (mean)*	0.8
20	*SD*	26
448	*Maximum*	539
329	*Minimum*	375
0.496	*Skewness*	0.278
0.548	*Kurtosis*	0.119
5.4%	*Coefficient of variation*	5.9%
	Percentiles	
440	P_{99}	504
426	P_{98}	498
419	P_{97}	491
411	P_{95}	485
403	P_{90}	472
399	P_{85}	465
395	P_{80}	460
390	P_{75}	456
386	P_{70}	452
385	P_{65}	448
384	P_{60}	445
379	P_{55}	442
377	P_{50}	439
374	P_{45}	435
372	P_{40}	432
370	P_{35}	430
367	P_{30}	425
364	P_{25}	421
360	P_{20}	417
356	P_{15}	413
351	P_{10}	408
347	P_{5}	398
343	P_{3}	393
342	P_{2}	390
341	P_{1}	384

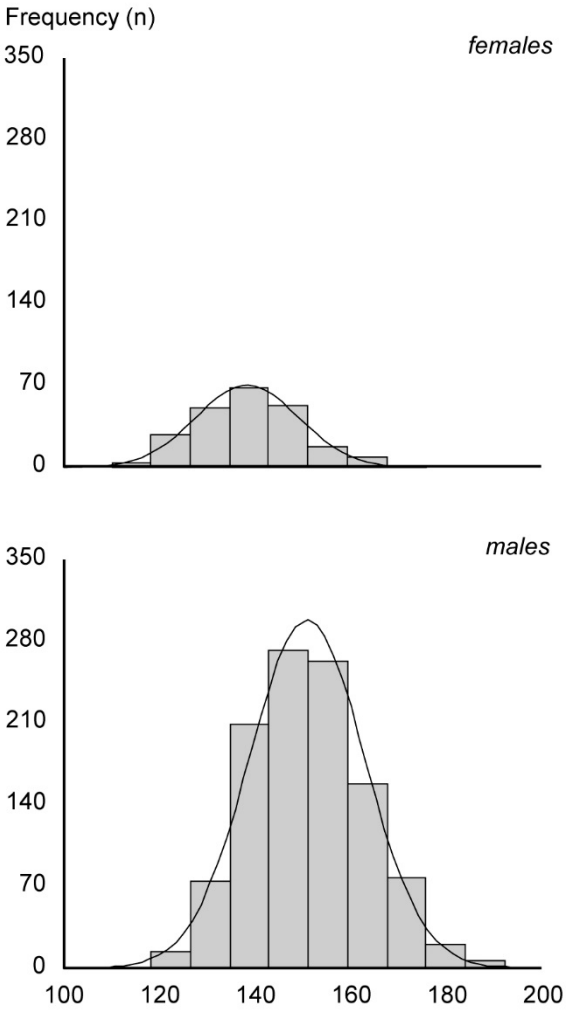


Shoulder Length (M30)

Posture: Anthropometric Standing.
Definition: The surface distance between the Trapezius Point, Right and the Acromion, Right (mm).



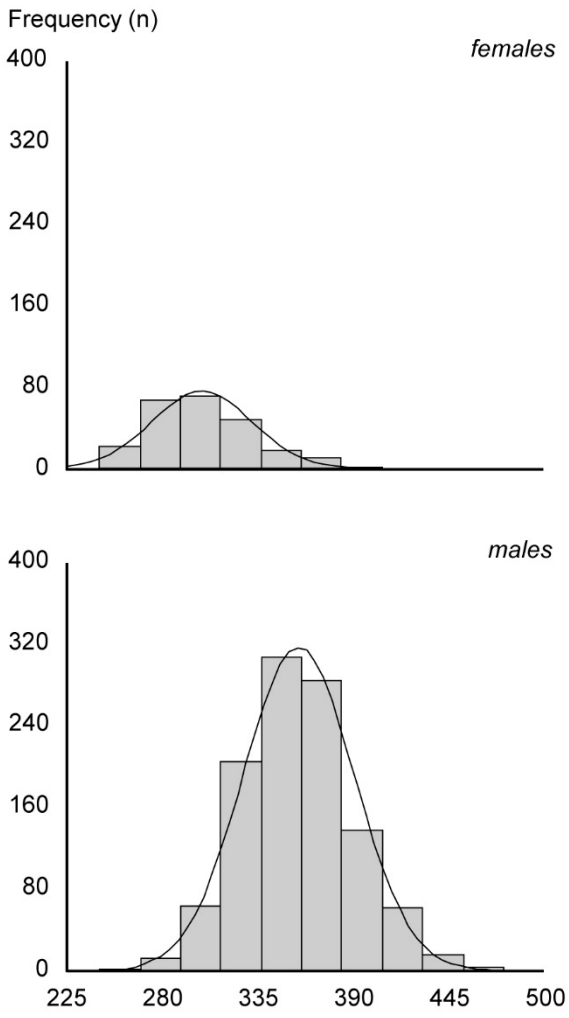
FEMALES	STATISTIC	MALES
232	*n*	1090
138	*Mean*	151
0.7	*SE (mean)*	0.4
11	*SD*	12
173	*Maximum*	192
110	*Minimum*	119
0.177	*Skewness*	0.227
0.083	*Kurtosis*	-0.103
7.8%	*Coefficient of variation*	8.0%
	Percentiles	
163	P_{99}	180
162	P_{98}	176
161	P_{97}	174
156	P_{95}	172
151	P_{90}	167
149	P_{85}	164
147	P_{80}	161
145	P_{75}	159
144	P_{70}	157
142	P_{65}	155
141	P_{60}	153
139	P_{55}	152
138	P_{50}	150
137	P_{45}	149
135	P_{40}	147
134	P_{35}	145
133	P_{30}	144
131	P_{25}	142
129	P_{20}	140
127	P_{15}	139
125	P_{10}	136
122	P_5	132
120	P_3	130
119	P_2	128
114	P_1	125



Biceps Circumference, Flexed (M31)

Posture: Anthropometric Standing with the right shoulder and elbow flexed at 90°.
Definition: The circumference of the upper arm at the height of the Biceps Point (mm).

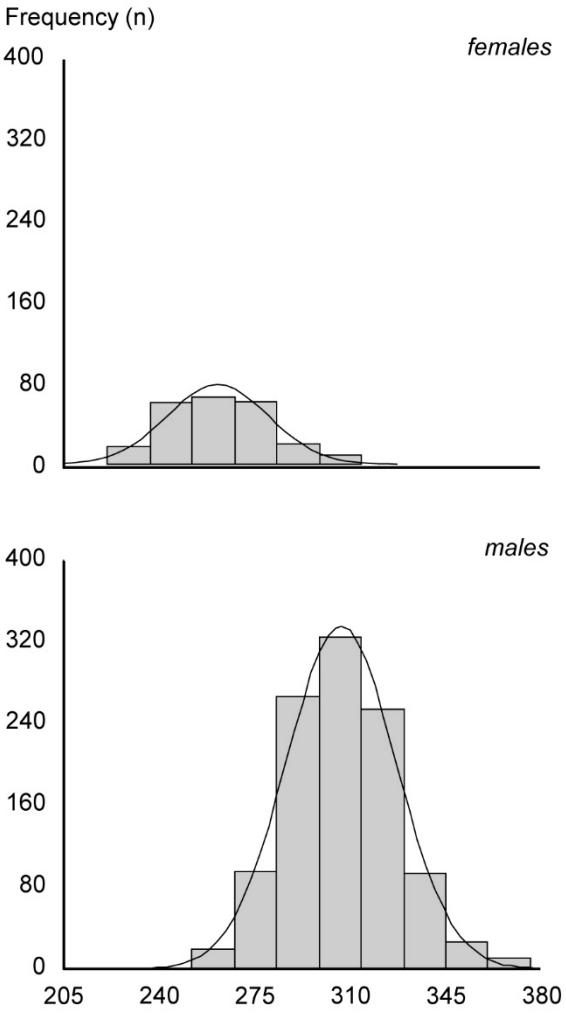
FEMALES	STATISTIC	MALES
232	*n*	1090
303	*Mean*	358
1.9	*SE (mean)*	1.0
29	*SD*	32
384	*Maximum*	476
244	*Minimum*	256
0.497	*Skewness*	0.259
-0.053	*Kurtosis*	0.200
9.4%	*Coefficient of variation*	8.9%
	Percentiles	
376	P_{99}	444
371	P_{98}	427
367	P_{97}	418
357	P_{95}	412
342	P_{90}	400
330	P_{85}	391
325	P_{80}	384
321	P_{75}	379
317	P_{70}	375
310	P_{65}	370
308	P_{60}	365
304	P_{55}	361
301	P_{50}	356
296	P_{45}	353
293	P_{40}	349
289	P_{35}	345
285	P_{30}	341
282	P_{25}	335
278	P_{20}	330
275	P_{15}	326
268	P_{10}	319
261	P_5	308
259	P_3	302
254	P_2	298
249	P_1	288



Forearm Circumference, Flexed (M32)

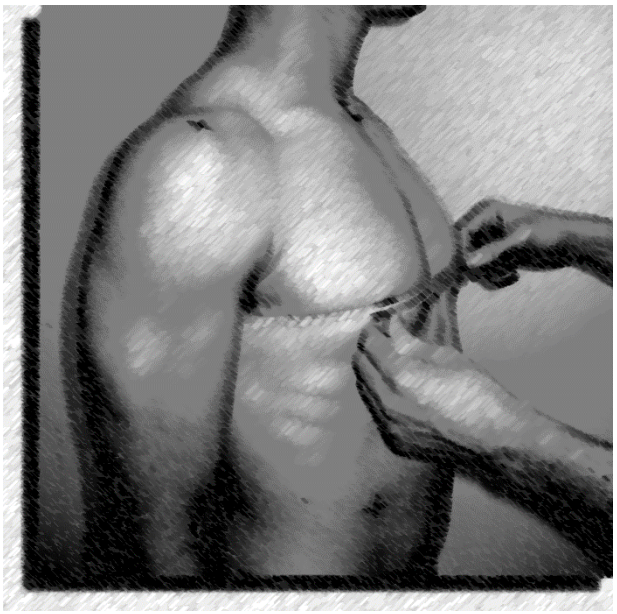
Posture: Anthropometric Standing with the right elbow flexed at 90°.
Definition: The circumference of the forearm at the Elbow Crease (mm).

FEMALES	STATISTIC	MALES
232	*n*	1089
261	*Mean*	307
1.2	*SE (mean)*	0.6
19	*SD*	20
311	*Maximum*	376
221	*Minimum*	254
0.372	*Skewness*	0.246
-0.246	*Kurtosis*	0.253
7.1%	*Coefficient of variation*	6.6%
	Percentiles	
308	P_{99}	360
303	P_{98}	350
299	P_{97}	346
295	P_{95}	340
285	P_{90}	332
281	P_{85}	326
275	P_{80}	323
274	P_{75}	321
271	P_{70}	316
269	P_{65}	314
265	P_{60}	311
263	P_{55}	308
259	P_{50}	306
255	P_{45}	303
254	P_{40}	301
252	P_{35}	298
251	P_{30}	296
249	P_{25}	293
246	P_{20}	290
243	P_{15}	286
239	P_{10}	282
233	P_{5}	274
231	P_{3}	270
230	P_{2}	268
227	P_{1}	262

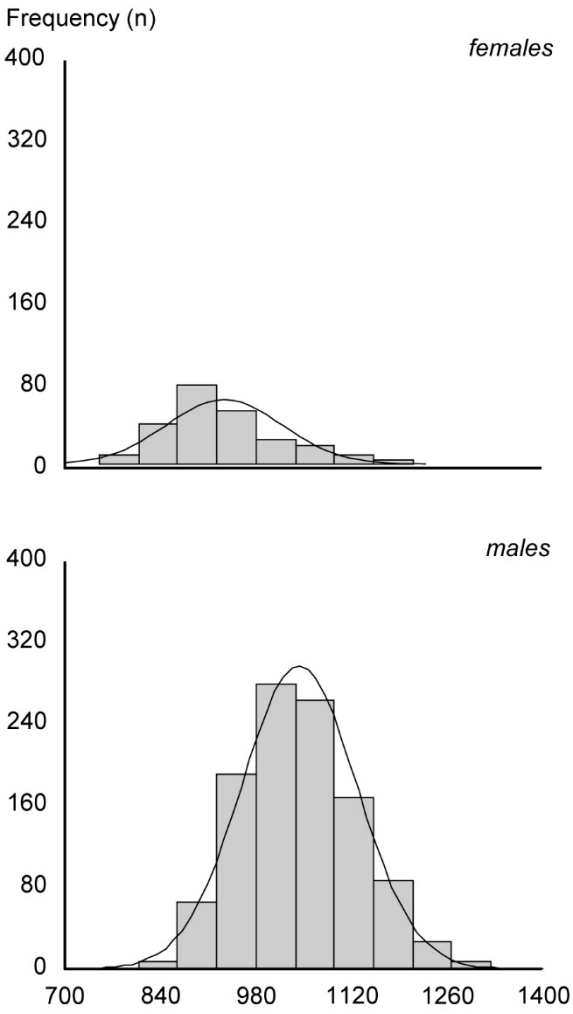


Chest Circumference (M33)
(PECCF data available)

Posture: Anthropometric Standing.
Definition: The circumference of the chest at the height of the Bustpoint, Right (females) or Thelion, Right (males) (mm).



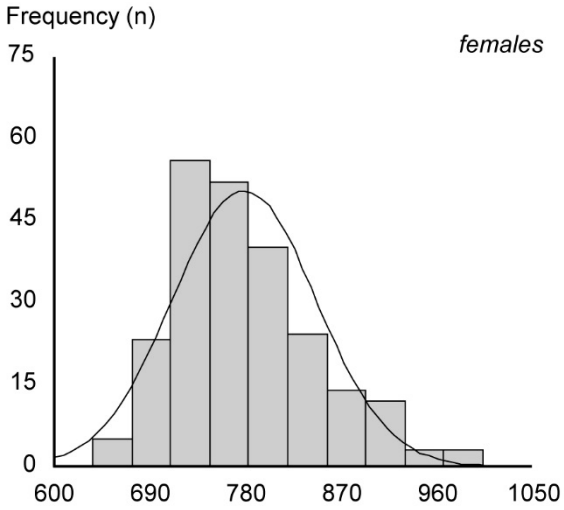
FEMALES	STATISTIC	MALES
232	*n*	1090
933	*Mean*	1043
5.5	*SE (mean)*	2.6
85	*SD*	84
1179	*Maximum*	1324
750	*Minimum*	818
0.728	*Skewness*	0.258
0.260	*Kurtosis*	-0.206
9.1%	*Coefficient of variation*	8.1%
	Percentiles	
1160	P_{99}	1251
1144	P_{98}	1223
1131	P_{97}	1212
1100	P_{95}	1190
1051	P_{90}	1155
1025	P_{85}	1134
1000	P_{80}	1112
973	P_{75}	1098
963	P_{70}	1085
948	P_{65}	1074
936	P_{60}	1062
926	P_{55}	1050
919	P_{50}	1037
909	P_{45}	1027
899	P_{40}	1015
892	P_{35}	1004
884	P_{30}	993
874	P_{25}	982
864	P_{20}	971
856	P_{15}	955
838	P_{10}	936
818	P_5	912
804	P_3	896
796	P_2	885
787	P_1	872



Chest Circumference Below Breast (M34)

Posture: Anthropometric Standing.
Definition: The circumference of the chest at the height of the Inferior Breastpoint (females only) (mm).

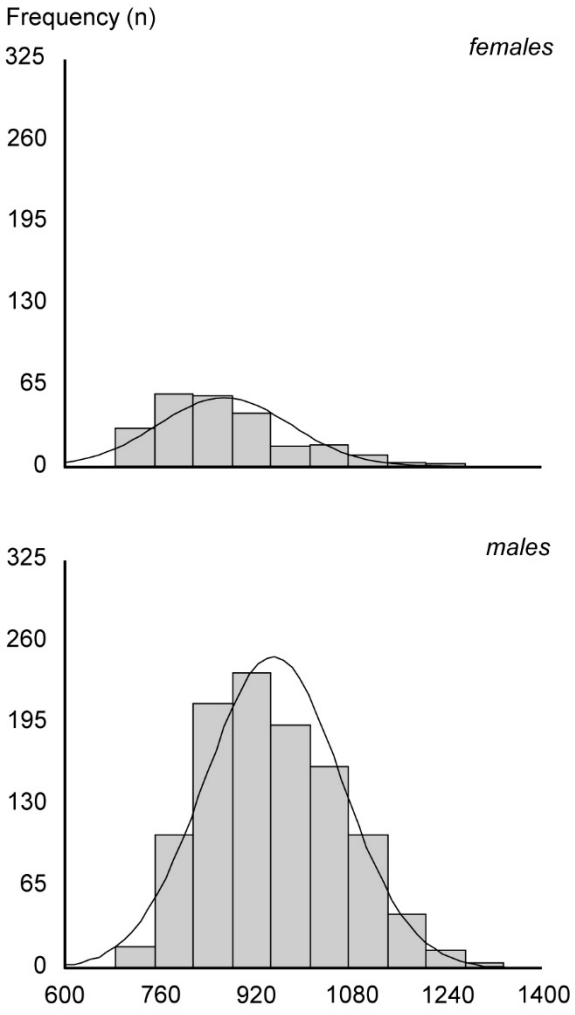
FEMALES	STATISTIC	MALES
232	*n*	NA
778	*Mean*	NA
4.4	*SE (mean)*	NA
67	*SD*	NA
1002	*Maximum*	NA
636	*Minimum*	NA
0.785	*Skewness*	N/A
0.556	*Kurtosis*	N/A
8.7%	*Coefficient of variation*	N/A
	Percentiles	
974	P_{99}	NA
934	P_{98}	NA
927	P_{97}	NA
912	P_{95}	NA
872	P_{90}	NA
845	P_{85}	NA
823	P_{80}	NA
813	P_{75}	NA
802	P_{70}	NA
792	P_{65}	NA
784	P_{60}	NA
777	P_{55}	NA
770	P_{50}	NA
760	P_{45}	NA
753	P_{40}	NA
744	P_{35}	NA
737	P_{30}	NA
731	P_{25}	NA
723	P_{20}	NA
715	P_{15}	NA
702	P_{10}	NA
687	P_5	NA
678	P_3	NA
673	P_2	NA
658	P_1	NA



Waist Circumference (Omphalion) (M35)
(PECCF and secular trend data available)

Posture: Anthropometric Standing.
Definition: The horizontal circumference of the torso at the height of the Waist Omphalion, Anterior (mm).

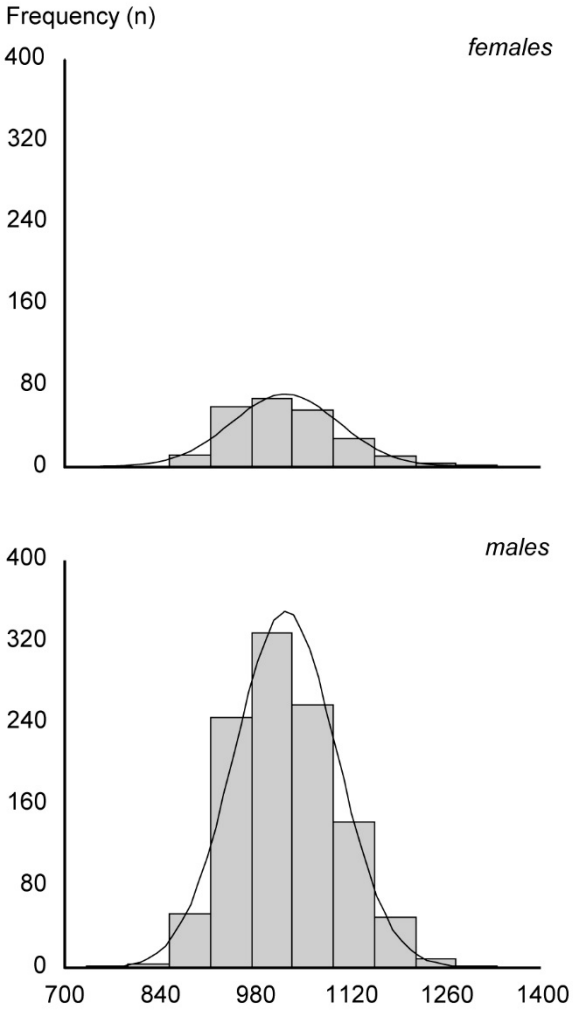
FEMALES	STATISTIC	MALES
232	*n*	1090
867	*Mean*	949
7.3	*SE (mean)*	3.5
111	*SD*	114
1254	*Maximum*	1335
685	*Minimum*	689
0.891	*Skewness*	0.404
0.632	*Kurtosis*	-0.328
12.8%	*Coefficient of variation*	12.0%
	Percentiles	
1176	P_{99}	1215
1141	P_{98}	1198
1123	P_{97}	1178
1086	P_{95}	1152
1026	P_{90}	1106
991	P_{85}	1076
945	P_{80}	1048
916	P_{75}	1030
903	P_{70}	1010
890	P_{65}	988
876	P_{60}	969
859	P_{55}	952
850	P_{50}	939
835	P_{45}	919
820	P_{40}	907
811	P_{35}	892
803	P_{30}	877
789	P_{25}	862
774	P_{20}	845
764	P_{15}	827
738	P_{10}	805
721	P_5	786
710	P_3	770
700	P_2	763
696	P_1	736



Buttock Circumference (M36)
(PECCF data available)

Posture: Anthropometric Standing.
Definition: The horizontal circumference of the torso at height of the Buttock Point, Posterior (mm).

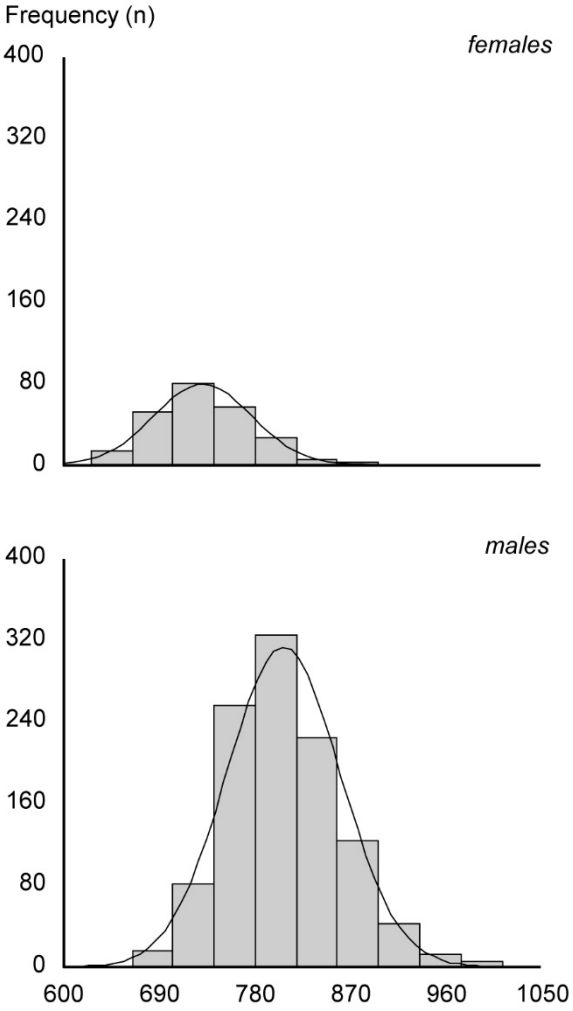
FEMALES	STATISTIC	MALES
231	*n*	1090
1023	*Mean*	1024
5.2	*SE (mean)*	2.3
79	*SD*	75
1334	*Maximum*	1292
878	*Minimum*	733
0.602	*Skewness*	0.287
0.391	*Kurtosis*	0.082
7.7%	*Coefficient of variation*	7.3%
	Percentiles	
1221	P_{99}	1208
1195	P_{98}	1185
1177	P_{97}	1172
1160	P_{95}	1155
1132	P_{90}	1120
1103	P_{85}	1102
1089	P_{80}	1089
1068	P_{75}	1074
1063	P_{70}	1063
1050	P_{65}	1049
1038	P_{60}	1038
1026	P_{55}	1029
1020	P_{50}	1021
1008	P_{45}	1008
999	P_{40}	1000
983	P_{35}	988
974	P_{30}	979
961	P_{25}	968
948	P_{20}	956
938	P_{15}	947
926	P_{10}	933
914	P_5	912
911	P_3	900
901	P_2	889
891	P_1	872



Thumbtip Reach (M37)

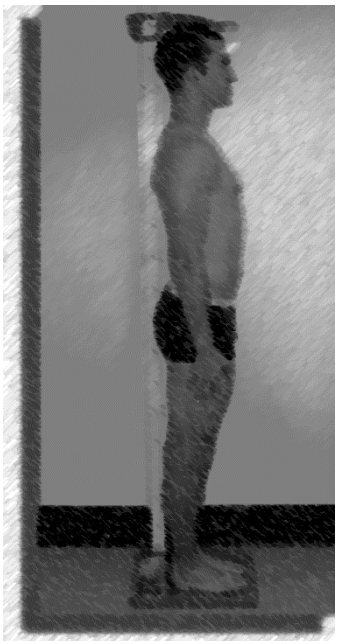
Posture: Anthropometric Standing.
Definition: The horizontal distance between the wall and the Thumbtip (mm).

FEMALES	STATISTIC	MALES
232	*n*	1084
730	*Mean*	806
3.0	*SE (mean)*	1.6
46	*SD*	54
865	*Maximum*	1012
625	*Minimum*	675
0.315	*Skewness*	0.461
-0.089	*Kurtosis*	0.347
6.3%	*Coefficient of variation*	6.6%
	Percentiles	
848	P_{99}	948
831	P_{98}	930
816	P_{97}	919
805	P_{95}	900
790	P_{90}	877
778	P_{85}	865
767	P_{80}	850
761	P_{75}	840
755	P_{70}	828
745	P_{65}	821
737	P_{60}	815
733	P_{55}	807
725	P_{50}	801
723	P_{45}	795
715	P_{40}	789
710	P_{35}	783
705	P_{30}	775
697	P_{25}	770
695	P_{20}	765
682	P_{15}	755
675	P_{10}	745
660	P_{5}	725
655	P_{3}	715
652	P_{2}	710
635	P_{1}	695

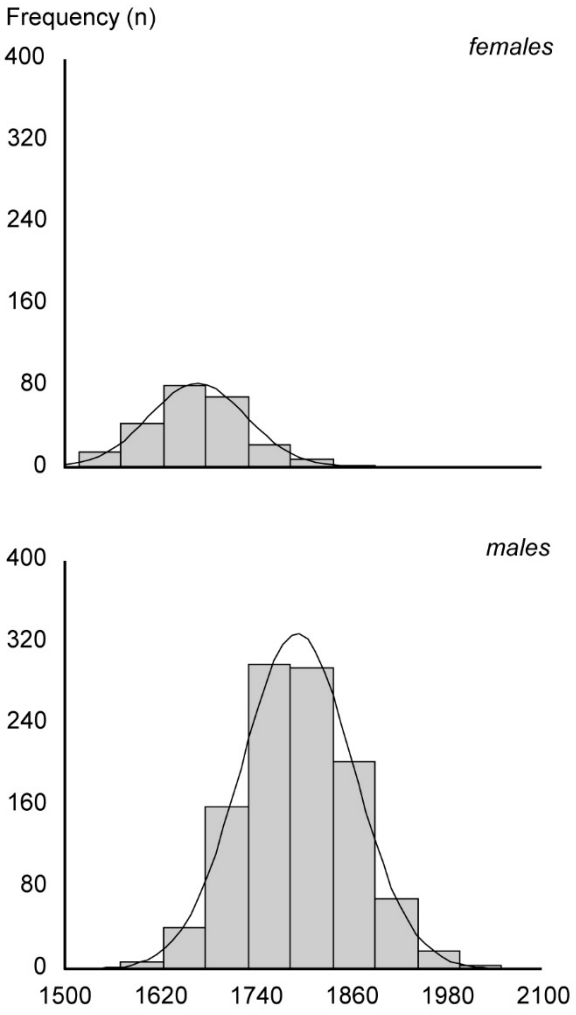


Stature (M38)
(PECCF and secular trend data available)

Posture: Anthropometric Standing with the head in the Frankfort plane.
Definition: The vertical distance between the standing surface and the Top of the Head landmark (mm).



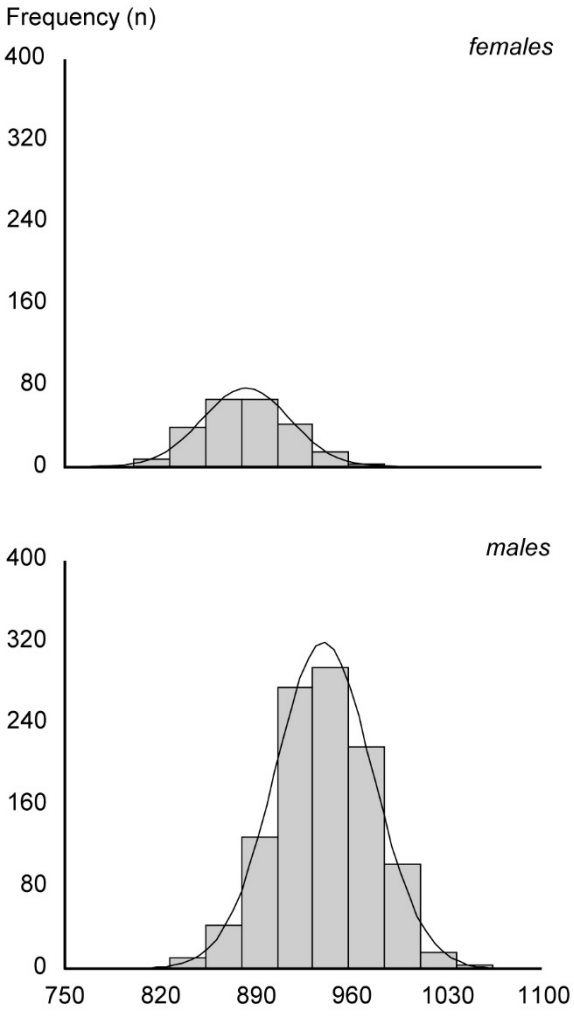
FEMALES	STATISTIC	MALES
232	*n*	1088
1667	*Mean*	1792
4.0	*SE (mean)*	2.1
61	*SD*	70
1875	*Maximum*	2049
1518	*Minimum*	1581
0.270	*Skewness*	0.102
0.160	*Kurtosis*	0.019
3.6%	*Coefficient of variation*	3.9%
	Percentiles	
1814	P_{99}	1958
1802	P_{98}	1940
1793	P_{97}	1925
1772	P_{95}	1906
1736	P_{90}	1881
1726	P_{85}	1865
1716	P_{80}	1851
1708	P_{75}	1840
1699	P_{70}	1830
1688	P_{65}	1823
1683	P_{60}	1811
1671	P_{55}	1801
1664	P_{50}	1793
1659	P_{45}	1781
1649	P_{40}	1771
1644	P_{35}	1762
1635	P_{30}	1753
1626	P_{25}	1743
1614	P_{20}	1732
1603	P_{15}	1719
1591	P_{10}	1702
1568	P_5	1683
1560	P_3	1669
1552	P_2	1652
1547	P_1	1640



Sitting Height (M39)
(Secular trend data available)

Posture: Anthropometric Sitting, with the arms hanging relaxed and the head in the Frankfort plane.
Definition: The vertical distance between the sitting surface and Top of the Head (mm).

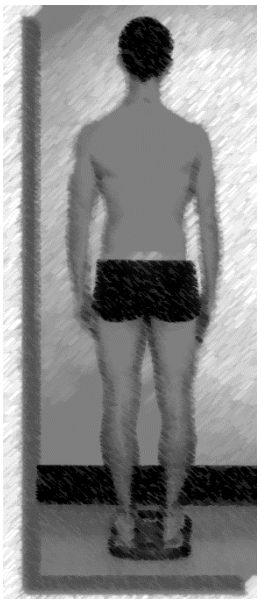
FEMALES	STATISTIC	MALES
232	*n*	1088
883	*Mean*	939
2.1	*SE (mean)*	1.1
32	*SD*	36
966	*Maximum*	1063
800	*Minimum*	830
0.065	*Skewness*	-0.028
-0.253	*Kurtosis*	-0.052
3.6%	*Coefficient of variation*	3.8%
	Percentiles	
949	P_{99}	1018
947	P_{98}	1010
944	P_{97}	1003
938	P_{95}	998
923	P_{90}	986
915	P_{85}	977
911	P_{80}	970
904	P_{75}	964
898	P_{70}	959
896	P_{65}	953
892	P_{60}	949
884	P_{55}	944
881	P_{50}	939
877	P_{45}	934
873	P_{40}	929
870	P_{35}	925
866	P_{30}	921
861	P_{25}	916
853	P_{20}	911
847	P_{15}	903
844	P_{10}	893
834	P_{5}	880
827	P_{3}	872
818	P_{2}	868
811	P_{1}	854



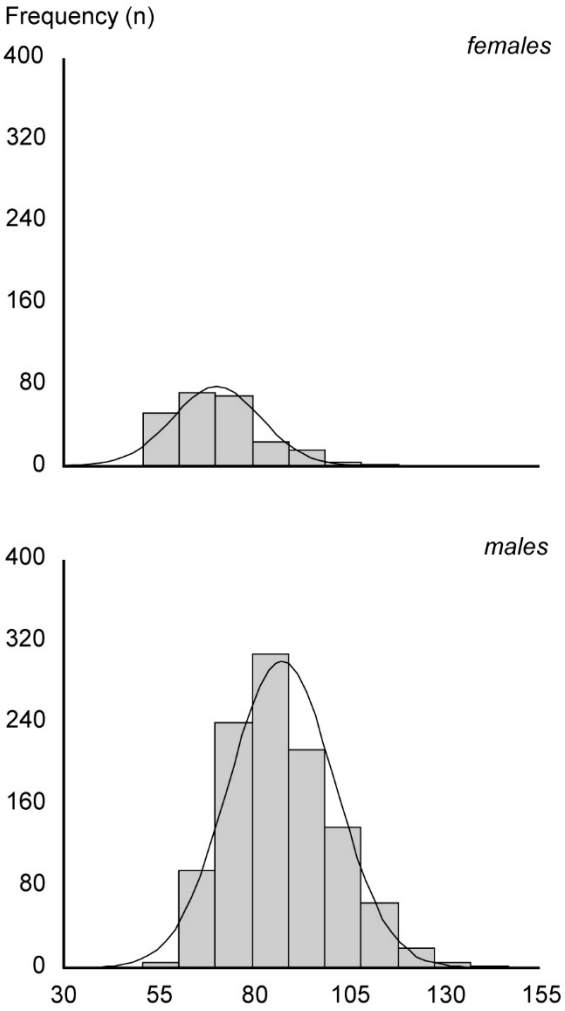
Weight (M40)

(PECCF and secular trend data available)

Posture: Anthropometric Standing.
Definition: The mass of the subject recorded to the nearest 0.1 kg.



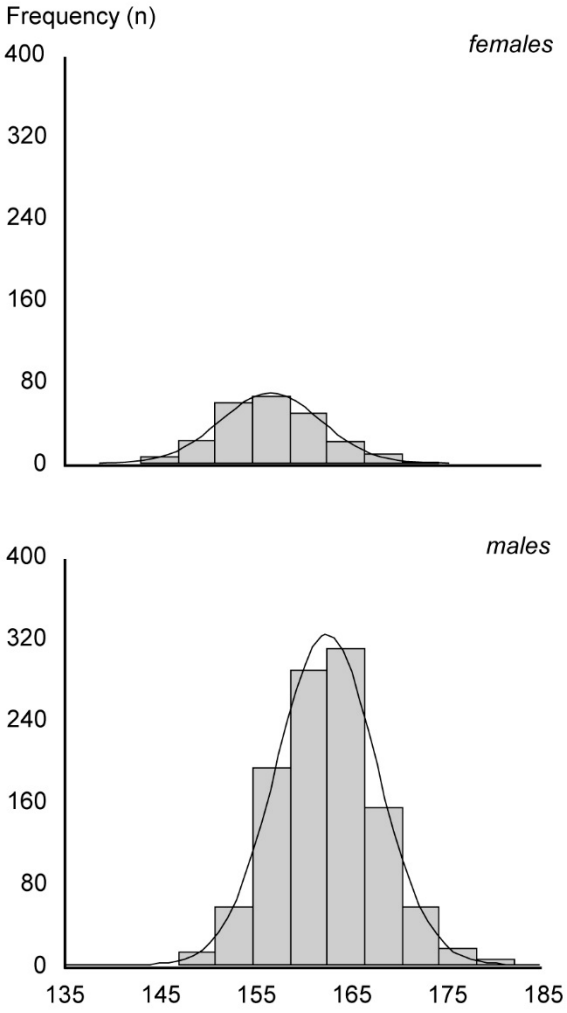
FEMALES	STATISTIC	MALES
232	*n*	1088
70.0	*Mean*	87.2
0.8	*SE (mean)*	0.4
11.5	*SD*	13.8
110.3	*Maximum*	146.3
50.6	*Minimum*	56.3
0.804	*Skewness*	0.542
0.373	*Kurtosis*	0.147
16.4%	*Coefficient of variation*	15.9%
	Percentiles	
100.8	P_{99}	123.3
97.9	P_{98}	118.2
94.8	P_{97}	115.4
92.7	P_{95}	112.4
86.5	P_{90}	105.9
82.5	P_{85}	101.9
77.9	P_{80}	98.9
76.3	P_{75}	96.5
74.6	P_{70}	93.8
72.9	P_{65}	90.9
71.9	P_{60}	89.1
70.4	P_{55}	87.3
68.5	P_{50}	85.4
66.7	P_{45}	84.0
65.2	P_{40}	82.4
63.8	P_{35}	80.5
62.3	P_{30}	79.0
61.0	P_{25}	77.6
59.9	P_{20}	75.7
58.1	P_{15}	73.3
57.1	P_{10}	70.4
55.0	P_{5}	67.1
54.3	P_{3}	64.7
53.3	P_{2}	63.5
52.9	P_{1}	61.4



Head Breadth (M41)
(PECCF data available)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Head Breadth Marker, Left and Head Breadth Marker, Right landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

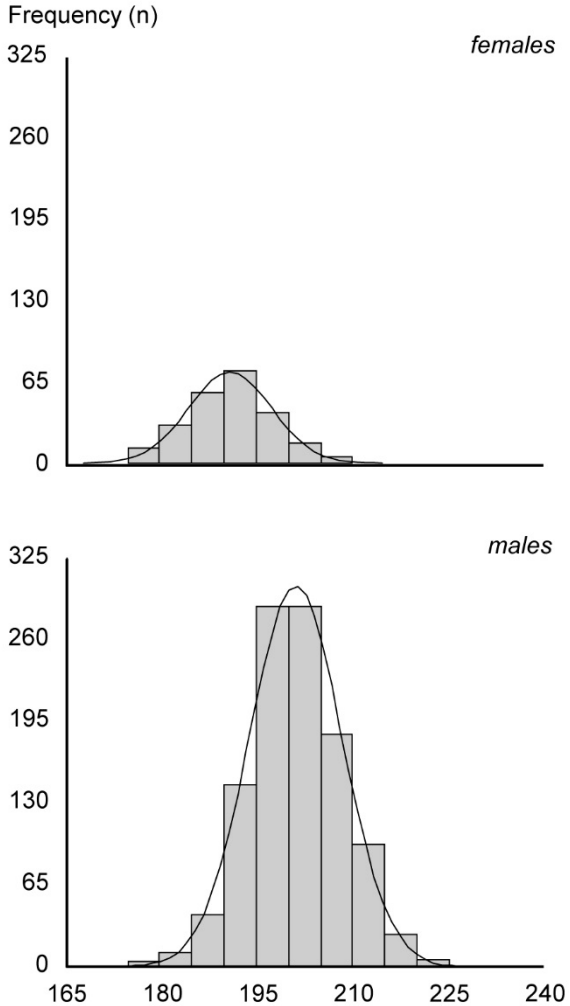
FEMALES	STATISTIC	MALES
232	*n*	1088
157	*Mean*	162
0.3	*SE (mean)*	0.2
5	*SD*	5
173	*Maximum*	182
143	*Minimum*	148
0.200	*Skewness*	0.263
-0.020	*Kurtosis*	0.235
3.4%	*Coefficient of variation*	3.2%
	Percentiles	
168	P_{99}	175
167	P_{98}	174
167	P_{97}	172
166	P_{95}	171
163	P_{90}	169
162	P_{85}	168
161	P_{80}	166
160	P_{75}	166
159	P_{70}	165
158	P_{65}	164
158	P_{60}	164
157	P_{55}	163
156	P_{50}	162
156	P_{45}	162
155	P_{40}	161
154	P_{35}	160
154	P_{30}	159
153	P_{25}	159
152	P_{20}	158
151	P_{15}	157
150	P_{10}	156
149	P_{5}	154
148	P_{3}	153
147	P_{2}	153
145	P_{1}	151



Head Length (M42)
(PECCF data available)

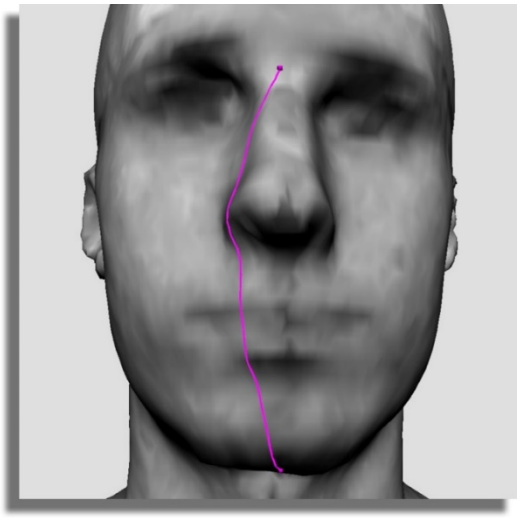
Posture: Anthropometric Standing.
Definition: The point-to-point distance between the Glabella and Opisthocranion landmarks (mm).

FEMALES	STATISTIC	MALES
232	*n*	1089
191	*Mean*	201
0.4	*SE (mean)*	0.2
6	*SD*	7
208	*Maximum*	225
175	*Minimum*	177
-0.012	*Skewness*	0.059
-0.249	*Kurtosis*	0.325
3.4%	*Coefficient of variation*	3.6%
	Percentiles	
206	P_{99}	218
204	P_{98}	217
202	P_{97}	215
201	P_{95}	213
199	P_{90}	210
197	P_{85}	208
196	P_{80}	207
195	P_{75}	206
194	P_{70}	204
193	P_{65}	204
192	P_{60}	203
192	P_{55}	201
191	P_{50}	201
190	P_{45}	200
189	P_{40}	199
188	P_{35}	198
187	P_{30}	197
186	P_{25}	196
185	P_{20}	195
184	P_{15}	194
182	P_{10}	192
180	P_5	189
178	P_3	188
178	P_2	186
176	P_1	184

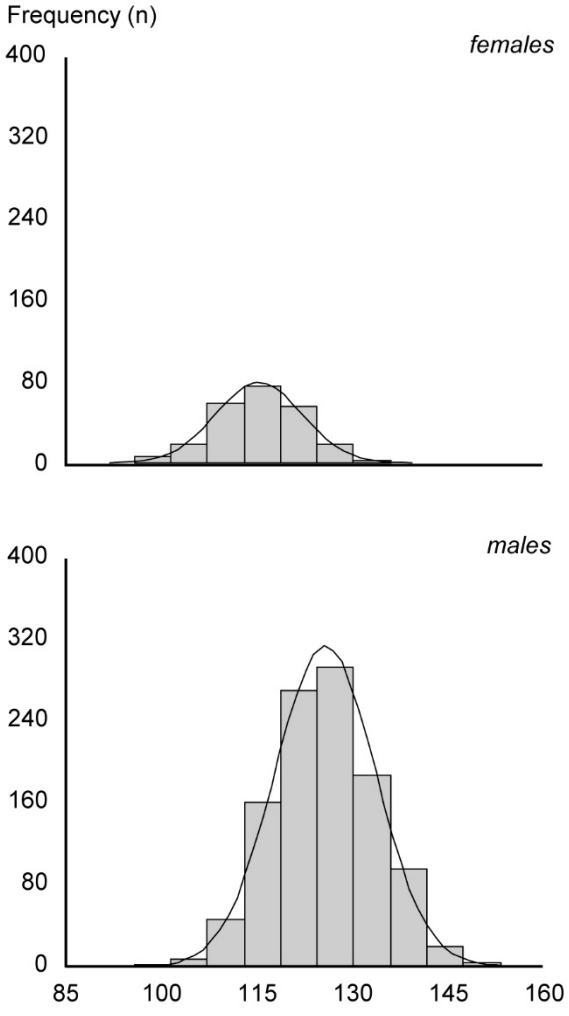


Menton-Sellion Length (M43)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Menton and Sellion landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).



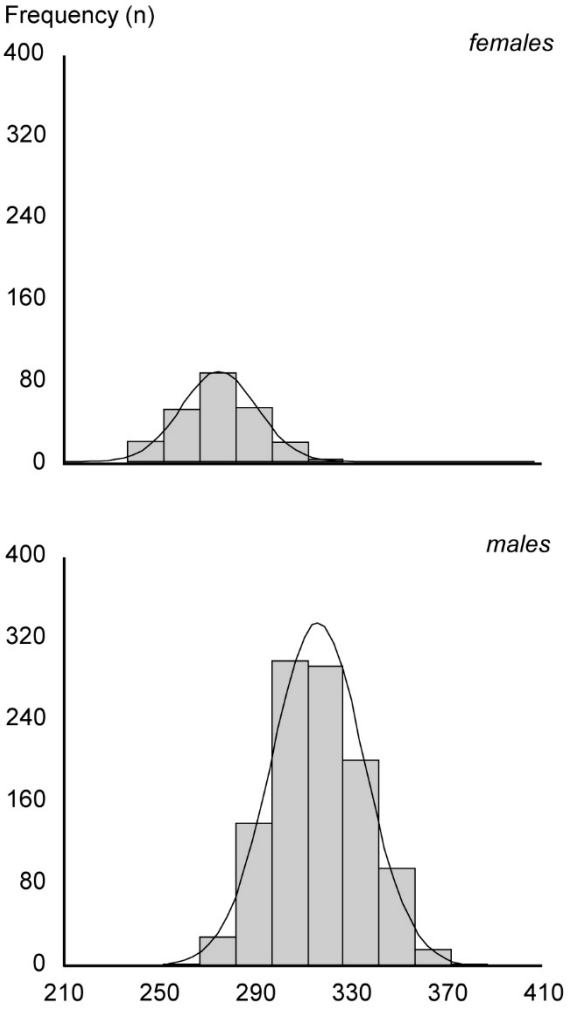
FEMALES	STATISTIC	MALES
232	*n*	1081
115	*Mean*	126
0.4	*SE (mean)*	0.2
7	*SD*	8
136	*Maximum*	153
96	*Minimum*	101
-0.008	*Skewness*	0.087
0.001	*Kurtosis*	-0.185
5.9%	*Coefficient of variation*	6.3%
	Percentiles	
130	P_{99}	144
129	P_{98}	142
127	P_{97}	141
126	P_{95}	139
124	P_{90}	137
122	P_{85}	134
121	P_{80}	133
120	P_{75}	131
119	P_{70}	130
118	P_{65}	129
118	P_{60}	127
116	P_{55}	127
115	P_{50}	126
114	P_{45}	124
114	P_{40}	123
113	P_{35}	122
112	P_{30}	122
111	P_{25}	120
109	P_{20}	119
108	P_{15}	117
107	P_{10}	115
104	P_{5}	113
103	P_{3}	112
101	P_{2}	111
100	P_{1}	108



Bitragion Submandibular Arc (M44)

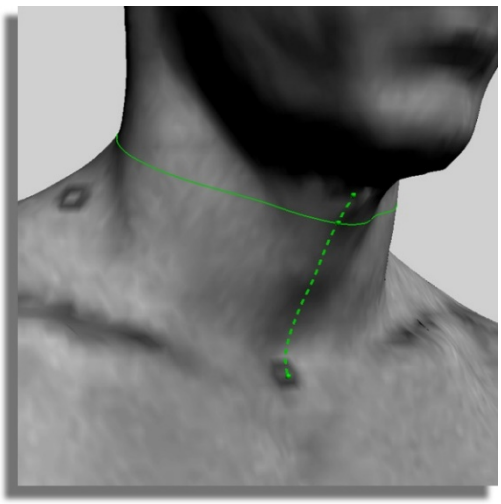
Posture: Anthropometric Standing with the head in the Frankfort plane.
Definition: The surface distance from the Tragion, Right landmark, through the Submandibular landmark, to the Tragion, Left landmark (mm).

FEMALES	STATISTIC	MALES
232	*n*	1074
275	*Mean*	316
1.0	*SE (mean)*	0.6
16	*SD*	19
319	*Maximum*	387
237	*Minimum*	260
0.158	*Skewness*	0.211
-0.235	*Kurtosis*	-0.190
5.7%	*Coefficient of variation*	6.1%
	Percentiles	
311	P_{99}	359
306	P_{98}	355
304	P_{97}	353
302	P_{95}	349
295	P_{90}	342
292	P_{85}	336
288	P_{80}	333
285	P_{75}	329
283	P_{70}	326
280	P_{65}	323
277	P_{60}	320
276	P_{55}	317
274	P_{50}	315
272	P_{45}	312
269	P_{40}	310
268	P_{35}	307
266	P_{30}	305
264	P_{25}	302
262	P_{20}	299
259	P_{15}	296
253	P_{10}	292
249	P_5	286
245	P_3	282
244	P_2	279
243	P_1	276

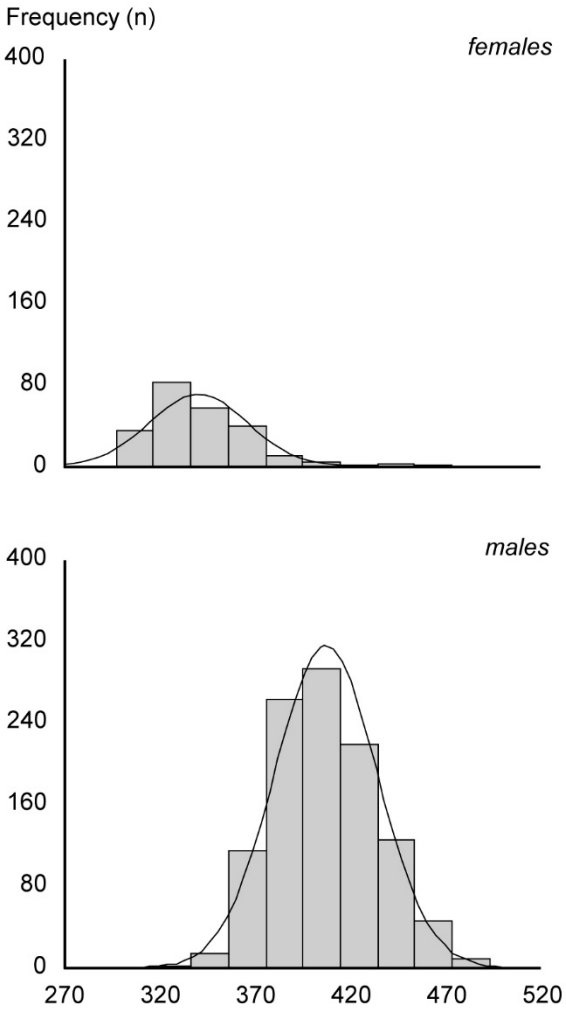


Neck Circumference (M45)

Posture: Anthropometric Standing with the head in the Frankfort plane.
Definition: The circumference of the neck at the height of the Infrathyroid landmark. The plane of the measurement is perpendicular to the long axis of the neck (mm).

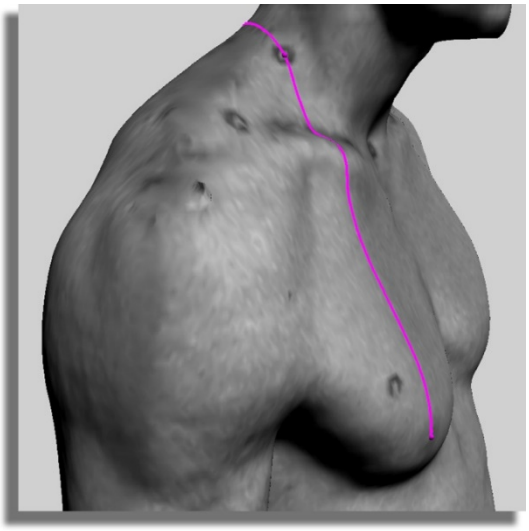


FEMALES	STATISTIC	MALES
231	*n*	1085
340	*Mean*	407
1.7	*SE (mean)*	0.8
26	*SD*	27
455	*Maximum*	493
297	*Minimum*	332
1.189	*Skewness*	0.268
2.623	*Kurtosis*	-0.247
7.5%	*Coefficient of variation*	6.6%
	Percentiles	
433	P_{99}	470
400	P_{98}	465
395	P_{97}	461
384	P_{95}	453
370	P_{90}	443
366	P_{85}	435
359	P_{80}	429
355	P_{75}	425
349	P_{70}	420
347	P_{65}	416
343	P_{60}	412
339	P_{55}	409
336	P_{50}	406
333	P_{45}	402
330	P_{40}	398
327	P_{35}	394
325	P_{30}	390
323	P_{25}	387
320	P_{20}	383
317	P_{15}	378
312	P_{10}	373
307	P_{5}	366
303	P_{3}	361
299	P_{2}	359
298	P_{1}	354

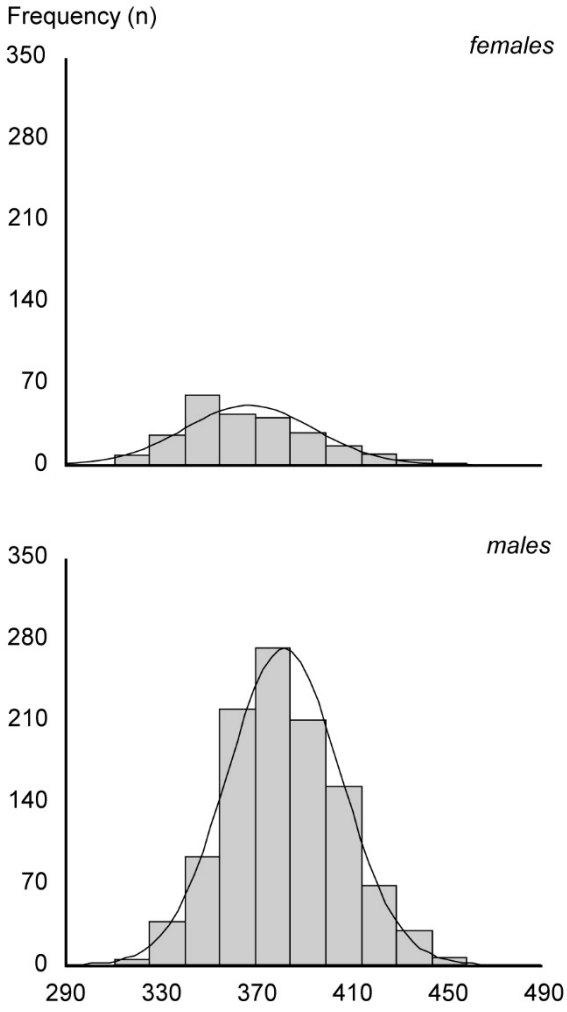


Nape – Bustpoint/Thelion Length (M46)

Posture: Anthropometric Standing.
Definition: The surface distance from the Cervicale landmark, across the Trapezius Point, Right landmark, to the Thelion (males) or Bustpoint (females) landmarks (mm).



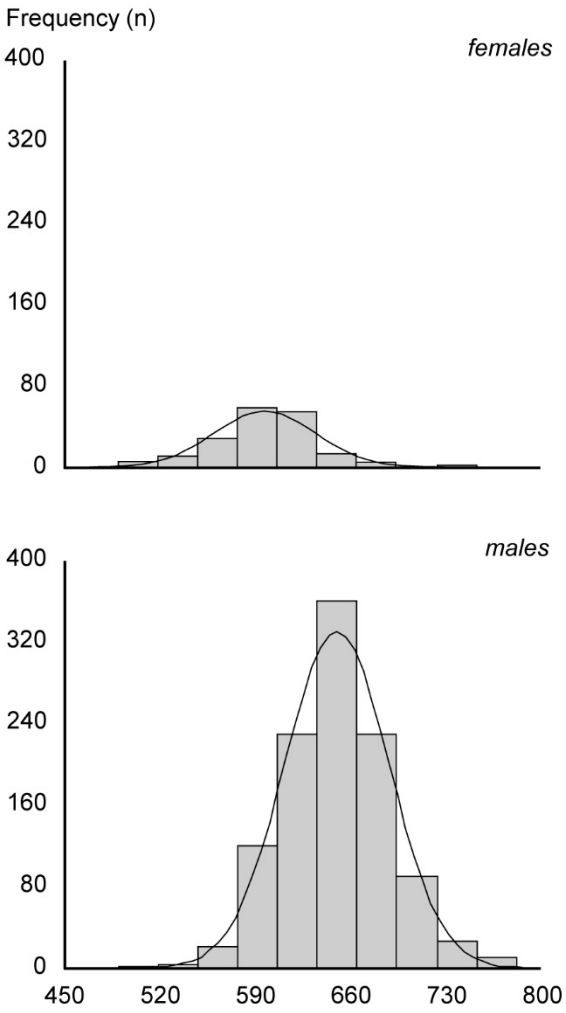
FEMALES	STATISTIC	MALES
232	*n*	1088
366	*Mean*	381
1.8	*SE (mean)*	0.7
27	*SD*	24
458	*Maximum*	454
310	*Minimum*	320
0.581	*Skewness*	0.203
0.045	*Kurtosis*	-0.210
7.4%	*Coefficient of variation*	6.2%
	Percentiles	
434	P_{99}	438
429	P_{98}	432
424	P_{97}	429
418	P_{95}	421
405	P_{90}	413
396	P_{85}	406
386	P_{80}	402
383	P_{75}	397
379	P_{70}	394
374	P_{65}	390
371	P_{60}	386
366	P_{55}	383
363	P_{50}	380
359	P_{45}	377
355	P_{40}	374
353	P_{35}	371
350	P_{30}	368
347	P_{25}	364
343	P_{20}	360
340	P_{15}	357
336	P_{10}	352
330	P_{5}	343
325	P_{3}	338
320	P_{2}	335
317	P_{1}	332



Nape – Waist Over Bust (M47)

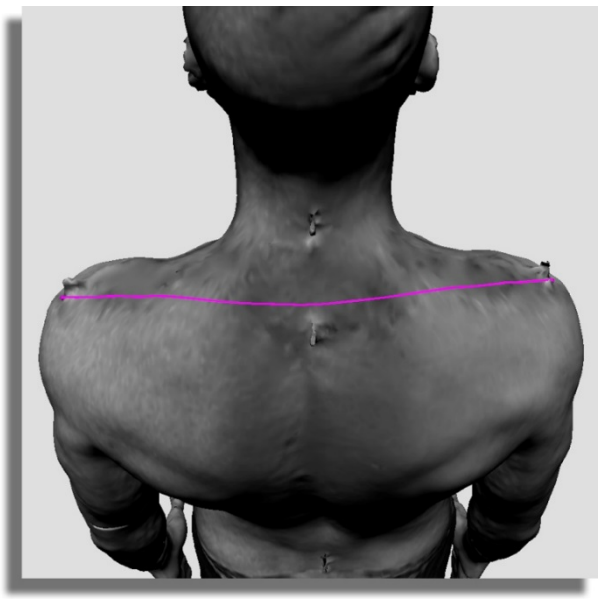
Posture: Anthropometric Standing.
Definition: The surface distance from the Cervicale landmark, across the Trapezius Point, Right landmark, across the Thelion (males) or Bustpoint (females) landmarks, to the Waist Preferred Posterior, Projected landmark (mm).

FEMALES	STATISTIC	MALES
232	*n*	1088
597	*Mean*	649
2.4	*SE (mean)*	1.2
37	*SD*	38
727	*Maximum*	781
490	*Minimum*	510
-0.051	*Skewness*	0.181
1.098	*Kurtosis*	0.287
6.2%	*Coefficient of variation*	5.9%
	Percentiles	
686	P_{99}	750
672	P_{98}	734
668	P_{97}	725
650	P_{95}	713
639	P_{90}	698
629	P_{85}	688
624	P_{80}	680
618	P_{75}	673
614	P_{70}	667
610	P_{65}	662
608	P_{60}	658
602	P_{55}	654
600	P_{50}	649
596	P_{45}	644
592	P_{40}	640
589	P_{35}	636
582	P_{30}	629
577	P_{25}	623
570	P_{20}	617
559	P_{15}	610
551	P_{10}	601
525	P_{5}	590
520	P_{3}	580
516	P_{2}	575
510	P_{1}	562

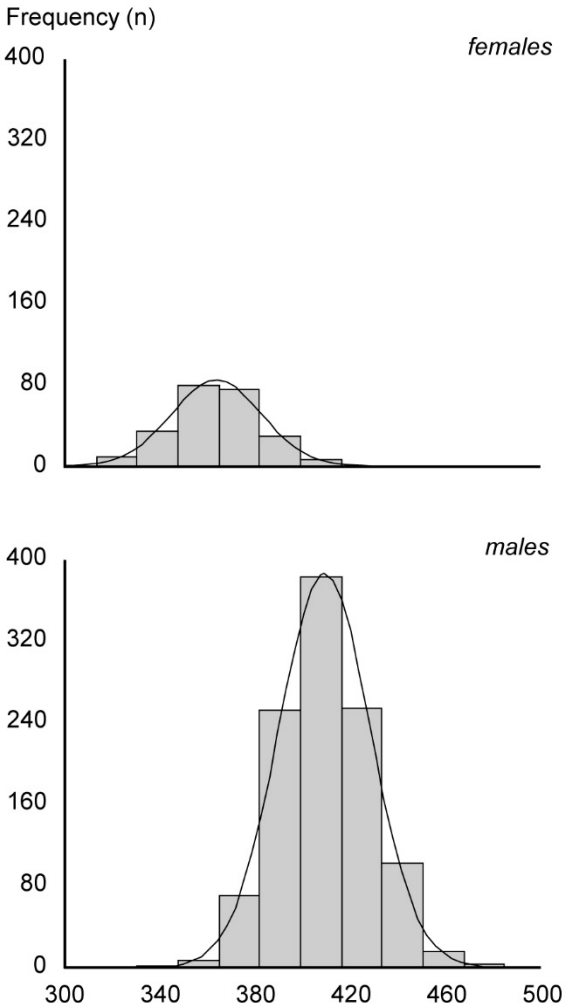


Biacromial Breadth (M48)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Acromion, Right and Acromion, Left landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

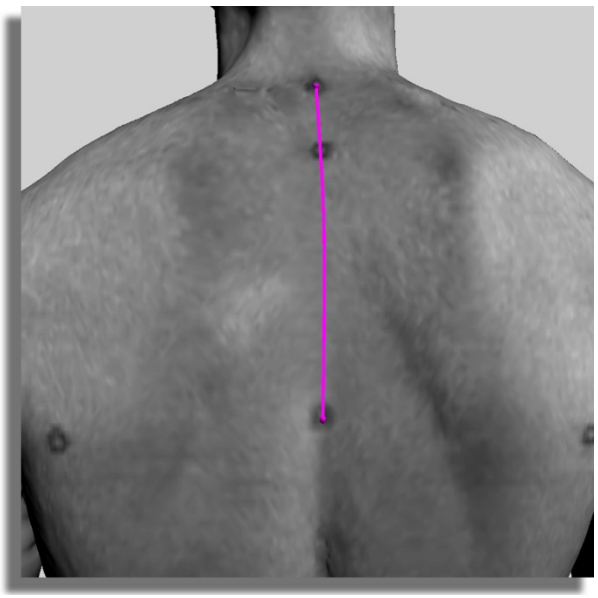


FEMALES	STATISTIC	MALES
232	*n*	1088
364	*Mean*	409
1.2	*SE (mean)*	0.6
19	*SD*	19
410	*Maximum*	485
313	*Minimum*	346
-0.008	*Skewness*	0.125
-0.179	*Kurtosis*	0.287
5.2%	*Coefficient of variation*	5.9%
	Percentiles	
408	P_{99}	454
402	P_{98}	449
398	P_{97}	446
394	P_{95}	441
388	P_{90}	435
382	P_{85}	428
379	P_{80}	424
376	P_{75}	421
374	P_{70}	418
371	P_{65}	416
369	P_{60}	413
366	P_{55}	411
363	P_{50}	409
361	P_{45}	406
358	P_{40}	403
355	P_{35}	401
354	P_{30}	399
351	P_{25}	396
349	P_{20}	392
344	P_{15}	389
339	P_{10}	385
333	P_{5}	377
326	P_{3}	373
325	P_{2}	370
322	P_{1}	367

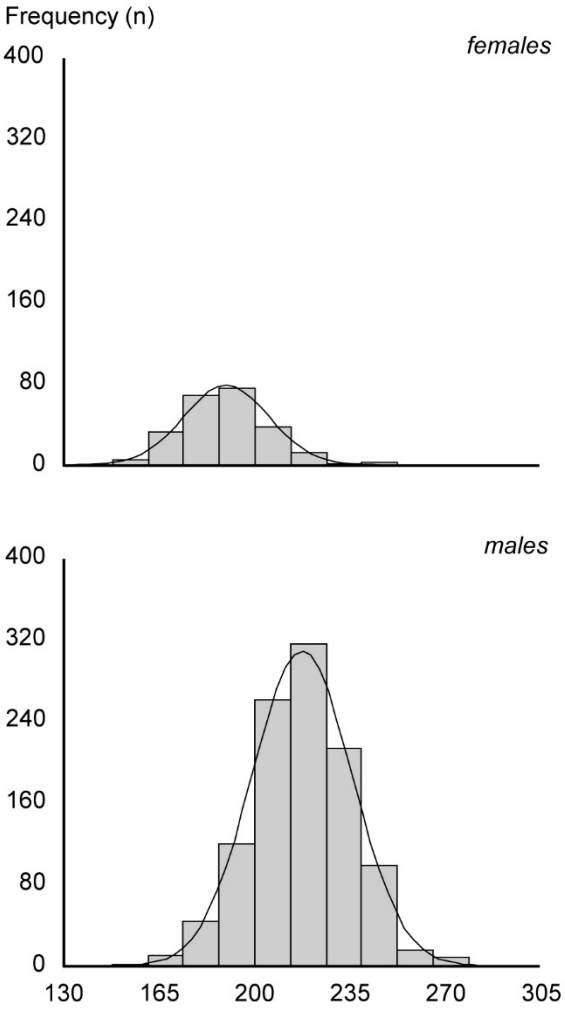


Scye Depth (M49)

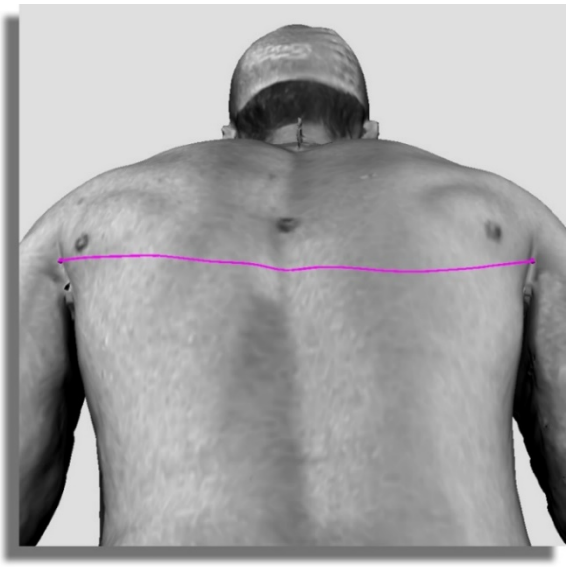
Posture: Anthropometric Standing.
Definition: The contour distance between the digitally-extracted Cervicale and Scye Level at Midspine landmarks (mm).



FEMALES	STATISTIC	MALES
232	*n*	1088
189	*Mean*	217
1.0	*SE (mean)*	0.6
16	*SD*	18
240	*Maximum*	278
148	*Minimum*	159
0.249	*Skewness*	-0.038
0.196	*Kurtosis*	0.161
8.2%	*Coefficient of variation*	8.4%
	Percentiles	
226	P_{99}	262
224	P_{98}	254
216	P_{97}	250
214	P_{95}	247
209	P_{90}	241
206	P_{85}	236
201	P_{80}	233
199	P_{75}	230
197	P_{70}	227
196	P_{65}	224
194	P_{60}	222
192	P_{55}	219
190	P_{50}	217
187	P_{45}	215
184	P_{40}	213
182	P_{35}	211
180	P_{30}	208
178	P_{25}	205
176	P_{20}	202
173	P_{15}	199
169	P_{10}	195
166	P_{5}	187
161	P_{3}	181
160	P_{2}	178
159	P_{1}	173

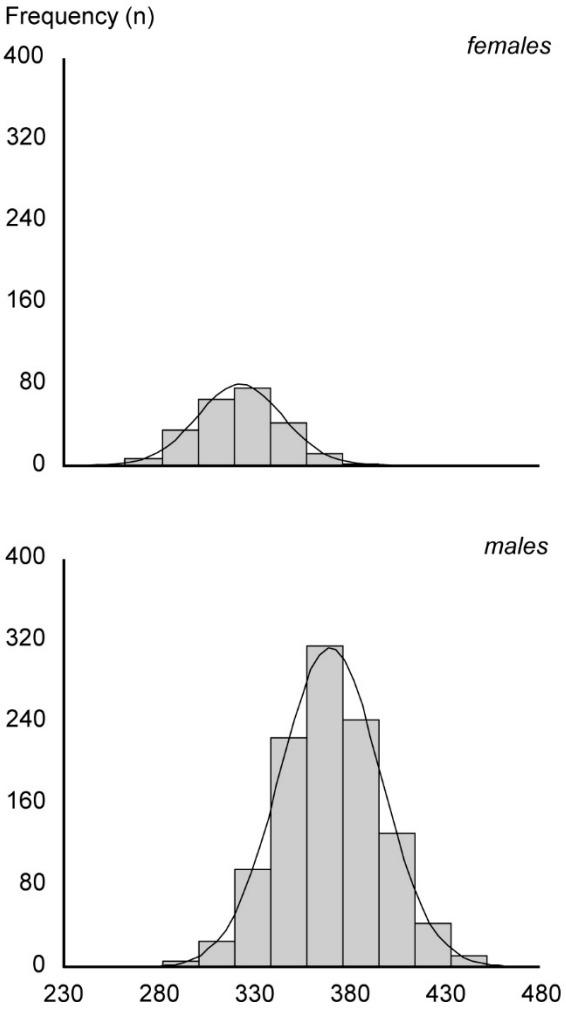


Back Width (M50)



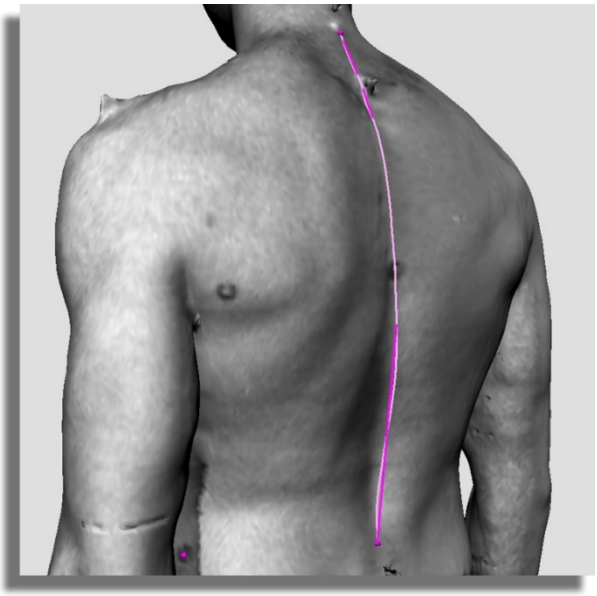
Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Posterior Horizontal Scye, Left and Posterior Horizontal Scye, Right landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

FEMALES	STATISTIC	MALES
232	*n*	1088
323	*Mean*	369
1.5	*SE (mean)*	0.8
22	*SD*	26
389	*Maximum*	452
263	*Minimum*	290
0.092	*Skewness*	0.030
-0.232	*Kurtosis*	-0.051
6.9%	*Coefficient of variation*	7.1%
	Percentiles	
371	P_{99}	431
370	P_{98}	420
367	P_{97}	419
359	P_{95}	413
350	P_{90}	405
346	P_{85}	397
342	P_{80}	391
337	P_{75}	387
334	P_{70}	383
332	P_{65}	379
328	P_{60}	376
326	P_{55}	373
324	P_{50}	370
319	P_{45}	366
316	P_{40}	363
312	P_{35}	359
310	P_{30}	356
307	P_{25}	351
303	P_{20}	347
299	P_{15}	342
294	P_{10}	336
287	P_5	328
283	P_3	322
281	P_2	316
277	P_1	309

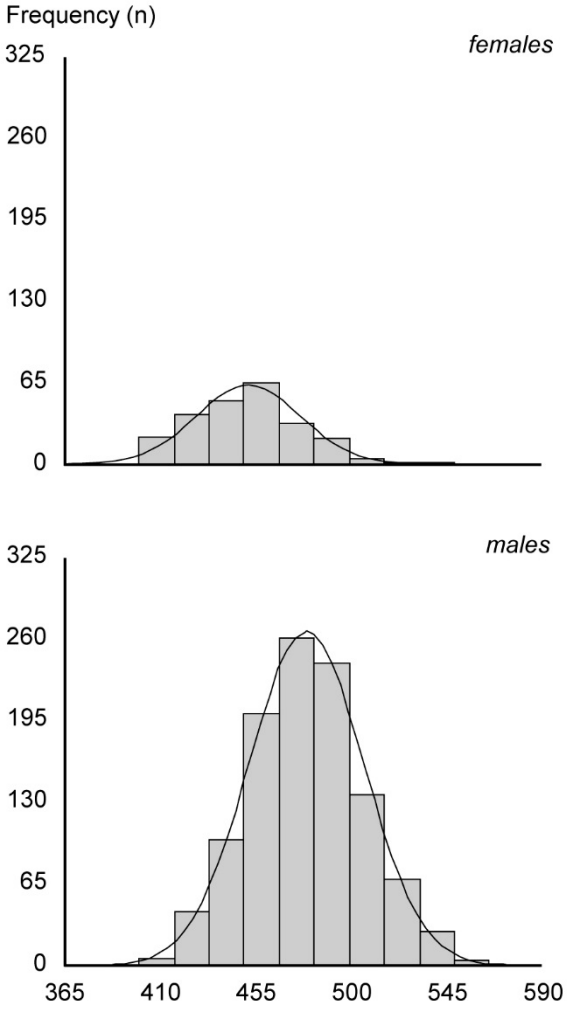


Back Length (M51)

Posture: Anthropometric Standing.
Definition: The contour distance between the digitally-extracted Cervicale and Back Length Marker landmarks (mm).

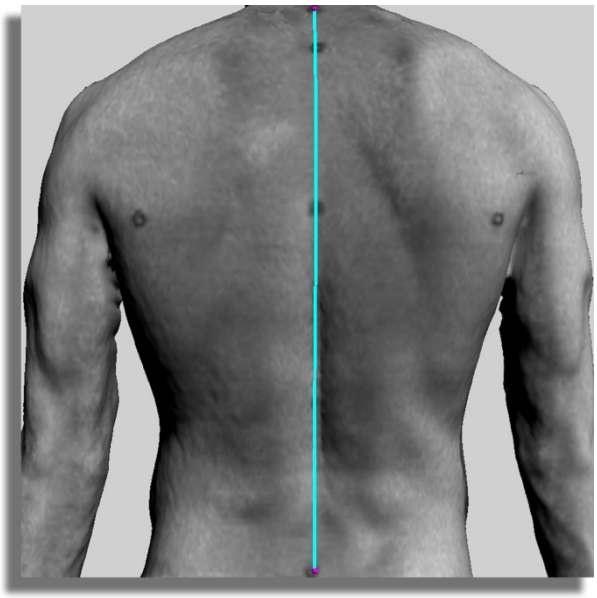


FEMALES	STATISTIC	MALES
232	*n*	1088
451	*Mean*	479
1.6	*SE (mean)*	0.8
24	*SD*	27
535	*Maximum*	565
400	*Minimum*	401
0.265	*Skewness*	0.162
-0.098	*Kurtosis*	-0.069
5.4%	*Coefficient of variation*	5.6%
	Percentiles	
508	P_{99}	545
500	P_{98}	538
496	P_{97}	532
492	P_{95}	524
485	P_{90}	514
479	P_{85}	507
472	P_{80}	501
466	P_{75}	496
463	P_{70}	492
460	P_{65}	487
457	P_{60}	484
454	P_{55}	482
451	P_{50}	478
448	P_{45}	474
445	P_{40}	471
441	P_{35}	468
437	P_{30}	465
433	P_{25}	461
431	P_{20}	457
427	P_{15}	451
419	P_{10}	445
412	P_{5}	435
409	P_{3}	429
407	P_{2}	426
404	P_{1}	422

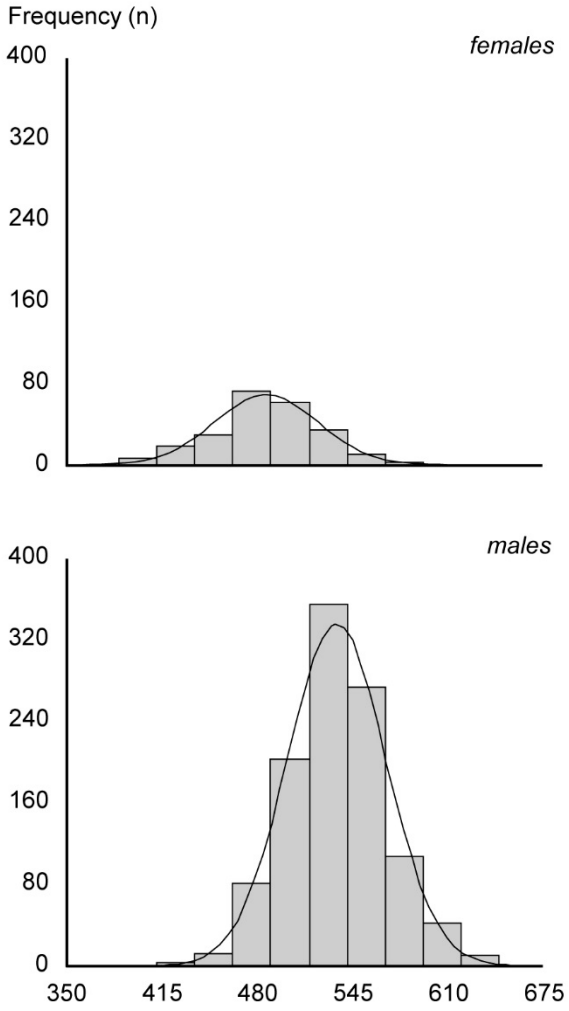


Nape – Waist Centre Back (M52)

Posture: Anthropometric Standing.
Definition: The surface distance from the digitally extracted Cervicale landmark to the Waist Preferred, Posterior landmark (mm).

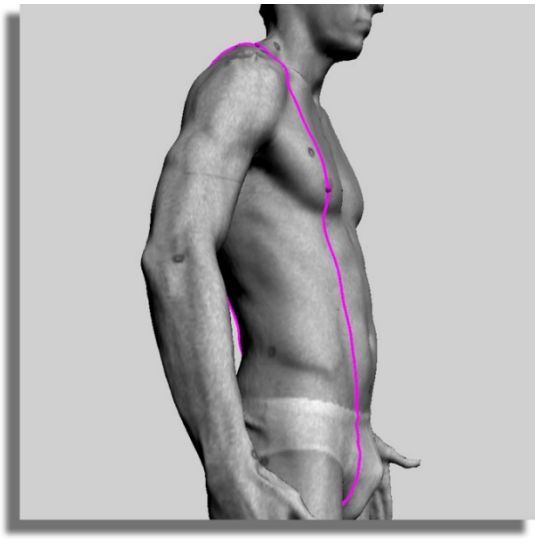


FEMALES	STATISTIC	MALES
232	*n*	1088
486	*Mean*	534
2.3	*SE (mean)*	1.0
35	*SD*	34
576	*Maximum*	645
385	*Minimum*	418
-0.177	*Skewness*	0.114
-0.013	*Kurtosis*	0.213
7.2%	*Coefficient of variation*	6.3%
	Percentiles	
559	P_{99}	617
552	P_{98}	606
547	P_{97}	600
541	P_{95}	592
532	P_{90}	576
525	P_{85}	567
514	P_{80}	561
509	P_{75}	555
503	P_{70}	551
499	P_{65}	546
494	P_{60}	541
490	P_{55}	536
487	P_{50}	532
482	P_{45}	529
478	P_{40}	526
474	P_{35}	522
470	P_{30}	517
465	P_{25}	513
459	P_{20}	506
452	P_{15}	499
436	P_{10}	491
425	P_5	478
414	P_3	473
410	P_2	466
401	P_1	460

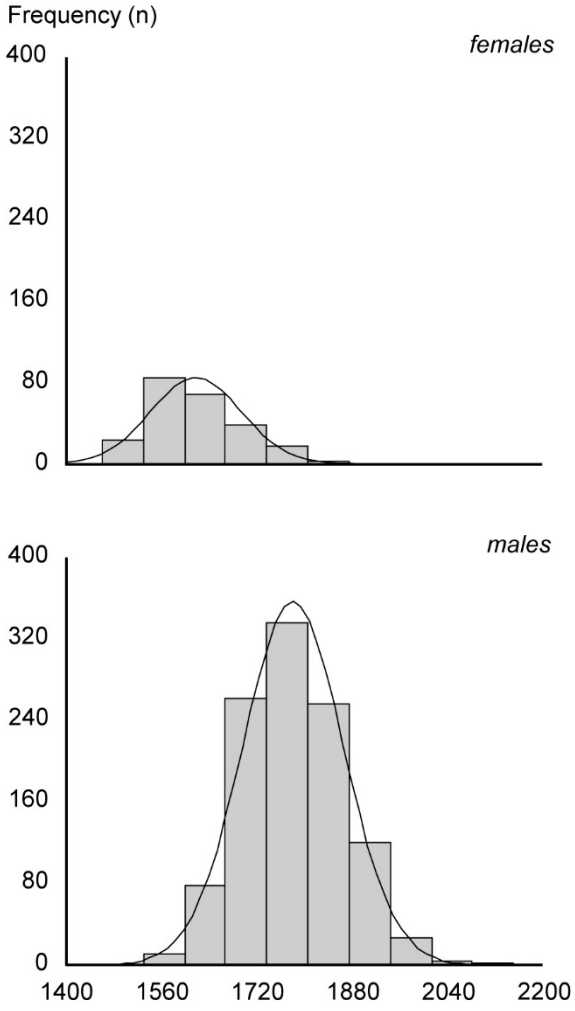


Vertical Trunk Circumference (Wide) (M53)

Posture: Standard Scanning Pose (P02).
Definition: The circumference of the trunk on a line passing through the Crotch landmark and over Bustpoint (females)/Thelion (males), Midshoulder, and Buttock Point, Posterior landmarks (mm).

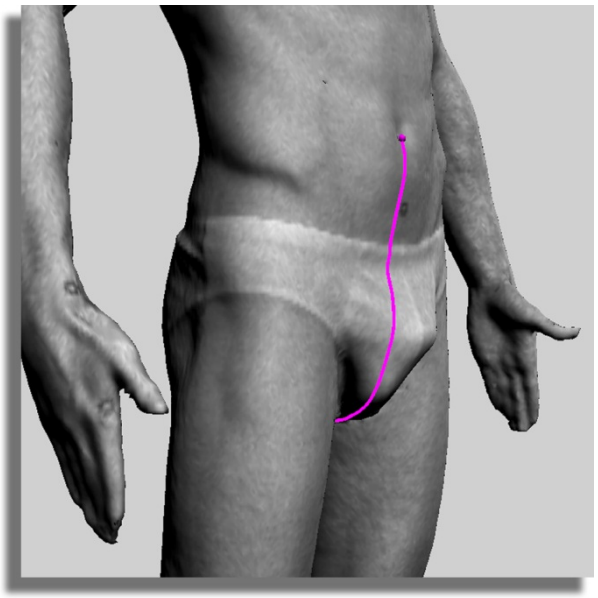


FEMALES	STATISTIC	MALES
232	*n*	1088
1617	*Mean*	1780
5.0	*SE (mean)*	2.6
76	*SD*	84
1837	*Maximum*	2149
1460	*Minimum*	1536
0.527	*Skewness*	0.245
-0.054	*Kurtosis*	-0.033
4.7%	*Coefficient of variation*	4.7%
	Percentiles	
1800	P_{99}	1979
1793	P_{98}	1958
1776	P_{97}	1940
1760	P_{95}	1924
1722	P_{90}	1895
1693	P_{85}	1865
1678	P_{80}	1852
1664	P_{75}	1837
1649	P_{70}	1825
1638	P_{65}	1811
1624	P_{60}	1799
1617	P_{55}	1788
1606	P_{50}	1774
1595	P_{45}	1763
1590	P_{40}	1752
1581	P_{35}	1741
1575	P_{30}	1731
1562	P_{25}	1721
1554	P_{20}	1707
1539	P_{15}	1692
1531	P_{10}	1675
1509	P_{5}	1651
1497	P_{3}	1635
1484	P_{2}	1626
1474	P_{1}	1602

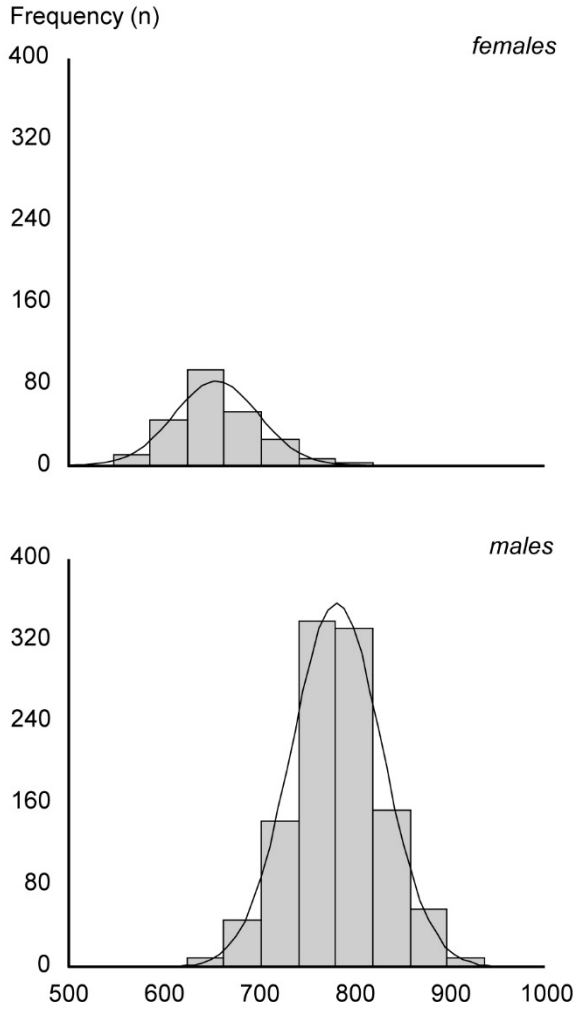


Crotch Length (Omphalion) (M54)

Posture: Anthropometric Standing.
Definition: The surface distance between the Waist Omphalion, Anterior and the Waist Omphalion, Posterior landmarks, passing through the Crotch landmark (mm).



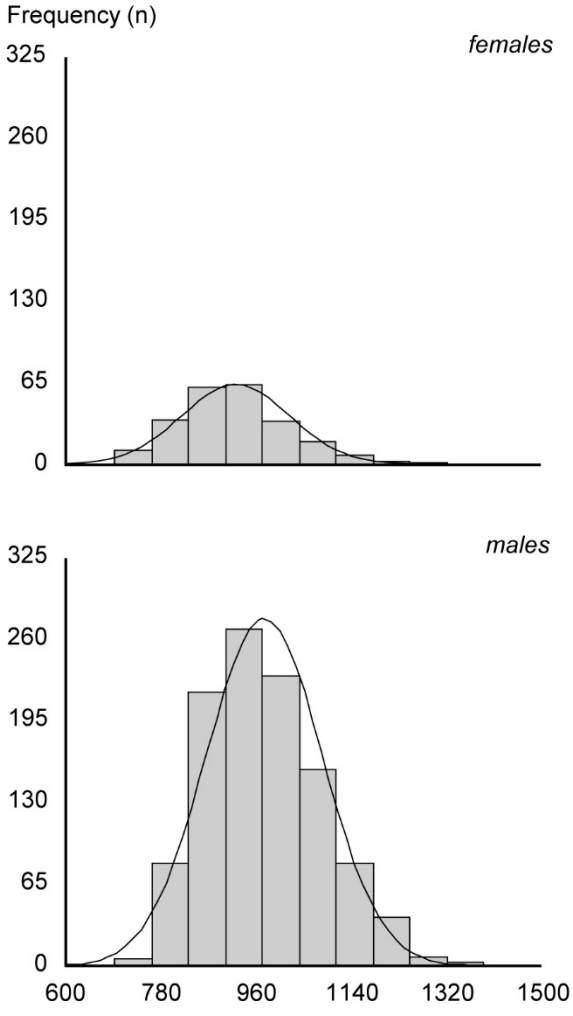
FEMALES	STATISTIC	MALES
232	*n*	1087
655	*Mean*	781
2.9	*SE (mean)*	1.4
44	*SD*	47
810	*Maximum*	936
546	*Minimum*	628
0.437	*Skewness*	0.073
0.426	*Kurtosis*	0.141
6.7%	*Coefficient of variation*	6.1%
	Percentiles	
762	P_{99}	893
752	P_{98}	881
746	P_{97}	874
730	P_{95}	862
713	P_{90}	846
699	P_{85}	830
689	P_{80}	819
681	P_{75}	809
673	P_{70}	803
668	P_{65}	796
661	P_{60}	791
658	P_{55}	786
653	P_{50}	781
648	P_{45}	774
641	P_{40}	768
636	P_{35}	762
632	P_{30}	756
628	P_{25}	750
617	P_{20}	743
609	P_{15}	736
603	P_{10}	721
587	P_{5}	702
578	P_{3}	693
573	P_{2}	685
568	P_{1}	668



Waist Circumference Preferred (M55)

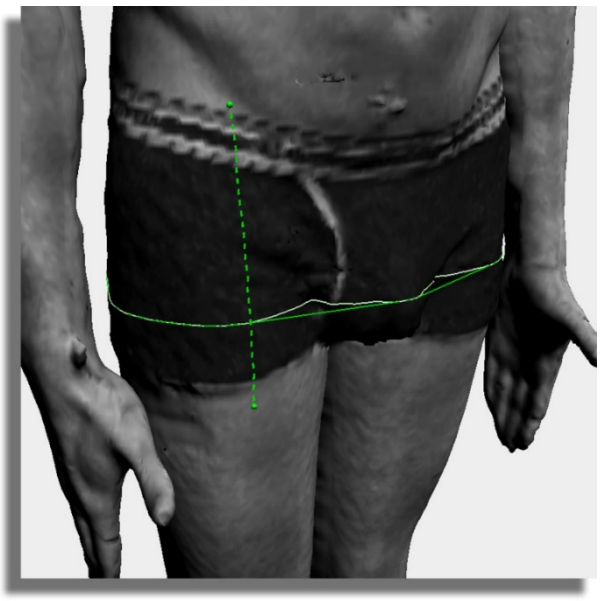
Posture: Anthropometric Standing.
Definition: The horizontal circumference of the torso at the height of the Waist Preferred, Posterior landmark (mm).

FEMALES	STATISTIC	MALES
232	*n*	1088
921	*Mean*	974
6.7	*SE (mean)*	3.3
102	*SD*	109
1281	*Maximum*	1389
693	*Minimum*	724
0.545	*Skewness*	0.493
0.424	*Kurtosis*	-0.025
11.0%	*Coefficient of variation*	11.2%
	Percentiles	
1190	P_{99}	1246
1142	P_{98}	1223
1119	P_{97}	1202
1103	P_{95}	1176
1056	P_{90}	1121
1020	P_{85}	1098
1002	P_{80}	1068
976	P_{75}	1045
964	P_{70}	1028
949	P_{65}	1009
937	P_{60}	993
924	P_{55}	978
910	P_{50}	963
898	P_{45}	947
890	P_{40}	933
875	P_{35}	921
862	P_{30}	908
851	P_{25}	892
833	P_{20}	878
820	P_{15}	862
807	P_{10}	840
766	P_{5}	817
753	P_{3}	805
744	P_{2}	783
733	P_{1}	771

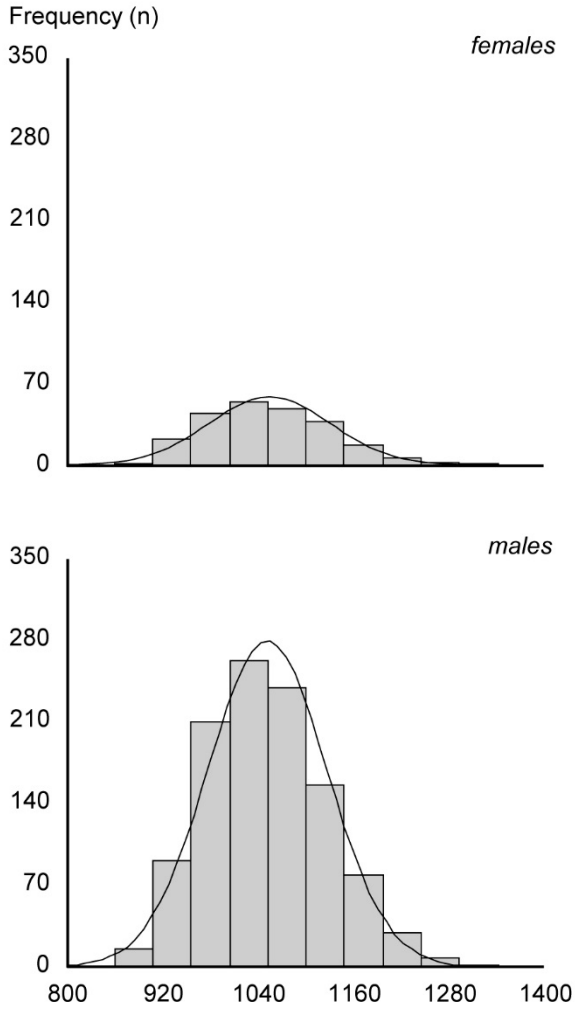


Maximum Hip Circumference (M56)

Posture: Anthropometric Standing.
Definition: The maximum circumference of the body (excluding the appendages) at or about the height of the hip. This measure must be taken below the height of the iliac crest (mm).



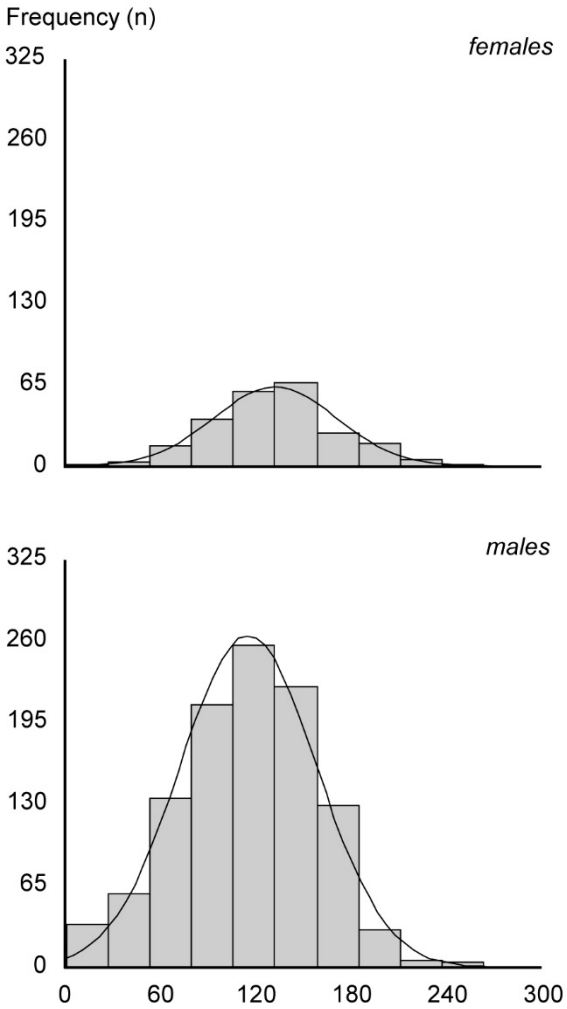
FEMALES	STATISTIC	MALES
232	*n*	1088
1054	*Mean*	1050
5.0	*SE (mean)*	2.3
77	*SD*	75
1323	*Maximum*	1340
903	*Minimum*	859
0.435	*Skewness*	0.353
-0.053	*Kurtosis*	-0.105
7.3%	*Coefficient of variation*	7.1%
	Percentiles	
1245	P_{99}	1232
1226	P_{98}	1213
1204	P_{97}	1200
1182	P_{95}	1182
1151	P_{90}	1150
1131	P_{85}	1132
1116	P_{80}	1115
1106	P_{75}	1099
1095	P_{70}	1088
1082	P_{65}	1076
1070	P_{60}	1065
1064	P_{55}	1056
1047	P_{50}	1045
1040	P_{45}	1036
1032	P_{40}	1025
1019	P_{35}	1018
1005	P_{30}	1006
990	P_{25}	995
979	P_{20}	984
970	P_{15}	973
956	P_{10}	956
943	P_{5}	938
936	P_{3}	925
928	P_{2}	918
923	P_{1}	903



Waist-Hip Distance (M57)

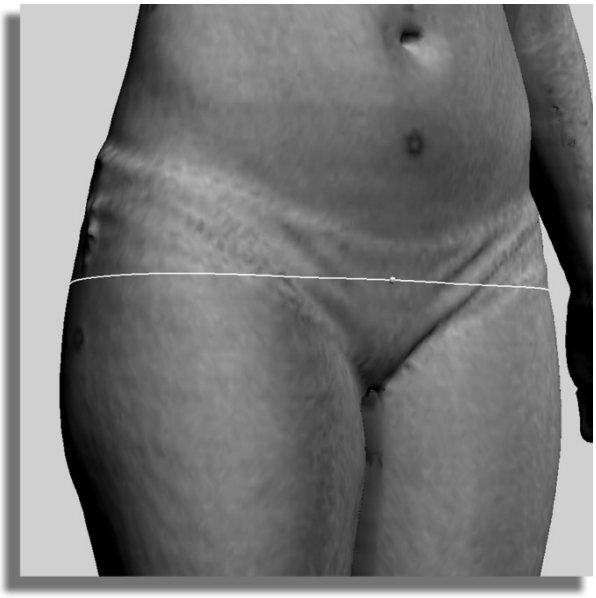
Posture: Anthropometric Standing.
Definition: The contoured distance between the digitally-extracted Waist Preferred, Anterior and Hip Marker (males)/Max Hip Marker (females) landmarks, vertically aligned with the Iliocristale, Right landmark (mm).

FEMALES	STATISTIC	MALES
232	*n*	1086
132	*Mean*	115
2.5	*SE (mean)*	1.3
39	*SD*	43
263	*Maximum*	253
21	*Minimum*	1
0.209	*Skewness*	-0.132
0.569	*Kurtosis*	-0.125
29.2%	*Coefficient of variation*	37.3%
	Percentiles	
231	P_{99}	210
219	P_{98}	198
208	P_{97}	191
192	P_{95}	180
184	P_{90}	167
171	P_{85}	158
161	P_{80}	153
153	P_{75}	145
149	P_{70}	141
142	P_{65}	134
138	P_{60}	128
134	P_{55}	122
132	P_{50}	117
128	P_{45}	111
123	P_{40}	106
117	P_{35}	100
113	P_{30}	93
107	P_{25}	86
101	P_{20}	79
96	P_{15}	70
84	P_{10}	60
74	P_{5}	40
66	P_{3}	27
58	P_{2}	23
39	P_{1}	16

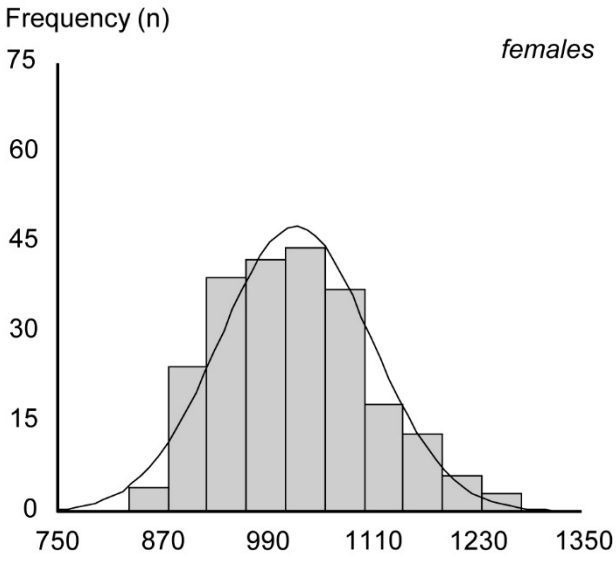


High Hip (M58)

Posture: Anthropometric Standing.
Definition: The horizontal circumference measured at the height of the digitally-extracted High Hip Marker (females only) (mm).



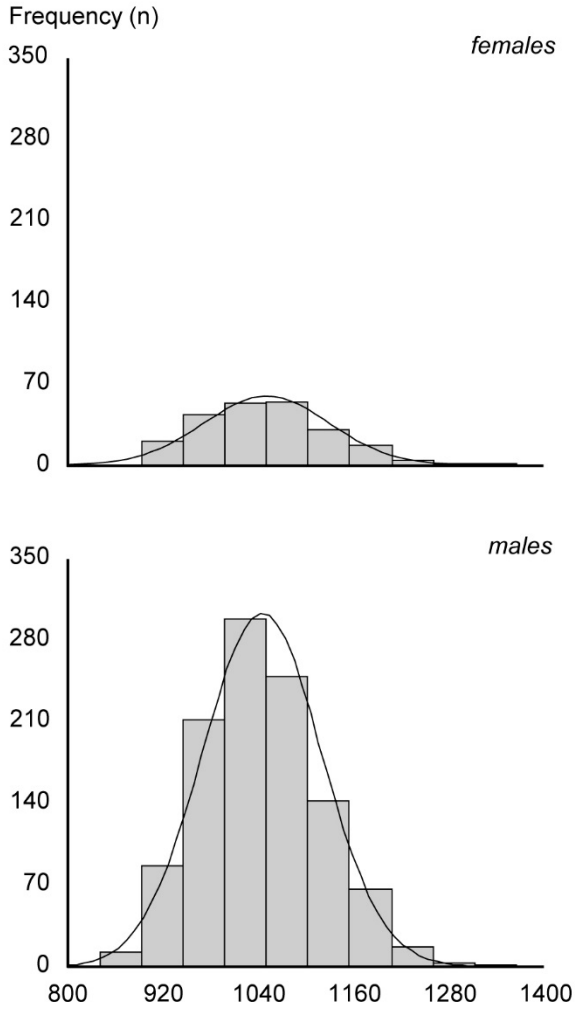
FEMALES	STATISTIC	MALES
230	*n*	NA
1022	*Mean*	NA
5.7	*SE (mean)*	NA
86	*SD*	NA
1279	*Maximum*	NA
831	*Minimum*	NA
0.391	*Skewness*	NA
-0.254	*Kurtosis*	NA
8.5%	*Coefficient of variation*	NA
	Percentiles	
1233	P_{99}	NA
1216	P_{98}	NA
1195	P_{97}	NA
1175	P_{95}	NA
1139	P_{90}	NA
1115	P_{85}	NA
1093	P_{80}	NA
1081	P_{75}	NA
1064	P_{70}	NA
1049	P_{65}	NA
1040	P_{60}	NA
1026	P_{55}	NA
1018	P_{50}	NA
1004	P_{45}	NA
991	P_{40}	NA
983	P_{35}	NA
970	P_{30}	NA
955	P_{25}	NA
942	P_{20}	NA
928	P_{15}	NA
916	P_{10}	NA
898	P_{5}	NA
882	P_{3}	NA
878	P_{2}	NA
863	P_{1}	NA



Hip (M59)

Posture: Anthropometric Standing.
Definition: The horizontal circumference of the torso at the height of the digitally-extracted Hip Marker landmark (mm).

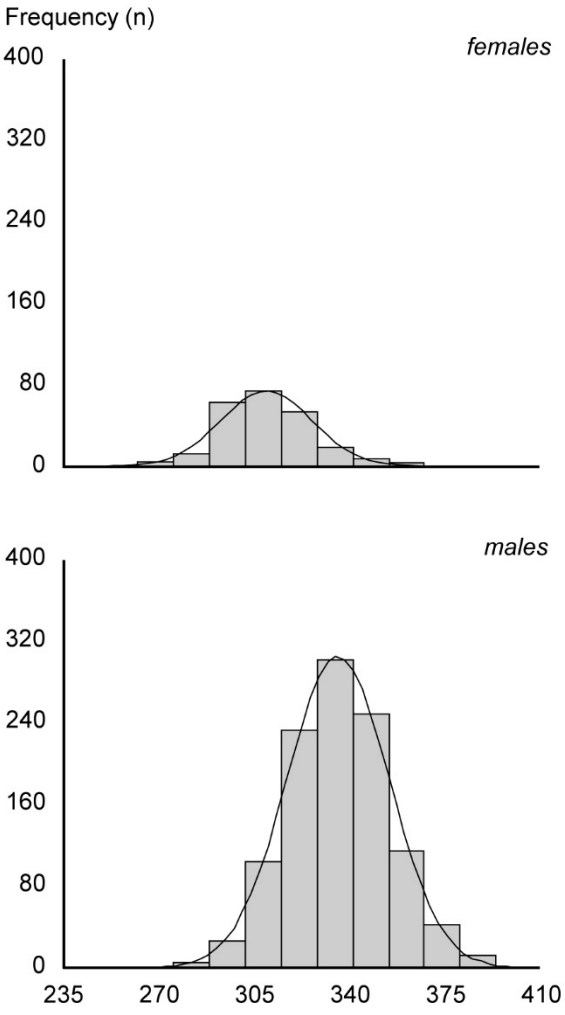
FEMALES	STATISTIC	MALES
223	*n*	1086
1050	*Mean*	1044
5.3	*SE (mean)*	2.3
79	*SD*	75
1363	*Maximum*	1316
901	*Minimum*	841
0.527	*Skewness*	0.308
0.371	*Kurtosis*	-0.084
7.5%	*Coefficient of variation*	7.2%
	Percentiles	
1251	P_{99}	1222
1213	P_{98}	1203
1201	P_{97}	1191
1183	P_{95}	1176
1158	P_{90}	1145
1130	P_{85}	1127
1113	P_{80}	1107
1100	P_{75}	1093
1090	P_{70}	1080
1080	P_{65}	1071
1066	P_{60}	1059
1056	P_{55}	1048
1045	P_{50}	1038
1035	P_{45}	1030
1025	P_{40}	1021
1012	P_{35}	1013
1001	P_{30}	1002
988	P_{25}	990
974	P_{20}	978
963	P_{15}	967
953	P_{10}	952
935	P_5	932
924	P_3	917
921	P_2	907
913	P_1	893



Acromion-Radiale Length (M60)

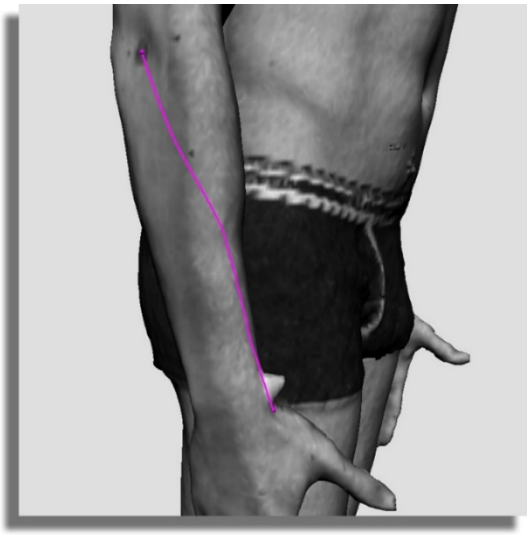
Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Acromion, Right and Radiale landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

FEMALES	STATISTIC	MALES
232	*n*	1088
309	*Mean*	336
1.1	*SE (mean)*	0.6
17	*SD*	19
362	*Maximum*	394
262	*Minimum*	280
0.336	*Skewness*	0.114
0.661	*Kurtosis*	-0.016
5.4%	*Coefficient of variation*	5.6%
	Percentiles	
354	P_{99}	381
349	P_{98}	377
347	P_{97}	373
339	P_{95}	368
330	P_{90}	359
325	P_{85}	355
322	P_{80}	351
319	P_{75}	348
316	P_{70}	345
314	P_{65}	343
311	P_{60}	340
310	P_{55}	338
308	P_{50}	336
307	P_{45}	333
304	P_{40}	331
302	P_{35}	328
300	P_{30}	325
299	P_{25}	322
296	P_{20}	319
294	P_{15}	316
291	P_{10}	312
284	P_{5}	306
281	P_{3}	301
278	P_{2}	299
270	P_{1}	294

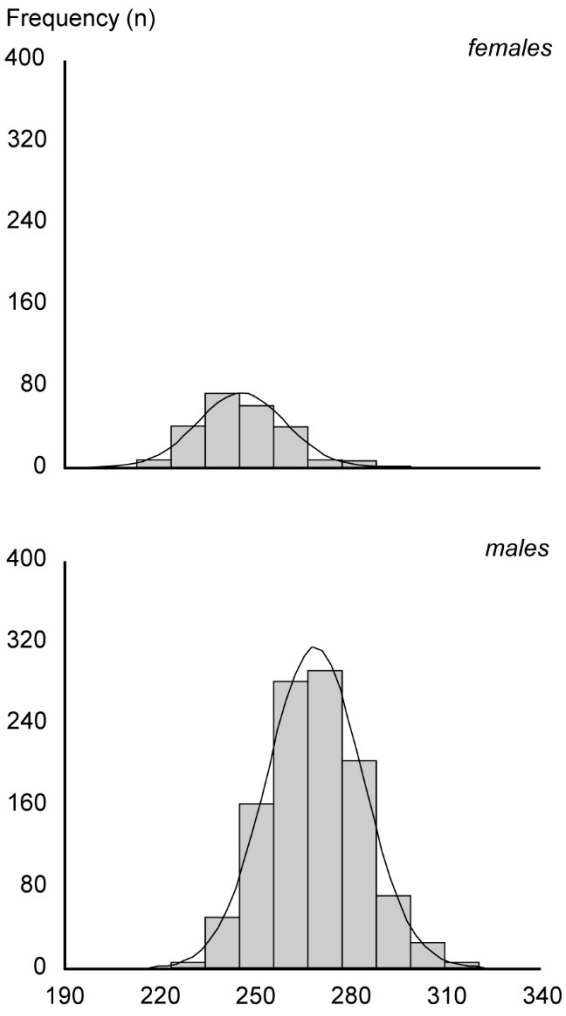


Radiale-Stylion Length (M61)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Radiale and Stylion landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

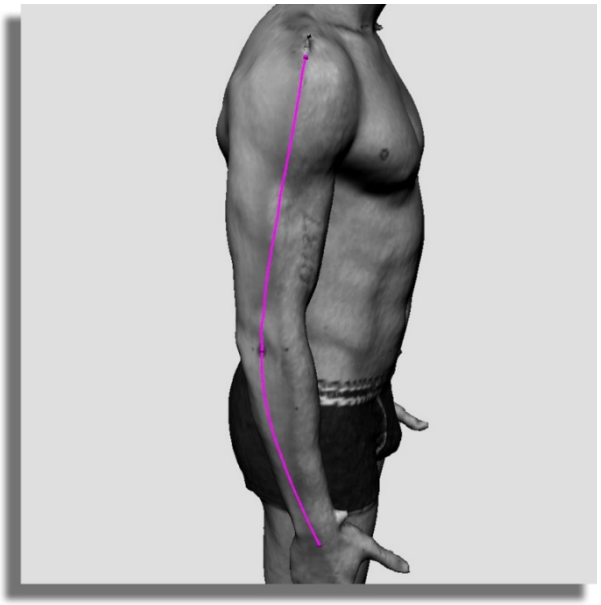


FEMALES	STATISTIC	MALES
232	*n*	1088
246	*Mean*	269
0.9	*SE (mean)*	0.5
14	*SD*	15
290	*Maximum*	320
213	*Minimum*	229
0.405	*Skewness*	0.204
0.213	*Kurtosis*	-0.101
5.6%	*Coefficient of variation*	5.5%
	Percentiles	
281	P_{99}	305
280	P_{98}	301
277	P_{97}	297
269	P_{95}	293
262	P_{90}	287
261	P_{85}	284
257	P_{80}	281
255	P_{75}	279
252	P_{70}	276
249	P_{65}	274
248	P_{60}	272
246	P_{55}	270
245	P_{50}	268
243	P_{45}	266
241	P_{40}	264
239	P_{35}	262
238	P_{30}	260
236	P_{25}	258
234	P_{20}	256
232	P_{15}	253
229	P_{10}	250
226	P_{5}	245
223	P_{3}	242
219	P_{2}	239
217	P_{1}	237

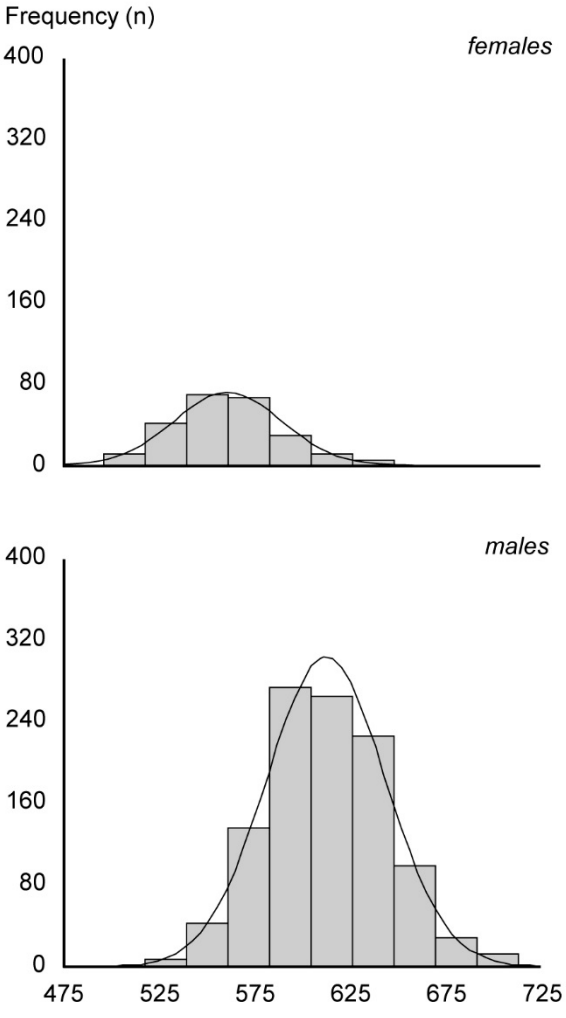


Sleeve Outseam (M62)

Posture: Anthropometric Standing.
Definition: The contour distance between the digitally-extracted Acromion, Right and Centre Wrist Marker landmarks, passing over the Radiale landmark (mm).

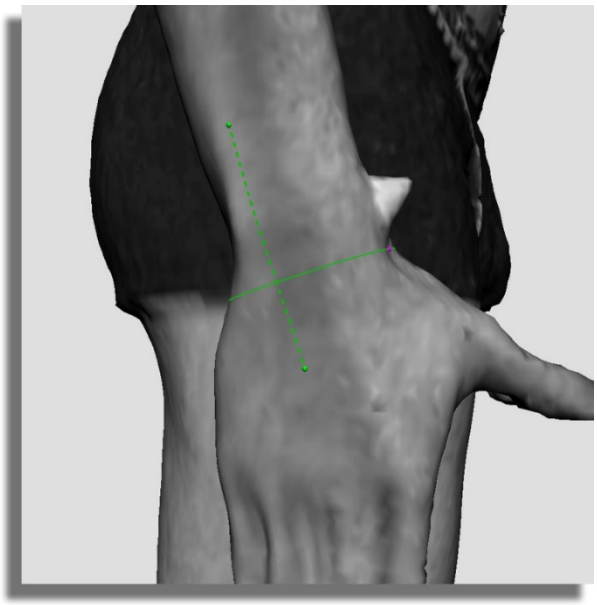


FEMALES	STATISTIC	MALES
232	*n*	1088
561	*Mean*	612
1.8	*SE (mean)*	0.9
28	*SD*	31
646	*Maximum*	713
496	*Minimum*	528
0.385	*Skewness*	0.172
0.193	*Kurtosis*	-0.080
5.0	*Coefficient of variation*	5.1
	Percentiles	
633	P_{99}	691
625	P_{98}	677
623	P_{97}	674
610	P_{95}	663
598	P_{90}	652
589	P_{85}	644
581	P_{80}	638
577	P_{75}	634
572	P_{70}	629
568	P_{65}	625
565	P_{60}	619
562	P_{55}	615
560	P_{50}	610
557	P_{45}	607
554	P_{40}	602
549	P_{35}	599
546	P_{30}	595
541	P_{25}	591
537	P_{20}	586
531	P_{15}	580
527	P_{10}	573
519	P_{5}	562
508	P_{3}	556
507	P_{2}	552
503	P_{1}	543

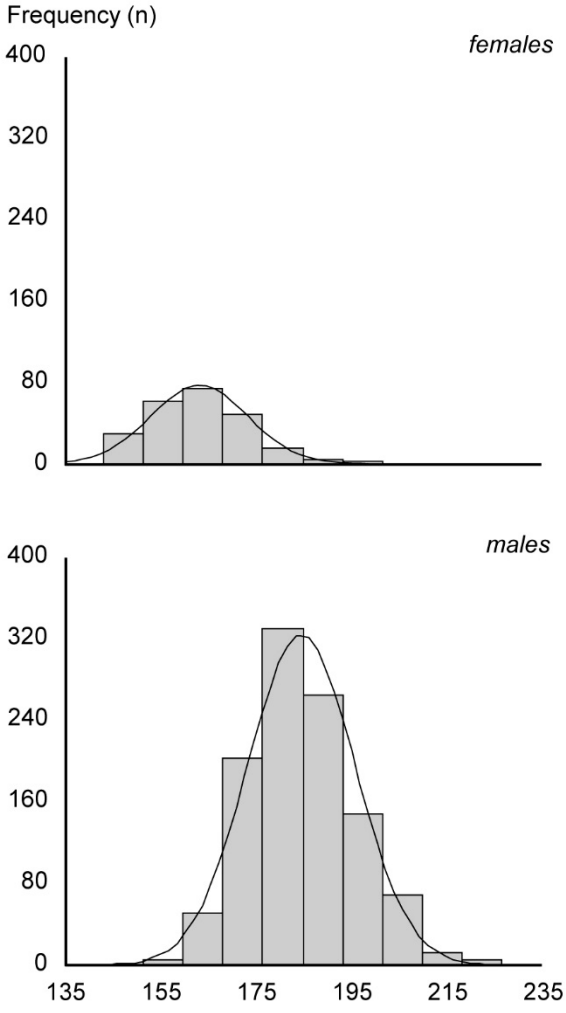


Wrist Circumference (M63)

Posture: Anthropometric Standing.
Definition: The circumference around the wrist at the height of the Stylion landmark, perpendicular to the long axis of the forearm (mm).

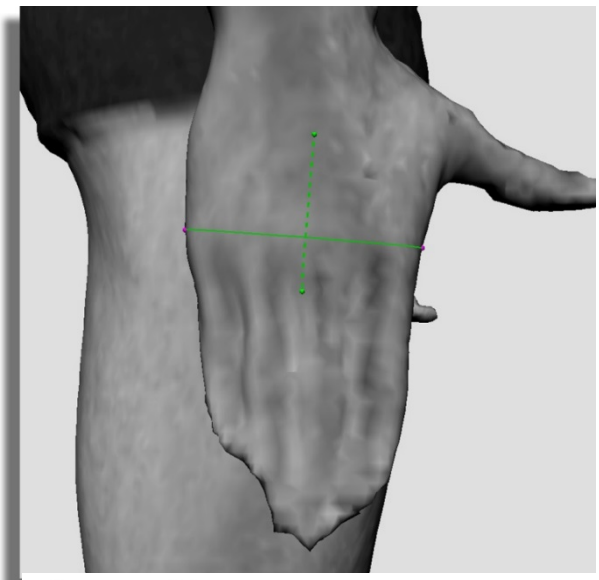


FEMALES	STATISTIC	MALES
232	*n*	1088
163	*Mean*	184
0.7	*SE (mean)*	0.3
10	*SD*	11
200	*Maximum*	227
143	*Minimum*	156
0.452	*Skewness*	0.374
0.526	*Kurtosis*	0.017
6.2%	*Coefficient of variation*	6.1%
	Percentiles	
190	P_{99}	213
187	P_{98}	208
185	P_{97}	206
179	P_{95}	204
176	P_{90}	200
173	P_{85}	197
171	P_{80}	194
170	P_{75}	191
168	P_{70}	190
166	P_{65}	188
165	P_{60}	186
164	P_{55}	185
162	P_{50}	183
161	P_{45}	182
160	P_{40}	181
159	P_{35}	179
158	P_{30}	178
156	P_{25}	176
155	P_{20}	175
153	P_{15}	173
150	P_{10}	171
147	P_{5}	167
145	P_{3}	165
144	P_{2}	163
143	P_{1}	162

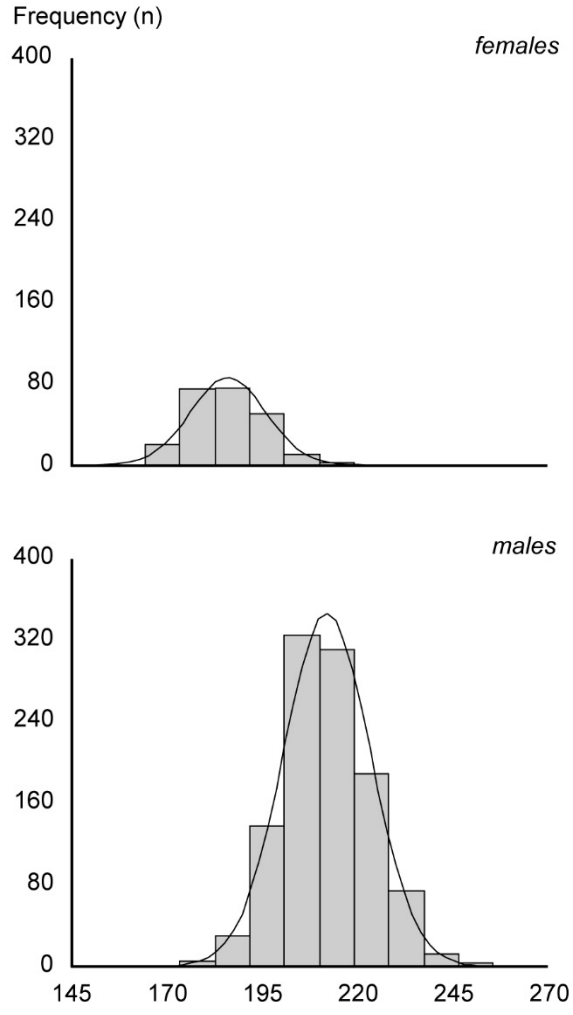


Hand Circumference (M64)

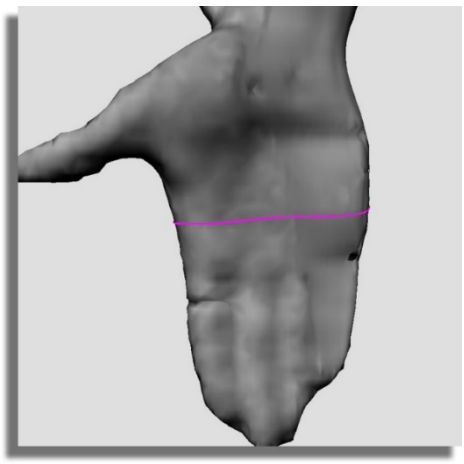
Posture: Anthropometric Standing.
Definition: The circumference around the hand that passes over the digital Metacarpale, II and Metacarpale, V landmarks (mm).



FEMALES	STATISTIC	MALES
231	*n*	1086
186	*Mean*	212
0.6	*SE (mean)*	0.3
10	*SD*	11
219	*Maximum*	256
164	*Minimum*	178
0.434	*Skewness*	0.169
0.174	*Kurtosis*	0.085
5.3%	*Coefficient of variation*	5.4%
	Percentiles	
210	P_{99}	240
209	P_{98}	236
206	P_{97}	234
201	P_{95}	232
200	P_{90}	227
196	P_{85}	224
194	P_{80}	222
192	P_{75}	219
191	P_{70}	218
190	P_{65}	216
189	P_{60}	214
187	P_{55}	213
186	P_{50}	212
185	P_{45}	210
183	P_{40}	209
181	P_{35}	207
180	P_{30}	206
179	P_{25}	204
178	P_{20}	202
176	P_{15}	200
174	P_{10}	198
171	P_{5}	194
169	P_{3}	192
169	P_{2}	189
168	P_{1}	186

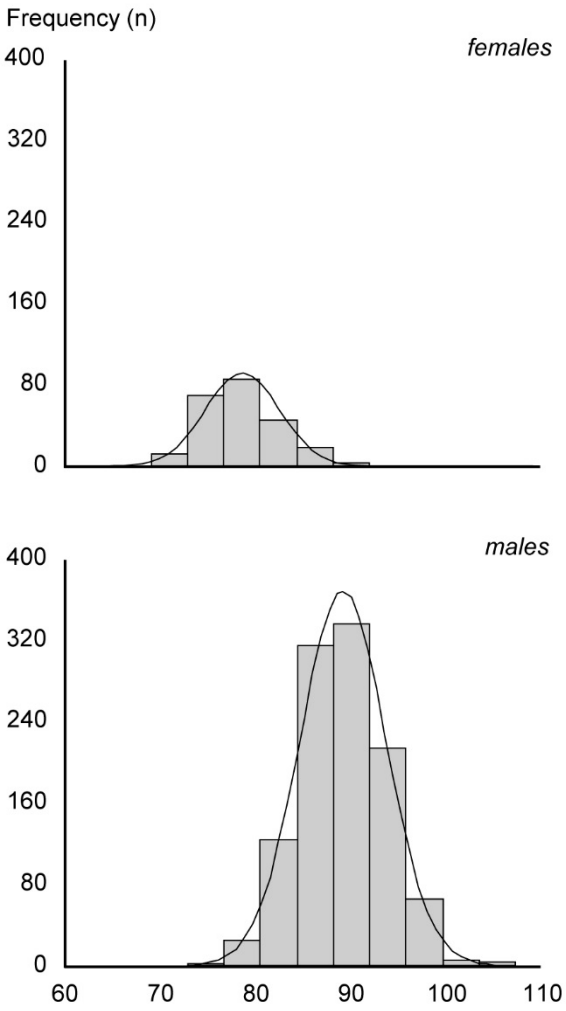


Hand Breadth (M65)
(PECCF data available)



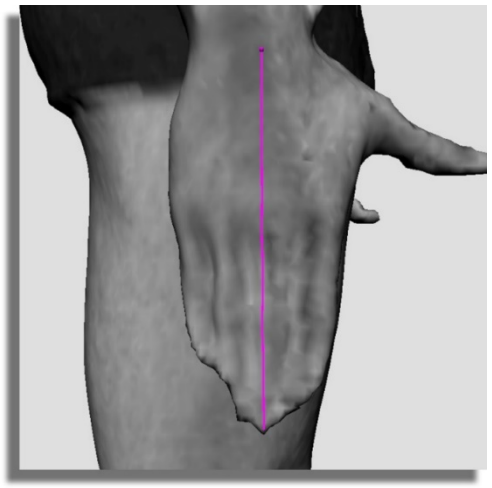
Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Metacarpale, II and Metacarpale, V landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

FEMALES	STATISTIC	MALES
232	*n*	1087
79	*Mean*	89
0.3	*SE (mean)*	0.1
4	*SD*	5
91	*Maximum*	107
69	*Minimum*	74
0.395	*Skewness*	0.144
0.061	*Kurtosis*	0.205
4.9%	*Coefficient of variation*	5.1%
	Percentiles	
88	P_{99}	99
87	P_{98}	98
86	P_{97}	98
85	P_{95}	96
84	P_{90}	95
83	P_{85}	94
82	P_{80}	93
81	P_{75}	92
80	P_{70}	91
80	P_{65}	91
79	P_{60}	90
79	P_{55}	90
78	P_{50}	89
78	P_{45}	88
77	P_{40}	88
77	P_{35}	87
76	P_{30}	87
76	P_{25}	86
75	P_{20}	85
75	P_{15}	84
74	P_{10}	84
73	P_{5}	82
72	P_{3}	81
71	P_{2}	80
71	P_{1}	79

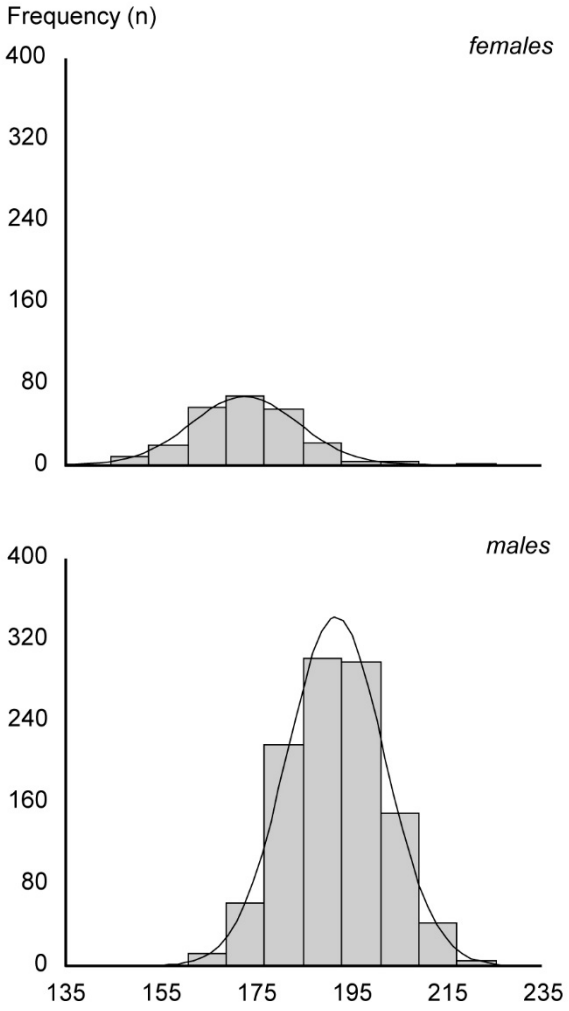


Hand Length (M66)
(PECCF data available)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Centre Wrist Marker and Dactylion, III landmarks. [Note, despite the figure appearing as a surface distance, CySlice actually extracts this measurement as a point-to-point distance] (mm).

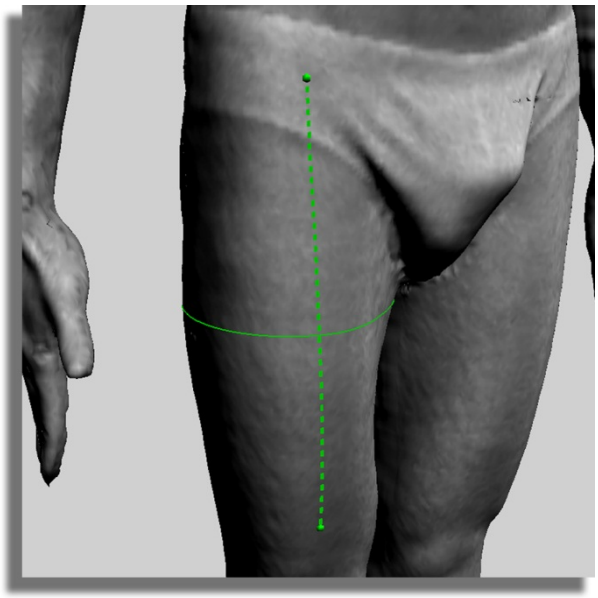


FEMALES	STATISTIC	MALES
232	*n*	1088
172	*Mean*	192
0.7	*SE (mean)*	0.3
11	*SD*	10
217	*Maximum*	225
144	*Minimum*	163
0.336	*Skewness*	0.093
0.882	*Kurtosis*	-0.136
6.5%	*Coefficient of variation*	5.3%
	Percentiles	
203	P_{99}	215
195	P_{98}	213
193	P_{97}	211
191	P_{95}	208
187	P_{90}	205
183	P_{85}	203
181	P_{80}	200
179	P_{75}	199
178	P_{70}	197
177	P_{65}	195
175	P_{60}	194
174	P_{55}	193
172	P_{50}	192
171	P_{45}	190
170	P_{40}	189
168	P_{35}	188
166	P_{30}	186
165	P_{25}	184
163	P_{20}	183
162	P_{15}	181
160	P_{10}	179
154	P_{5}	175
151	P_{3}	173
149	P_{2}	171
148	P_{1}	168

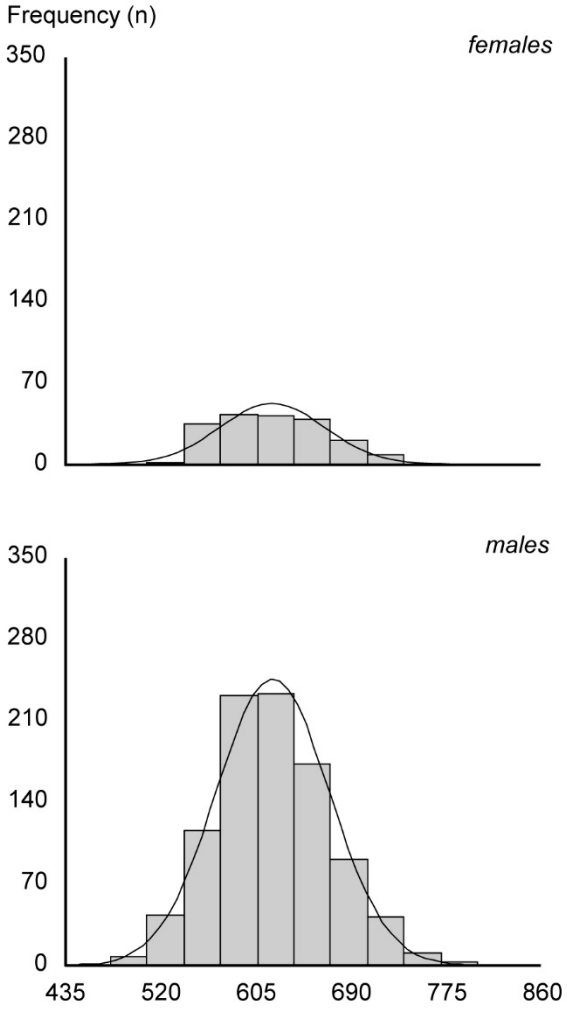


Thigh Circumference (M67)

Posture: Anthropometric Standing.
Definition: The maximum circumference of the thigh (measured perpendicular to the long axis of the leg) between the Trochanterion landmark and the Lateral Femoral Epicondyle, Standing landmark (mm).

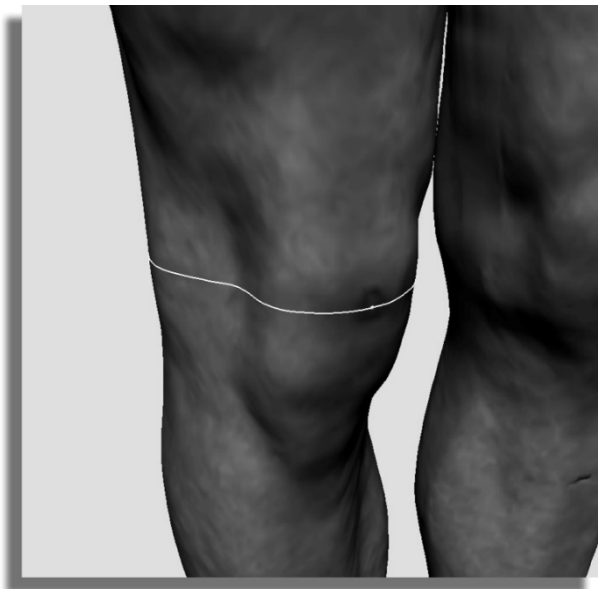


FEMALES	STATISTIC	MALES
184	*n*	948
619	*Mean*	620
3.4	*SE (mean)*	1.6
47	*SD*	50
731	*Maximum*	802
526	*Minimum*	475
0.319	*Skewness*	0.301
-0.664	*Kurtosis*	0.119
7.5%	*Coefficient of variation*	8.1%
	Percentiles	
728	P_{99}	747
721	P_{98}	732
716	P_{97}	722
698	P_{95}	709
683	P_{90}	687
671	P_{85}	672
660	P_{80}	658
653	P_{75}	650
649	P_{70}	643
640	P_{65}	637
630	P_{60}	631
622	P_{55}	624
614	P_{50}	617
610	P_{45}	610
603	P_{40}	605
594	P_{35}	599
586	P_{30}	591
582	P_{25}	586
577	P_{20}	578
567	P_{15}	570
560	P_{10}	560
553	P_5	539
550	P_3	532
547	P_2	524
545	P_1	513

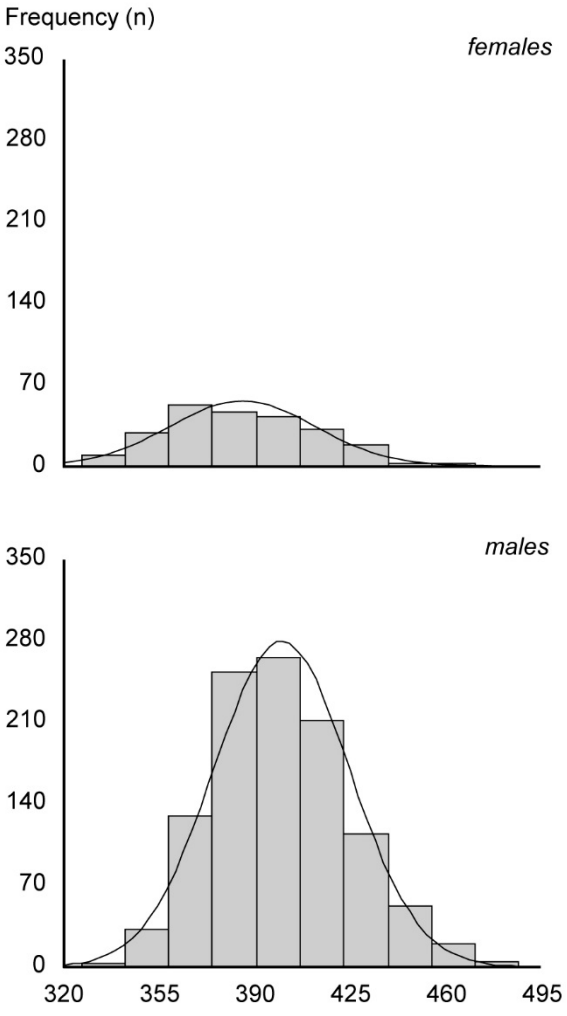


Knee Circumference (M68)

Posture: Anthropometric Standing.
Definition: The circumference of the knee at the height of the digitally-extracted Midpatella landmark (mm).

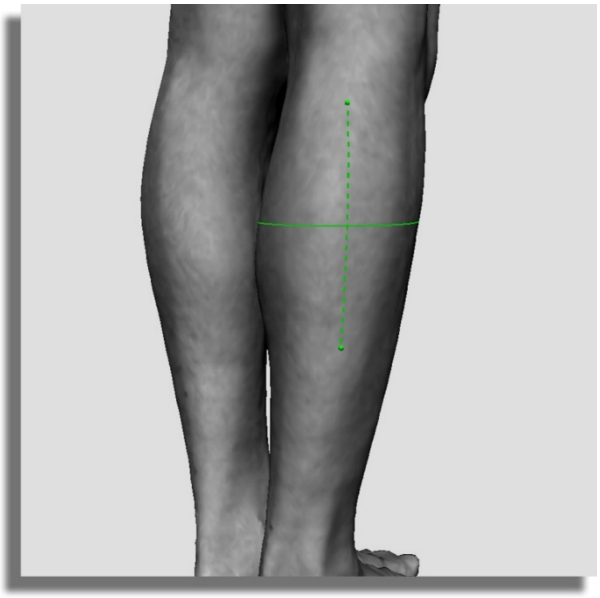


FEMALES	STATISTIC	MALES
230	*n*	1084
387	*Mean*	402
1.8	*SE (mean)*	0.8
27	*SD*	26
471	*Maximum*	491
327	*Minimum*	339
0.269	*Skewness*	0.347
-0.429	*Kurtosis*	-0.071
7.1%	*Coefficient of variation*	6.4%
	Percentiles	
445	P_{99}	466
439	P_{98}	459
437	P_{97}	454
430	P_{95}	448
425	P_{90}	436
419	P_{85}	429
412	P_{80}	423
407	P_{75}	419
403	P_{70}	414
397	P_{65}	411
394	P_{60}	407
390	P_{55}	403
386	P_{50}	400
381	P_{45}	397
377	P_{40}	393
374	P_{35}	391
371	P_{30}	387
366	P_{25}	384
363	P_{20}	380
358	P_{15}	376
352	P_{10}	370
346	P_{5}	363
342	P_{3}	359
340	P_{2}	355
338	P_{1}	351

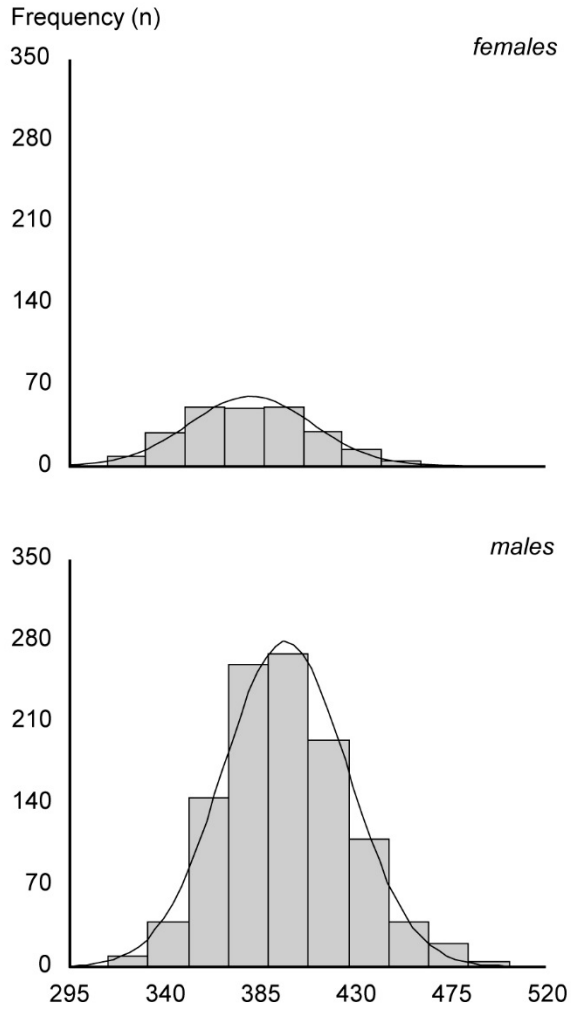


Calf Circumference (M69)

Posture: Anthropometric Standing.
Definition: The maximum horizontal circumference of the lower leg segment (mm).

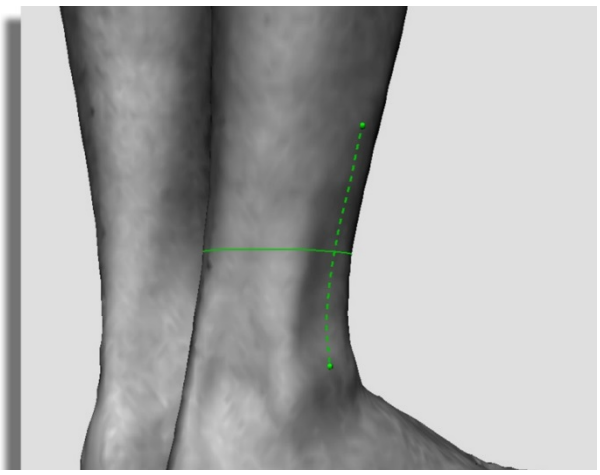


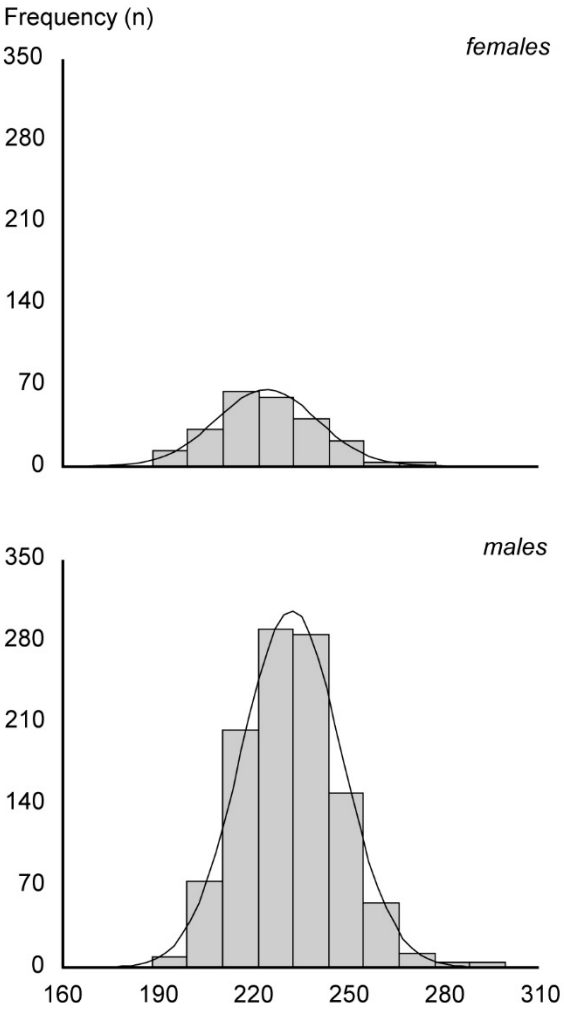
FEMALES	STATISTIC	MALES
232	*n*	1088
382	*Mean*	396
1.9	*SE (mean)*	0.9
30	*SD*	29
454	*Maximum*	502
321	*Minimum*	313
0.175	*Skewness*	0.315
-0.607	*Kurtosis*	0.104
7.7%	*Coefficient of variation*	7.4%
	Percentiles	
450	P_{99}	470
442	P_{98}	466
440	P_{97}	457
432	P_{95}	447
420	P_{90}	436
416	P_{85}	427
408	P_{80}	421
404	P_{75}	416
399	P_{70}	411
394	P_{65}	405
390	P_{60}	401
385	P_{55}	398
381	P_{50}	395
378	P_{45}	391
372	P_{40}	387
368	P_{35}	384
364	P_{30}	380
361	P_{25}	376
354	P_{20}	371
350	P_{15}	367
343	P_{10}	361
337	P_{5}	352
330	P_{3}	345
328	P_{2}	341
326	P_{1}	336



Ankle Circumference (M70)

Posture: Anthropometric Standing.
Definition: The minimum horizontal circumference above the digitally-extracted Lateral Malleolus landmark and below the level of the Maximum Calf Circumference (mm).

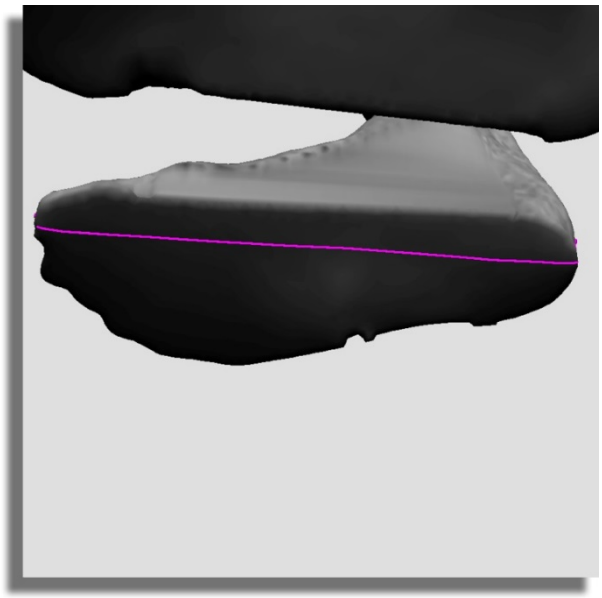




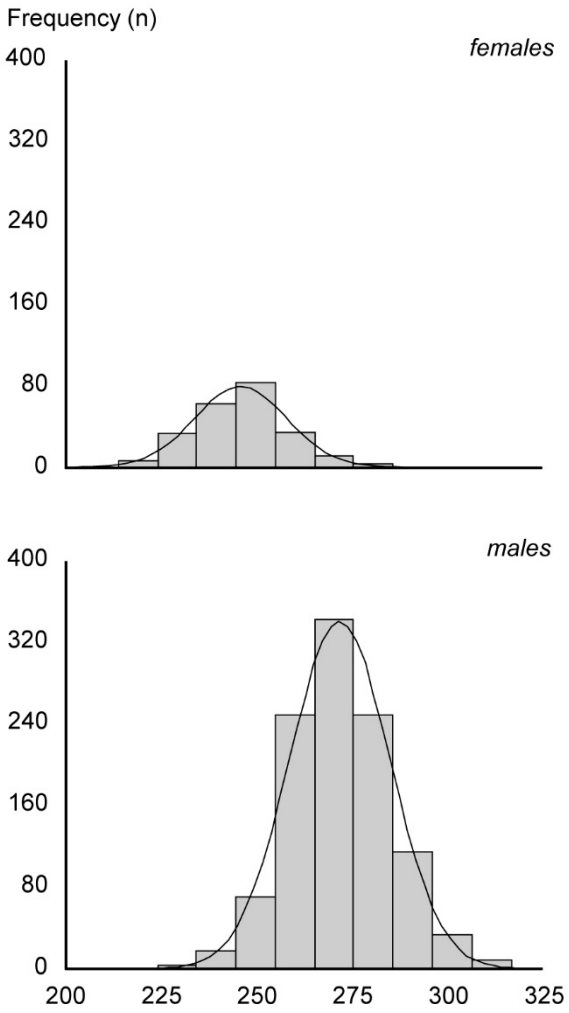
FEMALES	STATISTIC	MALES
232	*n*	1088
224	*Mean*	232
1.0	*SE (mean)*	0.5
16	*SD*	16
273	*Maximum*	299
191	*Minimum*	188
0.329	*Skewness*	0.414
-0.136	*Kurtosis*	0.539
7.1%	*Coefficient of variation*	6.8%
	Percentiles	
265	P_{99}	273
259	P_{98}	266
253	P_{97}	263
249	P_{95}	258
245	P_{90}	253
241	P_{85}	248
237	P_{80}	244
235	P_{75}	242
232	P_{70}	239
230	P_{65}	237
229	P_{60}	235
225	P_{55}	233
223	P_{50}	231
221	P_{45}	230
219	P_{40}	228
217	P_{35}	225
215	P_{30}	223
213	P_{25}	221
210	P_{20}	218
207	P_{15}	216
204	P_{10}	213
199	P_{5}	208
198	P_{3}	205
197	P_{2}	203
195	P_{1}	201

Foot Length (M71)

Posture: Anthropometric Standing.
Definition: The point-to-point distance between the digitally-extracted Acropodion and Pternion landmarks (mm).

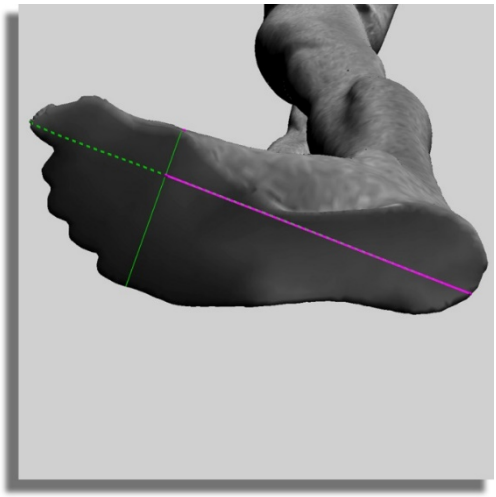


FEMALES	STATISTIC	MALES
232	*n*	1087
246	*Mean*	271
0.8	*SE (mean)*	0.4
12	*SD*	13
280	*Maximum*	316
214	*Minimum*	224
0.196	*Skewness*	0.150
0.130	*Kurtosis*	0.138
4.9%	*Coefficient of variation*	4.8%
	Percentiles	
275	P_{99}	303
273	P_{98}	300
271	P_{97}	297
267	P_{95}	294
261	P_{90}	288
258	P_{85}	285
255	P_{80}	283
253	P_{75}	280
251	P_{70}	278
250	P_{65}	276
248	P_{60}	274
246	P_{55}	273
245	P_{50}	271
245	P_{45}	269
243	P_{40}	268
241	P_{35}	266
240	P_{30}	264
238	P_{25}	262
237	P_{20}	261
233	P_{15}	258
229	P_{10}	255
226	P_{5}	252
224	P_{3}	248
223	P_{2}	245
221	P_{1}	242

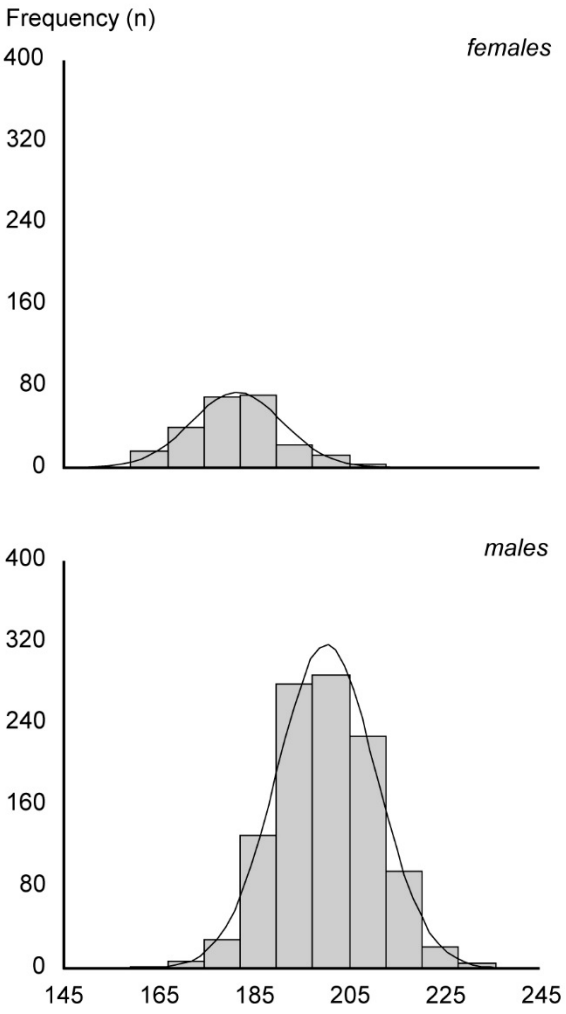


Ball of Foot Length (M72)

Posture: Anthropometric Standing.
Definition: The distance along a line between Acropodion and Pternion, between the Pternion and intersection of a line drawn through the First Metatarsophalangeal Protrusion landmark perpendicular to the line between Acropodion and Pternion (mm).

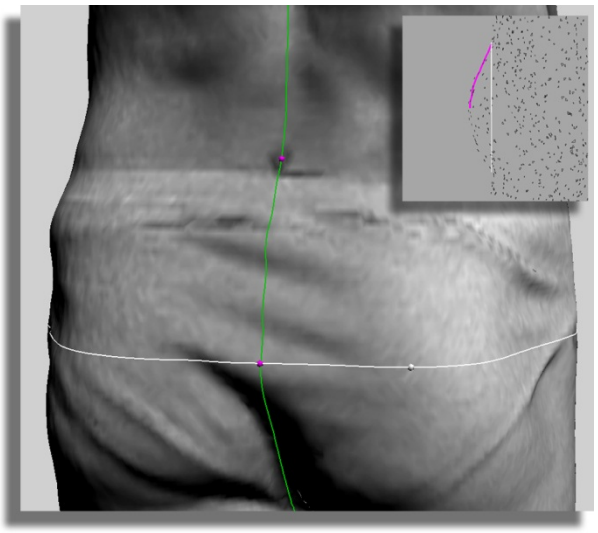


FEMALES	STATISTIC	MALES
232	*n*	1085
181	*Mean*	200
0.6	*SE (mean)*	0.3
10	*SD*	10
212	*Maximum*	235
159	*Minimum*	166
0.283	*Skewness*	0.048
0.159	*Kurtosis*	0.080
5.3%	*Coefficient of variation*	5.2%
	Percentiles	
205	P_{99}	225
203	P_{98}	221
202	P_{97}	219
199	P_{95}	217
193	P_{90}	214
190	P_{85}	211
189	P_{80}	209
187	P_{75}	207
186	P_{70}	206
185	P_{65}	204
184	P_{60}	203
182	P_{55}	201
181	P_{50}	199
180	P_{45}	198
179	P_{40}	197
178	P_{35}	196
176	P_{30}	195
175	P_{25}	193
173	P_{20}	191
171	P_{15}	189
170	P_{10}	187
165	P_{5}	183
165	P_{3}	182
164	P_{2}	179
162	P_{1}	176

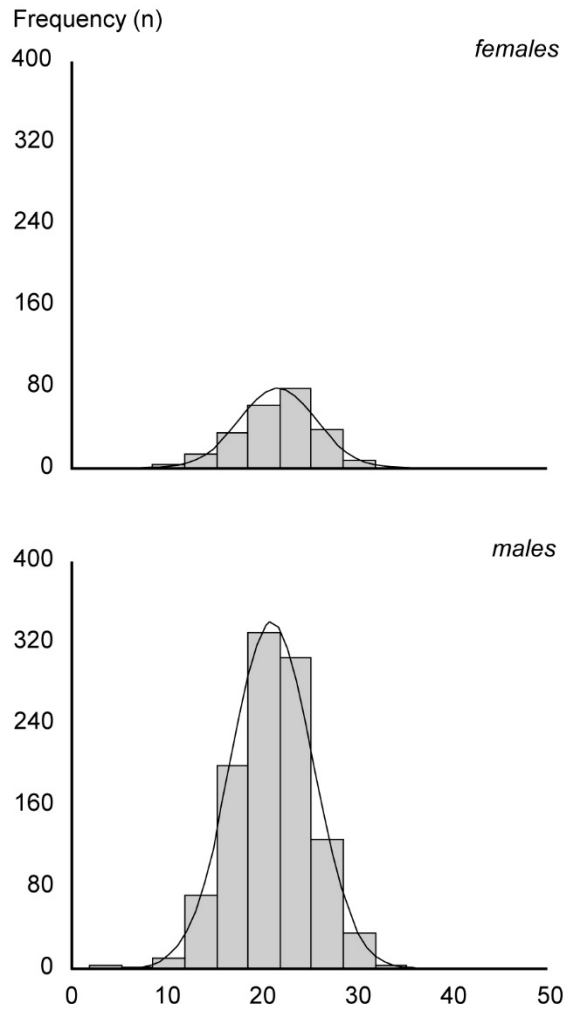


Seat Angle (M73)

Posture: Anthropometric Standing.
Definition: A two-dimensional angle in the anterior–posterior plane, defined by a vertical line and a line between the Buttock Point, Posterior landmark and the Waist Preferred, Posterior landmark (°).

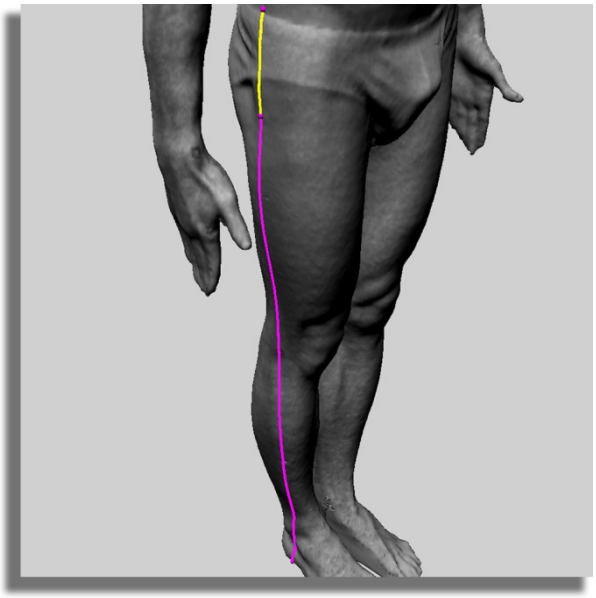


FEMALES	STATISTIC	MALES
232	*n*	1088
22	*Mean*	21
0.3	*SE (mean)*	0.3
4	*SD*	4
31	*Maximum*	35
10	*Minimum*	2
-0.317	*Skewness*	-0.321
-0.166	*Kurtosis*	1.020
18.4%	*Coefficient of variation*	20.3%
	Percentiles	
30	P_{99}	31
29	P_{98}	30
28	P_{97}	29
28	P_{95}	28
27	P_{90}	26
26	P_{85}	25
25	P_{80}	24
24	P_{75}	24
24	P_{70}	23
23	P_{65}	23
23	P_{60}	22
23	P_{55}	22
22	P_{50}	21
22	P_{45}	21
21	P_{40}	20
20	P_{35}	20
20	P_{30}	19
19	P_{25}	18
18	P_{20}	18
17	P_{15}	17
16	P_{10}	16
15	P_5	14
14	P_3	13
13	P_2	12
12	P_1	11

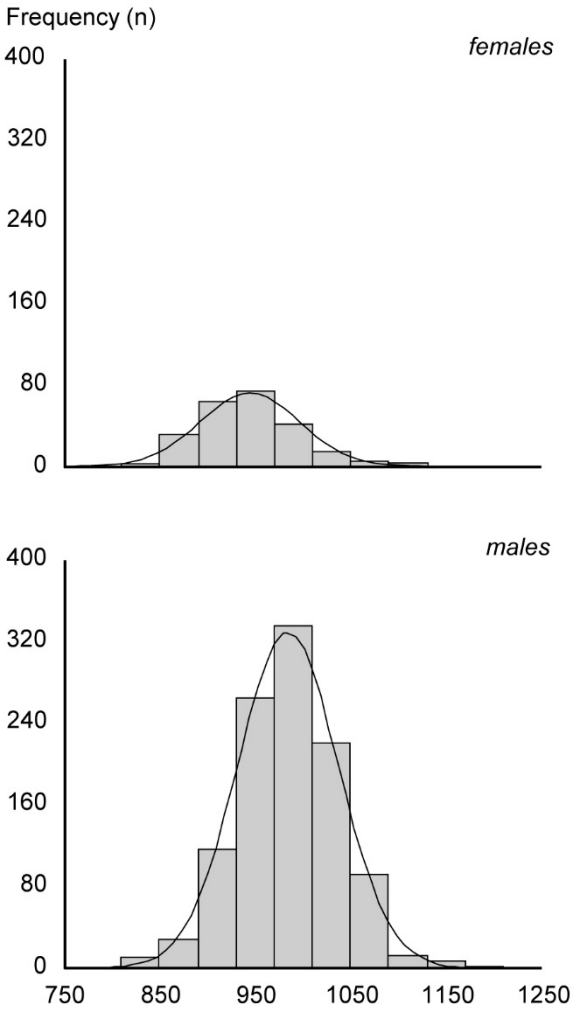


Outside Leg Length (M74)

Posture: Anthropometric Standing.
Definition: The sum of the Waist-Hip Distance and the Hip Level measurements (mm).

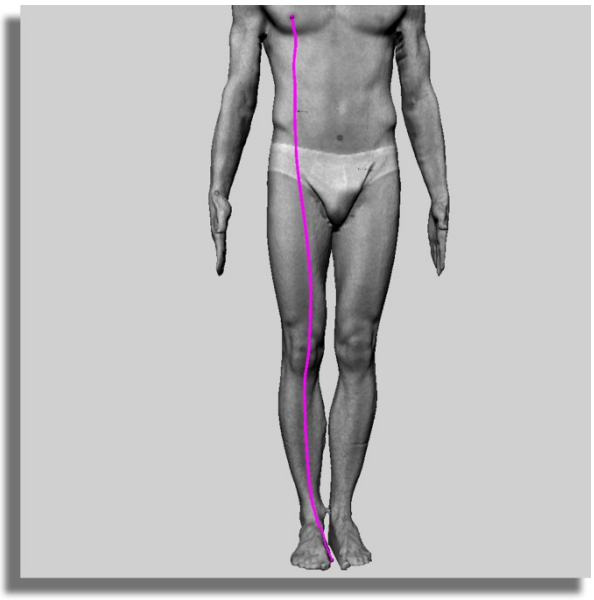


FEMALES	STATISTIC	MALES
232	*n*	1086
943	*Mean*	983
3.4	*SE (mean)*	1.6
52	*SD*	53
1128	*Maximum*	1208
845	*Minimum*	809
0.603	*Skewness*	0.018
0.631	*Kurtosis*	0.438
5.5%	*Coefficient of variation*	5.4%
	Percentiles	
1089	P_{99}	1111
1063	P_{98}	1086
1050	P_{97}	1079
1027	P_{95}	1065
1007	P_{90}	1050
998	P_{85}	1036
986	P_{80}	1028
973	P_{75}	1018
964	P_{70}	1010
959	P_{65}	1003
951	P_{60}	996
945	P_{55}	990
938	P_{50}	984
933	P_{45}	978
926	P_{40}	970
919	P_{35}	964
914	P_{30}	955
908	P_{25}	947
901	P_{20}	939
891	P_{15}	931
881	P_{10}	918
863	P_{5}	897
853	P_{3}	886
851	P_{2}	877
849	P_{1}	856

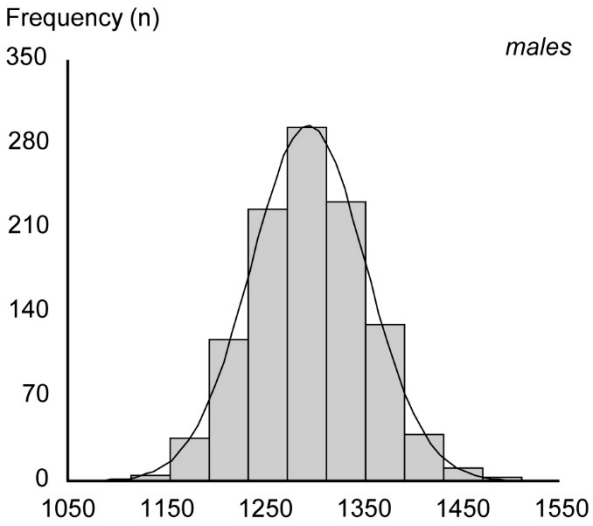


Chest Level (M75)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Thelion, Right landmark (males only) (mm).

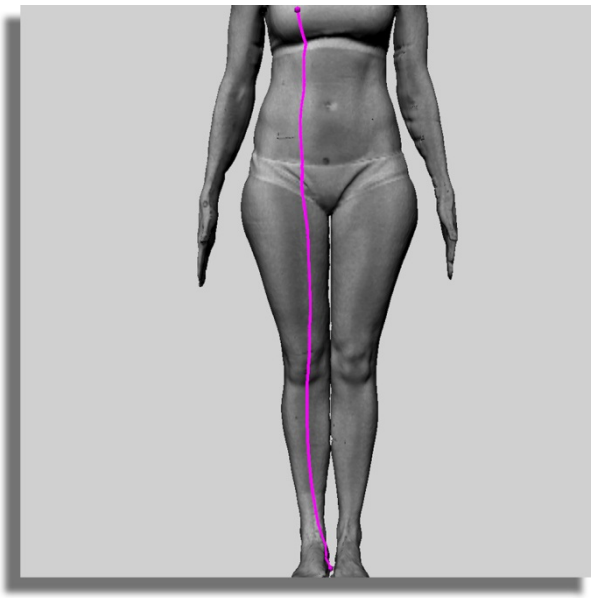


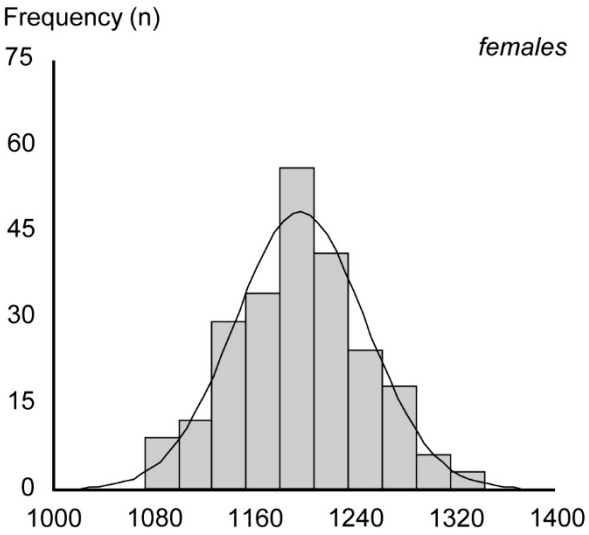
FEMALES	STATISTIC	MALES
NA	*n*	1088
NA	*Mean*	1294
NA	*SE (mean)*	1.8
NA	*SD*	58
NA	*Maximum*	1510
NA	*Minimum*	1113
NA	*Skewness*	0.129
NA	*Kurtosis*	0.053
NA	*Coefficient of variation*	4.5%
	Percentiles	
NA	P_{99}	1438
NA	P_{98}	1415
NA	P_{97}	1403
NA	P_{95}	1391
NA	P_{90}	1372
NA	P_{85}	1354
NA	P_{80}	1342
NA	P_{75}	1333
NA	P_{70}	1323
NA	P_{65}	1316
NA	P_{60}	1308
NA	P_{55}	1301
NA	P_{50}	1294
NA	P_{45}	1285
NA	P_{40}	1280
NA	P_{35}	1272
NA	P_{30}	1263
NA	P_{25}	1255
NA	P_{20}	1244
NA	P_{15}	1233
NA	P_{10}	1221
NA	P_{5}	1200
NA	P_{3}	1184
NA	P_{2}	1178
NA	P_{1}	1166



Bust Level (M76)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Bustpoint, Right landmark (females only) (mm).

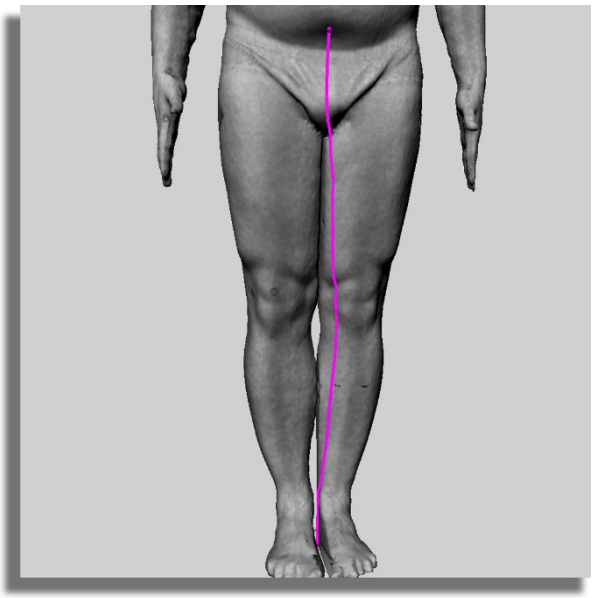




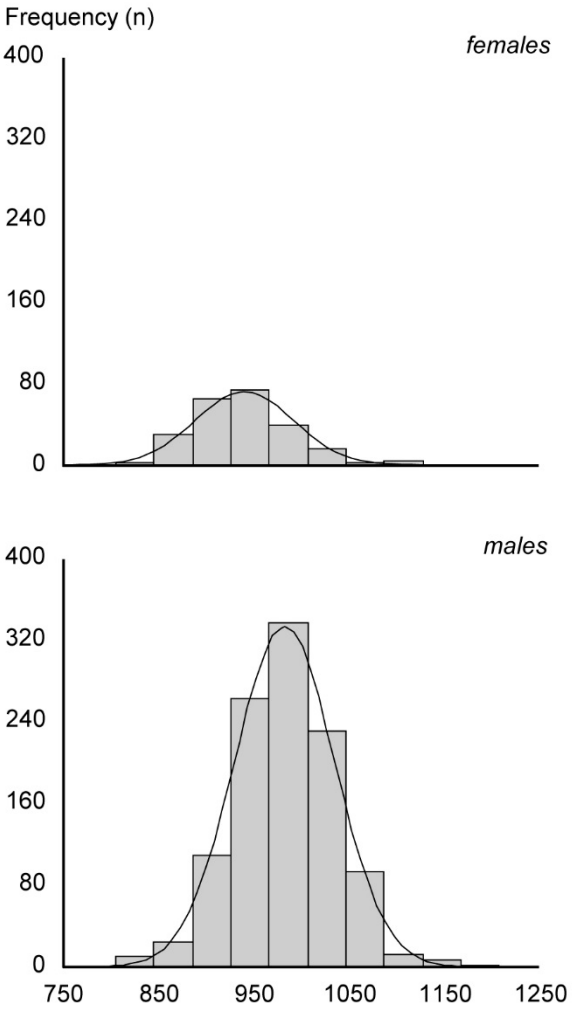
FEMALES	STATISTIC	MALES
232	*n*	NA
1196	*Mean*	NA
3.4	*SE (mean)*	NA
52	*SD*	NA
1342	*Maximum*	NA
1072	*Minimum*	NA
0.084	*Skewness*	NA
-0.092	*Kurtosis*	NA
4.3%	*Coefficient of variation*	NA
	Percentiles	
1318	P_{99}	NA
1307	P_{98}	NA
1297	P_{97}	NA
1282	P_{95}	NA
1265	P_{90}	NA
1249	P_{85}	NA
1238	P_{80}	NA
1229	P_{75}	NA
1222	P_{70}	NA
1214	P_{65}	NA
1207	P_{60}	NA
1201	P_{55}	NA
1196	P_{50}	NA
1189	P_{45}	NA
1185	P_{40}	NA
1178	P_{35}	NA
1170	P_{30}	NA
1163	P_{25}	NA
1150	P_{20}	NA
1143	P_{15}	NA
1131	P_{10}	NA
1112	P_{5}	NA
1097	P_{3}	NA
1087	P_{2}	NA
1083	P_{1}	NA

Waist Level Centre Front (M77)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Waist Preferred, Anterior landmark (mm).

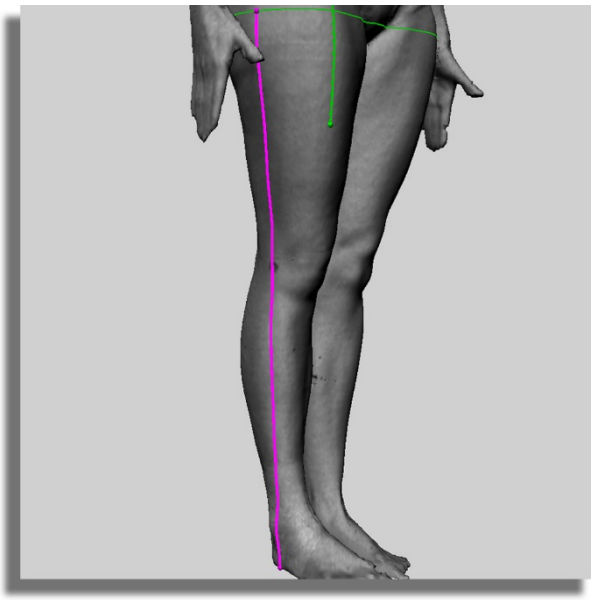


FEMALES	STATISTIC	MALES
232	*n*	1088
940	*Mean*	982
3.4	*SE (mean)*	1.6
52	*SD*	52
1124	*Maximum*	1207
828	*Minimum*	805
0.641	*Skewness*	0.021
0.901	*Kurtosis*	0.446
5.5%	*Coefficient of variation*	5.3%
	Percentiles	
1103	P_{99}	1110
1058	P_{98}	1084
1043	P_{97}	1078
1024	P_{95}	1064
1003	P_{90}	1048
994	P_{85}	1035
981	P_{80}	1026
969	P_{75}	1017
959	P_{70}	1009
955	P_{65}	1002
948	P_{60}	995
941	P_{55}	989
935	P_{50}	982
929	P_{45}	976
924	P_{40}	969
918	P_{35}	962
911	P_{30}	954
905	P_{25}	946
898	P_{20}	938
889	P_{15}	930
879	P_{10}	917
862	P_{5}	897
851	P_{3}	884
849	P_{2}	876
847	P_{1}	855

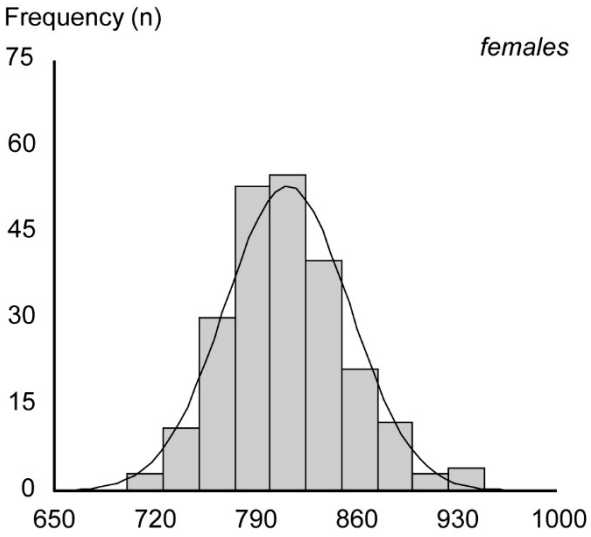


Hip Level (female) (M78)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the level at which the Maximum Hip Circumference measurement is established (females only) (mm).

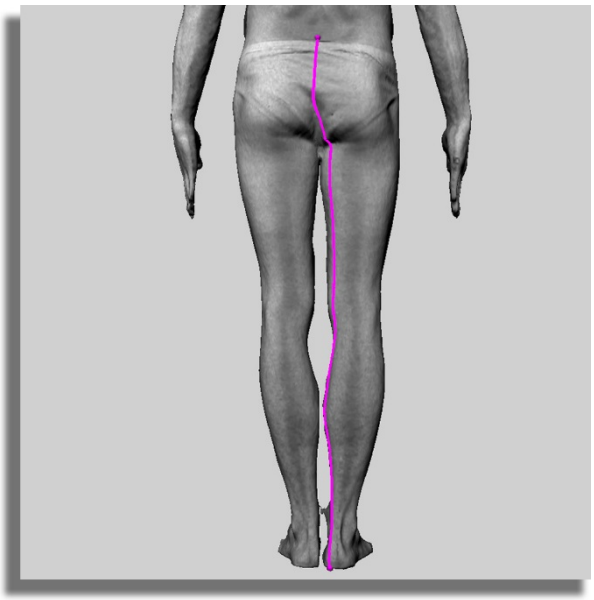


FEMALES	STATISTIC	MALES
232	*n*	NA
812	*Mean*	NA
2.8	*SE (mean)*	NA
43	*SD*	NA
948	*Maximum*	NA
701	*Minimum*	NA
0.472	*Skewness*	NA
0.459	*Kurtosis*	NA
5.3%	*Coefficient of variation*	NA
	Percentiles	
937	P_{99}	NA
912	P_{98}	NA
899	P_{97}	NA
888	P_{95}	NA
869	P_{90}	NA
854	P_{85}	NA
844	P_{80}	NA
836	P_{75}	NA
832	P_{70}	NA
824	P_{65}	NA
819	P_{60}	NA
815	P_{55}	NA
812	P_{50}	NA
804	P_{45}	NA
797	P_{40}	NA
794	P_{35}	NA
787	P_{30}	NA
783	P_{25}	NA
776	P_{20}	NA
767	P_{15}	NA
758	P_{10}	NA
749	P_{5}	NA
739	P_{3}	NA
736	P_{2}	NA
726	P_{1}	NA

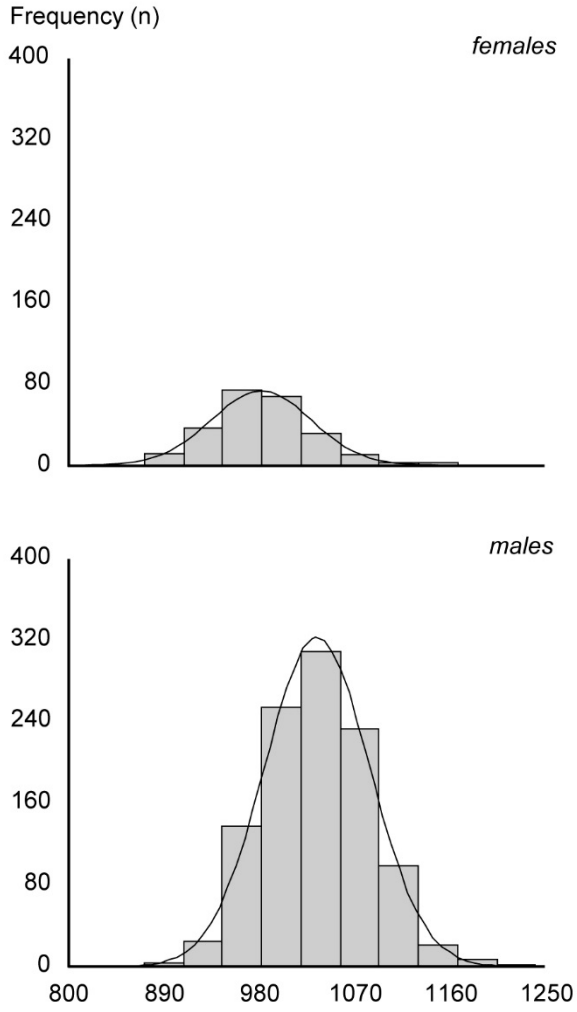


Waist Level Centre Back (M79)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Waist Preferred, Posterior landmark (mm).

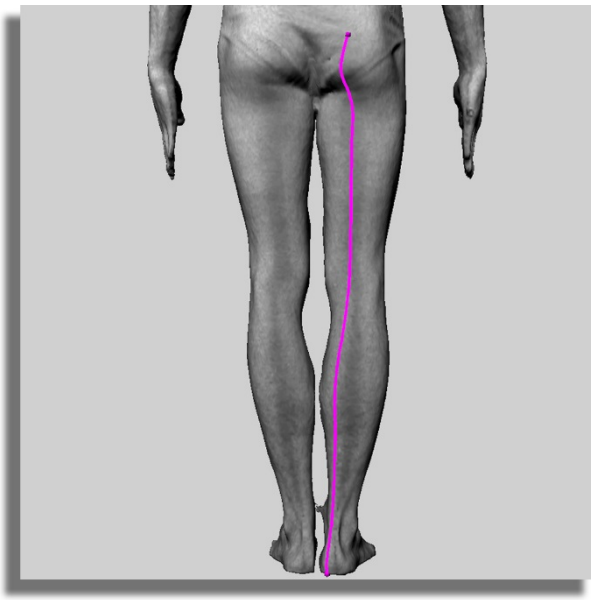


FEMALES	STATISTIC	MALES
232	*n*	1088
981	*Mean*	1034
3.1	*SE (mean)*	1.5
47	*SD*	50
1144	*Maximum*	1240
871	*Minimum*	877
0.511	*Skewness*	0.225
0.858	*Kurtosis*	0.244
4.8%	*Coefficient of variation*	4.8%
	Percentiles	
1128	P_{99}	1155
1085	P_{98}	1137
1077	P_{97}	1126
1061	P_{95}	1116
1043	P_{90}	1097
1029	P_{85}	1085
1015	P_{80}	1076
1004	P_{75}	1067
997	P_{70}	1061
992	P_{65}	1053
989	P_{60}	1046
984	P_{55}	1040
981	P_{50}	1034
974	P_{45}	1027
970	P_{40}	1021
964	P_{35}	1013
959	P_{30}	1006
951	P_{25}	999
944	P_{20}	991
932	P_{15}	982
921	P_{10}	969
909	P_5	956
902	P_3	949
896	P_2	942
883	P_1	932

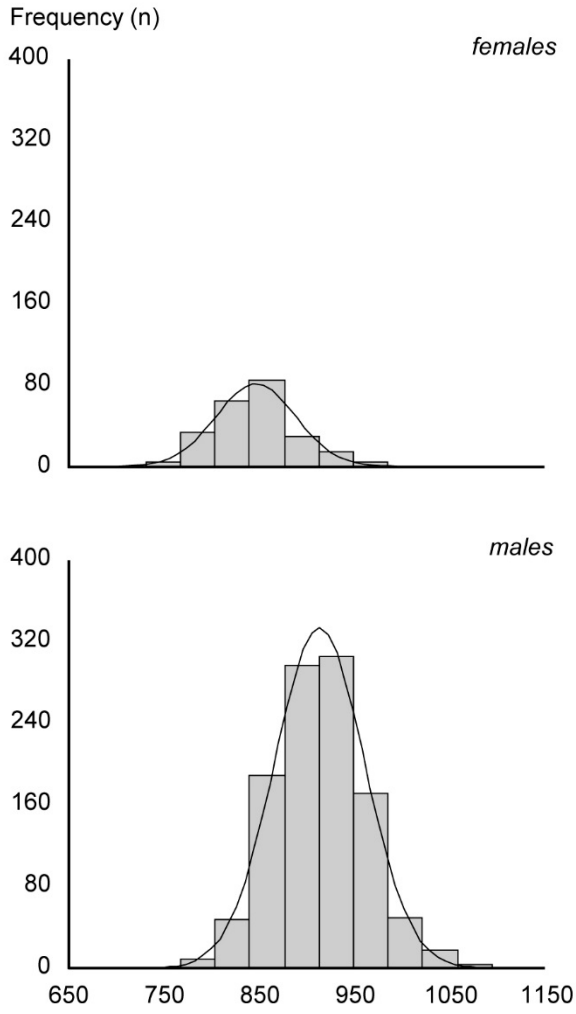


Seat Level (M80)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Buttock Point, Posterior landmark (mm).

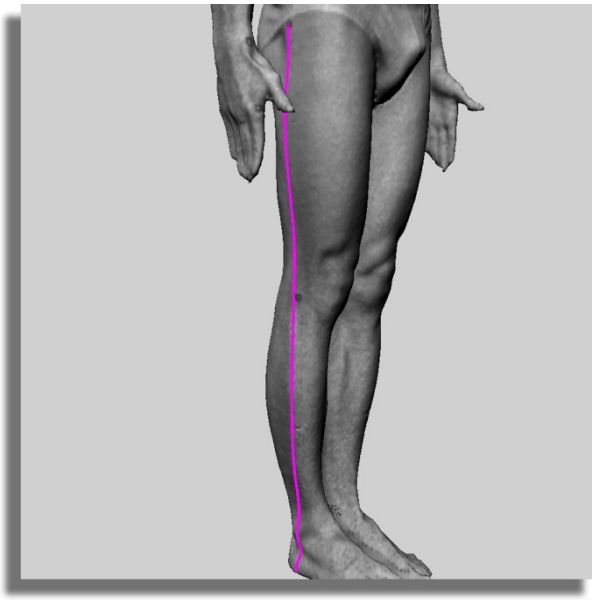


FEMALES	STATISTIC	MALES
232	*n*	1088
846	*Mean*	912
2.7	*SE (mean)*	1.4
41	*SD*	47
977	*Maximum*	1093
731	*Minimum*	780
0.305	*Skewness*	0.186
0.345	*Kurtosis*	0.089
4.9%	*Coefficient of variation*	5.2%
	Percentiles	
957	P_{99}	1030
938	P_{98}	1018
929	P_{97}	1003
920	P_{95}	991
897	P_{90}	972
884	P_{85}	960
876	P_{80}	951
870	P_{75}	944
864	P_{70}	937
859	P_{65}	931
854	P_{60}	925
850	P_{55}	918
845	P_{50}	913
841	P_{45}	904
836	P_{40}	898
831	P_{35}	893
825	P_{30}	886
822	P_{25}	880
811	P_{20}	871
802	P_{15}	865
793	P_{10}	853
782	P_5	839
774	P_3	827
771	P_2	821
761	P_1	810

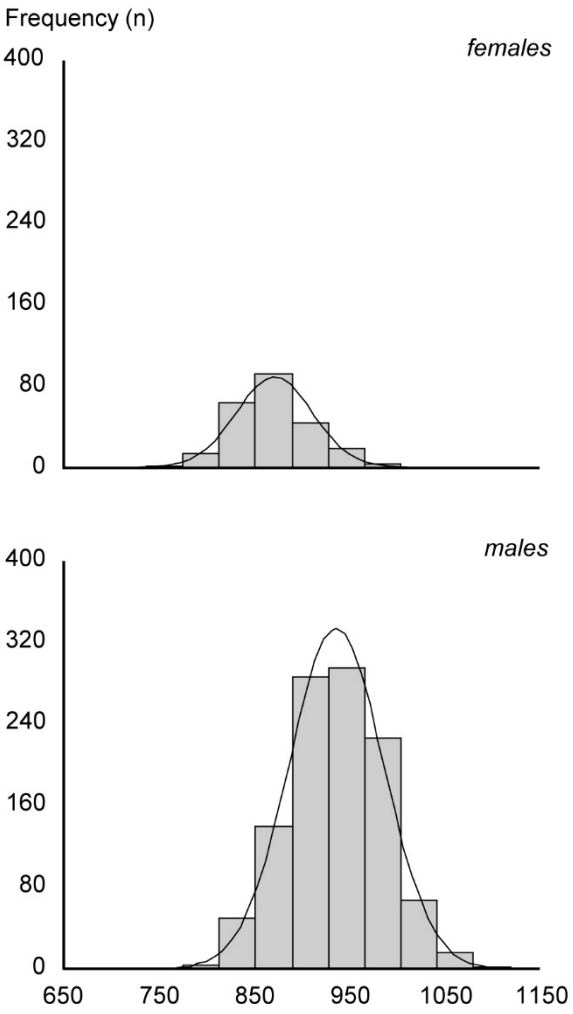


Trochanteric Height (M81)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally extracted Trochanterion landmark (mm).

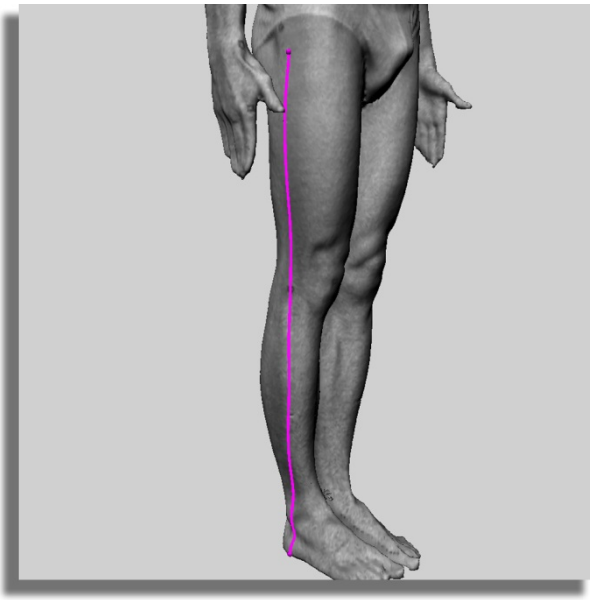


FEMALES	STATISTIC	MALES
232	*n*	1082
871	*Mean*	935
2.6	*SE (mean)*	1.5
40	*SD*	49
988	*Maximum*	1117
737	*Minimum*	795
0.239	*Skewness*	0.087
0.448	*Kurtosis*	-0.099
4.6%	*Coefficient of variation*	5.3%
	Percentiles	
974	P_{99}	1053
955	P_{98}	1036
951	P_{97}	1031
943	P_{95}	1015
923	P_{90}	997
909	P_{85}	986
901	P_{80}	977
891	P_{75}	969
887	P_{70}	962
884	P_{65}	955
880	P_{60}	948
876	P_{55}	940
870	P_{50}	934
863	P_{45}	928
857	P_{40}	922
853	P_{35}	914
848	P_{30}	907
843	P_{25}	901
838	P_{20}	894
834	P_{15}	885
824	P_{10}	873
811	P_{5}	854
806	P_{3}	844
794	P_{2}	835
785	P_{1}	826

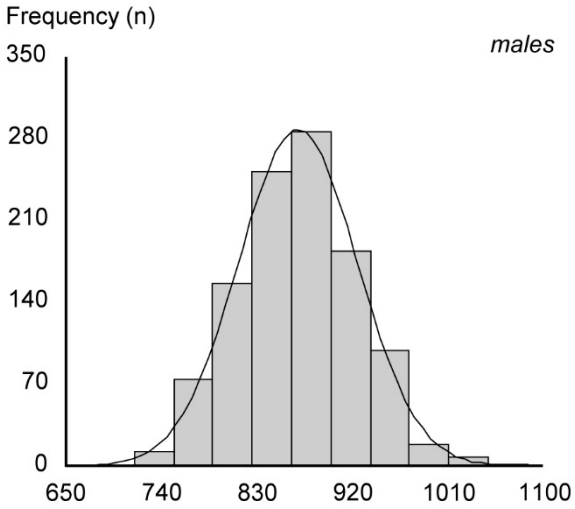


Hip Level (male) (M82)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Hip Marker landmark (males only) (mm).



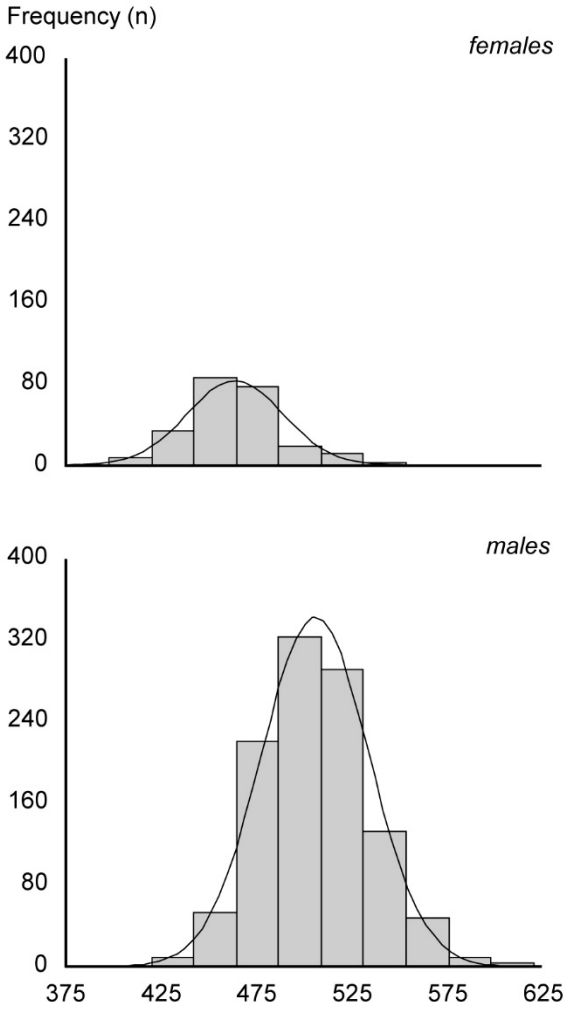
FEMALES	STATISTIC	MALES
NA	*n*	1088
NA	*Mean*	868
NA	*SE (mean)*	1.7
NA	*SD*	56
NA	*Maximum*	1084
NA	*Minimum*	714
NA	*Skewness*	0.050
NA	*Kurtosis*	-0.267
NA	*Coefficient of variation*	6.4%
	Percentiles	
NA	P_{99}	988
NA	P_{98}	980
NA	P_{97}	966
NA	P_{95}	956
NA	P_{90}	940
NA	P_{85}	930
NA	P_{80}	920
NA	P_{75}	909
NA	P_{70}	896
NA	P_{65}	888
NA	P_{60}	882
NA	P_{55}	876
NA	P_{50}	871
NA	P_{45}	862
NA	P_{40}	853
NA	P_{35}	845
NA	P_{30}	837
NA	P_{25}	830
NA	P_{20}	821
NA	P_{15}	806
NA	P_{10}	795
NA	P_{5}	779
NA	P_{3}	765
NA	P_{2}	758
NA	P_{1}	751



Knee Level (M83)

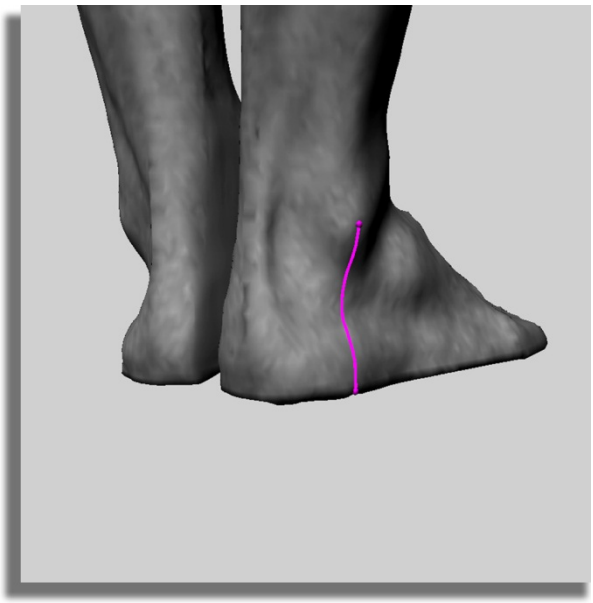
Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Midpatella landmark (mm).

FEMALES	STATISTIC	MALES
232	*n*	1088
464	*Mean*	506
1.6	*SE (mean)*	0.9
25	*SD*	28
534	*Maximum*	620
398	*Minimum*	432
0.385	*Skewness*	0.308
0.341	*Kurtosis*	0.202
5.4%	*Coefficient of variation*	5.6%
	Percentiles	
530	P_{99}	575
527	P_{98}	566
517	P_{97}	562
510	P_{95}	554
496	P_{90}	542
485	P_{85}	535
482	P_{80}	528
479	P_{75}	523
476	P_{70}	519
472	P_{65}	516
468	P_{60}	512
465	P_{55}	509
462	P_{50}	504
459	P_{45}	501
457	P_{40}	497
453	P_{35}	494
451	P_{30}	490
447	P_{25}	486
444	P_{20}	481
440	P_{15}	477
432	P_{10}	471
424	P_5	462
422	P_3	455
417	P_2	453
413	P_1	448

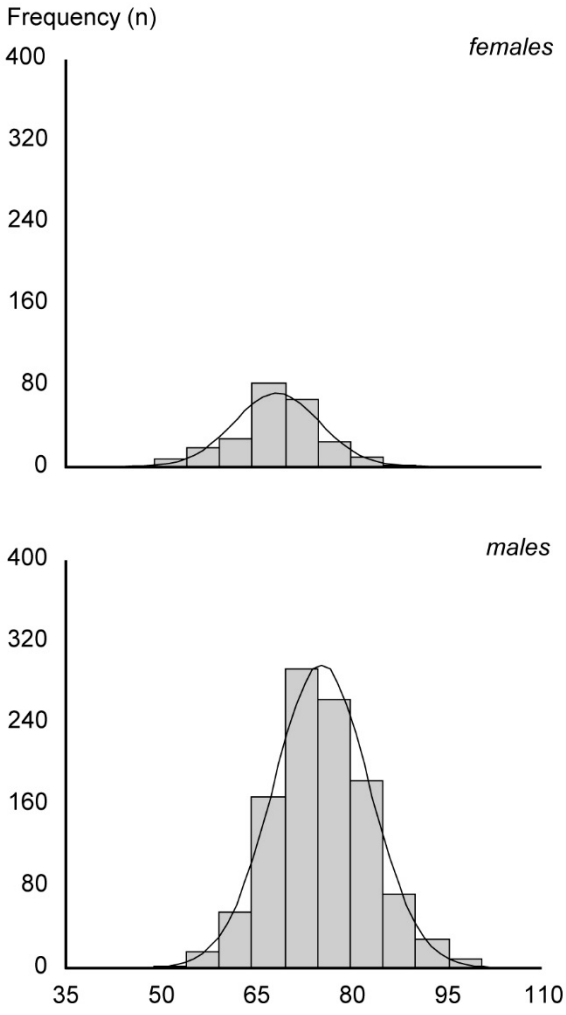


Ankle Height (M84)

Posture: Anthropometric Standing.
Definition: The vertical distance between the standing surface and the digitally-extracted Lateral Malleolus landmark (mm).

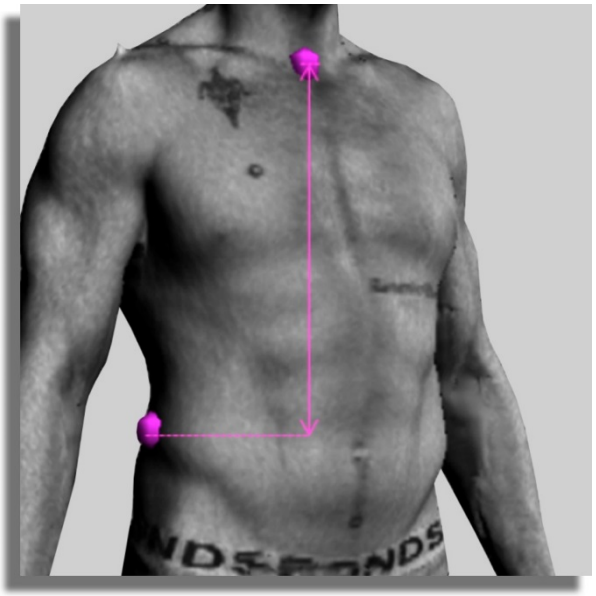


FEMALES	STATISTIC	MALES
232	*n*	1088
68	*Mean*	75
0.4	*SE (mean)*	0.2
7	*SD*	8
86	*Maximum*	100
49	*Minimum*	54
-0.274	*Skewness*	0.157
0.226	*Kurtosis*	0.140
9.8%	*Coefficient of variation*	10.0%
	Percentiles	
82	P_{99}	93
81	P_{98}	91
81	P_{97}	90
79	P_{95}	89
76	P_{90}	85
74	P_{85}	83
73	P_{80}	81
72	P_{75}	80
71	P_{70}	79
71	P_{65}	78
70	P_{60}	77
69	P_{55}	76
68	P_{50}	75
68	P_{45}	74
67	P_{40}	73
66	P_{35}	72
65	P_{30}	71
65	P_{25}	70
64	P_{20}	69
61	P_{15}	68
59	P_{10}	66
56	P_{5}	63
54	P_{3}	61
53	P_{2}	60
51	P_{1}	58

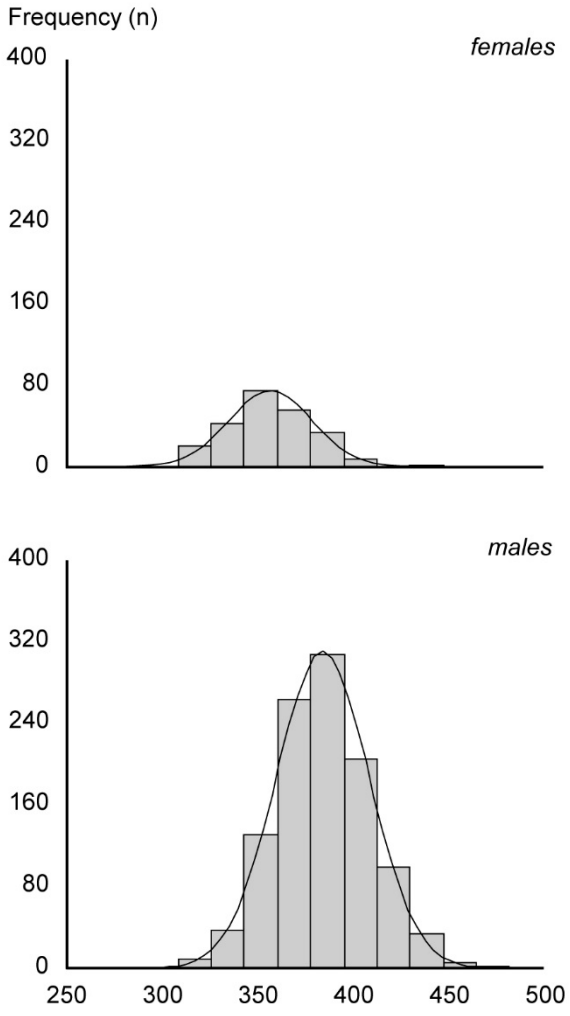


Torso Length (M85)

Posture: Anthropometric Standing.
Definition: The vertical distance between the digitally-extracted Suprasternale and Iliocristale landmarks (mm).

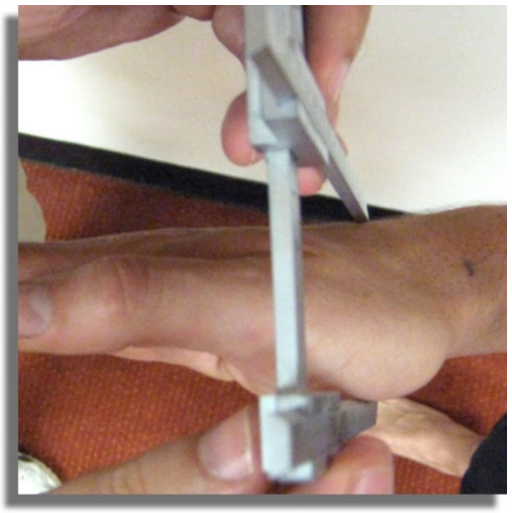


FEMALES	STATISTIC	MALES
232	*n*	1088
357	*Mean*	384
1.4	*SE (mean)*	0.7
22	*SD*	24
440	*Maximum*	482
308	*Minimum*	315
0.292	*Skewness*	0.179
0.173	*Kurtosis*	0.153
6.1%	*Coefficient of variation*	6.3%
	Percentiles	
406	P_{99}	441
401	P_{98}	437
399	P_{97}	432
392	P_{95}	426
385	P_{90}	415
379	P_{85}	408
376	P_{80}	403
371	P_{75}	399
368	P_{70}	396
365	P_{65}	393
361	P_{60}	389
358	P_{55}	386
356	P_{50}	383
352	P_{45}	380
350	P_{40}	377
347	P_{35}	374
345	P_{30}	371
342	P_{25}	367
340	P_{20}	364
334	P_{15}	359
329	P_{10}	353
321	P_{5}	346
318	P_{3}	340
317	P_{2}	336
315	P_{1}	329

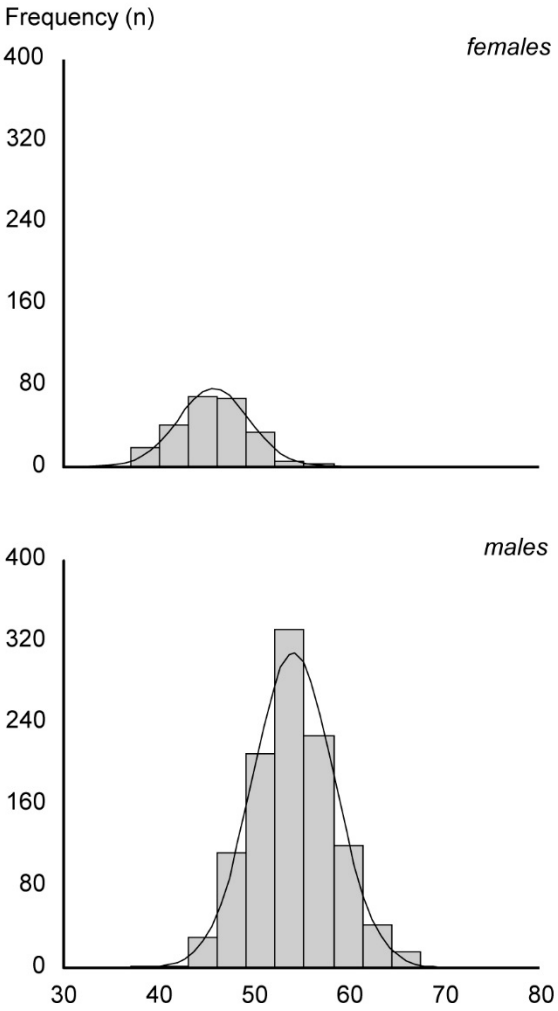


Hand Depth (M86)
(PECCF data available)

Posture: Anthropometric standing with the right elbow flexed to 90° with the forearm in a mid-prone position, palm facing inwards. **Definition:** The distance from most protuberant point on the palmar surface of the hand to the most protuberant point on the dorsal surface of the hand at the equivalent height (mm).

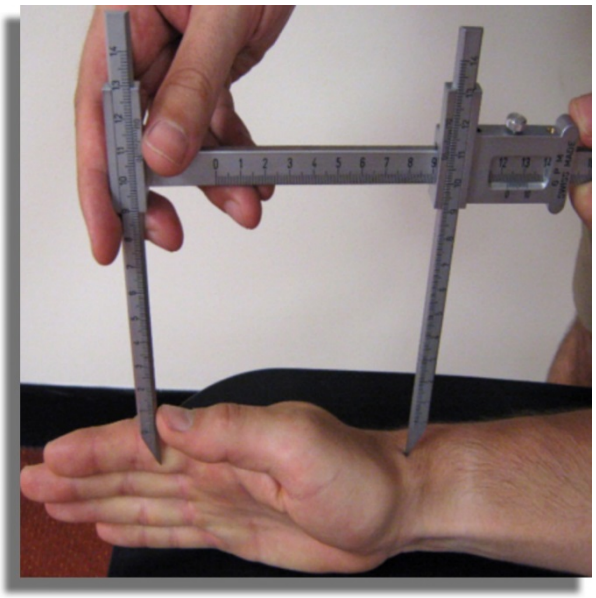


FEMALES	STATISTIC	MALES
232	*n*	1090
46	*Mean*	54
0.2	*SE (mean)*	0.1
4	*SD*	4
56	*Maximum*	67
37	*Minimum*	38
0.158	*Skewness*	0.171
-0.059	*Kurtosis*	0.079
8.1%	*Coefficient of variation*	7.9%
	Percentiles	
55	P_{99}	65
54	P_{98}	63
52	P_{97}	62
51	P_{95}	61
50	P_{90}	60
50	P_{85}	58
49	P_{80}	58
48	P_{75}	57
48	P_{70}	56
47	P_{65}	56
47	P_{60}	55
46	P_{55}	54
46	P_{50}	54
45	P_{45}	53
45	P_{40}	53
44	P_{35}	52
44	P_{30}	52
43	P_{25}	51
42	P_{20}	50
42	P_{15}	50
41	P_{10}	49
40	P_5	47
39	P_3	46
39	P_2	46
38	P_1	45

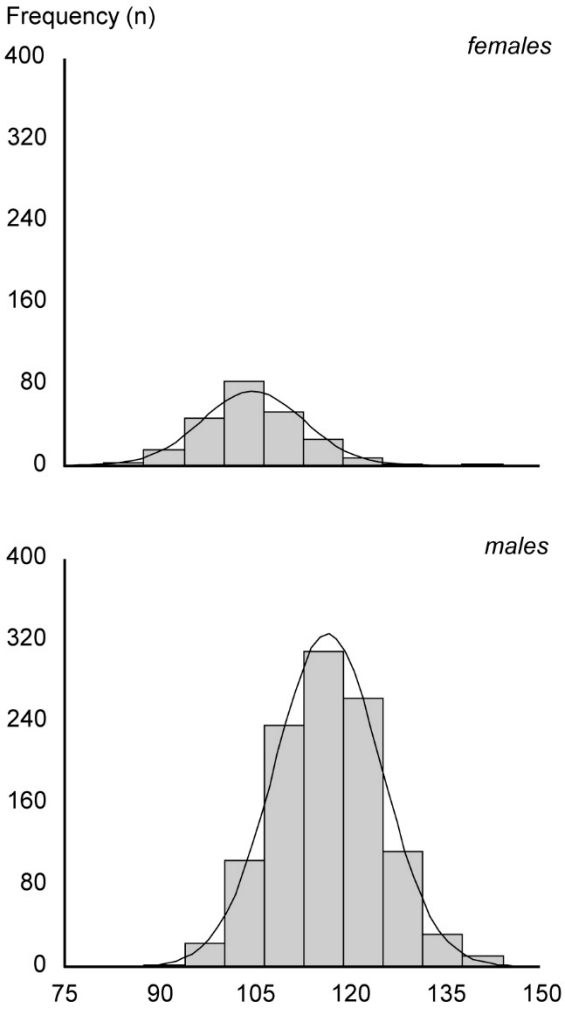


Wrist-Centre Thumbtip Distance (M87)

Posture: The subject rests the lateral edge of the fifth digit ("little" finger) of their right hand on a flat surface.
Definition: The horizontal distance between the right Stylion landmark and the tip of the right thumb (mm).

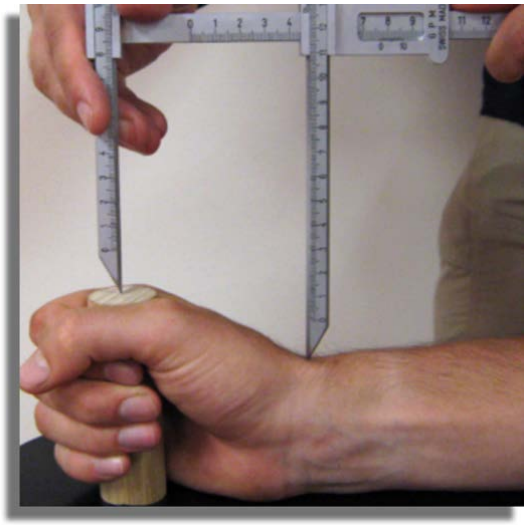


FEMALES	STATISTIC	MALES
231	*n*	1090
105	*Mean*	116
0.5	*SE (mean)*	0.3
8	*SD*	8
142	*Maximum*	144
81	*Minimum*	91
0.462	*Skewness*	0.186
1.700	*Kurtosis*	0.099
7.6%	*Coefficient of variation*	7.2%
	Percentiles	
124	P_{99}	137
122	P_{98}	134
121	P_{97}	133
117	P_{95}	131
115	P_{90}	127
113	P_{85}	125
111	P_{80}	123
110	P_{75}	122
108	P_{70}	121
107	P_{65}	119
106	P_{60}	118
105	P_{55}	117
104	P_{50}	116
103	P_{45}	115
103	P_{40}	114
102	P_{35}	113
101	P_{30}	112
100	P_{25}	111
99	P_{20}	110
97	P_{15}	108
95	P_{10}	106
92	P_{5}	103
90	P_{3}	101
89	P_{2}	100
88	P_{1}	98

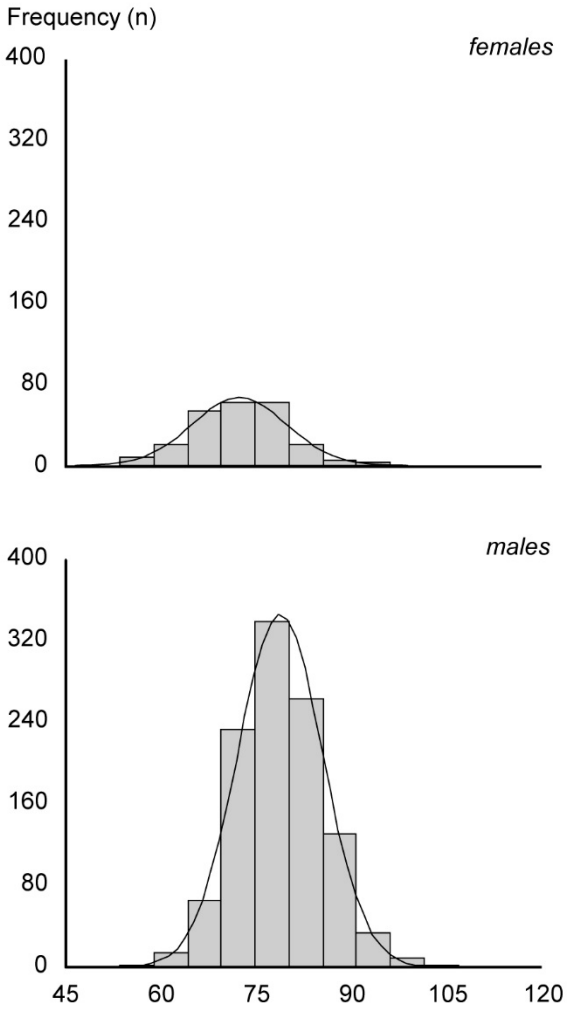


Wrist-Centre Grip Distance (M88)

Posture: The subject is seated grasping the dowel in the right hand. **Definition:** The distance between the right Stylion landmark and the centre of a dowel (3 cm diameter) gripped in the right hand, when measured with the caliper beam parallel to the flat surface supporting the forearm and fist (mm).



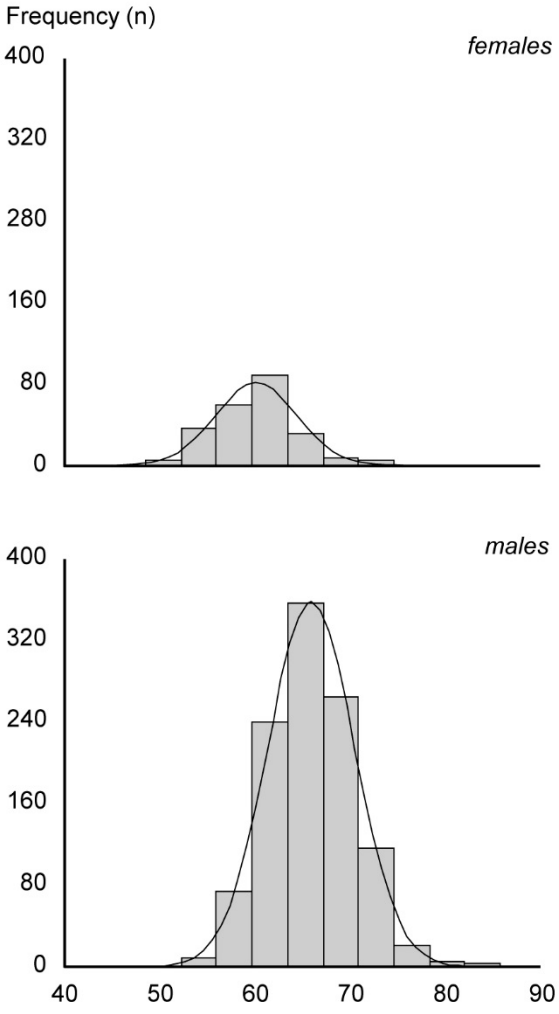
FEMALES	STATISTIC	MALES
231	*n*	1090
72	*Mean*	79
0.5	*SE (mean)*	0.2
7	*SD*	7
95	*Maximum*	107
54	*Minimum*	59
0.051	*Skewness*	0.199
0.294	*Kurtosis*	0.194
10.3%	*Coefficient of variation*	8.5%
	Percentiles	
91	P_{99}	95
89	P_{98}	93
86	P_{97}	92
83	P_{95}	90
81	P_{90}	87
80	P_{85}	86
78	P_{80}	84
78	P_{75}	83
76	P_{70}	82
75	P_{65}	81
74	P_{60}	80
73	P_{55}	79
72	P_{50}	79
71	P_{45}	78
70	P_{40}	77
69	P_{35}	76
68	P_{30}	75
67	P_{25}	74
66	P_{20}	73
65	P_{15}	72
63	P_{10}	70
60	P_5	68
58	P_3	67
56	P_2	66
54	P_1	63



Ear Length (M89)

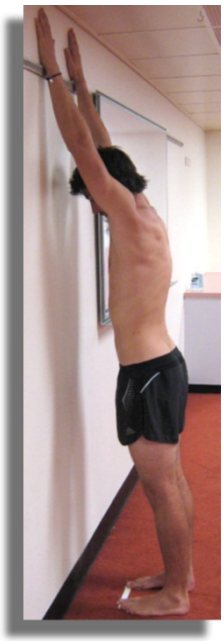
Posture: Anthropometric Sitting, with the head in the Frankfort plane.
Definition: The length of the right ear from the Ear, Top landmark to the Ear, Bottom landmark (mm).

FEMALES	STATISTIC	MALES
231	*n*	1090
60	*Mean*	66
0.3	*SE (mean)*	0.1
4	*SD*	5
73	*Maximum*	86
49	*Minimum*	53
0.197	*Skewness*	0.359
0.518	*Kurtosis*	0.556
7.0%	*Coefficient of variation*	6.9%
	Percentiles	
71	P_{99}	77
70	P_{98}	75
69	P_{97}	74
67	P_{95}	73
65	P_{90}	72
64	P_{85}	71
63	P_{80}	70
62	P_{75}	69
62	P_{70}	68
61	P_{65}	67
61	P_{60}	67
60	P_{55}	66
60	P_{50}	66
60	P_{45}	65
59	P_{40}	64
59	P_{35}	64
58	P_{30}	64
57	P_{25}	63
57	P_{20}	62
56	P_{15}	61
55	P_{10}	61
53	P_5	59
53	P_3	58
52	P_2	57
50	P_1	56

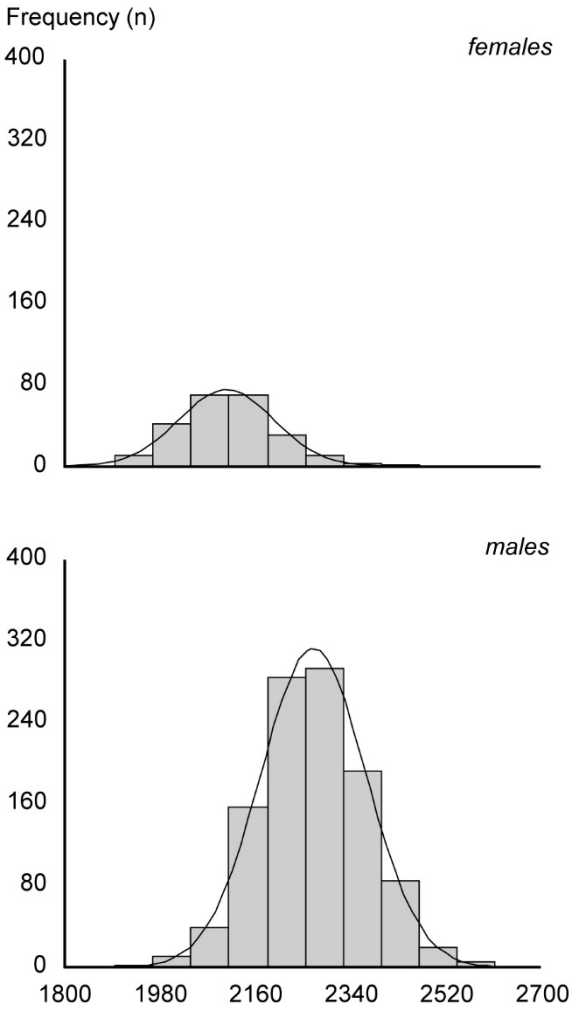


Overhead Fingertip Reach (M90)
(PECCF data available)

Posture: Subject stands facing a wall-mounted scale with both arms extended overhead, hands shoulder width apart and elbows fully extended without hyperextension.
Definition: The vertical distance between a standing surface and the tip of the right middle finger when the arms are extended overhead (mm).

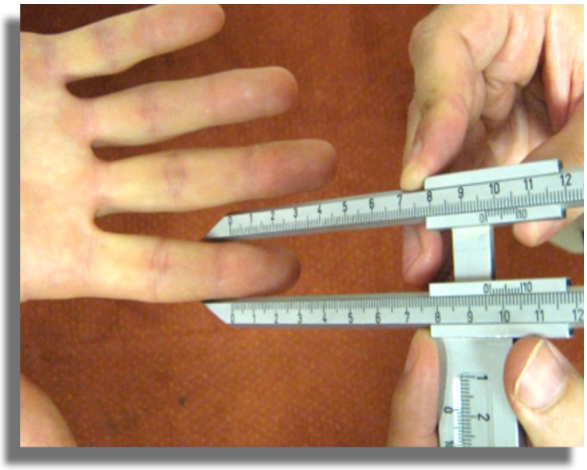


FEMALES	STATISTIC	MALES
232	*n*	1083
2105	*Mean*	2270
5.9	*SE (mean)*	3.0
89	*SD*	99
2403	*Maximum*	2613
1895	*Minimum*	1960
0.432	*Skewness*	0.113
0.421	*Kurtosis*	0.100
4.2%	*Coefficient of variation*	4.4%
	Percentiles	
2335	P_{99}	2507
2319	P_{98}	2483
2294	P_{97}	2462
2268	P_{95}	2435
2214	P_{90}	2398
2194	P_{85}	2371
2169	P_{80}	2354
2155	P_{75}	2336
2140	P_{70}	2320
2135	P_{65}	2309
2125	P_{60}	2295
2115	P_{55}	2280
2105	P_{50}	2265
2093	P_{45}	2250
2075	P_{40}	2240
2065	P_{35}	2225
2056	P_{30}	2215
2045	P_{25}	2200
2035	P_{20}	2185
2015	P_{15}	2170
1993	P_{10}	2146
1971	P_5	2115
1945	P_3	2095
1936	P_2	2073
1927	P_1	2035

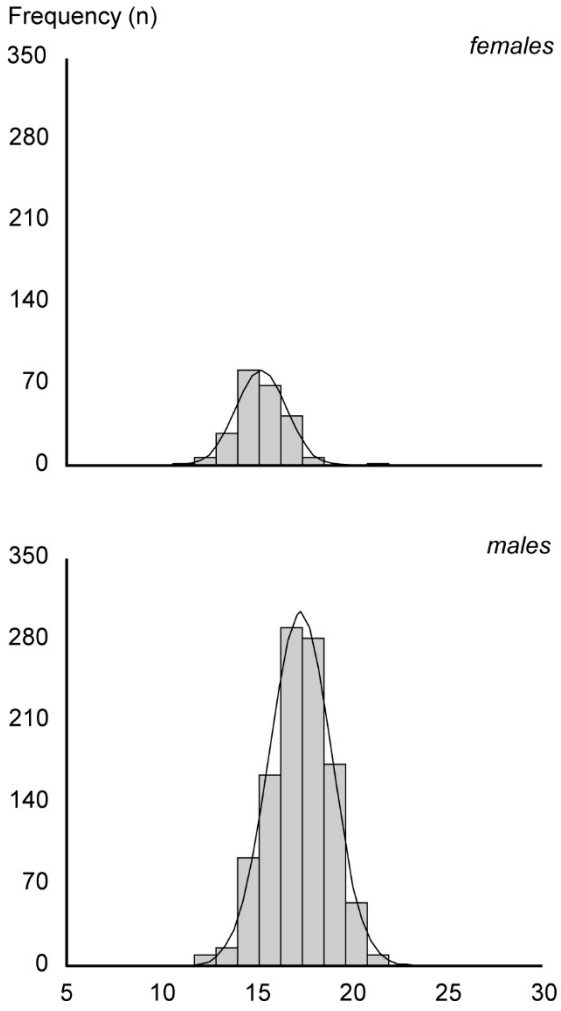


Index Finger Breadth Distal (M91)

Posture: Anthropometric Standing.
Definition: The maximum distance between the Distal Interphalangeal Joint II, Lateral and the Distal Interphalangeal Joint II, Medial landmarks (mm).



FEMALES	STATISTIC	MALES
232	*n*	1088
15	*Mean*	17
0.1	*SE (mean)*	0.0
1	*SD*	2
21	*Maximum*	22
11	*Minimum*	12
0.224	*Skewness*	-0.188
1.687	*Kurtosis*	0.018
8.5%	*Coefficient of variation*	9.4%
	Percentiles	
18	P_{99}	21
18	P_{98}	20
17	P_{97}	20
17	P_{95}	20
17	P_{90}	19
17	P_{85}	19
16	P_{80}	19
16	P_{75}	18
16	P_{70}	18
16	P_{65}	18
16	P_{60}	18
15	P_{55}	17
15	P_{50}	17
15	P_{45}	17
15	P_{40}	17
15	P_{35}	17
15	P_{30}	16
14	P_{25}	16
14	P_{20}	16
14	P_{15}	16
14	P_{10}	15
13	P_5	15
13	P_3	14
13	P_2	14
12	P_1	13



5. A multivariate approach: boundary manikin data

Boundary manikin data is presented below for 27 dimensions relative to general space claims that can be important when determining aspects such as workstation sizing, space required for maintenance tasks, and space required for general postures (kneeling, pushing etc.). This data can be used for paper based designs or assessments, or by implementing scaled digital human models into a computer aided design (CAD) tool. This data can be used where there is the requirement to add or use dimensions together.

Data is provided for males and females at accommodation targets of the central 90%, central 95%, and central 98%. The labels of the manikins refer to different combinations of the principle components which is explained in Appendix D. A positive value in Table 16 in Appendix D indicates a large manikin, a negative value indicates a small manikin. Therefore from Appendix D we can see principle component 1 refers to body length, and manikin A1 reflects a positive value on that principle component. Therefore manikin A1 reflects a person with a large body length. Manikin A2 would reflect a person with a small body length. Note also that manikin X is not a manikin on a boundary, it refers to values in the middle of the space (average values).

5.1. Example of use

Table 5 demonstrates how the boundary manikin data can be used in a paper based scenario. The requirement is to set a value for the width and depth of a ships shower. It is desired to have a shower width and depth that accommodates the central 98% of males for fit, with their upper arms (Acromion-Radiale Length M60) at 20° from their torso to allow for ease of washing and additional movement.

Table 5 Example of boundary manikin data use for a paper based scenario

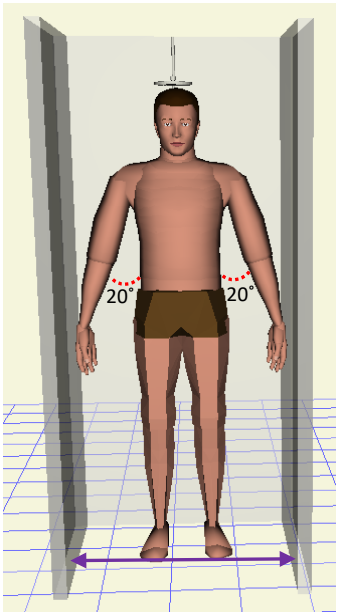
Requirement: Shower width and depth allowing central 98% accommodation with upper arms at 20° from torso  	Input data **Relevant dimensions:** • Bideltoid Breadth (M18) • Acromion-Radiale Length (M60) **Posture requirements:** • Upper arms at 20° from torso = sin(20) = .342 (per arm) **Additional allowances:** • Movement allowance of 50mm **Design formula:** = M18 + (M60 * .684) + 50 **Steps:** 1) Find the most extreme manikin from Table 6 of central 98% accommodation by adding each manikins M18 and M60 values together. In this case the limiting manikin is M8. 2) Apply M8's values to the Design Formula: = 564 + (371 * .684) + 50 = 867mm

Table 6 Central 98% male boundary manikin dimensions. Highlighted rows reflect the data used in the example.

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1715	1358	1567	1507	1615	1458	1371	1461	1406	1496	1577	1668	1612	1703	1537
M03 Acromion Height (mm)	1634	1286	1499	1421	1541	1379	1291	1384	1336	1429	1491	1585	1536	1630	1460
M09 Eye Height Sitting (mm)	861	758	818	801	898	720	723	826	733	836	783	885	793	895	809
M10 Acromion Height Sitting (mm)	643	564	625	582	680	528	525	612	550	637	570	658	595	683	604
M11 Elbow Rest Height Sitting (mm)	223	242	245	220	301	164	191	271	206	285	180	259	195	274	233
M12 Thigh Clearance (mm)	191	172	217	146	190	173	151	161	192	202	161	171	202	212	182
M13 Knee Height Sitting (mm)	640	478	579	540	572	546	493	509	516	531	587	602	610	625	559
M14 Popliteal Height (mm)	505	364	429	440	443	426	392	402	386	396	473	483	467	477	435
M18 Bideltoid Breadth (mm)	520	482	575	427	516	486	439	456	524	542	461	478	546	564	501
M20 Chest Depth (mm)	267	254	334	187	265	257	212	217	297	302	220	224	304	309	261
M22 Forearm Breadth (mm)	578	551	685	443	577	552	479	494	619	634	495	509	634	649	564
M23 Abdominal Extension Depth Sitting (mm)	261	268	371	159	264	265	206	205	328	327	202	201	324	323	265
M24 Hip Breadth Sitting (mm)	401	363	460	304	402	362	315	337	405	427	336	359	426	449	382
M25 Buttock Knee Length (mm)	696	543	664	576	630	610	544	556	595	607	633	644	684	695	620
M26 Buttock Popliteal Length (mm)	567	431	521	476	503	494	443	449	470	475	522	528	548	554	499
M37 Thumbtip Reach (mm)	910	703	829	785	814	799	730	739	756	764	849	858	875	884	807
M38 Stature (mm)	1985	1599	1816	1769	1885	1700	1614	1721	1641	1748	1837	1944	1864	1971	1792
M39 Sitting Height (mm)	997	882	956	923	1024	855	848	945	867	964	914	1012	933	1031	939
M40 Weight (kg)	100	74	126	48	98	77	51	63	96	108	67	78	111	123	87
M50 Back Width (mm)	383	355	424	314	376	363	326	333	389	397	342	350	405	413	369
M51 Back Length (mm)	505	452	501	456	531	426	420	481	446	506	451	511	476	537	479
M60 Acromion Radiale Length (mm)	382	289	344	328	342	329	300	308	309	317	354	362	363	371	336
M61 Radiale Stylion Length (mm)	307	230	275	262	272	265	241	245	248	252	285	289	293	296	269
M66 Hand Length (mm)	210	173	196	187	199	185	174	182	179	187	196	204	201	209	192
M71 Foot Length (mm)	301	242	279	264	282	261	244	256	252	265	278	291	287	299	271
M83 Knee Level (mm)	587	425	515	497	513	498	449	458	460	469	543	552	553	562	506
M90 Overhead Fingertip Reach (mm)	2553	1987	2316	2224	2358	2182	2029	2131	2082	2184	2356	2458	2409	2511	2270
Addition of M18 and M60	903	771	919	755	858	815	739	764	834	859	815	840	910	935	837

Table 7 Central 90% male boundary manikin dimensions

Dimension	Manikin														
	A1	**A2**	**A3**	**A4**	**A5**	**A6**	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**X**
M01 Cervicale Height (mm)	1679	1394	1561	1513	1599	1474	1405	1477	1432	1504	1569	1641	1597	1669	1537
M03 Acromion Height (mm)	1599	1322	1491	1429	1525	1396	1325	1400	1361	1435	1485	1559	1521	1595	1460
M09 Eye Height Sitting (mm)	850	769	816	803	880	738	741	823	749	831	788	870	796	878	809
M10 Acromion Height Sitting (mm)	635	572	621	586	664	543	541	611	561	631	577	647	597	667	604
M11 Elbow Rest Height Sitting (mm)	225	240	243	222	287	178	200	263	211	274	191	254	202	265	233
M12 Thigh Clearance (mm)	189	174	210	153	188	175	157	165	190	198	165	173	198	206	182
M13 Knee Height Sitting (mm)	624	495	575	544	570	549	507	519	525	537	581	594	599	612	559
M14 Popliteal Height (mm)	491	378	430	439	442	428	400	409	396	404	465	474	461	469	435
M18 Bideltoid Breadth (mm)	516	486	560	442	513	489	451	465	520	533	469	483	537	551	501
M20 Chest Depth (mm)	266	256	319	202	264	257	222	226	290	293	228	232	295	299	261
M22 Forearm Forearm Breadth (mm)	575	554	661	468	574	554	497	508	608	620	509	521	620	632	564
M23 Abdominal Extension Depth Sitting (mm)	262	267	349	180	264	265	218	217	315	315	215	214	312	312	265
M24 Hip Breadth Sitting (mm)	397	367	444	320	398	366	328	346	400	418	346	364	417	435	382
M25 Buttock Knee Length (mm)	681	559	655	585	628	612	560	569	600	609	630	639	671	680	620
M26 Buttock Popliteal Length (mm)	553	444	517	481	503	495	455	459	476	480	517	522	538	543	499
M37 Thumbtip Reach (mm)	889	724	825	789	813	801	745	752	766	773	841	848	861	868	807
M38 Stature (mm)	1946	1638	1811	1773	1866	1718	1650	1735	1671	1757	1828	1913	1849	1935	1792
M39 Sitting Height (mm)	985	893	953	926	1007	872	866	944	882	959	920	997	935	1012	939
M40 Weight (kg)	98	77	118	56	96	79	59	68	94	104	71	80	106	116	87
M50 Back Width (mm)	380	358	413	326	375	364	335	341	385	391	347	354	398	404	369
M51 Back Length (mm)	500	457	496	461	520	437	432	480	452	501	456	505	477	525	479
M60 Acromion Radiale Length (mm)	373	298	342	329	341	330	307	314	315	321	350	357	358	364	336
M61 Radiale Stylion Length (mm)	299	238	274	263	271	266	246	249	252	255	282	285	288	291	269
M66 Hand Length (mm)	207	177	195	188	197	186	178	184	182	188	195	202	199	205	192
M71 Foot Length (mm)	295	248	277	266	280	263	249	259	256	266	277	287	284	294	271
M83 Knee Level (mm)	570	441	513	499	512	500	461	468	469	476	535	542	543	551	506
M90 Overhead Fingertip Reach (mm)	2495	2044	2306	2234	2340	2200	2078	2159	2120	2201	2339	2420	2381	2462	2270

Table 8 Central 95% male boundary manikin dimensions

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1696	1377	1564	1510	1607	1467	1389	1470	1420	1501	1573	1653	1604	1684	1537
M03 Acromion Height (mm)	1615	1305	1495	1425	1532	1388	1309	1392	1349	1433	1488	1571	1528	1611	1460
M09 Eye Height Sitting (mm)	855	764	817	802	889	730	733	824	742	833	786	877	794	886	809
M10 Acromion Height Sitting (mm)	639	569	623	584	671	536	533	612	555	634	574	652	596	674	604
M11 Elbow Rest Height Sitting (mm)	224	241	244	221	294	171	196	266	209	279	186	256	199	269	233
M12 Thigh Clearance (mm)	190	173	213	150	189	174	154	163	191	200	164	172	200	209	182
M13 Knee Height Sitting (mm)	631	487	577	542	571	547	501	514	521	534	584	598	604	618	559
M14 Popliteal Height (mm)	498	372	430	439	442	427	396	405	391	400	469	478	464	473	435
M18 Bideltoid Breadth (mm)	518	484	567	435	514	488	445	461	522	537	465	480	541	557	501
M20 Chest Depth (mm)	266	255	326	195	264	257	218	222	293	297	224	228	299	304	261
M22 Forearm Forearm Breadth (mm)	576	552	672	456	576	553	489	502	613	626	502	515	627	640	564
M23 Abdominal Extension Depth Sitting (mm)	262	268	359	170	264	265	212	212	321	321	209	208	318	317	265
M24 Hip Breadth Sitting (mm)	399	365	451	312	399	364	322	342	402	422	341	362	422	442	382
M25 Buttock Knee Length (mm)	688	552	659	580	629	611	553	563	598	608	631	642	677	687	620
M26 Buttock Popliteal Length (mm)	559	438	519	478	503	494	449	454	473	478	520	525	543	548	499
M37 Thumbtip Reach (mm)	899	715	827	787	814	800	738	746	761	769	845	852	868	875	807
M38 Stature (mm)	1964	1620	1813	1771	1875	1710	1633	1728	1657	1752	1832	1927	1856	1951	1792
M39 Sitting Height (mm)	991	888	954	925	1015	864	858	945	875	962	917	1004	934	1021	939
M40 Weight (kg)	99	75	122	53	96	78	55	66	95	106	69	79	109	119	87
M50 Back Width (mm)	382	357	418	320	375	363	331	337	387	394	345	352	401	408	369
M51 Back Length (mm)	502	455	498	459	525	432	427	481	449	503	454	508	477	531	479
M60 Acromion Radiale Length (mm)	377	294	343	329	341	330	304	311	312	319	352	359	360	367	336
M61 Radiale Stylion Length (mm)	303	234	274	263	271	266	244	247	250	254	283	287	290	293	269
M66 Hand Length (mm)	208	175	195	188	198	185	176	183	180	188	195	203	200	207	192
M71 Foot Length (mm)	298	245	278	265	281	262	247	258	254	265	278	289	285	296	271
M83 Knee Level (mm)	578	434	514	498	513	499	456	464	465	473	539	547	548	556	506
M90 Overhead Fingertip Reach (mm)	2522	2018	2311	2229	2349	2191	2055	2146	2102	2193	2347	2437	2394	2484	2270

Table 9 Central 98% male boundary manikin dimensions

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1715	1358	1567	1507	1615	1458	1371	1461	1406	1496	1577	1668	1612	1703	1537
M03 Acromion Height (mm)	1634	1286	1499	1421	1541	1379	1291	1384	1336	1429	1491	1585	1536	1630	1460
M09 Eye Height Sitting (mm)	861	758	818	801	898	720	723	826	733	836	783	885	793	895	809
M10 Acromion Height Sitting (mm)	643	564	625	582	680	528	525	612	550	637	570	658	595	683	604
M11 Elbow Rest Height Sitting (mm)	223	242	245	220	301	164	191	271	206	285	180	259	195	274	233
M12 Thigh Clearance (mm)	191	172	217	146	190	173	151	161	192	202	161	171	202	212	182
M13 Knee Height Sitting (mm)	640	478	579	540	572	546	493	509	516	531	587	602	610	625	559
M14 Popliteal Height (mm)	505	364	429	440	443	426	392	402	386	396	473	483	467	477	435
M18 Bideltoid Breadth (mm)	520	482	575	427	516	486	439	456	524	542	461	478	546	564	501
M20 Chest Depth (mm)	267	254	334	187	265	257	212	217	297	302	220	224	304	309	261
M22 Forearm Forearm Breadth (mm)	578	551	685	443	577	552	479	494	619	634	495	509	634	649	564
M23 Abdominal Extension Depth Sitting (mm)	261	268	371	159	264	265	206	205	328	327	202	201	324	323	265
M24 Hip Breadth Sitting (mm)	401	363	460	304	402	362	315	337	405	427	336	359	426	449	382
M25 Buttock Knee Length (mm)	696	543	664	576	630	610	544	556	595	607	633	644	684	695	620
M26 Buttock Popliteal Length (mm)	567	431	521	476	503	494	443	449	470	475	522	528	548	554	499
M37 Thumbtip Reach (mm)	910	703	829	785	814	799	730	739	756	764	849	858	875	884	807
M38 Stature (mm)	1985	1599	1816	1769	1885	1700	1614	1721	1641	1748	1837	1944	1864	1971	1792
M39 Sitting Height (mm)	997	882	956	923	1024	855	848	945	867	964	914	1012	933	1031	939
M40 Weight (kg)	100	74	126	48	98	77	51	63	96	108	67	78	111	123	87
M50 Back Width (mm)	383	355	424	314	376	363	326	333	389	397	342	350	405	413	369
M51 Back Length (mm)	505	452	501	456	531	426	420	481	446	506	451	511	476	537	479
M60 Acromion Radiale Length (mm)	382	289	344	328	342	329	300	308	309	317	354	362	363	371	336
M61 Radiale Stylion Length (mm)	307	230	275	262	272	265	241	245	248	252	285	289	293	296	269
M66 Hand Length (mm)	210	173	196	187	199	185	174	182	179	187	196	204	201	209	192
M71 Foot Length (mm)	301	242	279	264	282	261	244	256	252	265	278	291	287	299	271
M83 Knee Level (mm)	587	425	515	497	513	498	449	458	460	469	543	552	553	562	506
M90 Overhead Fingertip Reach (mm)	2553	1987	2316	2224	2358	2182	2029	2131	2082	2184	2356	2458	2409	2511	2270

Table 10 Central 90% female boundary manikin dimensions

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1552	1306	1447	1411	1487	1371	1315	1381	1335	1402	1457	1523	1477	1544	1429
M03 Acromion Height (mm)	1482	1243	1383	1342	1422	1303	1247	1316	1271	1339	1386	1454	1409	1478	1363
M09 Eye Height Sitting (mm)	792	731	769	754	826	697	703	777	711	785	738	812	746	821	762
M10 Acromion Height Sitting (mm)	599	556	589	566	637	518	524	592	537	606	549	617	562	631	577
M11 Elbow Rest Height Sitting (mm)	219	251	244	226	290	181	208	270	218	281	189	252	200	263	235
M12 Thigh Clearance (mm)	171	166	200	137	179	158	142	155	179	191	146	158	183	195	169
M13 Knee Height Sitting (mm)	575	459	529	504	528	506	470	482	484	497	537	549	551	564	517
M14 Popliteal Height (mm)	450	345	391	405	406	389	367	376	358	368	427	437	419	429	398
M18 Bideltoid Breadth (mm)	460	427	501	386	454	433	395	407	461	473	414	426	480	492	444
M20 Chest Depth (mm)	253	248	316	186	254	247	210	213	285	288	213	217	288	292	251
M22 Forearm Forearm Breadth (mm)	496	474	590	381	490	480	416	422	536	542	428	434	549	555	485
M23 Abdominal Extension Depth Sitting (mm)	243	235	324	153	239	238	186	187	285	286	191	192	290	291	239
M24 Hip Breadth Sitting (mm)	409	406	472	343	422	394	361	378	436	452	363	379	438	454	408
M25 Buttock Knee Length (mm)	641	540	625	557	598	584	538	546	577	585	596	605	635	644	591
M26 Buttock Popliteal Length (mm)	529	430	500	459	479	480	440	439	463	463	497	496	520	520	480
M37 Thumbtip Reach (mm)	812	649	751	710	727	734	674	669	698	693	768	764	792	788	731
M38 Stature (mm)	1800	1534	1671	1663	1734	1600	1549	1626	1554	1631	1703	1780	1707	1785	1667
M39 Sitting Height (mm)	918	847	892	873	946	820	820	893	831	904	861	934	872	945	883
M40 Weight (kg)	77	63	96	44	77	63	47	55	77	85	55	63	86	94	70
M50 Back Width (mm)	336	309	358	287	322	323	294	294	335	335	310	310	351	351	323
M51 Back Length (mm)	469	434	466	438	494	409	409	458	425	474	429	478	445	494	452
M60 Acromion Radiale Length (mm)	344	274	311	307	312	307	286	289	289	292	327	330	329	332	309
M61 Radiale Stylion Length (mm)	271	220	250	242	251	240	225	232	230	236	255	261	260	266	246
M66 Hand Length (mm)	190	155	175	169	174	171	159	161	163	165	180	182	183	185	172
M71 Foot Length (mm)	269	223	252	240	252	240	225	232	232	239	252	259	259	266	246
M83 Knee Level (mm)	521	406	469	459	468	459	425	430	431	436	491	496	497	502	464
M90 Overhead Fingertip Reach (mm)	2313	1898	2121	2090	2168	2043	1941	2013	1959	2031	2180	2252	2198	2270	2106

Table 11 Central 95% female boundary manikin dimensions

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1567	1292	1449	1409	1494	1364	1301	1376	1324	1399	1460	1535	1483	1557	1429
M03 Acromion Height (mm)	1497	1228	1385	1340	1429	1296	1234	1310	1260	1336	1389	1465	1415	1491	1363
M09 Eye Height Sitting (mm)	796	727	770	754	834	689	696	779	705	788	735	818	744	828	762
M10 Acromion Height Sitting (mm)	601	553	590	564	644	511	518	594	533	609	545	622	560	637	577
M11 Elbow Rest Height Sitting (mm)	218	253	246	225	296	174	204	275	216	286	184	254	196	266	235
M12 Thigh Clearance (mm)	172	165	204	133	180	157	139	153	180	194	143	157	184	198	169
M13 Knee Height Sitting (mm)	582	452	531	503	529	505	464	478	481	494	539	553	556	569	517
M14 Popliteal Height (mm)	456	339	390	406	407	388	363	374	354	365	431	441	422	432	398
M18 Bideltoid Breadth (mm)	462	425	508	379	455	432	389	403	463	477	410	424	485	498	444
M20 Chest Depth (mm)	254	248	323	178	254	247	205	209	289	293	208	213	292	296	251
M22 Forearm Forearm Breadth (mm)	497	473	602	368	491	479	408	414	542	549	421	428	556	563	485
M23 Abdominal Extension Depth Sitting (mm)	243	234	334	143	240	238	180	181	291	292	185	186	296	297	239
M24 Hip Breadth Sitting (mm)	409	406	480	335	424	392	356	374	439	458	358	376	441	459	408
M25 Buttock Knee Length (mm)	647	534	629	553	599	583	532	541	575	585	597	606	641	650	591
M26 Buttock Popliteal Length (mm)	535	424	502	457	479	480	435	434	461	461	499	498	525	525	480
M37 Thumbtip Reach (mm)	822	639	754	707	726	735	667	662	694	689	772	767	799	794	731
M38 Stature (mm)	1816	1518	1671	1663	1742	1592	1536	1622	1540	1626	1708	1794	1712	1798	1667
M39 Sitting Height (mm)	922	843	893	872	953	812	813	895	825	907	859	940	871	952	883
M40 Weight (kg)	78	62	100	41	78	62	44	53	78	87	53	62	87	96	70
M50 Back Width (mm)	338	307	362	283	322	323	291	291	337	336	309	308	354	354	323
M51 Back Length (mm)	471	432	467	436	499	404	404	458	422	477	427	481	445	499	452
M60 Acromion Radiale Length (mm)	349	270	312	307	312	307	284	287	286	290	329	332	332	335	309
M61 Radiale Stylion Length (mm)	275	217	250	241	252	239	223	230	228	235	256	263	261	269	246
M66 Hand Length (mm)	192	152	176	169	174	171	158	160	162	164	181	183	185	187	172
M71 Foot Length (mm)	271	220	252	239	252	239	223	231	231	238	253	260	261	268	246
M83 Knee Level (mm)	528	400	469	458	468	459	421	426	427	433	495	500	501	506	464
M90 Overhead Fingertip Reach (mm)	2337	1874	2123	2088	2175	2036	1921	2002	1942	2022	2189	2269	2209	2290	2106

Table 12 Central 98% female boundary manikin dimensions

Dimension	Manikin														
	A1	A2	A3	A4	A5	A6	M1	M2	M3	M4	M5	M6	M7	M8	X
M01 Cervicale Height (mm)	1583	1275	1452	1407	1502	1357	1285	1369	1311	1395	1463	1547	1489	1573	1429
M03 Acromion Height (mm)	1513	1212	1388	1337	1437	1288	1218	1304	1247	1333	1392	1478	1421	1507	1363
M09 Eye Height Sitting (mm)	800	723	771	753	843	681	687	781	698	791	732	825	742	836	762
M10 Acromion Height Sitting (mm)	604	550	592	563	652	503	511	596	527	613	541	627	558	644	577
M11 Elbow Rest Height Sitting (mm)	215	255	247	224	303	167	201	279	214	293	178	257	191	270	235
M12 Thigh Clearance (mm)	172	165	208	129	182	155	136	151	182	197	140	155	186	201	169
M13 Knee Height Sitting (mm)	590	444	533	501	530	503	458	474	476	492	542	558	560	576	517
M14 Popliteal Height (mm)	463	332	389	407	408	387	359	371	348	360	435	447	425	437	398
M18 Bideltoid Breadth (mm)	464	423	516	372	457	431	383	398	466	481	406	422	490	505	444
M20 Chest Depth (mm)	254	247	332	169	255	247	199	204	293	298	203	208	297	302	251
M22 Forearm Forearm Breadth (mm)	499	472	616	354	492	479	398	406	549	557	414	421	565	572	485
M23 Abdominal Extension Depth Sitting (mm)	244	234	346	131	240	238	173	174	297	298	179	180	303	304	239
M24 Hip Breadth Sitting (mm)	409	406	489	327	425	390	350	370	443	464	352	372	445	466	408
M25 Buttock Knee Length (mm)	654	527	633	548	600	582	525	535	574	584	598	608	647	657	591
M26 Buttock Popliteal Length (mm)	542	418	505	454	479	480	429	429	459	458	501	501	531	530	480
M37 Thumbtip Reach (mm)	833	628	757	704	726	735	659	654	689	684	777	772	807	802	731
M38 Stature (mm)	1834	1500	1672	1662	1751	1583	1520	1616	1525	1621	1713	1809	1718	1814	1667
M39 Sitting Height (mm)	927	838	894	871	962	803	805	896	818	910	856	947	869	961	883
M40 Weight (kg)	79	61	103	37	79	61	41	51	79	89	51	61	89	100	70
M50 Back Width (mm)	340	305	367	278	322	323	287	287	338	338	307	307	358	358	323
M51 Back Length (mm)	474	430	469	434	505	399	398	459	418	480	424	485	444	505	452
M60 Acromion Radiale Length (mm)	353	265	312	307	313	306	281	284	284	287	331	335	334	338	309
M61 Radiale Stylion Length (mm)	278	213	251	241	253	239	220	228	226	234	257	266	263	271	246
M66 Hand Length (mm)	195	150	176	169	175	170	156	159	160	163	182	184	186	189	172
M71 Foot Length (mm)	274	217	253	238	253	238	220	229	229	238	254	262	262	271	246
M83 Knee Level (mm)	535	392	470	457	469	458	416	422	423	429	498	504	506	512	464
M90 Overhead Fingertip Reach (mm)	2365	1846	2125	2086	2184	2027	1899	1989	1922	2012	2199	2289	2222	2312	2106

6. Anthropometric requirements beyond this standard

The use of anthropometric data in design is critical to ensure optimal performance and safety. The design of a future RAN system may require anthropometric information beyond that which was collected as part of the ASRAN, and therefore not part of this standard. The ASRAN used three-dimensional scanning which provides two key benefits that may provide solutions to future anthropometric design issues not able to be addressed using this standard, they are:

1. Access to the ASRAN database of three-dimensional scans. This provides the opportunity for further body dimensions to be extracted at a later date.
2. The ability to take multi-dimensional measurements such as cross-sectional areas, surface areas and volumes.

Research in digital human modelling (DHM) and multivariate data approaches is progressing rapidly and future iterations of DHM programs or multivariate tools may provide the opportunity to import population data and individual three-dimensional scans into CAD programs to test the design of systems. The ASRAN database of three-dimensional scans is a valuable tool and should be considered where systems cannot be adequately tested using this standard.

7. Acknowledgements

The authors would like to acknowledge the essential contribution and great technical undertaking by the University of South Australia in collecting the anthropometric data. The success of the ASRAN was also heavily dependent on CAPT Simon Atkinson and CMDR Brian Chase from the Australian Defence Test and Evaluation Office, and WO Carl Larkin from the Future Submarine Program. Finally, we cannot thank enough the involvement of the women and men of the RAN who gave their time to generate the anthropometric data.

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Appendix A Personal equipment and clothing correction factors ensemble descriptions

PECCF data were collected on 10 male ASRAN participants in the same static postures as the basic anthropometric dimensions.

A.1. Applying PECCF data

What is typically applied to an anthropometric dimension is the mean PECCF value. Therefore a clothing correction factor for the fire-fighting ensemble for Bideltoid Breadth would be +40mm.

A.2. Future range of motion data

Research is currently underway at the University of South Australia to examine the impact that certain clothing combinations have on range of motion and movement.

A.3. Escape suit ensemble

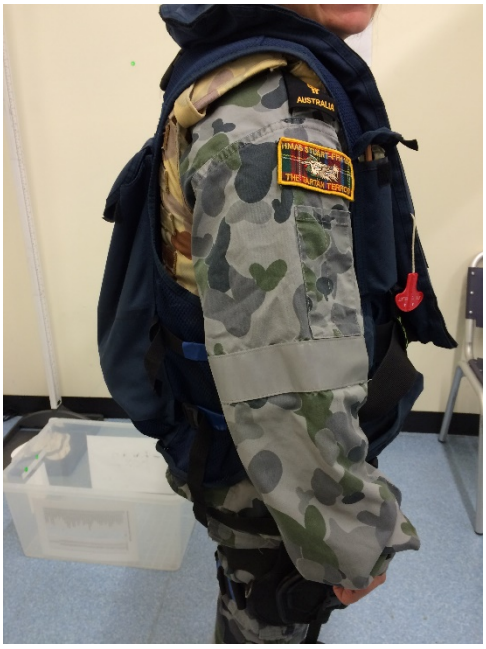
The escape suit PECCF data was collected with participants wearing the Submarine Escape Immersion Equipment MK10 Escape Suit. This is a one-size fits all suit, which was fitted over the participants standard Disruptive Pattern Navy Uniform (DPNU), without issued boots [11].

A.4. Firefighting ensemble

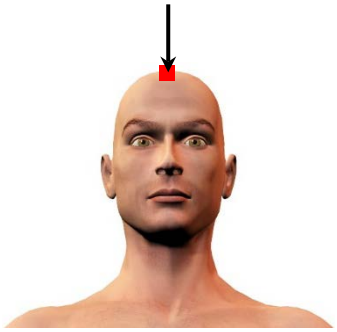
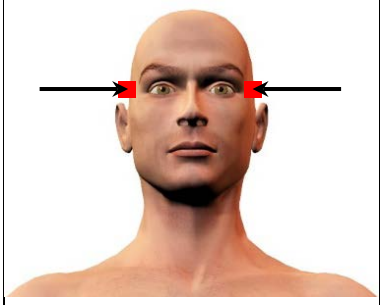
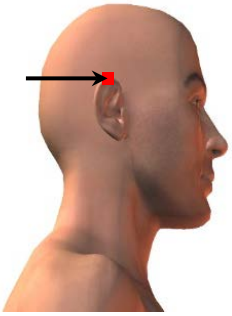
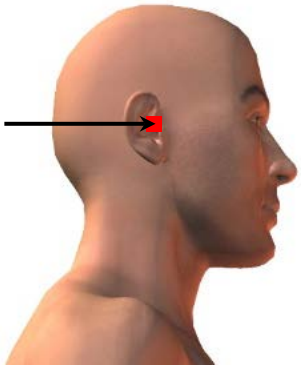
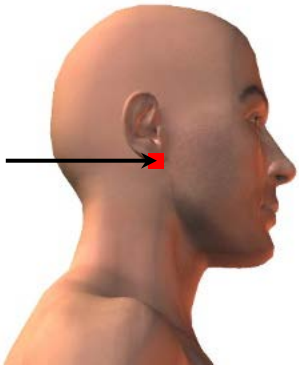
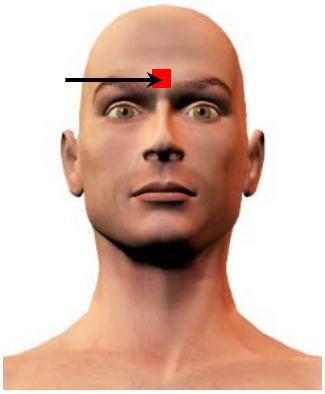
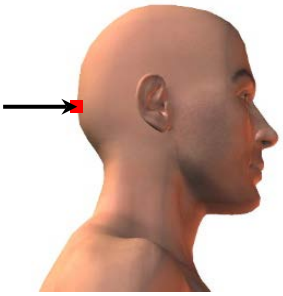
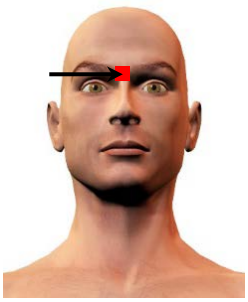
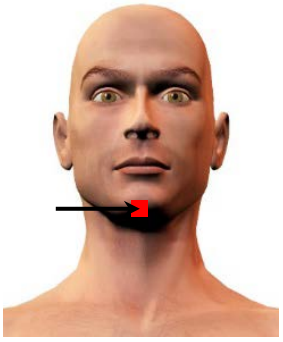
The firefighting PECCF data was collected with participants wearing the "full firefighting rig" [48], defined as: the standard DPNU (including issued boots), Breathing Apparatus (BA) hood, firefighting gloves, two piece firefighting ensemble, structural firefighting helmet, helmet torch and Open Circuit Compressed Air Breathing Apparatus (OCCABA) [11].

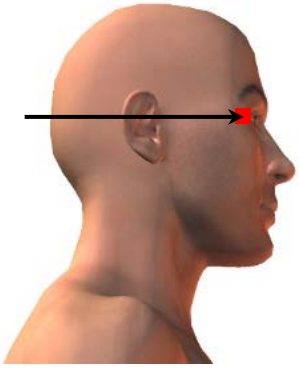
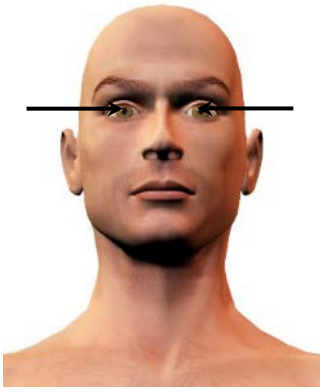
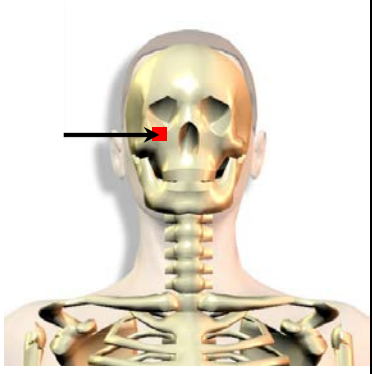
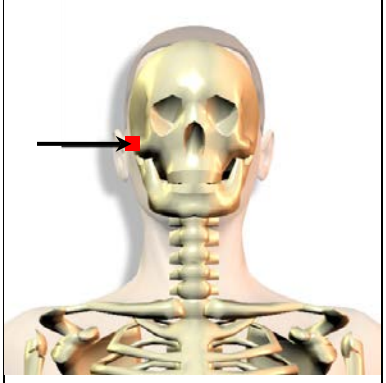
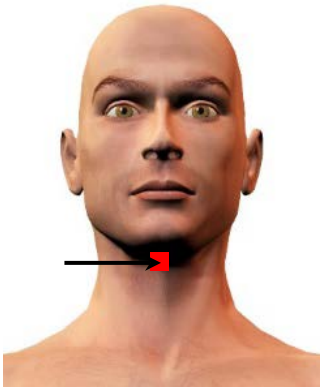
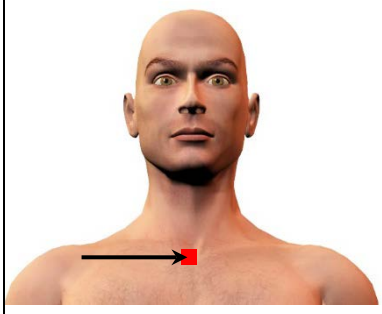
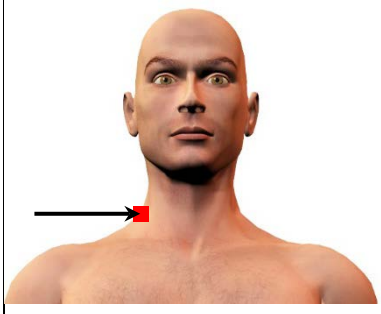
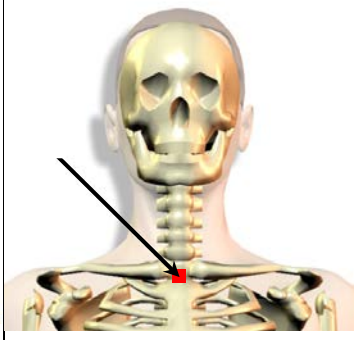
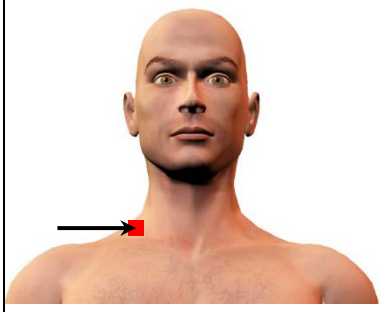
A.5. Boarding party ensemble

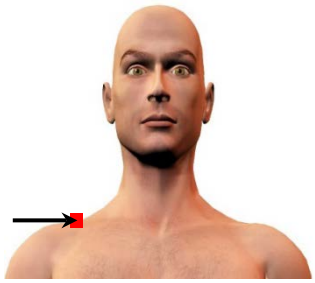
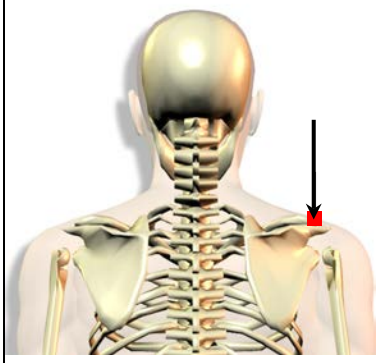
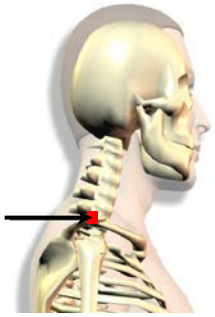
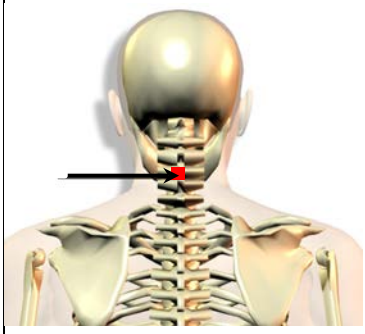
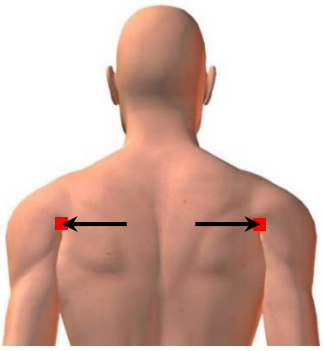
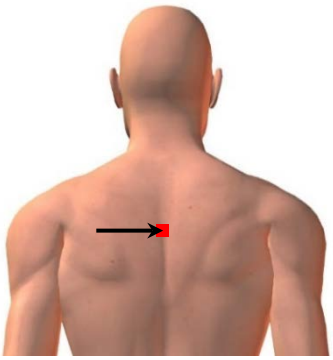
The boarding party ensemble was collected with participants wearing their standard DPNU including issued boots, along with MCBAS (Modular Combat Body Armour System; consisting of no plates, both stab and spike and low velocity inserts), SOS marine lifejacket with integrated pockets, marine safety helmet PAS028 and SOS marine duty belt with thigh pistol holster [11].

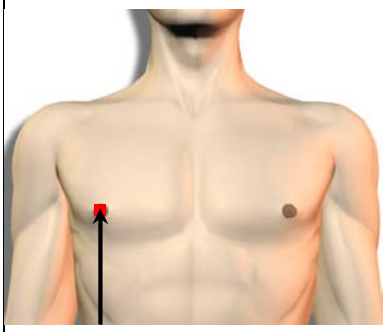
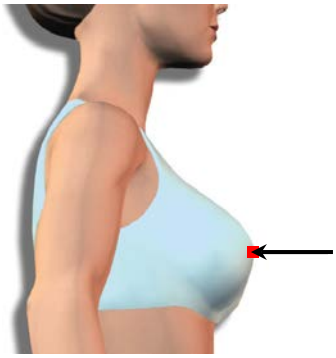
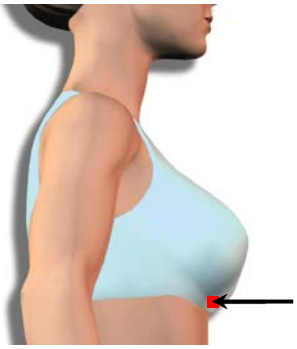
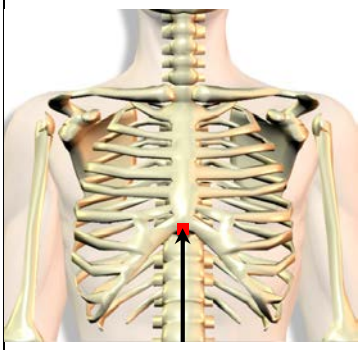
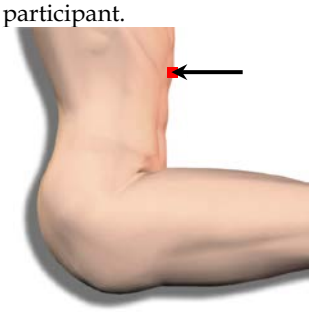
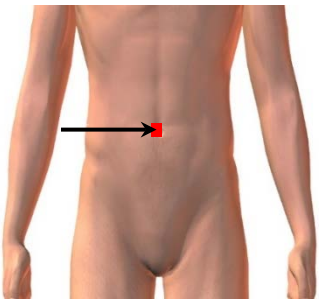
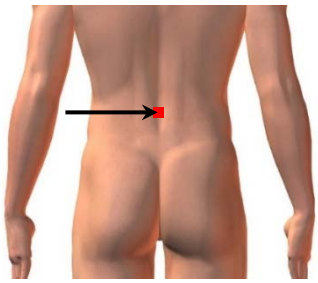
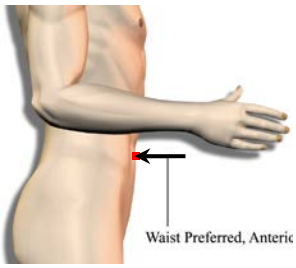
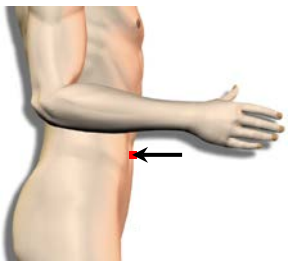


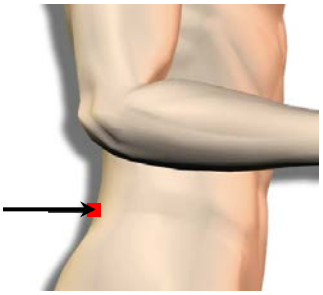
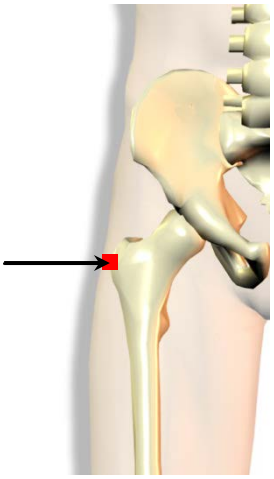
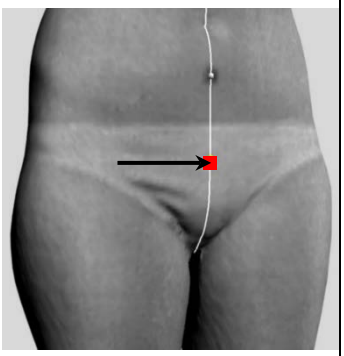
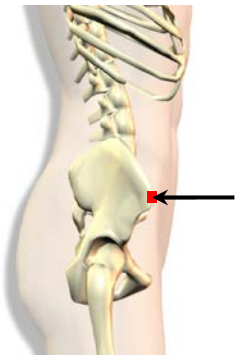
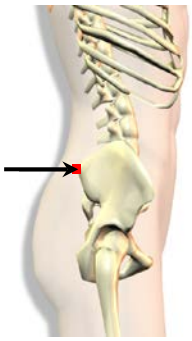
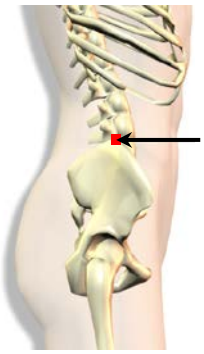
Appendix B Landmark definitions for the 87 ASRAN measures

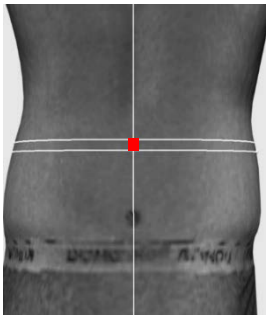
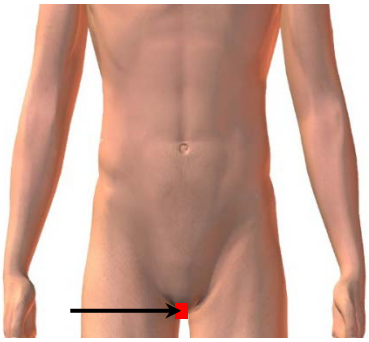
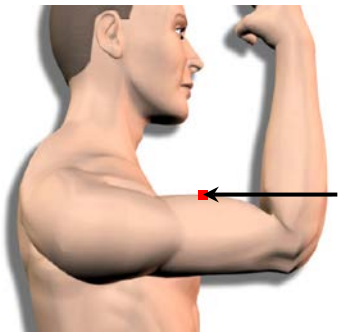
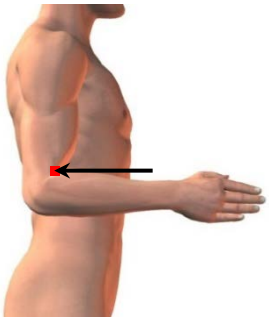
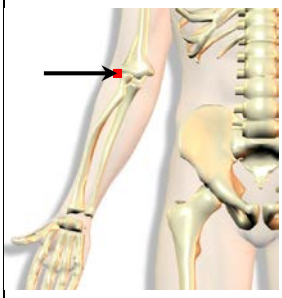
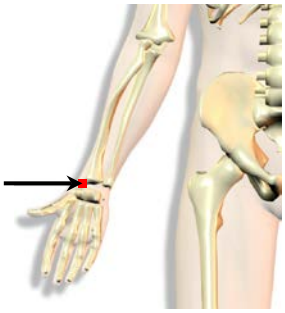
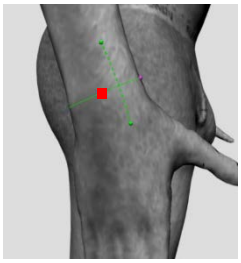
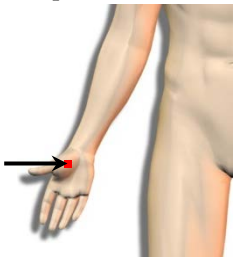
Top of the Head: The highest point of the head when the head is in the Frankfort Plane. 	**Head Breadth Marker (Right and Left):** The most lateral point on the head above the ears. 	**Ear, Top:** The highest point of the ear in its long axis. 
Tragion (Right and Left): The superior point on the juncture of the cartilaginous flap (tragus) of the ear with the head. 	**Ear, Bottom:** The lowest point of the ear in its long axis. 	**Glabella:** The most anterior point on the frontal bone midway between the bony brow ridges. 
Opisthocranion: The posterior point on the back of the head. 	**Sellion:** The deepest depression of the nasal bones at the top of the nose. 	**Menton:** The inferior point of the mandible in the mid-sagittal plane. 

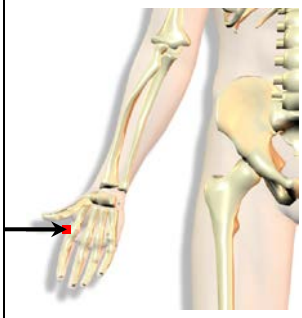
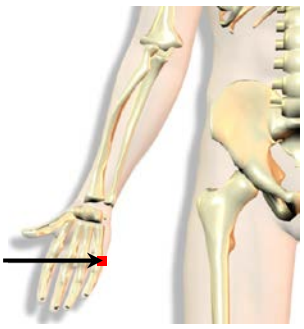
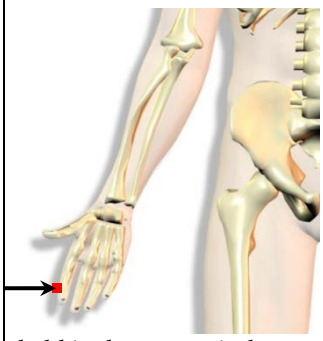
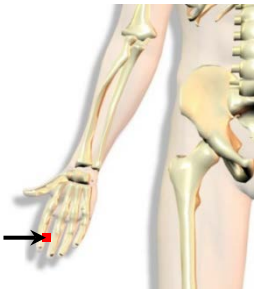
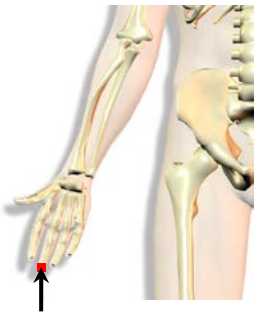
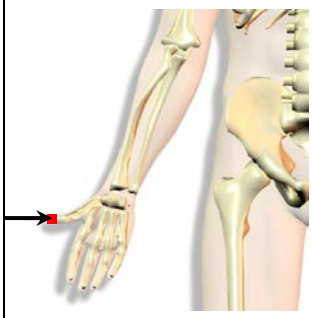
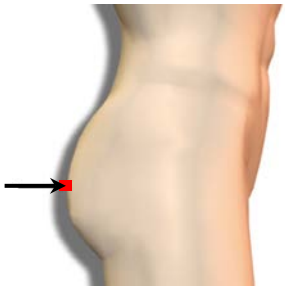
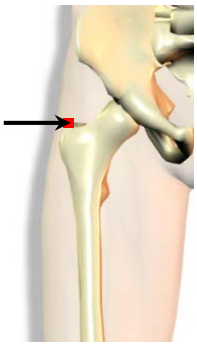
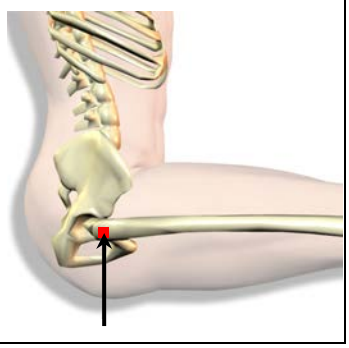
Ectocanthus: The outside corner of the right eye formed by the meeting of the upper and lower eyelids. 	Centre of the Pupil (Right and Left): The centre of the pupil of the eye. 	**Infraorbitale:** The lowest point on the anterior border of the bony eye socket. 
Zygion (Right and Left): The most lateral points on the zygomatic arches. 	**Submandibular:** The juncture in the mid sagittal plane of the lower jaw and the neck. 	**Anterior Neck:** A mark made midway between the medial superior borders of the right and left clavicles. 
Lateral Neck (Right and Left): Lateral points located at the base of the neck. 	**Suprasternale:** The inferior point of the jugular notch at the top of the sternum. 	**Trapezius Point (Right and Left):** The point at which the anterior border of the trapezius muscle crosses the Lateral Neck landmark. 

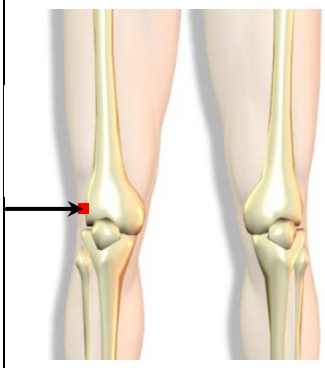
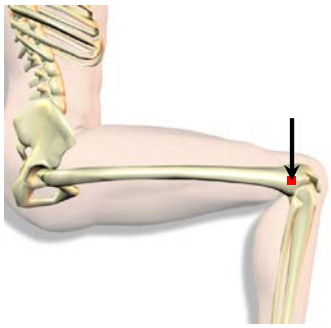
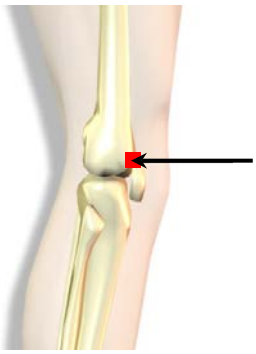
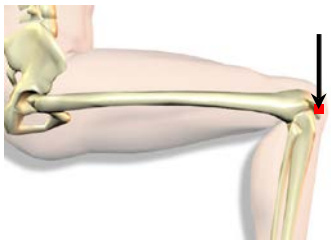
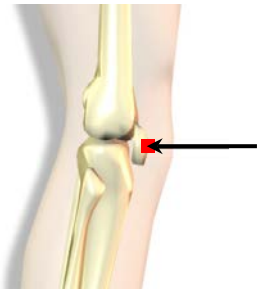
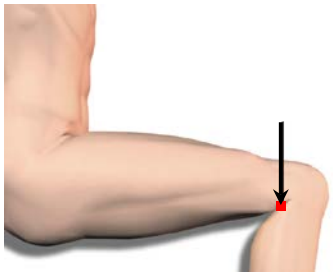
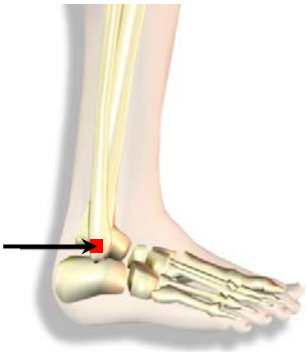
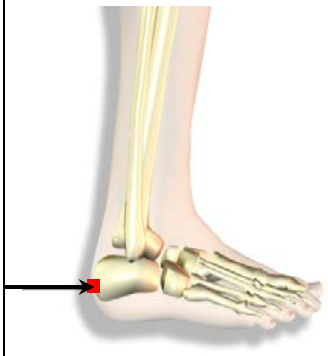
Midshoulder: The point on the top of the right shoulder midway between Trapezius Point, Right and Acromion, Right. 	**Clavicle Point (Right and Left):** The superior points on the lateral ends of the clavicle. 	**Acromion (Right and Left):** The point of intersection between the lateral border of the Acromion process and the extension of a line drawn from Trapezius Point which crosses over the Clavicle point landmark. 
Cervicale: The superior palpable point of the spine of the seventh cervical vertebrae. 	**Posterior Horizontal Scye (Right and Left):** A point on the posterior torso in line with the height of the axilla. 	**Scye Level at Midspoine:** A point on the posterior torso in line with the height of the axilla, at the midspine. 

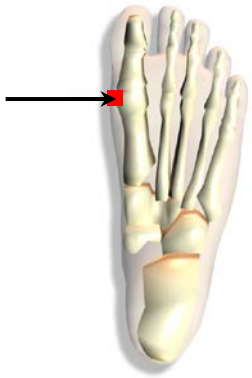
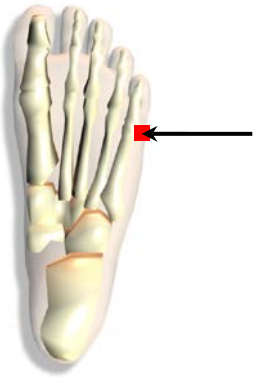
Thelion, Right: The centre of the nipple, right (males only). 	**Bustpoint, Right:** The most anterior point on f the right bra cup (females only). 	**Inferior Breastpoint:** The most inferior point of the juncture of the lower of the two breasts with the torso (females only). 
Substernale: The lowest palpable point on the sternum. 	**Abdominal Point, Anterior:** The most protruding point of the relaxed abdomen of the seated participant. 	Waist Omphalion, Anterior: The centre of the navel. 
Waist Omphalion, Posterior: A point on the spine at the height of the Waist Omphalion, Anterior landmark. 	**Waist Preferred, Anterior:** An anterior point of the torso in line with the spine and the preferred waist height. 	**Waist Preferred, Posterior:** A posterior point of the torso in line with the spine and the preferred waist height. 

Waist Preferred Posterior, Projected: A point on the right hand side of the anterior torso at the intersection of a line projected horizontally from the Waist Preferred, Posterior landmark and a line projected vertically from the Thelion, Right/Bustpoint, Right landmark. 	**Hip Marker:** The maximum lateral trochanteric protrusion on the right side of the body. 	**High Hip Marker:** The anterior point on the torso 8 cm below the Waist Preferred, Anterior landmark. 
Anterior Superior Iliac Spine (Right and Left): The anterior point of the right and left iliac crests, respectively. 	**Posterior Superior Iliac Spine (Right and Left):** The posterior point on the right and left crest of the ilium, respectively. 	**Iliocristale (Right and Left):** The highest palpable point of the iliac crests of the pelvis, one half the distance between the Anterior Superior Iliac Spine and the Posterior Superior Iliac Spine on each  ilium.

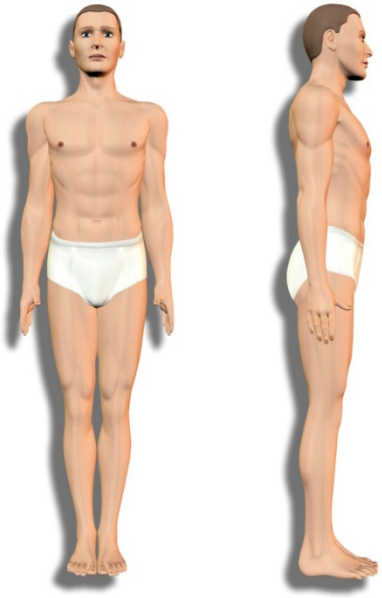
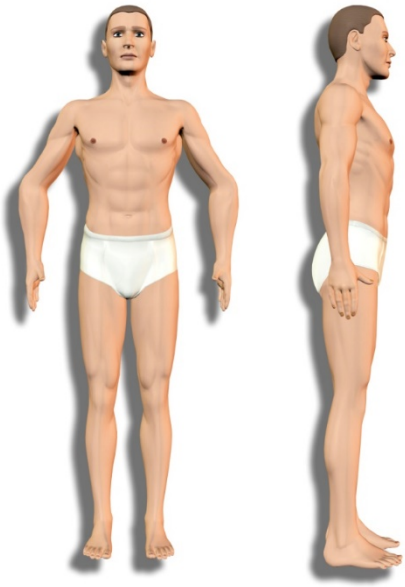
Back Length Marker: The point on the posterior torso vertically aligned with the Waist Preferred, Posterior landmark at a height equidistant between the heights of the Iliocristale, Right and Iliocristale, Left landmarks. 	**Crotch:** The underside of the groin on the right side of the genitalia. 	**Biceps Point:** The highest point of the right flexed biceps as viewed from the participant's right side. 
Elbow Crease: The skin crease on the anterior aspect of the elbow joint when the elbow flexed to 90°. 	**Olecranon Bottom:** The lowest point of the elbow with the elbow joint flexed at 90°. 	**Radiale:** The highest point on the outside edge of the radius. 
Stylion: The lowest point of the distal radius. 	**Centre Wrist Marker:** The point on the dorsal aspect of the wrist, lying on the wrist circumference (when measured at the Stylion landmark, perpendicular to the long axis of the forearm), at the mid-width of the wrist. 	**Thenar Eminence:** The most medial point of the thenar eminence when the right elbow is flexed to 90° with the forearm in a mid-prone position, palm facing inwards. Note that for ease of understanding and visibility of the landmark the image shows the participant in the anatomical position. 

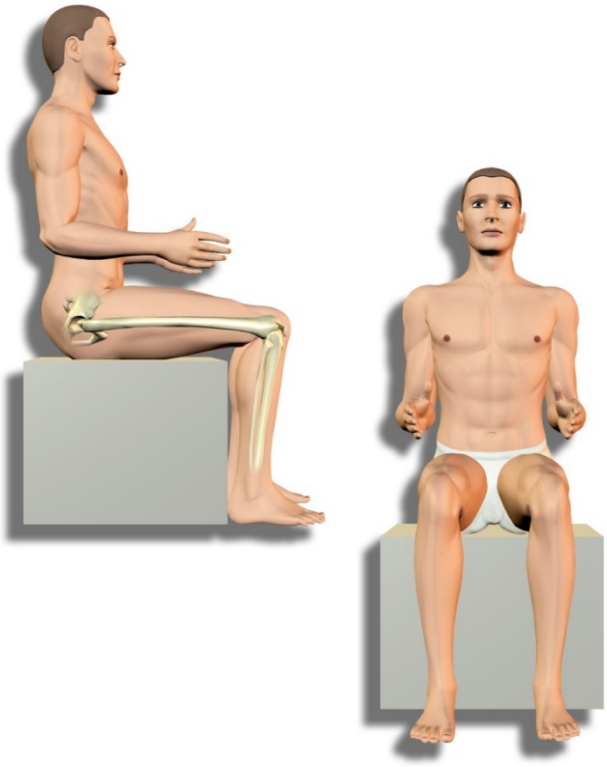
Metacarpale II: The anterior point on the right second metacarpophalangeal joint. 	**Metacarpale V:** The posterior point on the right fifth metacarpophalangeal joint. 	**Distal Interphalangeal Joint II, Lateral:** The lateral (i.e. thumb) side of the distal interphalangeal joint of the second (index) finger of the right hand when the hand is  held in the anatomical position.
Distal Interphalangeal Joint II, Medial: The medial (i.e. middle finger) side of the distal interphalangeal joint of the second (index) finger of the right hand when the hand is held in the anatomical position. 	**Dactylion III (Right):** The tip of the right middle finger. 	**Thumbtip:** The tip of the right thumb. 
Buttock Point, Posterior: The point of maximal protrusion of the right buttock of a standing participant. 	**Trochanterion:** The superior point of the greater trochanter of the right femur on a standing participant. 	**Trochanter:** A point at the centre of the lateral surface of the right greater trochanter of the right femur on a sitting participant. 

Thigh Point, Top: The highest point of the top of the right thigh on a seated participant. 	**Lateral Femoral Epicondyle, Standing:** The lateral point of the right femoral epicondyle. 	**Lateral Femoral Epicondyle, Sitting:** The lateral point of the right femoral epicondyle while seated. 
Suprapatella: The superior point of the patella. 	**Knee Point, Anterior:** The most protruding point of the right kneecap of the participant in Anthropometric Sitting posture. 	**Midpatella:** The anterior point midway between the top and bottom of the right patella. 
Dorsal Juncture of Calf and Thigh: The juncture between the right calf and thigh behind the knee for the participant in the Anthropometric Sitting posture. 	**Lateral Malleolus:** The most lateral point on the right lateral malleolus. 	**Pternion:** The most posterior point of the right heel. 

First Metatarsophalangeal Protrusion: The most medial protrusion of the right foot in the region of the first metatarsophalangeal joint. 	**Fifth Metatarsophalangeal Protrusion:** The most lateral protrusion of the right foot in the region of the fifth metatarsophalangeal joint. 	**Acropodion:** The tip of the first or second toe, whichever is longer. 

Appendix C ASRAN posture definitions

POSTURE	DEFINITION
P01: Anthropometric Standing 	Participants are required to stand erect with their weight distributed evenly on both feet. The heels are together as much as possible, the legs and trunk are straight without stiffness, and the head is erect and looking straight ahead. The arms hang relaxed with the upper arms lightly touching the sides, and the palms of the hands are beside, but do not touch, the thighs. The posture is similar to that of the position of military 'at attention', but without the associated stiffness and bracing. This posture is modified slightly when used for 3D scan measurements. When this posture is adopted for a 3D scan the arms are abducted slightly from the body, fingers are extended and the thumb is pointed forward. This prevents areas of the torso and arms from being occluded on the scan.
P02: Scanning Standing 	The participant stands erect with the weight evenly distributed on both feet. The feet are shoulder width apart, the legs and the trunk are straight without stiffness, and the head is erect with the eyes looking straight ahead. The upper arms are abducted, and the forearms hang vertically. The palms face the body with the fingers together and extended, and the thumbs pointing directly forward. The shoulders should not round or hunch or elevate in this posture—as much as possible, the shoulder girdle should be held in a neutral position. The mouth should be closed and the teeth together.

P03: Anthropometric Sitting 	The participant sits on a flat, cushionless surface with the long axis of the thighs parallel. The feet are on an adjustable footrest (if unavailable footplates can be used), and the knees are flexed at 90°. Two seated landmarks on the thigh are used to establish this position. Using the adjustable footrest, the height of the feet are elevated until the Trochanter and the Lateral Femoral Epicondyle, Sitting landmarks are horizontally aligned. The trunk is erect without stiffness, the head is erect and the participant looks straight ahead. The shoulders are relaxed and the upper arms hang loosely at the sides. The elbows are flexed at 90° and the hands are straight.

Appendix D Boundary manikin development

D.1. Source data

Data are from the Anthropometric Survey of the Royal Australian Navy (ASRAN) study. Manual measurements on 87 characteristics are available on 1322 male and female participants. Of these 23 male and 3 female subjects had observations missing and were excluded from the analysis. Resulting subjects for analysis are:

Male: n = 1067
Female: n = 229

D.2. Analysis

D.2.1. Step 1 – review input data

Of the 87 measured characteristics, 27[3] were identified by ergonomics practitioners as being relevant for general space claims that can be important when determining aspects such as workstation sizing, space required for maintenance tasks, and space required for general postures (kneeling, pushing etc.). This subset of characteristics was used for subsequent data analysis. Male and female physical characteristics can be significantly different so the analysis was conducted along gender lines with the exploratory aspects of the analysis performed on the male sub-sample because of the larger sample size.

The objective is to reduce the dimensionality of the data set in order to develop models that would be representative of extremes in the population for the subsequent design of workstations. A Principle Components Analysis (PCA) was used for the dimension reduction.

D.2.2. Step 2 – run PCA analysis (male data)

A script written in the R Statistical Language [31] was used to conduct the analysis on data filtered to limit the analysis to the male participants. Output of the PCA analysis provided:

[3] M01 Cervicale Height, M03 Acromion Height, M09 Eye Height Sitting, M10 Acromion Height Sitting, M11 Elbow Rest Height Sitting, M12 Thigh Clearance, M13 Knee Height Sitting, M14 Popliteal Height, M18 Bideltoid Breadth, M20 Chest Depth, M22 Forearm Forearm Breadth, M23 Abdominal Extension Depth Sitting, M24 Hip Breadth Sitting, M25 Buttock Knee Length, M26 Buttock Popliteal Length, M37 Thumbtip Reach, M38 Stature, M39 Sitting Height, M40 Weight, M50 Back Width, M51 Back Length, M60 Acromion Radiale Length, M61 Radiale Stylion Length, M66 Hand Length, M71 Foot Length, M83 Knee Level, M90 Overhead Fingertip Reach. Note other dimensions were initially included in the PCA but did not have a significant correlation with any of the axes in the PCA space and therefore were removed.

- descriptive statistics for each dimension
- correlation coefficients between all dimensions
- determinant test for multicollinearity and singularity
- KMO (Kaiser-Meyer-Olkin) and Bartletts test of sphericity
- PCA with varimax rotation (to align the resulting space with the characteristics)
- communalities for all dimensions
- scree plots.

A single PCA was run selecting only those components with eigenvalues greater than 1. This selects for those components contributing more than they would on average. The statistics for this PCA are summarised in Table 13.

Table 13 Summary of Step 2 PCA statistics (Male)

Statistic	**Value**
Partial correlations (>0.7)	None
Determinant	1.078E-017
KMO	0.936
Bartletts test of sphericity (sig)	0.000
Scree plot	Suggests 3 factors
Communalities (<0.5)	0.400 (Thumbtip reach) 0.410 (Hand length) 0.476 (Back width)
% variance explained (factors)	75.567 (3 factors)

Both the Bartlett's test of sphericity and KMO suggest that principal components analysis is appropriate and that there are not redundant characteristics. Both the scree plots and selection by eigenvalue>1 suggest that 3 components be selected. A varimax rotation was performed to align the resulting 3 dimensional space of observations to named characteristics.

The resulting components are calculated by this PCA are listed below:

1. PC 1 – Body length (popliteal height, knee height sitting, stature, radiale stylion length, buttock popliteal length, buttock knee length, acromion radiale length, hand length, foot length, thumbtip reach, knee level, overhead fingertip reach, cervicale height and acromion height)
2. PC 2 – Body depth/breadth (weight, chest depth, abdominal extension depth sitting, bideltoid breadth, forearm to forearm breadth, hip breadth sitting, thigh clearance, and back width)

3. PC 3 - upper body length (elbow rest height sitting, acromion height sitting, eye height sitting, sitting height and back length).

Variables are attributed to the component explaining the greatest variance.

D.2.3. Step 3 – check PCA results (male data)

The rotated principal component analysis reduces each participant observation to a value on each of the three principal components. The components are uncorrelated as a result of the principal component analysis providing an orthogonal basis for the resulting space. As observations on each of the component axis are formed as a linear combination of the original characteristics we can expect the result to be approximately normally distributed as a result of the central limit theorem. Thus the principal components are observations of the marginal distributions of this multivariate normal distribution. Scaling was performed before analysis resulting in these marginal data having a zero mean and unit variance.

We test the assumption of zero mean unit variance normal distribution of the principle components prior to conducting further analysis. QQPlots and a Kolmogrov-Smirnov test were produced to perform the test.

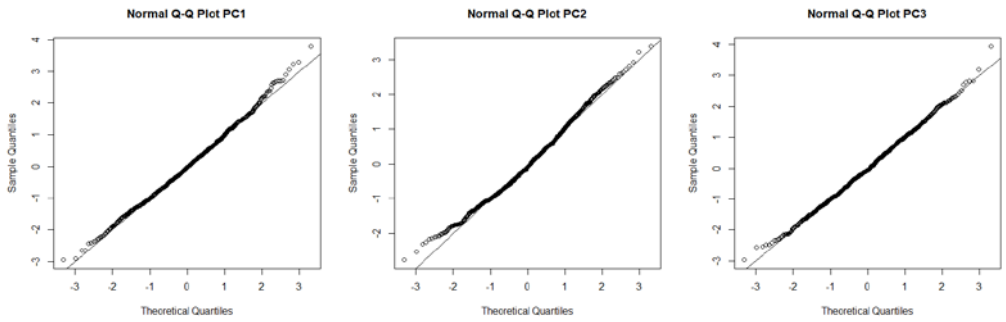


Figure 3 QQPlots of the 3 principle components

Table 14 Individual Kolmogrov-Smirnov statistics for a test of normal distribution

Statistic	**Significance value**
Principle Component 1	0.5485
Principle Component 2	0.0656
Principle Component 3	0.3507

We note that the significance value for the Kolmogrov-Smirnov test on component 2 is low and this is indicated on the QQPlot. As we are performing simultaneous tests that the three marginal distributions are from a normal distribution the Bonferroni argument

reduces the point at which a significant result can be claimed. We cannot reject the null hypothesis that the data come from a normal distribution.

D.3. Participant identification

These analyses are intended to form boundary manikins to represent the extremes of the data. Having performed a principal component analysis we assume that our data (the principle components) are approximately uncorrelated standard multivariate normal. The data have the same scale on each of the coordinate axis and are centred on the origin. If we consider a sphere encompassing some proportion of the population in this data space then we seek to identify points on the surface of this sphere to represent extremes of the population. A set of 14 points on the sphere and at the origin as shown in Figure 3 are used.

The radius of a sphere encompassing the desired proportion of the data could be determined empirically from the data if the number of observations is sufficiently large however there is also a closed form result from [32]. We know that an ellipse covering all points from the underlying population with probability p for multivariate normal is given by

$$(x-\mu)^T \sum^{-1} (x-\mu) \leq \chi^2_k(p)$$

where k is the dimensionality of the distribution. For samples with large N the sample estimate converges to the population estimate hence we can calculate the radius of the sphere for any given proportion of the population. In our case we will be determining boundary manikins for 90%, 95% and 98% for the population. The radius of a sphere containing a proportion of 3 dimensional multivariate standard normal population are shown in Table 15. These values were checked against the PCA results for male subjects of the ASRAN survey. Some 90.4% of observations were within the theoretical 90% bound, 95.5% were within the theoretical 95% bound and 98.6% were within the theoretical 95% bound.

Table 15 Radius of a sphere containing a proportion of the 3 dimensional multivariate standard normal population

Proportion	Value
90%	2.500278
95%	2.795483
98%	3.136464

These dimensions are used together with the points on the unit sphere shown in Table 16 to produce the 15 boundary manikins.

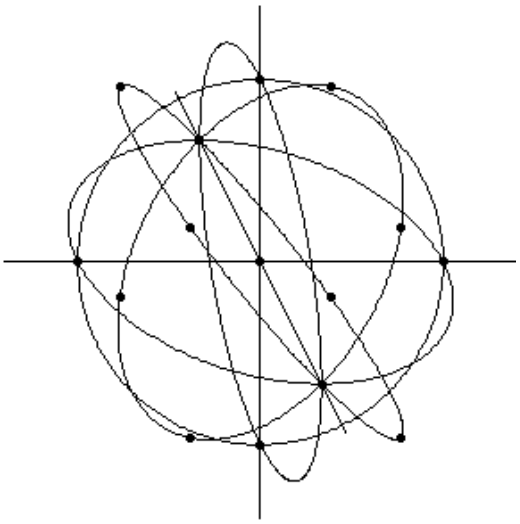


Figure 4 Six boundary points on the component axis and a further eight points at the centre of each quadrant plus a point at the origin have been selected as the boundary cases

Table 16 Coordinate points for boundary manikins

	Component		
	1	**2**	**3**
A1	1	0	0
A2	-1	0	0
A3	0	1	0
A4	0	-1	0
A5	0	0	1
A6	0	0	-1
M1	-1/√3	-1/√3	-1/√3
M2	-1/√3	-1/√3	1/√3
M3	-1/√3	1/√3	-1/√3
M4	-1/√3	1/√3	1/√3
M5	1/√3	-1/√3	-1/√3
M6	1/√3	-1/√3	1/√3
M7	1/√3	1/√3	-1/√3
M8	1/√3	1/√3	1/√3
X	0	0	0

The selected boundary points in principle component space are then transformed back into measurement space to define the dimensions of the boundary manikins.

D.4. Female PCA and participant identification

An identical analysis was performed on the female sample. The same components and associations with original characteristic resulted from the analysis so the same interpretation can be made for the resulting principal components. The process used for the male boundary manikins was then repeated to produce 15 separate boundary manikins that represent the extremes of the female populations (and the mean) in terms of body size.

DEFENCE SCIENCE AND TECHNOLOGY GROUP DOCUMENT CONTROL DATA			1. DLM/CAVEAT (OF DOCUMENT)
2. TITLE Revised Anthropometry Guidance for the Royal Australian Navy		3. SECURITY CLASSIFICATION (FOR UNCLASSIFIED LIMITED RELEASE USE (U/L) NEXT TO DOCUMENT CLASSIFICATION) Document (U) Title (U) Abstract (U)	
4. AUTHOR(S) Kate Ponton, Sam Huf, David Gamble, Jemma Coleman, Alistair Furnell, Susan Cockshell, and Kingsley Fletcher		5. CORPORATE AUTHOR Defence Science and Technology Group HMAS Stirling PO Box 2188 Rockingham DC WA 6967	
6a. DST GROUP NUMBER DST-Group-TR-3564	6b. AR NUMBER	6c. TYPE OF REPORT Technical Report	7. DOCUMENT DATE January 2019
8.TASK NUMBER 17/525	9.TASK SPONSOR Director General Submarines	10. RESEARCH DIVISION Maritime Division	
11. MSTC Undersea Command and Control		12. STC Human Systems and Information Integration	
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17. ABSTRACT In 2015 an Anthropometric Survey of the Royal Australian Navy (ASRAN) was completed providing comprehensive digital and manual anthropometric data on the permanent RAN operational workforce that can be used for the design and evaluation of vessels, equipment and clothing. The ASRAN included the measurement of 1322 Permanent Royal Australian Navy (RAN) personnel (232 females and 1090 males), aged 18–54 years. A total of 87 measurements, comprising of both manual and digital measures were captured. This document presents the anthropometric percentile data captured and provides information on how to apply the data, as well as information on secular trend, personal equipment and clothing correction factors, and other allowances that should be considered when using the anthropometric data. Boundary manikin data that can assist with multivariate design requirements are also provided. This document supersedes all previous RAN anthropometric data and guidance documents. This report is a revision of the Preliminary Anthropometry Guidance for the RAN.			

Version 2, 24/07/2020. This version contains corrections to Section 2.3 and Figure 1 regarding the univariate and multivariate examples, and to Figure 2 to correct the illustration of dimensions M09 and M10.