Anthropometric Study of U.S. Truck Drivers

Methods, Summary Statistics, and Multivariate Accommodation Models

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Foreword

Motor vehicle-related injuries have been identified by the Centers for Disease Control and Prevention (CDC) as a domestic "winnable battle." This designation established motor vehicle-related deaths and injuries as a public health priority in the United States. As the federal agency under CDC responsible for conducting research in occupational safety and health, the National Institute for Occupational Safety and Health (NIOSH) is committed to reducing work-related fatalities and injuries on America's highways.

Work-related highway incidents are a leading cause of occupational deaths and injuries in the United States. Prevention of work-related highway injuries and deaths poses one of the greatest challenges for occupational safety researchers. Compared with other work settings, the work environment surrounding trucking and other transportation-related activities is fluid and dynamic. As such, it is difficult to exert direct control over a range of factors (e.g., fatigue, inattention, subpar road and weather conditions) that may negatively influence a worker's safety. Despite these challenges, NIOSH has been actively engaged in a range of research efforts that are likely to have the greatest impact on the reduction of work-related highway incidents. One of these research efforts is focused on reducing hazards to truck drivers by improving ergonomic design in medium-duty and heavy-duty truck cabs.

Since up-to-date anthropometric data, which plays an important role in improving ergonomic design of truck cabs, has not been collected for decades, NIOSH launched the first-ever federal anthropometric study of U.S. truck drivers. This document summarizes the results of the study that, we hope, will be used by truck manufacturers, parts suppliers, transportation researchers, fleet managers, and other interested parties for decades to come.

This research exemplifies efforts by government agencies, private industry, the research community, and trade unions to work together in reducing work-related roadway crashes and injuries. We look forward to continuing similar lines of work with our partners in public and private sector settings to promote public health for the truck driving population of this country.

John Howard, M.D.
Director
National Institute for Occupational
Safety and Health

Abbreviations

ANSUR	U.S. Army Anthropometric Survey
BLS	Bureau of Labor Statistics
CDC	Centers for Disease Control and Prevention
CDL	commercial driver's license
CM	centimeter
CumF	cumulative frequency
CumFPct	percentage of cumulative frequency
COEF VAR	coefficient of variation
F	frequency
FPct	percentage of frequency
ISO	International Organization for Standardization
kg	kilogram
M	mean
Min	minimum
Max	maximum
MAM	multivariate accommodation model
mm	millimeter
N	number (sample size)
NIOSH	National Institute for Occupational Safety and Health
NORA	National Occupational Research Agenda
PC	principal component
PCA	principal component analysis
r	Pearson's product-moment correlation coefficient
RAD	radius
SD	standard deviation
SE	standard error
U.S.	United States

Executive Summary

Background Information

In 2006, the National Institute for Occupational Safety and Health (NIOSH) initiated a 4 year anthropometric study of U.S. truck drivers. The purpose of this project was to establish an anthropometric database for the design of the next generation of medium- and heavy-duty trucks. Primary funding for this project came from the National Occupational Research Agenda (NORA), a partnership program unveiled by NIOSH in 1996 to stimulate innovative research and improved workplace practices in the United States. As word of this project circulated, it attracted widespread stakeholder interest. A Research Cooperative of Industry Partners (PACCAR Inc., Daimler Trucks North America LLC., Navistar Inc., Volvo Group North America, Commercial Vehicle Group Inc., IMMI, and Isringhausen Inc., U.S.A.) was established not only to share invaluable technical knowledge, but also to provide additional financial support to increase the sample size. Data collection took place between 2009 and 2010. This publication is the final report of the study results.

Selection of Key Anthropometric Dimensions

The selection of key anthropometric dimensions for this study had undergone a vigorous evaluation process. In 2006, NIOSH conducted a pilot study to investigate the feasibility of measuring up to 50 anthropometric dimensions from a tri-state sample of 60 West Virginia, Western Pennsylvania, and Eastern Ohio truck drivers. The results of this pilot study were analyzed and evaluated in view of the following two guiding principles: (1) relevance of these dimensions to the design of the cab work environment and (2) manageability of the time factor in field data collection efforts.

As a result of this analysis, NIOSH determined the number of dimensions needed to be reduced. On October 19, 2007, NIOSH convened a stakeholder meeting in Morgantown, West Virginia, to discuss sampling issues, including the finalization of the dimensions to be measured. Based on the input from the meeting participants, NIOSH decided on a final list of 33 dimensions plus shoe length and shoe width.

The Sample

This study sample consisted of 1,779 male and 171 female truck drivers. Data were collected at 16 different locations in 15 states across the continental United States. A sampling strategy that took into account age, sex, and race categories was used. Only those with a valid Class A Commercial Vehicle Driver's License (CDL) were measured. More details about the sampling strategy are described in Chapter III.

Summary of Study Results

The study results showed that truck drivers were on average larger and heavier (13.5 kg for males and 15.4 kg for females) than individuals in the general U.S. population. The current male drivers were heavier by about 12 kg on

average than male drivers of 25–30 years ago. They were larger in body width and girth, even though they were not taller. A comparison of current female truck drivers to their counterparts of 25–30 years ago was not possible due to the small sample size for the female truck drivers in the previous studies. Detailed summary statistics about the current driver population can be found in Chapter IV.

Applications to Workstation Design in Truck Cabs

To facilitate truck cab design, this study used the Multivariate Accommodation Model (MAM) approach to select 15 body models each for male and female truck drivers. Each of the 15 body models represents a unique combination of body size and physique. These models, together with the anthropometric values of their closest neighbor participants, should benefit the design of the next generation of truck cabs. If a combined set of the male and female models are more desirable, the 20 male and female models selected in this study may be used for the same purposes.

Introduction

Truck driving is one of the most hazardous occupations in the United States. Data from the Bureau of Labor Statistics (BLS) show that, in 2009, truck drivers experienced 16.8% (303 out of 1,795) of all transportation-related fatalities [BLS, 2009a] and 2.0% of the nonfatal injuries requiring days away from work, even though they only made up 1.0% of the U.S. workforce [BLS, 2009b].

Truck drivers spend long hours behind the wheel, working an average of 41.5 hours per week [BLS, 2009c]. Therefore, a well-designed truck cab can make a significant difference in the working conditions for a truck driver. Truck cab design impacts not only comfort, but also the safety of truck drivers and other road users. If the design of the truck cab is poorly fitted to the size and dimensions of the driver, the road may be less visible, controls may be more difficult to reach, and seat belts may be less comfortable and less likely to be used—all of which may increase the risk of injury to the driver and other road users.

U.S. manufacturers have long recognized that improving the ergonomic design of truck cabs relies, to a large extent, on the availability of accurate and up-to-date anthropometric data on the nation's medium- and heavy-truck-driving population. Unfortunately, the U.S. has not collected truck driver anthropometric data for almost three decades. In the 1980s, the Society of Automotive Engineers, at the urging of the domestic truck industry, sponsored an anthropometric study of truck drivers [Sanders, 1983; Shaw and Sanders, 1985] in an effort to create a database that could be used for the design of trucks. While these data were an important advancement at the time, their usefulness has always been limited due to relatively small sample sizes and questions about the representativeness of the sample.

These problems have become exacerbated by changes in the demographics of the American truck drivers in the last 25–30 years. In 1983, the combined category of truck drivers (heavy and light) and driver-sales workers consisted of 11.7% African American, 5.6% Hispanic, and 3.5% females [BLS, 1983]. In 2009, the driver-sales workers and truck drivers category consisted of 13.4% African American, 18.7% Hispanic, and 5.2% females [BLS, 2009d]. This new demographic reality necessitated an updating of the anthropometric data used for the design of truck cabs because anthropometric data are related to various demographic characteristics [Bradtmiller et al., 1985; Gordon et al., 1986; ISO, 2006].

In addition to the demographic changes, there may be important secular changes in the body weight and girth of today's truck driver population compared to the truck driver population of 30 years ago. Today's truck drivers are on average heavier and differently shaped perhaps as part of the obesity epidemic that has hit the U.S. population in recent decades. The sedentary lifestyle of this profession, compounded by poor diet and nutrition, could contribute significantly to the increase in the weight and girth of the current driving population [Sieber et al., 2014; Korelitz et al., 1993].

Based on these considerations, NIOSH decided to conduct the first-ever federal anthropometric study of U.S. truck drivers. Data collection took place between 2009 and 2010. The goal of the study was to create a practical and up-to-date anthropometric database of U.S. medium-duty and heavy-duty truck drivers, which could be relied upon by truck manufacturers for designing new truck cabs and by professional organizations for updating industry standards for cab workspace environments. Anthrotech, an Ohio-based anthropometry consulting firm, was contracted by NIOSH to conduct data collection for this project. While NIOSH funded the bulk of the study, the partners in the trucking industry also provided financial support to increase the study sample size. This objective was achieved through SAE International, which obtained and packaged financial contributions from a number of firms in the trucking industry, making it possible to add hundreds of additional truck drivers to the database. The final sample is composed of 1,950 male and female truck drivers in a range of ages and racial/ethnic backgrounds, measured in widely dispersed sites around the nation.

Study Design

SELECTION OF STUDY DIMENSIONS

From the very beginning, the selection of body dimensions to be measured was guided by two principles: relevance of the dimensions to the design of truck cabs and manageability of the time factor in field-data collection efforts. In an earlier NIOSH pilot study of truck driver anthropometric dimensions, a total of 50 dimensions were measured on a tri-state (West Virginia, western Pennsylvania and eastern Ohio) sample of 60 drivers of medium-duty and heavy-duty trucks [Guan et al., 2006]. However, due to the time constraints likely to be encountered in a national field-data collection effort, the number of dimensions would need to be reduced. On October 19, 2007, NIOSH convened a stakeholder meeting in Morgantown, West Virginia, to discuss sampling issues, including the finalization of the dimensions to be measured. Based on the input from the meeting participants, NIOSH decided on a final list of 33 dimensions plus shoe length and shoe width (see Table 1).

Table 1. List of Study Measurements.

Dimensions	Compatible Sources
Abdominal Breadth, Sitting	Defined for This Study
Abdominal Depth, Sitting	ANSUR*
Acromial Height	ANSUR
Acromial Height, Sitting	ANSUR
Ankle Height	ANSUR (Lateral Malleolus Height)/RAMSIS (Foot Height: Lateral Ankle)
Arm Length	Defined for This Study
Biacromial Breadth	ANSUR
Bideltoid Breadth	ANSUR
Buttock-Knee Length	ANSUR/RAMSIS
Buttock-Popliteal Length	ANSUR
Calf Circumference	ANSUR
Chest Depth	RAMSIS
Chest Width	RAMSIS
Elbow-Fingertip Length	ANSUR
Elbow Rest Height	ANSUR
Eye Height, Sitting	ANSUR

Forearm Circumference	RAMSIS
Forearm-Forearm Breadth	ANSUR
Hand Breadth	ANSUR
Hand Length	ANSUR
Hip Breadth, Sitting	ANSUR
Knee Height, Sitting	ANSUR/RAMSIS
Popliteal Height, Sitting	ANSUR
Shoe Length	Defined for This Study
Shoe Width	Defined for This Study
Shoulder-Elbow Length	ANSUR
Sitting Height	ANSUR/RAMSIS
Stature/No Shoes	ANSUR/RAMSIS
Stature with Shoes	Defined for This Study
Thigh Circumference	ANSUR/RAMSIS
Thigh Clearance	ANSUR
Thumbtip Reach	Defined for This Study
Upper Arm Circumference	RAMSIS
Waist Circumference (Natural Indentation)	ANSUR/RAMSIS
Weight (Kg)	ANSUR

*U.S. Army Anthropometric Survey of 1987–1988

This list was largely comprised of sitting workspace measurements relevant in the design of truck cabs. Several other measurements on overall body dimensions, reaches, and clearances were also included. Most of the dimension definitions came from U.S. Army Anthropometric Survey [ANSUR, Clauser et al., 1988; Gordon et al., 1989] and RAMSIS Anthropometric Databases [Spyer, 2007]. The remaining measurements (abdominal breadth sitting, arm length, thumbtip reach, stature with shoes, shoe length, and shoe width) were specifically defined for this study.

Dimensions were defined in terms of body landmarks. A list of landmarks used in this study is provided in Appendix A. Since the measurements in the study were taken with the drivers' own clothing on, most of the body landmarks were not marked. Only a few landmarks were marked with a white dot or with an eyebrow pencil.

A Visual Index of all the dimensions measured appears on the following pages.

VISUAL INDEX
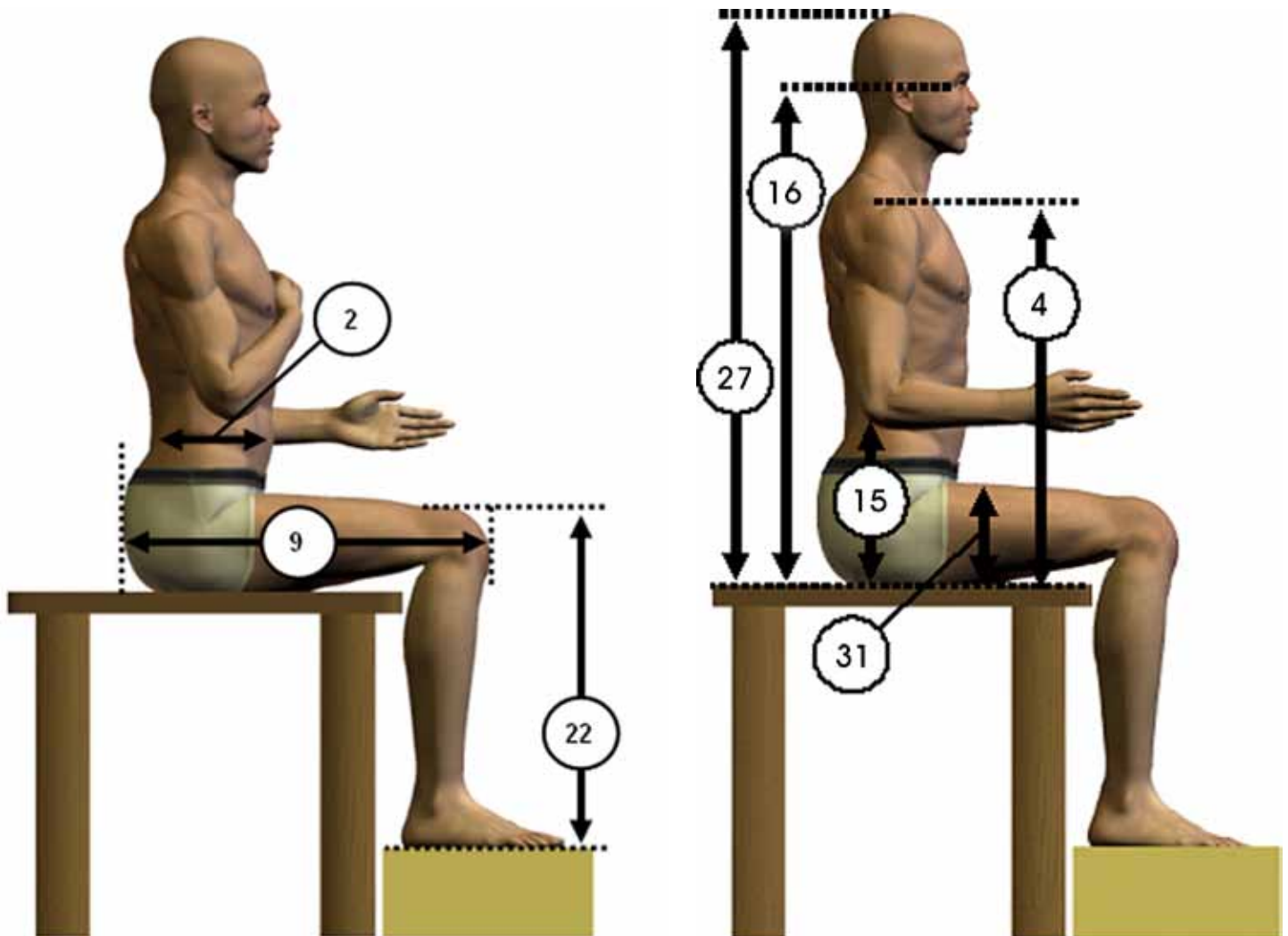
(2)   ABDOMINAL DEPTH, SITTING

(4)   ACROMIAL HEIGHT, SITTING

(9)   BUTTOCK-KNEE LENGTH

(15)   ELBOW REST HEIGHT

(16)   EYE HEIGHT, SITTING

(22)   KNEE HEIGHT, SITTING

(27)   SITTING HEIGHT

(31)   THIGH CLEARANCE
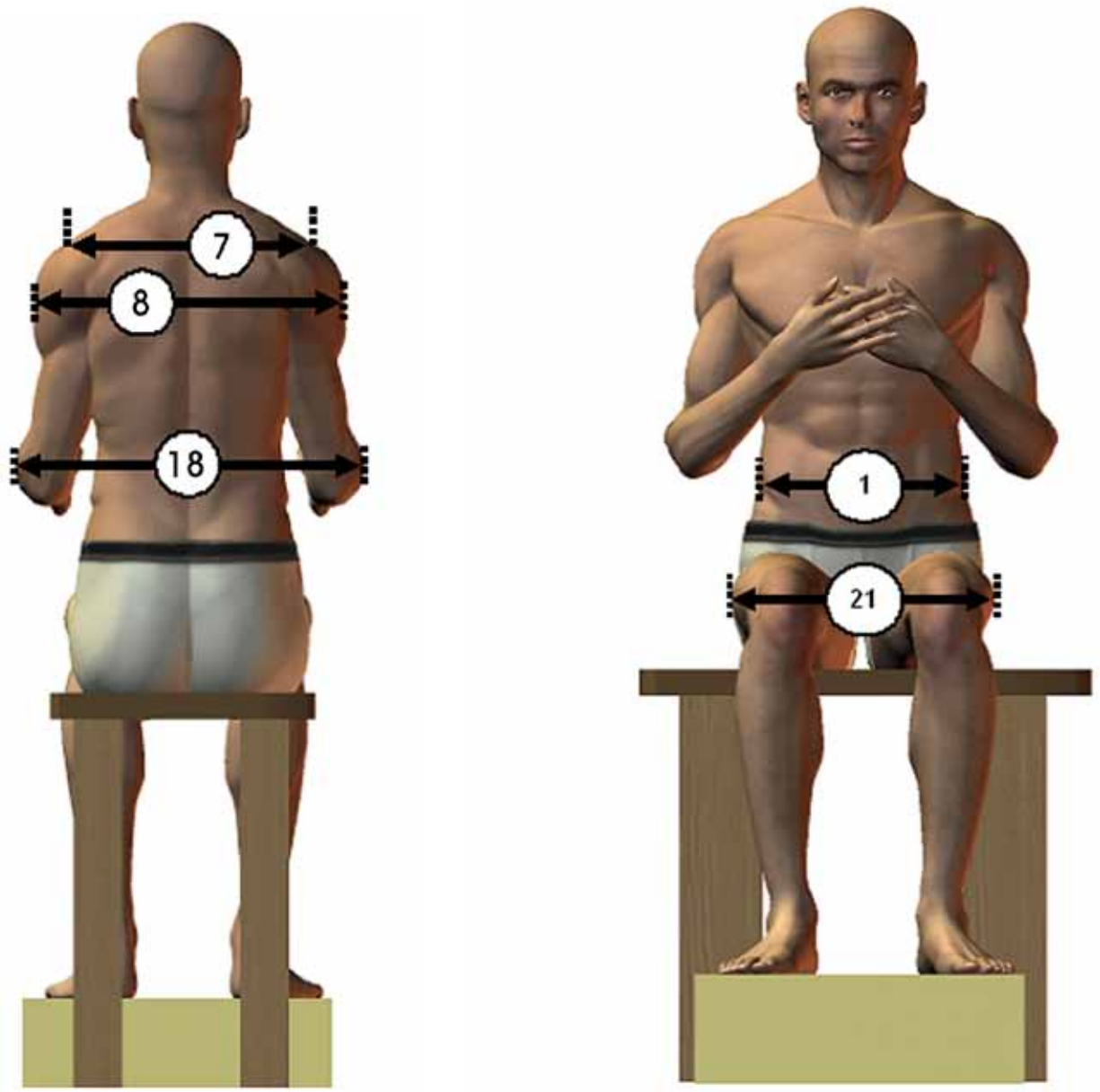
(1)   ABDOMINAL BREADTH, SITTING

(7)   BIACROMIAL BREADTH

(8)   BIDELTOID BREADTH

(18)   FOREARM-FOREARM BREADTH

(21)   HIP BREADTH, SITTING
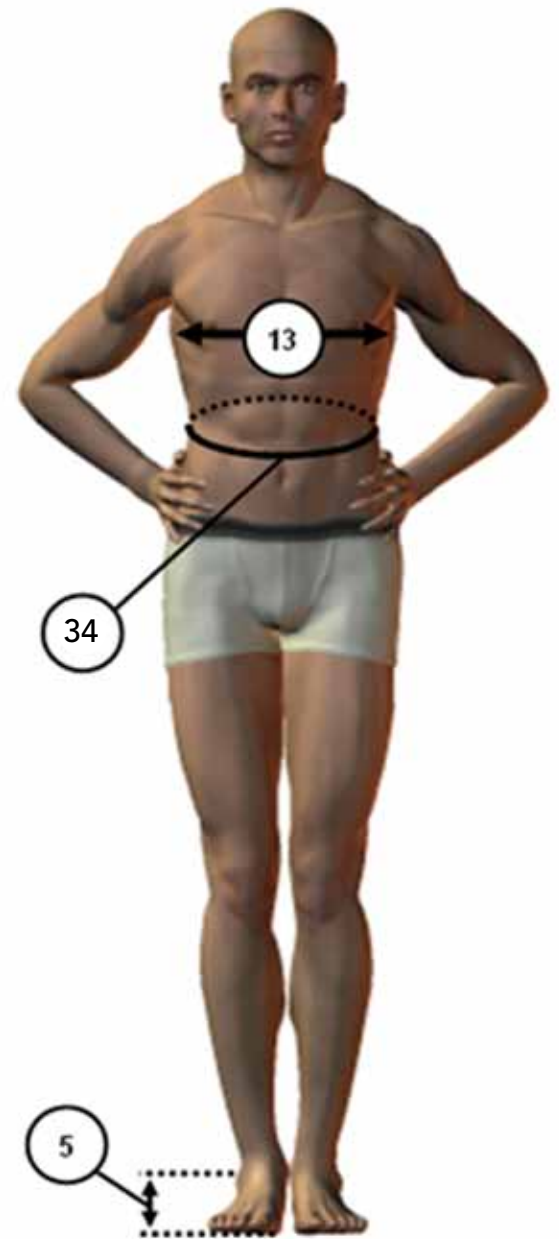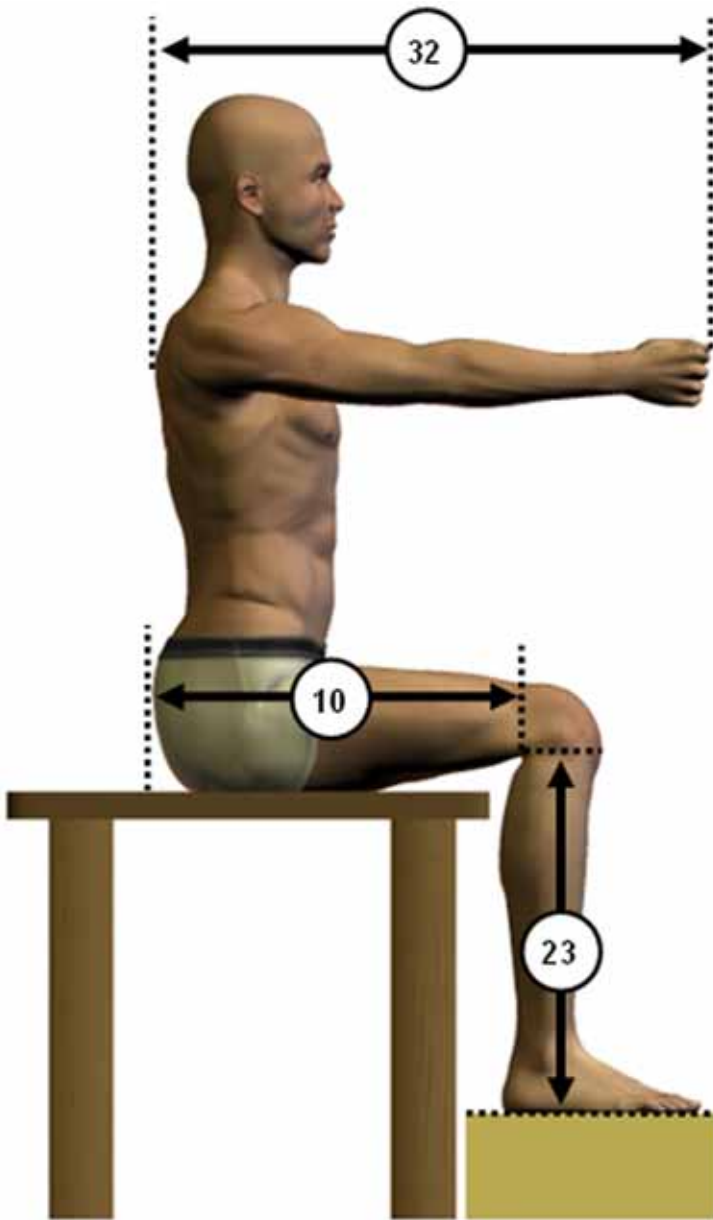
(5)   ANKLE HEIGHT

(10)   BUTTOCK-POPLITEAL LENGTH

(13)   CHEST WIDTH

(23)   POPLITEAL HEIGHT

(32)   THUMBTIP REACH

(34)   WAIST CIRCUMFERENCE (NI)
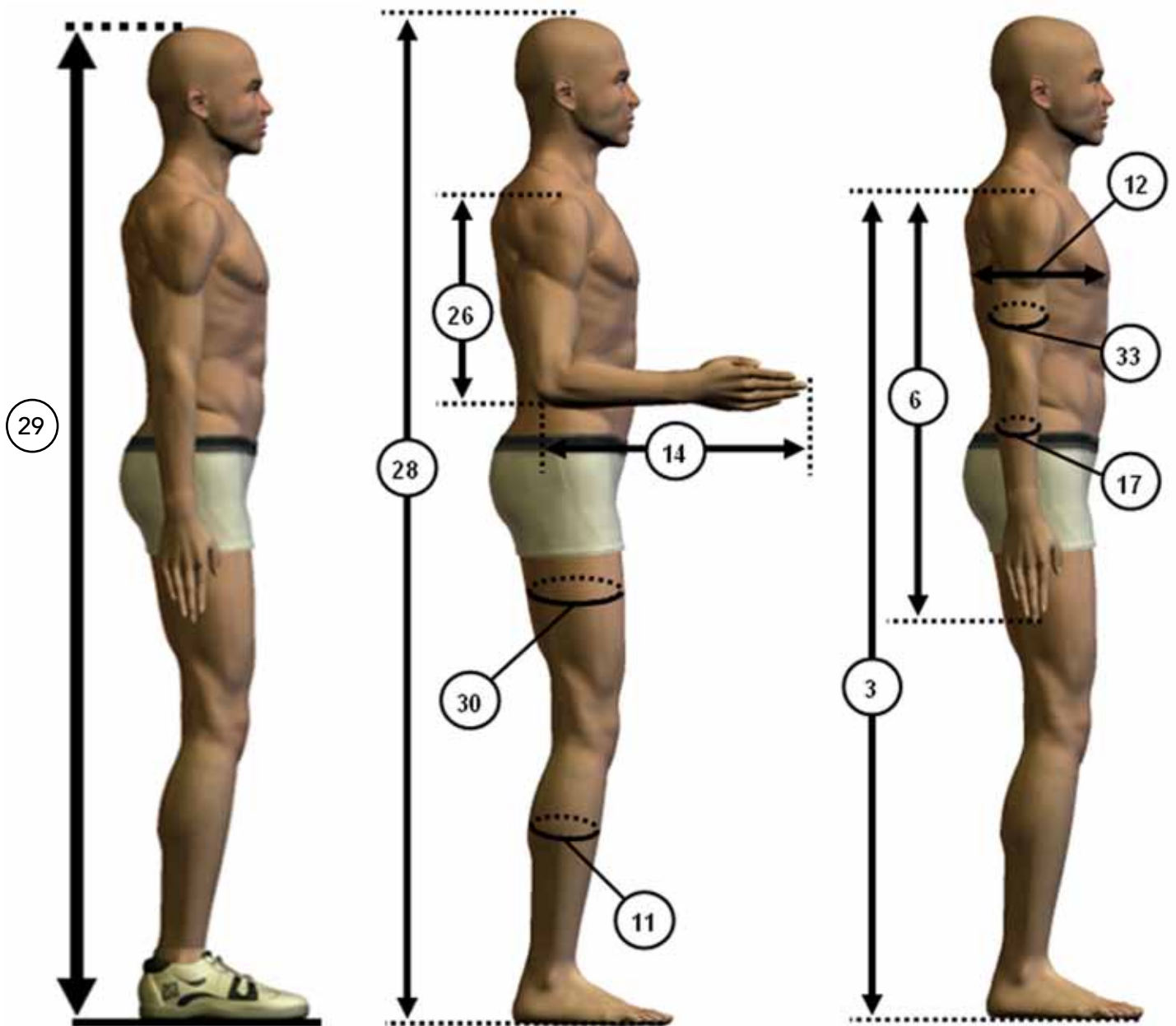
(3)   ACROMIAL HEIGHT

(6)   ARM LENGTH

(11)   CALF CIRCUMFERENCE

(12)   CHEST DEPTH

(14)   ELBOW-FINGERTIP LENGTH

(17)   FOREARM CIRCUMFERENCE

(26)   SHOULDER-ELBOW LENGTH

(28)   STATURE/NO SHOES

(29)   STATURE WITH SHOES

(30)   THIGH CIRCUMFERENCE

(33)   UPPER ARM CIRCUMFERENCE
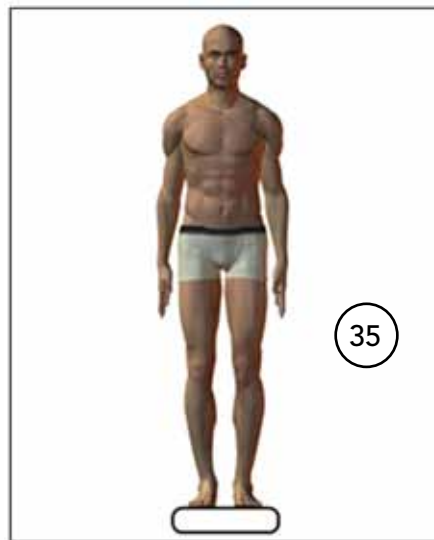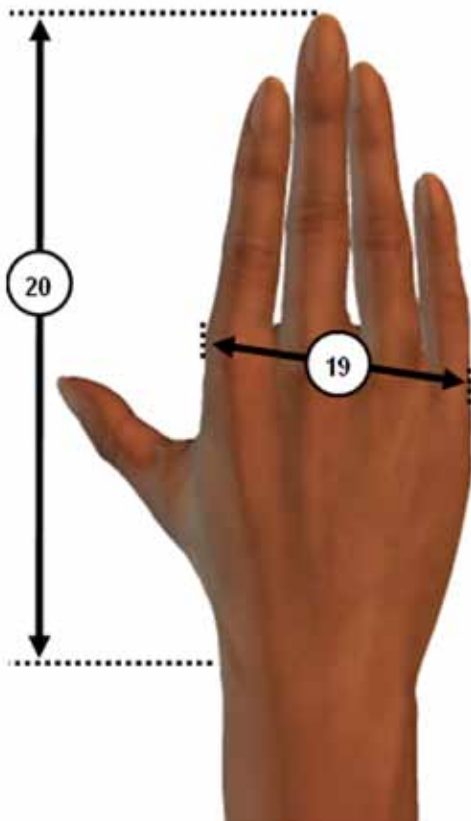
(19)   HAND BREADTH
(20)   HAND LENGTH
(24)   SHOE WIDTH
(25)   SHOE LENGTH
(35)   WEIGHT (KG)

ANTHROPOMETRIC INSTRUMENTS

The standard anthropometric instruments used in this study included a GPM sliding caliper, beam caliper, anthropometer (Zurich, Switzerland), Seca scale (Hamburg, Germany), and a Lufkin steel tape (Sparks, MA) (see Figures 1 through 5). For chest depth, the beam caliper was outfitted with curved blades (Figure 6).

FIGURE 1

GPM Sliding Caliper
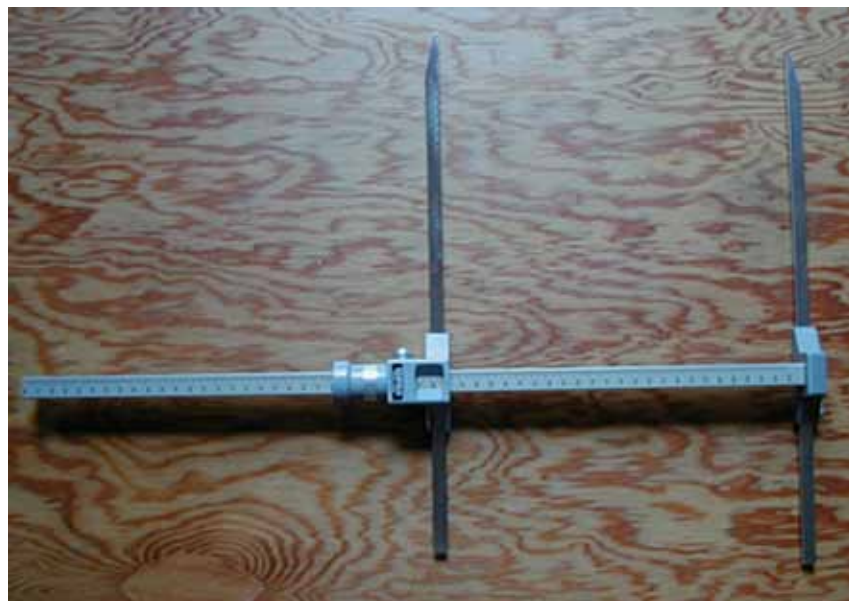
FIGURE 2

GPM Beam Caliper

FIGURE 3

GPM Anthropometer

FIGURE 4

Seca Scale (Alpha 770)

FIGURE 5

Lufkin Steel Tape

FIGURE 6

GPM Beam Caliper with Curved Blades

THE SAMPLE

The first task in our sampling strategy was to estimate the minimum sample size required for this study. Sample size estimation in anthropometry relies customarily on a precision-based method to estimate the true population 5th and 95th percentiles with 95% confidence and a certain percentage (e.g., 1%) of relative accuracy [ISO 15535, 2006]. The general practice is to calculate the minimum sample size for a study using the body dimension that has the largest coefficient of variation (COEF VAR). The rationale for this worst-case approach is that sample size calculated on the single dimension with the largest COEF VAR will be more than sufficient for all other body dimensions. However, since an anthropometric study carries high cost, the decision to choose an adequate sample size often reflects a delicate balance of benefit and cost. We estimated our sample size based on the results of our pilot study of 60 truck drivers in the tri-state area of West Virginia, western Pennsylvania, and eastern Ohio. We calculated the minimal sample size for each of the 32 body measurements, except for the weight and stature with shoes (not included in the pilot study), in accordance to the method provided in ISO 15535 for estimating the minimum sample size [ISO 15535, 2006].

Table 2 presents the minimum sample size estimations based on the eight body dimensions with the largest COEF VAR in the pilot study.

With the exception of waist circumference, the minimum sample size estimations based on the remaining seven dimensions were all below 1,600 participants. With industry input obtained at the stakeholder meeting held on October 19, 2007, NIOSH decided to set the targeted sample size between 1,800 and 2,000 participants. Major funding for this project came from NIOSH's National Occupational Research Agenda (NORA). Additional funding was provided by an industrial group made of four original equipment manufacturers and three parts suppliers, which was used to increase the sample size.

Table 2. Estimation of minimum sample size (values in mm)

Dimension	M	SD	COEF VAR	Min Sample Size
Waist Circumference	1,090	221.17	20.29	3,721
Chest Depth	290	38.53	13.30	1,599
Upper Arm Circumference	366	47.85	13.06	1,541
Hip Breadth, Sitting	419	54.04	12.91	1,506
Chest Breadth	368	46.35	12.58	1,431
Thigh Circumference	642	72.77	11.33	1,161
Hand Length	200	22.31	11.17	1,129
Calf Circumference	404	40.39	9.99	903

Once the total sample size had been determined, the next step was to choose a design for the study sampling. An anthropometric study is most useful when its composition accurately represents the demographic characteristics of the target population, in this case the U.S. medium- and heavy-duty-truck drivers. The reason that the demographic characteristics are important is that many anthropometric dimensions vary with the demographic group. It is clear that males and females are anthropometrically different, and for that reason they are typically analyzed, and the data presented, separately as will be done here in the Results section. But, different racial/ethnic groups have specific anthropometric characteristics, and there are definitive body size and shape changes

with age [Bradtmiller et al., 1985; Clauser et al., 1988]. Therefore, the ideal study execution would be one in which drivers could be sampled in proportion to their demographic representation in the actual population. A most economical and efficient way to capture the demographic characteristics in proportion to the target population would be to use a stratified random sampling design. In this design, the sample was obtained by separating the population into non-overlapping strata based on age and racial/ethnic distributions, and then selecting a simple random sample for each stratum.

Unfortunately, the age distribution of U.S. truck drivers was not definitively known at the time of study planning and can only be estimated even now. At the time of study planning we had census data from the U.S. Bureau of Labor Statistics (BLS), an agency of the U.S. Department of Labor. This information provided a reasonably up-to-date breakdown of the racial and ethnic distribution of U.S. truck drivers. But, the BLS tables did not include an age breakdown for specific occupations. As a result, we were forced to assume that the age distribution of the truck-driving population was broadly similar to the age distribution of the total U.S. workforce. We created our sampling strategy based on the BLS data, with that assumption. In the time since the sampling plan was created, we became aware of an industry publication [Global Insight, 2005] which has an estimated age distribution of the current trucker population. We have used the Global Insight distribution when calculating our sample weights.

The original sampling plan is presented in Table 3. This plan was based on a total sample size of 1,880 participants. The male participants were divided into 24 strata (8 age groups × 3 racial/ethnic groups). It is important to note the Hispanic group is an ethnic group that could be composed of individuals of any race. Due to the very low proportion of female truck drivers (5% of the total population), the female group was treated as a single stratum. It must be pointed out that the 100 female participants was a minimum number of participants in this category. It was the intention of this project to measure as many female participants as possible with a final target of 10% of the sample size. This over sampling of female participants is advantageous for data analysis and design purposes.

Table 3. Original Sampling Plan

	AGE RANGE	NUMBER NON-HISPANIC WHITE	NUMBER HISPANIC	NUMBER NON-HISPANIC BLACK & OTHERS	TOTAL
MALES	20–24	129	30	24	183
	25–29	149	38	28	215
	30–34	139	38	26	203
	35–39	151	40	26	217
	40–44	157	39	26	222
	45–49	164	37	25	226
	50–54	146	32	21	199
	55+	241	47	27	315
	Total	1,276	301	203	1,780
FEMALES	All Ages	All Races			100
GRAND TOTAL					1,880

Table 4 presents the final sample that was collected. The total number of participants was 1,950, meeting our targeted sample size of 1,800 to 2,000 participants. It is worth noting that the final sample included 171 female truck drivers or about 8.8 percent of the total sample. This percentage is higher than that of the actual female truck driver population and has satisfied our intention to over sample female truck drivers.

Table 4. Final Sample

	AGE RANGE	NUMBER NON-HISPANIC WHITE	NUMBER HISPANIC	NUMBER NON-HISPANIC BLACK & OTHERS	TOTAL
MALES	< 25*	33	10	8	51
	25–29	65	31	21	117
	30–34	124	42	27	193
	35–39	155	41	42	238
	40–44	186	49	33	268
	45–49	216	45	38	299
	50–54	214	32	30	276
	55+	290	25	22	337
	Total	1,283	275	221	1,779
FEMALES	<25	2	2	0	4
	25–29	3	2	0	5
	30–34	9	2	0	11
	35–39	18	2	2	22
	40–44	20	5	2	27
	45–49	32	2	3	37
	50–54	26	3	1	30
	55+	31	1	3	35
	Total	141	19	11	171
	TOTAL				1,950

* Two drivers, aged 18 and 19, were added to the youngest age category, so it is not exactly equivalent to the youngest BLS category range of 21 to 25 years.

PREPARING THE MEASURING TEAM

Data collection was conducted by Anthrotech—an Ohio-based anthropometry consulting company under contract with NIOSH. NIOSH staff assisted in conducting the project. The data collection team, staffed by Anthrotech personnel, consisted of experienced measurers. The training practice sessions were conducted by Anthrotech before data collection began and when there was a gap of more than 3 weeks between measurement locations. These training sessions were structured around repeat-measures of the same test subjects. Training was considered complete when technicians' inter- and intra-observer errors were lower than the allowable inter- and intra-observer errors [Gordon et al., 1989] for each measured variable.

Table 5 presents results of the training session that took place prior to the data collection. Five measurers received training, though only four of them were used in subsequent data collection. Nine fully clothed (t-shirts and pants) participants were measured during the training session. Since this was a training session, dimensions

that are more difficult to measure (e.g., chest width) were practiced more often than dimensions that were less difficult (e.g., shoe length). The measuring team repeated the measurements on practice participants until the inter-observer differences were at or below the levels specified in ISO 20685 (ISO, 2005). Data on measurement errors (minimum and maximum absolute difference between any two measurers and the mean and standard deviation of absolute differences among all measurers) on each measurement are presented.

Table 5. Absolute Differences of Inter-Observer Errors in Team Training

Dimensions	N* (Absolute Difference)	Min (Absolute Difference)	Max (Absolute Difference)	M (Absolute Difference)	SD (Absolute Difference)
Abdominal Breadth, Sit.	32	0	36	12	9.35
Acromial Height	32	0	19	5	3.91
Acromial Height, Sit.	32	0	38	9	9.03
Abdominal Depth, Sit.	32	0	39	11	10.49
Ankle Height	35	0	10	3	2.41
Arm Length	35	0	30	5	6.78
Biacromial Breadth	31	0	19	6	4.23
Bideltoid Breadth	33	0	34	1	8.10
Buttock-Knee Length	32	2	21	10	5.00
Buttock-Popliteal Length	32	2	39	17	11.74
Calf Circumference	36	1	23	6	5.38
Chest Depth	38	0	29	8	6.48
Chest Width	42	1	36	15	10.60
Elbow Rest Height	32	0	45	12	10.98
Elbow-Fingertip Length	36	0	20	6	4.99
Eye Height, Sit.	32	0	23	7	6.20
Forearm Circumference	36	0	9	3	2.14
Forearm-Forearm Breadth	32	0	37	10	9.03
Hand Breadth	32	0	6	2	1.52
Hand Length	32	0	11	4	2.86
Hip Breadth, Sit.	31	0	23	8	6.47
Knee Height, Sit.	33	0	55	8	9.65
Popliteal Height	32	0	35	8	7.03
Shoulder-Elbow Length	35	0	30	7	6.54
Sitting Height	32	0	13	5	3.64
Stature With Shoes	26	0	19	4	3.74
Stature (No Shoes)	31	0	16	4	3.10
Thigh Circumference	39	0	50	13	11.00
Thigh Clearance	32	0	15	5	4.59
Thumb-tip Reach	33	1	23	8	5.68
Upper Arm Circumference	38	0	24	10	7.22

Waist Circumference, Natural Indentation	33	0	85	18	21.43
Weight (kg)	10	0	3.5	0.7	1.47
Shoe Length	29	0	13	3	3.56
Shoe Width	29	0	11	3	2.47

Note. Values are in millimeters except for weight (kg).
*N indicates the number of inter-observer comparisons.

COMPUTER PROCEDURES

All data were entered on prepared and pre-numbered data sheets, an example of which is shown in Appendix B. For some sites, the physical arrangements lent themselves to the use of on-site data entry directly into laptop computers. In these cases, a data entry and editing software package was used instead.

The purpose of this software is to enhance accuracy in data collection, as it makes it possible to identify potential errors while the participant is still available for a re-measure [Churchill et al., 1988, Kikta and Churchill, 1978]. These have been used successfully for many years in a number of previous studies. The approach is essentially two-phased:

1. A value is first checked against the highest value and the lowest value measured for that variable. If the measured value is higher than the highest value to date, or lower than the lowest value, a signal is given on the computer that instructs the measurer to take the measurement again. This approach is very effective in screening out wildly aberrant values resulting from a misassembled instrument, misreading an instrument, transposing digits, or mis-entering a value by 100 or 1,000.

2. For the second phase of the editing program, regression equations, in which the value for each dimension is predicted from the values of two other dimensions, are incorporated into the computer software. The measured value for a given participant for a given dimension is compared to the predicted value. If the measured and the predicted values differ by more than a preset amount, a signal instructs the measurer to re-measure that dimension. In that way, values that are not aberrant for the population as a whole but are disproportionate for that individual are identified and checked. In the case of a flagged minimum or maximum, if the value was validated by the regression test, then it is confirmed as a new minimum or maximum.

In the current study, 2nd and 98th percentile ANSUR values were used as initial minima and maxima. Regression equations with two independent variables were based on ANSUR data and initially used in the software. After 50 participants (of each sex) were measured in this study, the software automatically calculated the best independent variables for each dimension and recalculated the regression equations. Subsequently, the equations were recalculated after every participant, thus continually improving the sensitivity of the equations.

Site Selection, Participant Recruitment, Data Collection, and Results and Discussion

SITE SELECTION

Data were collected at 16 different locations in 15 states across the continental United States (Figure 7). Geographical location was not treated as a variable in the sampling plan because truck drivers are, by definition, mobile. Nevertheless, for convenience sake, the continental U.S. was divided into four widespread regions—Northeast, Midwest and Great Lakes, South, and Pacific West—to describe the location of the data collection sites. Detailed information about data collection regions, states, and location types are provided in Table 6.

Figure 7
A schematic of regions and states in data collection.
Regions are demarcated by the thick line in black. The states where data collection took place are marked with color.

One variable unique to the truck-driving population is the distinction between fleet truckers and owner-operators. We did not know, *a priori,* whether there were any significant differences between these two segments of the population, but our site selection plan took into account this possibility. In order to access fleet drivers and owner-operators, we chose data collection sites at different types of locations. Fleet drivers were accessed at trucking companies and at distribution centers for large chain stores. Owner-operators, not normally available at these sorts of facilities, were recruited at regional or national trucking shows. Additionally, we measured drivers at a few major highway truck stops. Drivers were reimbursed $50 for their time.

At truck shows, a booth was set up in the exhibition hall where a staff person explained the project to passers-by and invited them to participate. A measuring area was set up in the booth and truck drivers were measured on a first-come, first-serve basis. A similar procedure was used at highway truck stops. At trucking companies and distribution centers, we worked with personnel at those facilities to set up appointments for participants. This

approach minimized down-time for the measuring team and waiting time for drivers. Suitable measuring areas were set up in a variety of spaces with the help of company officials.

Table 6. Data Collection Regions, States, and Sites

Regions	States	Sites	N	Percent
Northeast	New Jersey	JB Hunt	137	7.0
	New York	TA Truck Stop	61	3.1
	Pennsylvania	Estes Transportation	127	6.5
	West Virginia	Dallas Pike Truck Stop	28	1.4
Midwest and Great Lakes	Indiana	Schneider Trucking	224	11.4
	Kentucky	Mid-America Truck Show	202	10.3
	Missouri	Owner-Operator Independent Drivers Assn.	31	1.5
	Ohio	Wilmington Truck Show	84	4.3
South	Florida	Grimes Trucking	16	0.8
	Texas	MTV Trucking	174	8.9
		Great American Truck Show	177	9.0
	Tennessee	TA Truck Stop	142	7.2
Pacific West	Arizona	Swift Transportation	117	6.0
	California	Petro Stopping Centers	169	8.6
	Nevada	Great West Truck Show	126	6.4
	Oregon	TA Truck Stop	135	6.9
Total			1,950	100

PARTICIPANT PROCESSING

After the project was explained to each participant, he or she signed a consent form (see Appendix C) and biographical data form (see Appendix B). At the fleet locations, the data form was customized with the name of the company at the top of the first page. A slightly different version of the data form—without the company name—was used at truck shows. Participants were measured after completing the front pages of these forms.

The first step in the measuring process is landmarking—marking points on the body that define the beginning and end of many measurements. Often, participants in anthropometric studies are measured wearing only running shorts (males) or running shorts and a sports bra (females). When participants are measured in such minimal clothing, the landmarks are penciled directly on the body. For this study, in which participants were

measured fully clothed, most landmarks were undrawn and located by the measurer through the clothing as the measurement was taken. Even the undrawn landmarks, however, were precisely defined. The only marked landmarks were acromion (right and left), stylion (right), and xiphoidale. Stylion was marked on the wrist with an eyebrow pencil. The acromion and xiphoidale marks were located through the clothing and then marked with a ¼-inch adhesive dot placed on the clothing at the appropriate spot. The dots were re-checked immediately prior to taking any measurements from those locations to verify that the clothing (and the dot) had not moved.   The dots were removed when the measurement process was complete.

Following the marking, the 32 dimensions, 2 shoe dimensions, and body weight were obtained using traditional measuring instruments and methods. Shoe length and width were measured only if the individual was wearing shoes that were typically worn while driving. As is customary, bilateral measurements were taken on the right side except in rare cases where an injury or anatomical abnormality made it necessary to measure on the left side. All measurements were made to the nearest millimeter or tenth of a kilogram. Results of the measurements were entered into a laptop computer at some locations and recorded on the data sheet (at every location) by the recorder.

DATA EDITING

The first task in preparing anthropometric data after collection is to ensure that there are as few errors as possible. The first line of defense is the computerized data entry and editing system described above. Despite the efficiency of this system, however, erroneous values can sometimes creep into the database, and as noted above, the physical arrangements at some of the sites precluded the use of computers during data collection. Therefore, the data were edited again using a combination of regression and outlier identification techniques that are incorporated into the software, and have been previously described (Churchill et al., 1988; Kikta and Churchill, 1978). Any unusual values identified were checked against the data sheets and corrected when necessary.

STATISTICAL WEIGHTS

After data editing, the next step prior to actual analysis is the calculation of the statistical weights. The cell-by-cell sampling goals for any study are rarely met exactly. It is possible to correct for any over- or under-sampling of particular cells using a process called statistical weighting. Previous anthropometric studies (e.g., Gordon et al., 1989) used another approach to correcting the sample demographics to match the total population. In those studies, individuals in sampling cells where too many people had been measured were eliminated from the final data set. This approach allowed for an accurate demographic representation in the final data set but had the disadvantage that some sampling cells (older American Indians, in the Army example) were represented by very few people. The weighting approach we use here does not eliminate any of the measured participants, thus preserving the variability. Instead, each measured participant is multiplied so that he/she represents other persons with the same demographic characteristics as him/herself. Thus if a participant is in a cell that is over sampled, that participant's data are multiplied by a value less than one to reduce his/her statistical effect. If a participant is in a cell that is under sampled, that participant's data are multiplied by a value of more than one. This is the more common and currently standard approach used in anthropometric studies [Gordon, 2000; Harrison and Robinette, 2002; ISO TR 7250-2 (2008); ISO 11228-2 (2007)].

To calculate the weights, we used the U.S. truck driver demographic distribution developed in the sampling

strategy, modified by the additional information from the Global Insight study, as noted above. The weights are calculated as the relative frequency of a given cell in the driver population, divided by the relative frequency of the same cell in the study sample. It can be expressed as:

$$[N_{j,k}/(N_{1,1} + N_{1,2} + \cdots + N_{J,K})]/[n_{j,k}/(n_{1,1} + n_{1,2} + \cdots + n_{J,K})]$$

where N is the size of any age/race cell in the driver population,
n is the size of any age/race cell in the study sample,
j is a running subscript indicating the jth age group,
k is a running subscript indicating the kth racial/ethnic group,
J is the number of age groups, and
K is the number of racial/ethnic groups.

The Global Insight age categories were grouped differently from the BLS categories. So, to perform the calculations it was necessary to re-categorize the ages in our sample to match the age groups in the Global Insight report. The sample weights are shown in Table 7.

Table 7. Sample Weights

	AGE GROUP	NON-HISPANIC WHITE	HISPANIC	NON-HISPANIC BLACK & OTHERS
MALES	< 25	1.303030	1.000000	0.875000
	25–29	1.769231	0.870968	0.857143
	30–34	1.233871	0.857143	0.888889
	35–44	1.225806	1.100000	0.880000
	45–54	0.779070	1.025974	0.779412
	55+	0.734483	2.000000	1.500000
FEMALES	<25	12.588960	3.147240	0.000000
	25–29	14.687120	4.196320	0.000000
	30–34	13.638040	4.196320	0.000000
	35–44	29.374240	8.392640	6.294480
	45–54	29.374240	7.343560	5.245400
	55+	23.079760	5.245400	3.147240

RESULTS AND DISCUSSION

Summary statistics of this study are provided in Chapter IV. Further results and discussion are provided in Appendices E through G. Appendix H provides a discussion of the challenges of measuring fully clothed (t-shirts and pants) participants.

Summary Statistics

Summary statistics, including means, standard deviations, minimum, maximum, symmetry, kurtosis, coefficient of variation, percentiles, and frequency counts for male and female participants, are tabulated in this chapter. They are presented in centimeters/kilograms and inches/pounds. The data pages also include photographs and descriptions of each of the measurements on the same page spread as the statistics.

(1) ABDOMINAL BREADTH, SITTING

The horizontal distance between the lateral points of the abdomen (abdominal point, lateral, left and right) is measured with a beam caliper. The subject sits erect looking straight ahead. The measurement is made at the maximum point of quiet respiration.
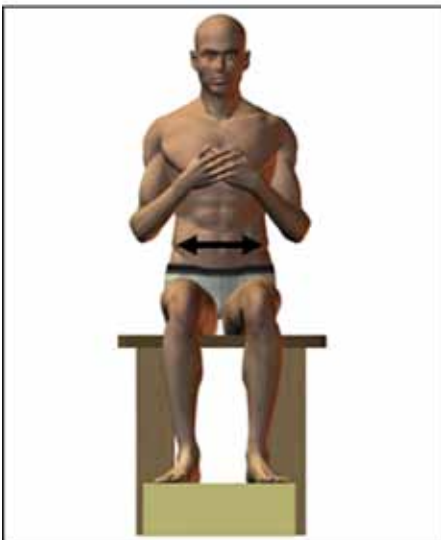
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
23.90	9.41	1ST	26.73	10.52
26.40	10.39	2ND	27.90	10.98
26.50	10.43	3RD	28.40	11.18
28.30	11.14	5TH	29.20	11.50
30.00	11.81	10TH	30.70	12.09
31.40	12.36	15TH	31.80	12.52
32.60	12.83	20TH	32.50	12.80
33.60	13.23	25TH	33.30	13.11
34.40	13.54	30TH	34.03	13.40
34.60	13.62	35TH	34.70	13.66
35.80	14.09	40TH	35.30	13.90
36.70	14.45	45TH	35.80	14.09
37.70	14.84	50TH	36.40	14.33
38.40	15.12	55TH	37.10	14.61
39.40	15.51	60TH	37.70	14.84
39.90	15.71	65TH	38.50	15.16
40.40	15.91	70TH	39.20	15.43
41.40	16.30	75TH	40.20	15.83
42.20	16.61	80TH	41.20	16.22
42.90	16.89	85TH	42.60	16.77
44.20	17.40	90TH	44.20	17.40
46.30	18.23	95TH	47.07	18.53
47.70	18.78	97TH	49.17	19.36
49.40	19.45	98TH	50.98	20.07
50.50	19.88	99TH	54.35	21.40

ABDOMINAL BREADTH, SITTING

FEMALES		
CM		**INCHES**
37.39	MEAN	14.72
0.42	SE (MEAN)	0.17
5.54	STD. DEVIATION	2.18
0.30	SE (STD.DEV)	0.12
23.80	MINIMUM	9.37
50.70	MAXIMUM	19.96
	SKEWNESS	-0.24
	KURTOSIS	-0.32
	COEF VAR	14.81%
	N	171

MALES		
CM		**INCHES**
37.11	MEAN	14.61
0.13	SE (MEAN)	0.05
5.55	STD. DEVIATION	2.18
0.09	SE (STD.DEV)	0.04
22.80	MINIMUM	8.98
66.70	MAXIMUM	26.26
	SKEWNESS	0.86
	KURTOSIS	1.57
	COEF VAR	14.95%
	N	1779

ABDOMINAL BREADTH, SITTING

FREQUENCY TABLE

FEMALES				CENTIMETERS		MALES			
F	FPct	CumF	CumFPct			F	FPct	CumF	CumFPct
				22.50 - 23.50		1	0.07	1	0.07
2	1.17	2	1.17	23.50 - 24.50		1	0.05	2	0.12
1	0.58	3	1.75	24.50 - 25.50		3	0.19	6	0.31
1	0.58	4	2.34	25.50 - 26.50		8	0.44	13	0.75
1	0.58	5	2.92	26.50 - 27.50		14	0.80	28	1.56
4	2.34	9	5.26	27.50 - 28.50		29	1.65	57	3.21
3	1.75	12	7.02	28.50 - 29.50		39	2.20	96	5.41
6	3.51	18	10.53	29.50 - 30.50		64	3.61	160	9.02
8	4.68	26	15.20	30.50 - 31.50		74	4.19	235	13.20
8	4.68	34	19.88	31.50 - 32.50		116	6.50	351	19.70
6	3.51	40	23.39	32.50 - 33.50		110	6.19	461	25.89
17	9.94	57	33.33	33.50 - 34.50		132	7.43	593	33.31
14	8.19	71	41.52	34.50 - 35.50		151	8.49	744	41.81
9	5.26	80	46.78	35.50 - 36.50		147	8.28	891	50.08
9	5.26	89	52.05	36.50 - 37.50		144	8.08	1035	58.16
11	6.43	100	58.48	37.50 - 38.50		111	6.24	1146	64.40
8	4.68	108	63.16	38.50 - 39.50		135	7.61	1281	72.01
15	8.77	123	71.93	39.50 - 40.50		81	4.56	1362	76.57
9	5.26	132	77.19	40.50 - 41.50		79	4.45	1441	81.01
8	4.68	140	81.87	41.50 - 42.50		62	3.51	1504	84.53
9	5.26	149	87.13	42.50 - 43.50		56	3.15	1560	87.68
5	2.92	154	90.06	43.50 - 44.50		54	3.04	1614	90.72
1	0.58	155	90.64	44.50 - 45.50		31	1.72	1644	92.44
8	4.68	163	95.32	45.50 - 46.50		27	1.52	1672	93.96
2	1.17	165	96.49	46.50 - 47.50		26	1.44	1697	95.40
2	1.17	167	97.66	47.50 - 48.50		20	1.11	1717	96.51
1	0.58	168	98.25	48.50 - 49.50		12	0.67	1729	97.18
1	0.58	169	98.83	49.50 - 50.50		12	0.66	1741	97.85
2	1.17	171	100.00	50.50 - 51.50		7	0.40	1748	98.25
				51.50 - 52.50		7	0.39	1755	98.64
				52.50 - 53.50		6	0.32	1760	98.96
				53.50 - 54.50		2	0.09	1762	99.05
				54.50 - 55.50		4	0.24	1766	99.29
				55.50 - 56.50		3	0.16	1769	99.45
				56.50 - 57.50		2	0.11	1771	99.56
				57.50 - 58.50		1	0.05	1772	99.61
				58.50 - 59.50		2	0.13	1774	99.74
				59.50 - 60.50		3	0.14	1777	99.88
				60.50 - 61.50		0	0.00	1777	99.88
				61.50 - 62.50		1	0.05	1778	99.93
				62.50 - 63.50		0	0.00	1778	99.93
				63.50 - 64.50		0	0.00	1778	99.93
				64.50 - 65.50		0	0.00	1778	99.93
				65.50 - 66.50		0	0.00	1778	99.93
				66.50 - 67.50		1	0.07	1779	100.00

(2) ABDOMINAL DEPTH SITTING (ABDOMINAL EXTENSION DEPTH, SITTING)

The horizontal distance between the anterior point of the abdomen and the back at the same level is measured with a beam caliper. The subject sits erect looking straight ahead. The measurement is made at the maximum point of quiet respiration.
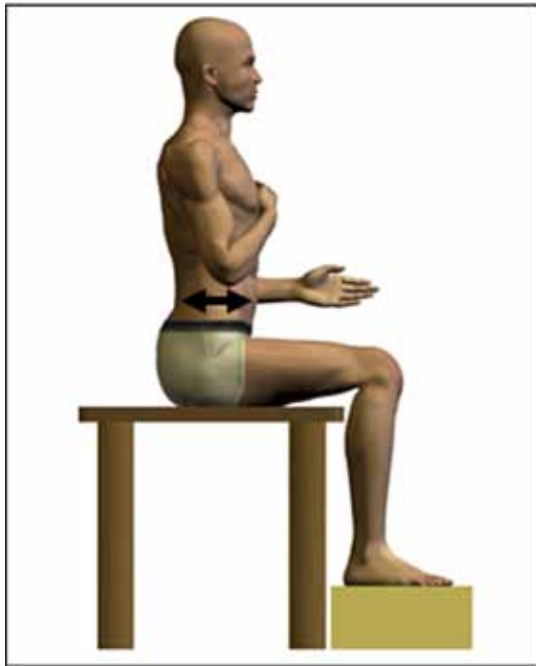
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
20.20	7.95	1ST	20.40	8.03
21.00	8.27	2ND	21.80	8.58
21.30	8.39	3RD	22.40	8.82
22.50	8.86	5TH	23.20	9.13
24.00	9.45	10TH	25.20	9.92
25.40	10.00	15TH	26.60	10.47
26.60	10.47	20TH	27.61	10.87
28.10	11.06	25TH	28.40	11.18
28.80	11.34	30TH	29.30	11.54
29.70	11.69	35TH	30.00	11.81
31.20	12.28	40TH	30.70	12.09
32.00	12.60	45TH	31.55	12.42
32.50	12.80	50TH	32.30	12.72
33.20	13.07	55TH	33.10	13.03
33.80	13.31	60TH	34.00	13.39
35.00	13.78	65TH	34.90	13.74
35.50	13.98	70TH	35.90	14.13
36.60	14.41	75TH	37.00	14.57
38.00	14.96	80TH	38.30	15.08
39.09	15.39	85TH	39.65	15.61
40.90	15.78	90TH	42.00	16.54
43.00	16.93	95TH	45.20	17.79
44.60	17.56	97TH	47.00	18.50
45.60	17.95	98TH	49.48	19.48
47.30	18.62	99TH	51.26	20.18

(2) ABDOMINAL DEPTH SITTING (ABDOMINAL EXTENSION DEPTH, SITTING)

FEMALES		
CM		**INCHES**
32.48	MEAN	12.79
0.47	SE (MEAN)	0.18
6.19	STD. DEVIATION	2.44
0.33	SE (STD.DEV)	0.13
18.10	MINIMUM	7.13
47.90	MAXIMUM	18.86
	SKEWNESS	0.13
	KURTOSIS	-0.44
	COEF VAR	19.06%
	N	171

MALES		
CM		**INCHES**
33.07	MEAN	13.02
0.16	SE (MEAN)	0.06
6.60	STD. DEVIATION	2.60
0.11	SE (STD.DEV)	0.04
17.20	MINIMUM	6.77
62.70	MAXIMUM	24.69
	SKEWNESS	0.62
	KURTOSIS	0.55
	COEF VAR	19.96%
	N	1779

(2) ABDOMINAL DEPTH SITTING (ABDOMINAL EXTENSION DEPTH, SITTING)

				FREQUENCY TABLE						
	FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS			F	FPct	CumF	CumFPct
				17.00	-	18.00	2	0.10	2	0.10
1	0.58	1	0.58	18.00	-	19.00	3	0.17	5	0.27
0	0.00	1	0.58	19.00	-	20.00	7	0.39	12	0.66
1	0.58	2	1.17	20.00	-	21.00	13	0.75	25	1.41
3	1.75	5	2.92	21.00	-	22.00	15	0.86	40	2.27
4	2.34	9	5.26	22.00	-	23.00	39	2.19	79	4.46
6	3.51	15	8.77	23.00	-	24.00	31	1.73	110	6.19
5	2.92	20	11.70	24.00	-	25.00	51	2.89	161	9.08
7	4.09	27	15.79	25.00	-	26.00	52	2.95	213	12.03
11	6.43	38	22.22	26.00	-	27.00	85	4.77	298	16.80
6	3.51	44	25.73	27.00	-	28.00	81	4.55	379	21.35
12	7.02	56	32.75	28.00	-	29.00	114	6.40	493	27.75
11	6.43	67	39.18	29.00	-	30.00	122	6.88	615	34.64
5	2.92	72	42.11	30.00	-	31.00	124	6.96	739	41.59
10	5.85	82	47.95	31.00	-	32.00	100	5.62	839	47.22
14	8.19	96	56.14	32.00	-	33.00	121	6.78	960	54.00
13	7.60	109	63.74	33.00	-	34.00	102	5.73	1062	59.73
6	3.51	115	67.25	34.00	-	35.00	99	5.55	1161	65.28
11	6.43	126	73.68	35.00	-	36.00	91	5.12	1252	70.40
8	4.68	134	78.36	36.00	-	37.00	79	4.42	1331	74.82
5	2.92	139	81.29	37.00	-	38.00	73	4.08	1404	78.90
6	3.51	145	84.80	38.00	-	39.00	59	3.33	1463	82.24
3	1.75	148	86.55	39.00	-	40.00	60	3.35	1523	85.59
8	4.68	156	91.23	40.00	-	41.00	36	2.02	1559	87.60
5	2.92	161	94.15	41.00	-	42.00	42	2.35	1601	89.95
2	1.17	163	95.32	42.00	-	43.00	34	1.93	1635	91.88
2	1.17	165	96.49	43.00	-	44.00	23	1.31	1658	93.19
2	1.17	167	97.66	44.00	-	45.00	28	1.58	1686	94.77
1	0.58	168	98.25	45.00	-	46.00	26	1.48	1712	96.25
1	0.58	169	98.83	46.00	-	47.00	13	0.74	1725	96.99
2	1.17	171	100.00	47.00	-	48.00	9	0.48	1734	97.47
				48.00	-	49.00	8	0.45	1742	97.92
				49.00	-	50.00	6	0.33	1748	98.25
				50.00	-	51.00	8	0.47	1756	98.72
				51.00	-	52.00	9	0.51	1765	99.24
				52.00	-	53.00	1	0.09	1766	99.32
				53.00	-	54.00	1	0.04	1767	99.37
				54.00	-	55.00	3	0.17	1770	99.54
				55.00	-	56.00	4	0.22	1774	99.76
				56.00	-	57.00	2	0.09	1776	99.85
				57.00	-	58.00	1	0.04	1777	99.89
				58.00	-	59.00	1	0.07	1778	99.96
				59.00	-	60.00	0	0.00	1778	99.96
				60.00	-	61.00	0	0.00	1778	99.96
				61.00	-	62.00	0	0.00	1778	99.96
				62.00	-	63.00	1	0.04	1779	100.00

(3) ACROMIAL HEIGHT

The vertical distance between the standing surface and the marked acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject stands erect with heels together and the head in the Frankfort plane. The measurement is taken at the maximum point of quiet respiration.
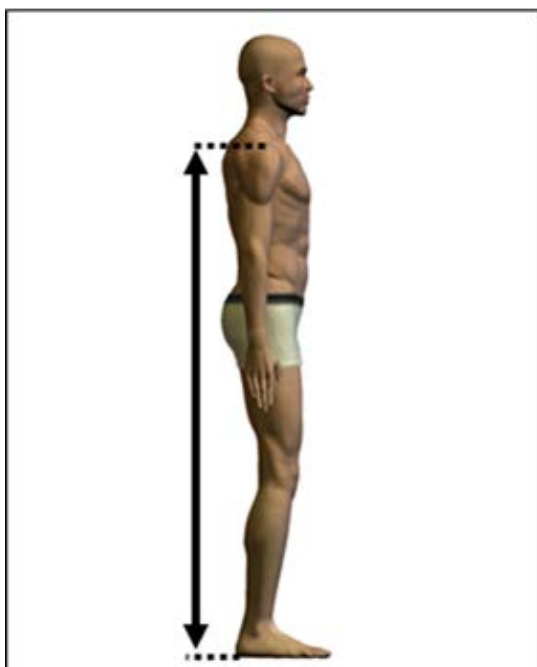
PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
122.50	48.23	1ST		130.22	51.27
122.70	48.31	2ND		132.02	51.98
122.80	48.35	3RD		133.30	52.48
123.60	48.66	5TH		134.47	52.94
125.90	49.57	10TH		136.80	53.86
127.30	50.12	15TH		138.50	54.53
129.00	50.79	20TH		139.70	55.00
129.80	51.10	25TH		140.70	55.39
130.60	51.42	30TH		141.52	55.72
131.20	51.65	35TH		142.40	56.06
131.70	51.85	40TH		143.10	56.34
132.70	52.24	45TH		143.90	56.65
133.50	52.56	50TH		144.70	56.97
134.10	52.80	55TH		145.50	57.28
134.90	53.11	60TH		146.40	57.64
135.50	53.35	65TH		147.27	57.98
136.20	53.62	70TH		148.08	58.30
137.20	54.02	75TH		149.30	58.78
139.20	54.80	80TH		150.40	59.21
140.70	55.39	85TH		151.60	59.69
142.60	56.14	90TH		153.16	60.30
145.00	57.09	95TH		155.40	61.18
145.50	57.28	97TH		157.01	61.81
148.00	58.27	98TH		158.11	62.25
149.60	58.90	99TH		159.90	62.95

(3) ACROMIAL HEIGHT

FEMALES			MALES		
CM		**INCHES**	**CM**		**INCHES**
133.74	MEAN	52.65	144.90	MEAN	57.05
0.47	SE (MEAN)	0.18	0.15	SE (MEAN)	0.06
6.12	STD. DEVIATION	2.41	6.38	STD. DEVIATION	2.51
0.33	SE (STD.DEV)	0.13	0.11	SE (STD.DEV)	0.04
119.90	MINIMUM	47.20	123.60	MINIMUM	48.66
150.30	MAXIMUM	59.17	172.90	MAXIMUM	68.07
	SKEWNESS	0.31		SKEWNESS	0.07
	KURTOSIS	-0.19		KURTOSIS	0.18
	COEF VAR	4.58%		COEF VAR	4.40%
	N	171		N	1779

(3) ACROMIAL HEIGHT

				FREQUENCY TABLE					
	FEMALES						MALES		
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	119.75	- 120.75				
0	0.00	1	0.58	120.75	- 121.75				
2	1.17	3	1.75	121.75	- 122.75				
5	2.92	8	4.68	122.75	- 123.75	2	0.10	2	0.10
4	2.34	12	7.02	123.75	- 124.75	1	0.05	3	0.15
2	1.17	14	8.19	124.75	- 125.75	2	0.08	5	0.23
8	4.68	22	12.87	125.75	- 126.75	0	0.00	5	0.23
3	1.75	25	14.62	126.75	- 127.75	1	0.04	6	0.27
7	4.09	32	18.71	127.75	- 128.75	6	0.32	12	0.59
11	6.43	43	25.15	128.75	- 129.75	5	0.26	17	0.85
11	6.43	54	31.58	129.75	- 130.75	7	0.41	24	1.27
16	9.36	70	40.94	130.75	- 131.75	8	0.46	32	1.72
10	5.85	80	46.78	131.75	- 132.75	14	0.80	46	2.52
8	4.68	88	51.46	132.75	- 133.75	20	1.11	66	3.63
13	7.60	101	59.06	133.75	- 134.75	35	1.95	101	5.58
15	8.77	116	67.84	134.75	- 135.75	35	1.95	136	7.53
11	6.43	127	74.27	135.75	- 136.75	39	2.19	175	9.72
6	3.51	133	77.78	136.75	- 137.75	51	2.88	226	12.60
3	1.75	136	79.53	137.75	- 138.75	69	3.87	295	16.47
6	3.51	142	83.04	138.75	- 139.75	65	3.67	360	20.14
3	1.75	145	84.80	139.75	- 140.75	94	5.29	454	25.43
3	1.75	148	86.55	140.75	- 141.75	99	5.59	553	31.02
6	3.51	154	90.06	141.75	- 142.75	105	5.91	658	36.94
3	1.75	157	91.81	142.75	- 143.75	124	6.98	782	43.92
5	2.92	162	94.74	143.75	- 144.75	109	6.14	891	50.05
4	2.34	166	97.08	144.75	- 145.75	109	6.12	1000	56.17
1	0.58	167	97.66	145.75	- 146.75	102	5.73	1102	61.90
0	0.00	167	97.66	146.75	- 147.75	114	6.38	1216	68.28
2	1.17	169	98.83	147.75	- 148.75	86	4.85	1302	73.12
1	0.58	170	99.42	148.75	- 149.75	76	4.29	1378	77.41
1	0.58	171	100.00	149.75	- 150.75	73	4.12	1451	81.53
				150.75	- 151.75	70	3.96	1521	85.49
				151.75	- 152.75	58	3.28	1579	88.77
				152.75	- 153.75	58	3.28	1637	92.05
				153.75	- 154.75	31	1.73	1668	93.78
				154.75	- 155.75	35	1.96	1703	95.74
				155.75	- 156.75	15	0.85	1718	96.59
				156.75	- 157.75	18	1.03	1736	97.62
				157.75	- 158.75	19	1.04	1755	98.66
				158.75	- 159.75	5	0.30	1760	98.97
				159.75	- 160.75	7	0.37	1767	99.34
				160.75	- 161.75	3	0.14	1770	99.48
				161.75	- 162.75	3	0.19	1773	99.66
				162.75	- 163.75	2	0.11	1775	99.77
				163.75	- 164.75	2	0.11	1777	99.89
				164.75	- 165.75	1	0.04	1778	99.93
				165.75	- 166.75	0	0.00	1778	99.93
				166.75	- 167.75	0	0.00	1778	99.93
				167.75	- 168.75	0	0.00	1778	99.93
				168.75	- 169.75	0	0.00	1778	99.93
				169.75	- 170.75	0	0.00	1778	99.93
				170.75	- 171.75	0	0.00	1778	99.93
				171.75	- 172.75	0	0.00	1778	99.93
				172.75	- 173.75	1	0.07	1779	100.00

(4) ACROMIAL HEIGHT, SITTING

The vertical distance between a sitting surface and the marked acromion landmark on the tip of the right shoulder is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane and the elbows and knees at 90 degrees. The measurement is taken at the maximum point of quiet respiration.
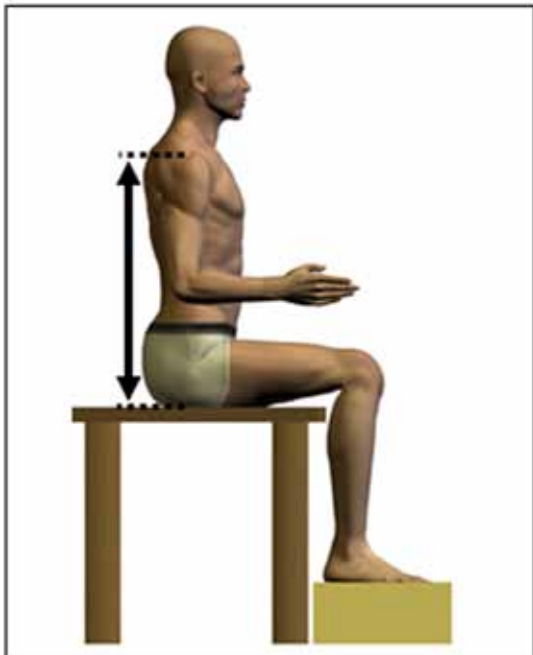
PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
49.80	19.61	1ST		54.12	21.31
51.50	20.28	2ND		55.02	21.66
51.70	20.35	3RD		55.50	21.85
52.40	20.63	5TH		56.10	22.09
54.10	21.30	10TH		57.20	22.52
55.00	21.65	15TH		58.10	22.87
55.30	21.77	20TH		58.70	23.11
56.00	22.05	25TH		59.20	23.31
56.20	22.13	30TH		59.70	23.50
56.50	22.24	35TH		60.20	23.70
57.20	22.52	40TH		60.60	23.86
57.62	22.69	45TH		61.00	24.02
58.00	22.83	50TH		61.40	24.17
58.30	22.95	55TH		61.90	24.37
58.70	23.11	60TH		62.30	24.53
58.90	23.19	65TH		62.70	24.69
59.30	23.35	70TH		63.20	24.88
60.10	23.66	75TH		63.61	25.04
60.30	23.74	80TH		64.20	25.28
60.80	23.94	85TH		64.90	25.55
62.00	24.41	90TH		65.70	25.87
63.00	24.80	95TH		66.90	26.34
63.50	25.00	97TH		67.73	26.67
63.50	25.00	98TH		68.30	26.89
64.90	25.55	99TH		69.31	27.29

(4) ACROMIAL HEIGHT, SITTING

FEMALES		
CM		**INCHES**
57.85	MEAN	22.78
0.23	SE (MEAN)	0.09
3.07	STD. DEVIATION	1.21
0.17	SE (STD.DEV)	0.07
48.60	MINIMUM	19.13
68.70	MAXIMUM	27.05
	SKEWNESS	-0.05
	KURTOSIS	0.42
	COEF VAR	5.31%
	N	171

MALES		
CM		**INCHES**
61.46	MEAN	24.20
0.08	SE (MEAN)	0.03
3.24	STD. DEVIATION	1.28
0.05	SE (STD.DEV)	0.02
51.20	MINIMUM	20.16
73.70	MAXIMUM	29.02
	SKEWNESS	0.08
	KURTOSIS	-0.07
	COEF VAR	5.28%
	N	1779

(4) ACROMIAL HEIGHT, SITTING

				FREQUENCY TABLE					
FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	48.50 - 49.00					
0	0.00	1	0.58	49.00 - 49.50					
1	0.58	2	1.17	49.50 - 50.00					
0	0.00	2	1.17	50.00 - 50.50					
1	0.58	3	1.75	50.50 - 51.00					
0	0.00	3	1.75	51.00 - 51.50		2	0.10	2	0.10
3	1.75	6	3.51	51.50 - 52.00		0	0.00	2	0.10
3	1.75	9	5.26	52.00 - 52.50		1	0.04	3	0.14
2	1.17	11	6.43	52.50 - 53.00		3	0.17	6	0.31
4	2.34	15	8.77	53.00 - 53.50		1	0.09	7	0.40
0	0.00	15	8.77	53.50 - 54.00		7	0.40	14	0.80
6	3.51	21	12.28	54.00 - 54.50		11	0.64	25	1.44
5	2.92	26	15.20	54.50 - 55.00		5	0.27	30	1.71
12	7.02	38	22.22	55.00 - 55.50		22	1.22	52	2.93
6	3.51	44	25.73	55.50 - 56.00		23	1.29	75	4.23
15	8.77	59	34.50	56.00 - 56.50		31	1.77	106	6.00
8	4.68	67	39.18	56.50 - 57.00		41	2.31	147	8.31
9	5.26	76	44.44	57.00 - 57.50		53	2.96	200	11.27
12	7.02	88	51.46	57.50 - 58.00		50	2.81	250	14.08
12	7.02	100	58.48	58.00 - 58.50		55	3.10	305	17.18
13	7.60	113	66.08	58.50 - 59.00		85	4.79	390	21.98
10	5.85	123	71.93	59.00 - 59.50		94	5.30	484	27.27
5	2.92	128	74.85	59.50 - 60.00		92	5.18	576	32.46
14	8.19	142	83.04	60.00 - 60.50		106	5.94	682	38.40
5	2.92	147	85.96	60.50 - 61.00		117	6.56	799	44.96
4	2.34	151	88.30	61.00 - 61.50		96	5.39	895	50.35
3	1.75	154	90.06	61.50 - 62.00		93	5.23	988	55.58
8	4.68	162	94.74	62.00 - 62.50		101	5.66	1089	61.24
0	0.00	162	94.74	62.50 - 63.00		116	6.50	1205	67.74
4	2.34	166	97.08	63.00 - 63.50		92	5.14	1297	72.88
2	1.17	168	98.25	63.50 - 64.00		90	5.06	1387	77.94
0	0.00	168	98.25	64.00 - 64.50		80	4.54	1467	82.48
2	1.17	170	99.42	64.50 - 65.00		57	3.21	1524	85.69
0	0.00	170	99.42	65.00 - 65.50		60	3.37	1584	89.05
0	0.00	170	99.42	65.50 - 66.00		36	2.03	1620	91.08
0	0.00	170	99.42	66.00 - 66.50		53	2.96	1673	94.04
0	0.00	170	99.42	66.50 - 67.00		20	1.11	1693	95.15
0	0.00	170	99.42	67.00 - 67.50		25	1.42	1718	96.57
0	0.00	170	99.42	67.50 - 68.00		20	1.10	1738	97.67
0	0.00	170	99.42	68.00 - 68.50		11	0.63	1749	98.30
1	0.58	171	100.00	68.50 - 69.00		7	0.41	1756	98.71
				69.00 - 69.50		8	0.43	1764	99.14
				69.50 - 70.00		8	0.45	1772	99.59
				70.00 - 70.50		3	0.18	1775	99.78
				70.50 - 71.00		1	0.07	1776	99.85
				71.00 - 71.50		1	0.04	1777	99.89
				71.50 - 72.00		1	0.04	1778	99.93
				72.00 - 72.50		0	0.00	1778	99.93
				72.50 - 73.00		0	0.00	1778	99.93
				73.00 - 73.50		0	0.00	1778	99.93
				73.50 - 74.00		1	0.07	1779	100.00

(5) ANKLE HEIGHT

The vertical distance between the standing surface and the lateral malleolus landmark on the outside of the ankle is measured with a modified sliding caliper.

| PERCENTILES | | | | |
| FEMALES | | | MALES | |
CM	INCHES		CM	INCHES
5.40	2.13	1ST	6.00	2.36
5.50	2.17	2ND	6.20	2.44
5.70	2.24	3RD	6.30	2.48
5.80	2.28	5TH	6.40	2.52
6.10	2.40	10TH	6.70	2.64
6.30	2.48	15TH	6.80	2.68
6.40	2.52	20TH	6.90	2.72
6.40	2.52	25TH	7.00	2.76
6.50	2.56	30TH	7.10	2.80
6.60	2.60	35TH	7.20	2.83
6.60	2.60	40TH	7.30	2.87
6.70	2.64	45TH	7.30	2.87
6.70	2.64	50TH	7.40	2.91
6.80	2.68	55TH	7.50	2.95
6.80	2.68	60TH	7.50	2.95
6.90	2.72	65TH	7.60	2.99
7.00	2.76	70TH	7.70	3.03
7.10	2.80	75TH	7.80	3.07
7.20	2.83	80TH	7.90	3.11
7.30	2.87	85TH	8.00	3.15
7.50	2.95	90TH	8.20	3.23
7.80	3.07	95TH	8.50	3.35
8.00	3.15	97TH	8.70	3.43
8.00	3.15	98TH	8.80	3.46
8.30	3.27	99TH	8.90	3.50

(5) ANKLE HEIGHT

FEMALES		
CM		**INCHES**
6.76	MEAN	2.66
0.04	SE (MEAN)	0.02
0.57	STD. DEVIATION	0.22
0.03	SE (STD.DEV)	0.01
5.40	MINIMUM	2.13
8.50	MAXIMUM	3.35
	SKEWNESS	0.28
	KURTOSIS	0.40
	COEF VAR	8.43%
	N	171

MALES		
CM		**INCHES**
7.42	MEAN	2.92
0.01	SE (MEAN)	0.01
0.62	STD. DEVIATION	0.24
0.01	SE (STD.DEV)	0.00
5.40	MINIMUM	2.13
9.90	MAXIMUM	3.90
	SKEWNESS	0.21
	KURTOSIS	0.38
	COEF VAR	8.38%
	N	1779

(5) ANKLE HEIGHT

	FREQUENCY TABLE					
FEMALES				CENTIMETERS	MALES			
F	FPct	CumF	CumFPct		F	FPct	CumF	CumFPct
2	1.17	2	1.17	5.35 - 5.45	1	0.04	1	0.04
1	0.58	3	1.75	5.45 - 5.55	2	0.13	3	0.17
1	0.58	4	2.34	5.55 - 5.65	0	0.00	3	0.17
2	1.17	6	3.51	5.65 - 5.75	2	0.10	5	0.27
3	1.75	9	5.26	5.75 - 5.85	6	0.35	11	0.61
2	1.17	11	6.43	5.85 - 5.95	5	0.29	16	0.91
5	2.92	16	9.36	5.95 - 6.05	7	0.37	23	1.28
3	1.75	19	11.11	6.05 - 6.15	11	0.61	34	1.88
6	3.51	25	14.62	6.15 - 6.25	12	0.65	46	2.53
10	5.85	35	20.47	6.25 - 6.35	16	0.92	62	3.45
14	8.19	49	28.65	6.35 - 6.45	31	1.72	93	5.17
13	7.60	62	36.26	6.45 - 6.55	36	2.01	129	7.18
14	8.19	76	44.44	6.55 - 6.65	35	1.94	164	9.12
16	9.36	92	53.80	6.65 - 6.75	77	4.30	241	13.42
19	11.11	111	64.91	6.75 - 6.85	97	5.48	338	18.90
9	5.26	120	70.18	6.85 - 6.95	62	3.51	400	22.41
6	3.51	126	73.68	6.95 - 7.05	98	5.53	498	27.94
4	2.34	130	76.02	7.05 - 7.15	95	5.32	593	33.26
9	5.26	139	81.29	7.15 - 7.25	113	6.32	706	39.58
9	5.26	148	86.55	7.25 - 7.35	130	7.33	836	46.91
2	1.17	150	87.72	7.35 - 7.45	137	7.73	973	54.64
4	2.34	154	90.06	7.45 - 7.55	102	5.75	1075	60.39
2	1.17	156	91.23	7.55 - 7.65	93	5.24	1168	65.63
4	2.34	160	93.57	7.65 - 7.75	91	5.13	1259	70.76
5	2.92	165	96.49	7.75 - 7.85	135	7.62	1394	78.38
1	0.58	166	97.08	7.85 - 7.95	68	3.83	1462	82.21
3	1.75	169	98.83	7.95 - 8.05	68	3.81	1530	86.01
0	0.00	169	98.83	8.05 - 8.15	31	1.73	1561	87.74
0	0.00	169	98.83	8.15 - 8.25	49	2.77	1610	90.51
1	0.58	170	99.42	8.25 - 8.35	44	2.47	1654	92.98
0	0.00	170	99.42	8.35 - 8.45	33	1.88	1687	94.86
1	0.58	171	100.00	8.45 - 8.55	14	0.77	1701	95.63
				8.55 - 8.65	16	0.92	1717	96.55
				8.65 - 8.75	19	1.09	1736	97.64
				8.75 - 8.85	23	1.27	1759	98.91
				8.85 - 8.95	5	0.25	1764	99.17
				8.95 - 9.05	4	0.23	1768	99.40
				9.05 - 9.15	2	0.11	1770	99.50
				9.15 - 9.25	3	0.16	1773	99.66
				9.25 - 9.35	1	0.04	1774	99.71
				9.35 - 9.45	1	0.04	1775	99.75
				9.45 - 9.55	1	0.04	1776	99.79
				9.55 - 9.65	0	0.00	1776	99.79
				9.65 - 9.75	0	0.00	1776	99.79
				9.75 - 9.85	2	0.14	1778	99.93
				9.85 - 9.95	1	0.07	1779	100.00

(6) ARM LENGTH

The distance between the marked acromion landmark on the tip of the right shoulder and the dactylion III landmark at the tip of the middle finger is measured with a beam caliper. The subject stands erect with the shoulders and arms relaxed and the fingers pointed straight down. The measurement is made at the maximum point of quiet respiration.
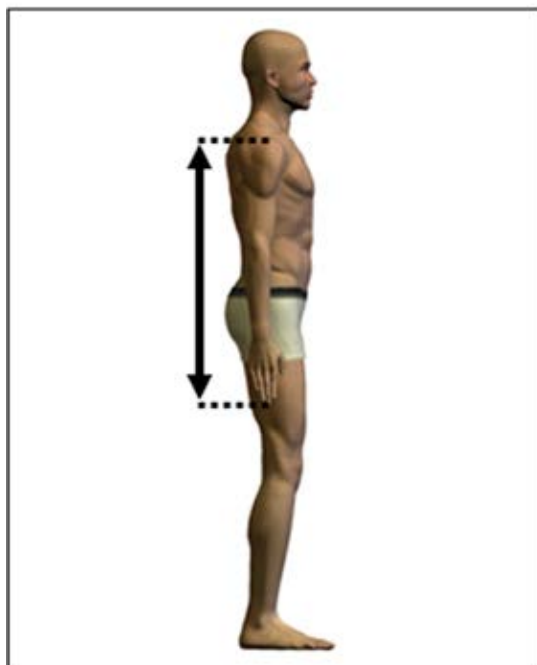
PERCENTILES				
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
62.70	24.69	1ST	69.21	27.25
63.30	24.92	2ND	70.20	27.64
63.80	25.11	3RD	70.63	27.81
65.00	25.59	5TH	71.50	28.15
65.80	25.91	10TH	72.90	28.70
66.90	26.34	15TH	73.70	29.02
67.70	26.65	20TH	74.55	29.35
68.00	26.77	25TH	75.20	29.61
68.60	27.01	30TH	75.70	29.80
69.00	27.17	35TH	76.20	30.00
69.30	27.28	40TH	76.70	30.20
69.60	27.40	45TH	77.10	30.35
70.40	27.72	50TH	77.60	30.55
71.00	27.95	55TH	78.00	30.71
71.30	28.07	60TH	78.40	30.87
71.90	28.31	65TH	78.80	31.02
72.30	28.46	70TH	79.40	31.26
73.00	28.74	75TH	80.13	31.55
73.40	28.90	80TH	80.70	31.77
74.00	29.13	85TH	81.50	32.09
74.80	29.44	90TH	82.70	32.56
75.60	29.76	95TH	83.80	32.99
77.40	30.47	97TH	84.70	33.35
77.50	31.51	98TH	85.30	33.58
81.55	32.11	99TH	86.70	34.13

(6) ARM LENGTH

FEMALES		
CM		**INCHES**
70.44	MEAN	27.73
0.27	SE (MEAN)	0.11
3.52	STD. DEVIATION	1.39
0.19	SE (STD.DEV)	0.07
62.70	MINIMUM	24.69
84.00	MAXIMUM	33.07
	SKEWNESS	0.28
	KURTOSIS	0.30
	COEF VAR	5.00%
	N*	170

MALES		
CM		**INCHES**
77.62	MEAN	30.56
0.09	SE (MEAN)	0.03
3.75	STD. DEVIATION	1.47
0.06	SE (STD.DEV)	0.02
65.50	MINIMUM	25.79
91.50	MAXIMUM	36.02
	SKEWNESS	0.12
	KURTOSIS	0.05
	COEF VAR	4.83%
	N*	1776

* N was reduced due to the missing observations

(6) ARM LENGTH

F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
		FEMALES		**FREQUENCY TABLE**				MALES	
3	1.76	3	1.76	62.50 - 63.50					
1	0.59	4	2.35	63.50 - 64.50					
8	4.71	12	7.06	64.50 - 65.50					
9	5.29	21	12.35	65.50 - 66.50		2	0.09	2	0.09
8	4.71	29	17.06	66.50 - 67.50		2	0.12	4	0.21
18	10.59	47	27.65	67.50 - 68.50		6	0.34	10	0.55
23	13.53	70	41.18	68.50 - 69.50		9	0.54	19	1.08
18	10.59	88	51.76	69.50 - 70.50		23	1.32	42	2.40
16	9.41	104	61.18	70.50 - 71.50		42	2.35	84	4.75
16	9.41	120	70.59	71.50 - 72.50		61	3.46	145	8.21
16	9.41	136	80.00	72.50 - 73.50		82	4.60	227	12.81
11	6.47	147	86.47	73.50 - 74.50		118	6.67	345	19.48
10	5.88	157	92.35	74.50 - 75.50		153	8.61	498	28.10
5	2.94	162	95.29	75.50 - 76.50		168	9.48	666	37.57
2	1.18	164	96.47	76.50 - 77.50		197	11.11	863	48.68
3	1.76	167	98.24	77.50 - 78.50		219	12.35	1082	61.02
0	0.00	167	98.24	78.50 - 79.50		167	9.39	1249	70.42
0	0.00	167	98.24	79.50 - 80.50		134	7.53	1383	77.94
0	0.00	167	98.24	80.50 - 81.50		118	6.66	1501	84.60
1	0.59	168	98.82	81.50 - 82.50		80	4.49	1581	89.10
1	0.59	169	99.41	82.50 - 83.50		76	4.30	1657	93.39
1	0.59	170	100.00	83.50 - 84.50		56	3.17	1713	96.57
				84.50 - 85.50		30	1.67	1743	98.24
				85.50 - 86.50		9	0.49	1752	98.73
				86.50 - 87.50		12	0.66	1764	99.39
				87.50 - 88.50		4	0.21	1768	99.60
				88.50 - 89.50		5	0.26	1773	99.86
				89.50 - 90.50		2	0.09	1775	99.96
				90.50 - 91.50		0	0.00	1775	99.96
				91.50 - 92.50		1	0.04	1776	100.00

(7) BIACROMIAL BREADTH

The distance between the marked right and left acromion landmarks at the tips of the shoulders is measured with a beam caliper. The subject sits erect looking straight ahead with the elbows and knees at 90 degrees. The measurement is made at the maximum point of quiet respiration.
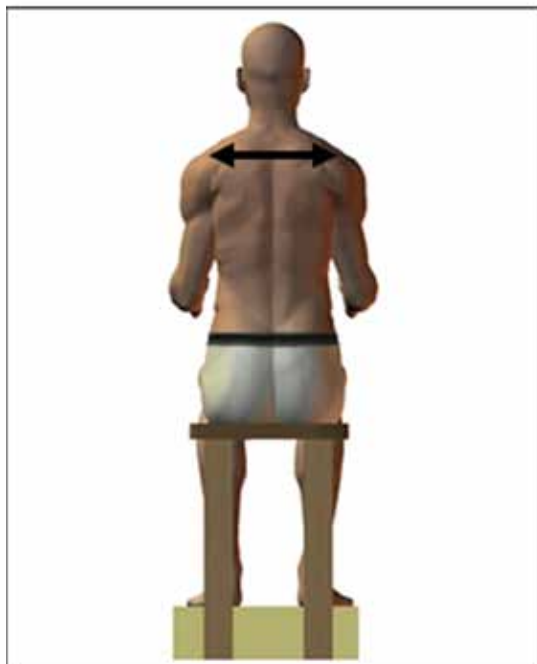
PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
34.10	13.43	1ST		37.90	14.92
34.20	13.46	2ND		38.20	15.04
34.30	13.50	3RD		38.60	15.20
34.40	13.54	5TH		39.20	15.43
35.70	14.06	10TH		39.90	15.71
36.28	14.28	15TH		40.40	15.91
36.90	14.53	20TH		40.70	16.02
37.10	14.61	25TH		41.00	16.14
37.50	14.76	30TH		41.40	16.30
37.60	14.80	35TH		41.60	16.38
37.90	14.92	40TH		41.90	16.50
38.10	15.00	45TH		42.30	16.65
38.30	15.08	50TH		42.50	16.73
38.50	15.16	55TH		42.80	16.85
38.70	15.24	60TH		43.10	16.97
39.30	15.47	65TH		43.40	17.09
39.40	15.51	70TH		43.60	17.17
39.80	15.67	75TH		44.00	17.32
40.10	15.79	80TH		44.30	17.44
40.40	15.91	85TH		44.70	17.60
41.30	16.26	90TH		45.30	17.83
42.50	16.73	95TH		46.20	18.19
43.20	17.01	97TH		46.87	18.45
43.30	17.05	98TH		47.30	18.62
44.80	17.64	99TH		48.20	18.98

(7) BIACROMIAL BREADTH

FEMALES		
CM		**INCHES**
38.46	MEAN	15.14
0.17	SE (MEAN)	0.07
2.19	STD. DEVIATION	0.86
0.12	SE (STD.DEV)	0.05
33.90	MINIMUM	13.35
45.80	MAXIMUM	18.03
	SKEWNESS	0.39
	KURTOSIS	0.58
	COEF VAR	5.69%
	N	171

MALES		
CM		**INCHES**
42.56	MEAN	16.76
0.05	SE (MEAN)	0.02
2.15	STD. DEVIATION	0.85
0.04	SE (STD.DEV)	0.01
36.20	MINIMUM	14.25
51.70	MAXIMUM	20.35
	SKEWNESS	0.22
	KURTOSIS	0.22
	COEF VAR	5.06%
	N	1779

(7) BIACROMIAL BREADTH

	FEMALES				FREQUENCY TABLE			MALES		
F	FPct	CumF	CumFPct		CENTIMETERS		F	FPct	CumF	CumFPct
4	2.34	4	2.34	33.75	-	34.25				
4	2.34	8	4.68	34.25	-	34.75				
3	1.75	11	6.43	34.75	-	35.25				
4	2.34	15	8.77	35.25	-	35.75				
7	4.09	22	12.87	35.75	-	36.25	3	0.14	3	0.14
8	4.68	30	17.54	36.25	-	36.75	3	0.18	6	0.32
17	9.94	47	27.49	36.75	-	37.25	2	0.11	8	0.43
16	9.36	63	36.84	37.25	-	37.75	6	0.34	14	0.77
17	9.94	80	46.78	37.75	-	38.25	23	1.31	37	2.08
25	14.62	105	61.40	38.25	-	38.75	23	1.31	60	3.39
8	4.68	113	66.08	38.75	-	39.25	35	1.94	95	5.33
13	7.60	126	73.68	39.25	-	39.75	59	3.31	154	8.64
15	8.77	141	82.46	39.75	-	40.25	85	4.79	239	13.43
9	5.26	150	87.72	40.25	-	40.75	133	7.45	372	20.89
3	1.75	153	89.47	40.75	-	41.25	129	7.26	501	28.15
6	3.51	159	92.98	41.25	-	41.75	155	8.71	656	36.85
4	2.34	163	95.32	41.75	-	42.25	140	7.88	796	44.74
1	0.58	164	95.91	42.25	-	42.75	165	9.28	961	54.01
2	1.17	166	97.08	42.75	-	43.25	158	8.89	1119	62.90
2	1.17	168	98.25	43.25	-	43.75	158	8.88	1277	71.78
1	0.58	169	98.83	43.75	-	44.25	139	7.79	1416	79.57
0	0.00	169	98.83	44.25	-	44.75	100	5.62	1516	85.18
1	0.58	170	99.42	44.75	-	45.25	81	4.57	1597	89.76
0	0.00	170	99.42	45.25	-	45.75	56	3.14	1653	92.90
1	0.58	171	100.00	45.75	-	46.25	41	2.33	1694	95.23
				46.25	-	46.75	27	1.49	1721	96.72
				46.75	-	47.25	19	1.05	1740	97.77
				47.25	-	47.75	19	1.07	1759	98.84
				47.75	-	48.25	5	0.30	1764	99.14
				48.25	-	48.75	5	0.29	1769	99.43
				48.75	-	49.25	5	0.30	1774	99.73
				49.25	-	49.75	2	0.11	1776	99.84
				49.75	-	50.25	2	0.12	1778	99.96
				50.25	-	50.75	0	0.00	1778	99.96
				50.75	-	51.25	0	0.00	1778	99.96
				51.25	-	51.75	1	0.04	1779	100.00

(8) BIDELTOID BREADTH

The horizontal distance between the lateral margins of the upper arms on the deltoid muscles is measured with a beam caliper. The subject sits erect looking straight ahead with the elbows and knees at 90 degrees. The measurement is made at the maximum point of quiet respiration.
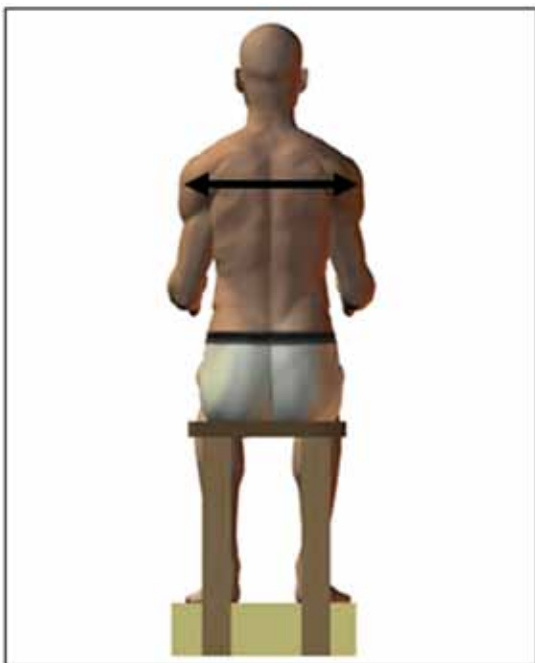
PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
40.00	15.75	1ST		44.20	17.40
40.20	15.83	2ND		45.40	17.87
41.30	16.26	3RD		46.00	18.11
42.10	16.57	5TH		46.90	18.46
44.10	17.36	10TH		47.90	18.86
44.90	17.68	15TH		48.90	19.25
45.60	17.95	20TH		49.60	19.53
46.00	18.11	25TH		50.30	19.80
46.50	18.31	30TH		51.00	20.08
47.00	18.50	35TH		51.50	20.28
48.00	18.90	40TH		52.10	20.51
49.00	19.29	45TH		52.60	20.71
49.70	19.57	50TH		53.20	20.94
50.80	20.00	55TH		53.80	21.18
51.70	20.35	60TH		54.40	21.42
52.20	20.55	65TH		55.10	21.69
52.50	20.67	70TH		55.80	21.97
52.70	20.75	75TH		56.60	22.28
53.40	21.02	80TH		57.60	22.68
55.40	21.81	85TH		58.51	23.04
56.10	22.09	90TH		59.90	23.58
58.70	23.11	95TH		62.40	24.57
60.50	23.82	97TH		64.30	25.31
61.80	24.33	98TH		65.93	25.96
61.80	24.33	99TH		68.00	26.77

(8) BIDELTOID BREADTH

FEMALES		
CM		**INCHES**
49.88	MEAN	19.64
0.38	SE (MEAN)	0.15
4.93	STD. DEVIATION	1.94
0.27	SE (STD.DEV)	0.11
39.80	MINIMUM	15.67
61.90	MAXIMUM	24.37
	SKEWNESS	0.28
	KURTOSIS	-0.36
	COEF VAR	9.88%
	N	171

MALES		
CM		**INCHES**
53.73	MEAN	21.15
0.12	SE (MEAN)	0.05
4.89	STD. DEVIATION	1.93
0.08	SE (STD.DEV)	0.03
41.10	MINIMUM	16.18
76.00	MAXIMUM	29.92
	SKEWNESS	0.72
	KURTOSIS	1.05
	COEF VAR	9.10%
	N	1779

(8) BIDELTOID BREADTH

				FREQUENCY TABLE				
		FEMALES					MALES	
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
3	1.75	3	1.75	39.75 - 40.75				
3	1.75	6	3.51	40.75 - 41.75	1	0.07	1	0.07
4	2.34	10	5.85	41.75 - 42.75	2	0.13	3	0.21
4	2.34	14	8.19	42.75 - 43.75	6	0.32	9	0.53
11	6.43	25	14.62	43.75 - 44.75	18	1.00	27	1.53
15	8.77	40	23.39	44.75 - 45.75	22	1.26	49	2.78
17	9.94	57	33.33	45.75 - 46.75	33	1.84	82	4.62
12	7.02	69	40.35	46.75 - 47.75	78	4.40	160	9.02
6	3.51	75	43.86	47.75 - 48.75	90	5.03	250	14.05
14	8.19	89	52.05	48.75 - 49.75	120	6.76	370	20.81
10	5.85	99	57.89	49.75 - 50.75	134	7.56	504	28.36
10	5.85	109	63.74	50.75 - 51.75	161	9.05	665	37.41
21	12.28	130	76.02	51.75 - 52.75	150	8.41	815	45.82
11	6.43	141	82.46	52.75 - 53.75	163	9.15	978	54.97
3	1.75	144	84.21	53.75 - 54.75	139	7.83	1117	62.80
6	3.51	150	87.72	54.75 - 55.75	121	6.79	1238	69.59
6	3.51	156	91.23	55.75 - 56.75	110	6.18	1348	75.77
4	2.34	160	93.57	56.75 - 57.75	93	5.20	1441	80.97
3	1.75	163	95.32	57.75 - 58.75	90	5.05	1531	86.02
3	1.75	166	97.08	58.75 - 59.75	60	3.39	1591	89.41
0	0.00	166	97.08	59.75 - 60.75	47	2.66	1638	92.06
2	1.17	168	98.25	60.75 - 61.75	30	1.69	1668	93.75
3	1.75	171	100.00	61.75 - 62.75	33	1.86	1701	95.61
				62.75 - 63.75	15	0.82	1716	96.43
				63.75 - 64.75	15	0.85	1731	97.27
				64.75 - 65.75	12	0.69	1743	97.96
				65.75 - 66.75	9	0.52	1752	98.48
				66.75 - 67.75	9	0.50	1761	98.98
				67.75 - 68.75	3	0.17	1764	99.15
				68.75 - 69.75	3	0.16	1767	99.32
				69.75 - 70.75	4	0.24	1771	99.56
				70.75 - 71.75	0	0.00	1771	99.56
				71.75 - 72.75	4	0.24	1775	99.80
				72.75 - 73.75	1	0.05	1776	99.84
				73.75 - 74.75	1	0.05	1777	99.89
				74.75 - 75.75	1	0.06	1778	99.96
				75.75 - 76.75	1	0.04	1779	100.00

(9) BUTTOCK-KNEE LENGTH

The horizontal distance between the buttock plate and the anterior point of the right knee (knee point, anterior) is measured with an anthropometer. The subject sits erect with the knees at 90 degrees. The thighs are parallel and the knees flexed 90 degrees with the feet in line with the thighs.
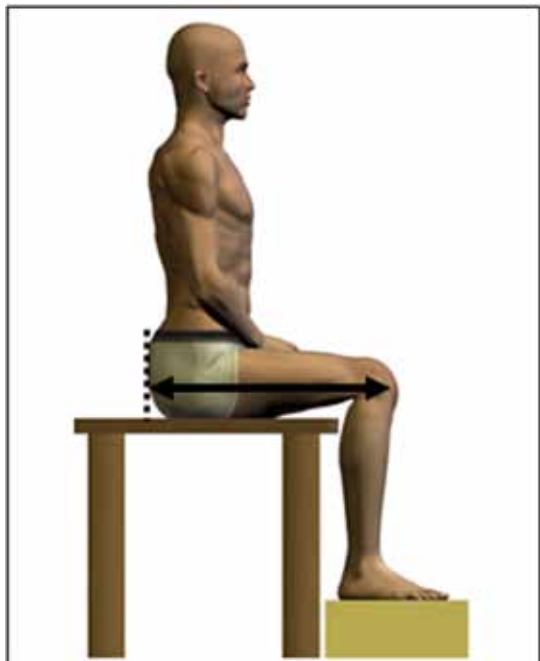
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
53.30	20.98	1ST	56.00	22.05
53.80	21.18	2ND	56.64	22.30
55.30	21.77	3RD	57.05	22.46
56.30	22.17	5TH	57.70	22.72
56.70	22.32	10TH	58.70	23.11
57.40	22.60	15TH	59.60	23.46
58.00	22.83	20TH	60.10	23.66
58.50	23.03	25TH	60.70	23.90
58.90	23.19	30TH	61.20	24.09
59.20	23.31	35TH	61.60	24.25
59.50	23.43	40TH	62.20	24.49
60.00	23.62	45TH	62.60	24.65
60.20	23.70	50TH	63.00	24.80
60.70	23.90	55TH	63.40	24.96
61.20	24.09	60TH	64.00	25.20
61.50	24.21	65TH	64.40	25.35
62.10	24.45	70TH	64.90	25.55
62.60	24.65	75TH	65.40	25.75
63.20	24.88	80TH	66.00	25.98
63.80	25.12	85TH	66.70	26.26
65.10	25.63	90TH	67.70	26.65
66.70	26.26	95TH	69.30	27.28
67.30	26.50	97TH	70.30	27.68
67.70	26.65	98TH	71.18	28.02
71.00	27.95	99TH	71.93	28.32

(9) BUTTOCK-KNEE LENGTH

FEMALES		
CM		**INCHES**
60.65	MEAN	23.88
0.25	SE (MEAN)	0.10
3.26	STD. DEVIATION	1.28
0.18	SE (STD.DEV)	0.07
52.90	MINIMUM	20.83
71.50	MAXIMUM	28.15
	SKEWNESS	0.44
	KURTOSIS	0.45
	COEF VAR	5.38%
	N	171

MALES		
CM		**INCHES**
63.16	MEAN	24.87
0.08	SE (MEAN)	0.03
3.50	STD. DEVIATION	1.38
0.06	SE (STD.DEV)	0.02
51.80	MINIMUM	20.39
75.20	MAXIMUM	29.61
	SKEWNESS	0.25
	KURTOSIS	0.05
	COEF VAR	5.55%
	N	1779

(9) BUTTOCK-KNEE LENGTH

FEMALES				FREQUENCY TABLE		MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
				51.75 - 52.75		3	0.14	3	0.14
2	1.17	2	1.17	52.75 - 53.75		1	0.06	4	0.21
3	1.75	5	2.92	53.75 - 54.75		4	0.20	8	0.41
2	1.17	7	4.09	54.75 - 55.75		8	0.45	16	0.86
12	7.02	19	11.11	55.75 - 56.75		28	1.55	44	2.41
15	8.77	34	19.88	56.75 - 57.75		47	2.66	91	5.07
14	8.19	48	28.07	57.75 - 58.75		90	5.06	181	10.13
27	15.79	75	43.86	58.75 - 59.75		108	6.06	289	16.18
19	11.11	94	54.97	59.75 - 60.75		168	9.46	457	25.64
19	11.11	113	66.08	60.75 - 61.75		182	10.26	639	35.90
14	8.19	127	74.27	61.75 - 62.75		197	11.07	836	46.96
15	8.77	142	83.04	62.75 - 63.75		209	11.75	1045	58.71
7	4.09	149	87.13	63.75 - 64.75		182	10.25	1227	68.96
6	3.51	155	90.64	64.75 - 65.75		157	8.85	1384	77.81
7	4.09	162	94.74	65.75 - 66.75		137	7.68	1521	85.48
7	4.09	169	98.83	66.75 - 67.75		83	4.66	1604	90.14
0	0.00	169	98.83	67.75 - 68.75		56	3.14	1660	93.28
0	0.00	169	98.83	68.75 - 69.75		46	2.60	1706	95.87
0	0.00	169	98.83	69.75 - 70.75		28	1.59	1734	97.47
2	1.17	171	100.00	70.75 - 71.75		25	1.42	1759	98.89
				71.75 - 72.75		8	0.47	1767	99.36
				72.75 - 73.75		10	0.55	1777	99.91
				73.75 - 74.75		1	0.05	1778	99.96
				74.75 - 75.75		1	0.04	1779	100.00

(10) BUTTOCK-POPLITEAL LENGTH

The horizontal distance between the buttock plate and the back of the knee is measured with an anthropometer. The subject sits erect with the knees at 90 degrees.
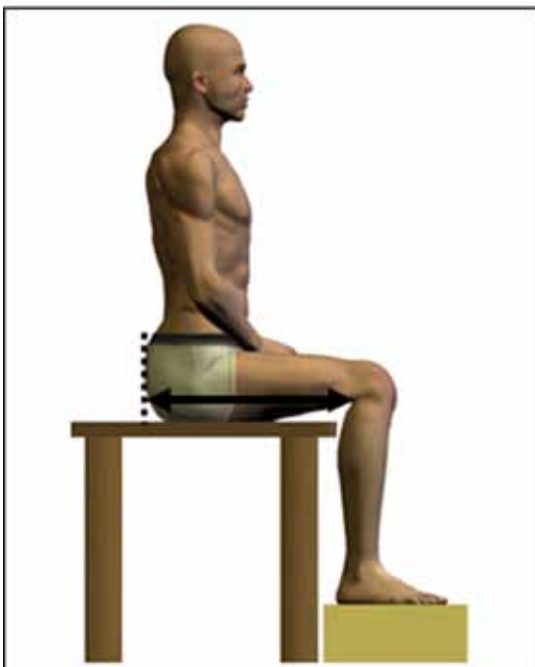
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
44.30	17.44	1ST	45.60	17.95
45.00	17.72	2ND	46.10	18.15
45.20	17.80	3RD	46.75	18.40
45.80	18.03	5TH	47.30	18.62
46.60	18.35	10TH	48.10	18.94
47.20	18.58	15TH	48.80	19.21
47.70	18.78	20TH	49.40	19.45
48.20	18.98	25TH	49.80	19.61
48.50	19.09	30TH	50.30	19.80
49.20	19.37	35TH	50.70	19.96
49.40	19.45	40TH	51.10	20.12
49.80	19.61	45TH	51.50	20.28
50.00	19.69	50TH	51.90	20.43
50.30	19.80	55TH	52.20	20.55
51.00	20.08	60TH	52.60	20.71
51.30	20.20	65TH	53.00	20.87
51.60	20.31	70TH	53.50	21.06
52.00	20.47	75TH	53.90	21.22
52.50	20.67	80TH	54.40	21.42
52.80	20.79	85TH	55.20	21.73
53.80	21.18	90TH	55.80	21.97
55.10	21.69	95TH	57.20	22.52
56.09	22.08	97TH	58.30	22.95
57.00	22.44	98TH	59.13	23.28
57.30	22.56	99TH	59.83	23.56

(10) BUTTOCK-POPLITEAL LENGTH

FEMALES		
CM		**INCHES**
50.15	MEAN	19.74
0.22	SE (MEAN)	0.09
2.84	STD. DEVIATION	1.12
0.15	SE (STD.DEV)	0.06
43.00	MINIMUM	16.93
58.90	MAXIMUM	23.19
	SKEWNESS	0.27
	KURTOSIS	0.15
	COEF VAR	5.66%
	N	171

MALES		
CM		**INCHES**
51.98	MEAN	20.46
0.07	SE (MEAN)	0.03
3.07	STD. DEVIATION	1.21
0.05	SE (STD.DEV)	0.02
41.80	MINIMUM	16.46
62.90	MAXIMUM	24.76
	SKEWNESS	0.27
	KURTOSIS	0.15
	COEF VAR	5.90%
	N	1779

(10) BUTTOCK-POPLITEAL LENGTH

FEMALES				FREQUENCY TABLE		MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
				41.50 - 42.00		1	0.06	1	0.06
				42.00 - 42.50		0	0.00	1	0.06
				42.50 - 43.00		1	0.04	2	0.11
2	1.17	2	1.17	43.00 - 43.50		1	0.07	3	0.17
0	0.00	2	1.17	43.50 - 44.00		1	0.04	4	0.22
1	0.58	3	1.75	44.00 - 44.50		5	0.28	9	0.50
0	0.00	3	1.75	44.50 - 45.00		2	0.15	11	0.64
5	2.92	8	4.68	45.00 - 45.50		4	0.22	15	0.86
3	1.75	11	6.43	45.50 - 46.00		12	0.70	27	1.56
3	1.75	14	8.19	46.00 - 46.50		14	0.81	41	2.36
6	3.51	20	11.70	46.50 - 47.00		21	1.20	62	3.56
10	5.85	30	17.54	47.00 - 47.50		41	2.29	103	5.85
10	5.85	40	23.39	47.50 - 48.00		57	3.20	160	9.06
10	5.85	50	29.24	48.00 - 48.50		62	3.48	222	12.54
8	4.68	58	33.92	48.50 - 49.00		69	3.86	291	16.40
13	7.60	71	41.52	49.00 - 49.50		88	4.94	379	21.34
13	7.60	84	49.12	49.50 - 50.00		86	4.83	465	26.17
12	7.02	96	56.14	50.00 - 50.50		99	5.57	564	31.75
5	2.92	101	59.06	50.50 - 51.00		118	6.62	682	38.36
12	7.02	113	66.08	51.00 - 51.50		111	6.22	793	44.58
12	7.02	125	73.10	51.50 - 52.00		116	6.54	909	51.12
8	4.68	133	77.78	52.00 - 52.50		116	6.51	1025	57.64
10	5.85	143	83.63	52.50 - 53.00		116	6.51	1141	64.14
4	2.34	147	85.96	53.00 - 53.50		94	5.28	1235	69.43
6	3.51	153	89.47	53.50 - 54.00		100	5.62	1335	75.05
3	1.75	156	91.23	54.00 - 54.50		90	5.06	1425	80.11
3	1.75	159	92.98	54.50 - 55.00		60	3.36	1485	83.47
4	2.34	163	95.32	55.00 - 55.50		66	3.72	1551	87.18
0	0.00	163	95.32	55.50 - 56.00		55	3.08	1606	90.27
2	1.17	165	96.49	56.00 - 56.50		44	2.49	1650	92.76
3	1.75	168	98.25	56.50 - 57.00		28	1.56	1678	94.32
2	1.17	170	99.42	57.00 - 57.50		25	1.41	1703	95.73
0	0.00	170	99.42	57.50 - 58.00		12	0.71	1715	96.44
0	0.00	170	99.42	58.00 - 58.50		15	0.83	1730	97.26
1	0.58	171	100.00	58.50 - 59.00		10	0.59	1740	97.85
				59.00 - 59.50		12	0.69	1752	98.54
				59.50 - 60.00		10	0.57	1762	99.11
				60.00 - 60.50		3	0.17	1765	99.27
				60.50 - 61.00		3	0.16	1768	99.44
				61.00 - 61.50		6	0.33	1774	99.76
				61.50 - 62.00		2	0.09	1776	99.86
				62.00 - 62.50		1	0.04	1777	99.90
				62.50 - 63.00		2	0.10	1779	100.00

(11) CALF CIRCUMFERENCE

The maximum horizontal circumference of the lower leg is measured with a measuring tape.   The subject stands erect with the weight distributed equally on both feet. Exert only enough pressure to compress the clothing.
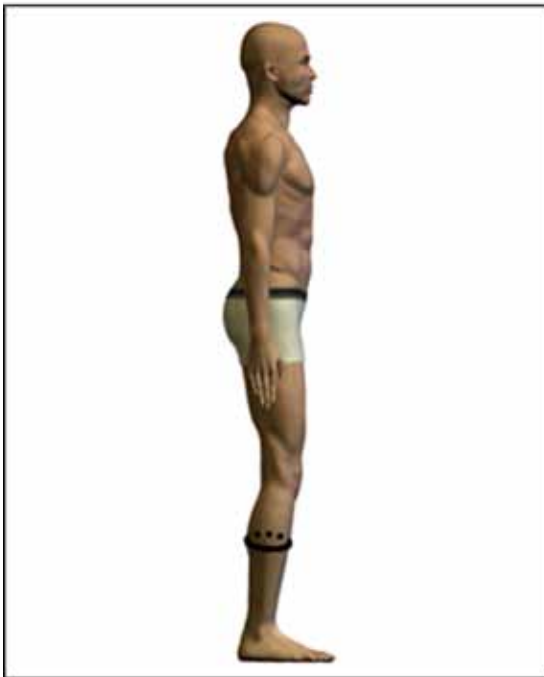
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
31.60	12.44	1ST	33.65	13.25
33.30	13.11	2ND	34.30	13.50
34.00	13.39	3RD	34.87	13.73
34.30	13.50	5TH	35.60	14.02
35.20	13.86	10TH	36.60	14.41
36.20	14.25	15TH	37.50	14.76
37.00	14.57	20TH	38.20	15.04
37.80	14.88	25TH	38.70	15.24
38.30	15.08	30TH	39.40	15.51
39.00	15.35	35TH	39.80	15.67
39.50	15.55	40TH	40.30	15.87
40.10	15.79	45TH	40.80	16.06
40.50	15.94	50TH	41.40	16.30
40.80	16.06	55TH	41.80	16.46
41.60	16.38	60TH	42.50	16.73
42.40	16.69	65TH	43.00	16.93
43.30	17.05	70TH	43.50	17.13
44.00	17.32	75TH	44.20	17.40
44.90	17.68	80TH	44.80	17.64
46.30	18.23	85TH	45.73	18.01
47.60	18.74	90TH	46.80	18.43
49.10	19.33	95TH	48.80	19.21
51.90	20.43	97TH	50.30	19.80
52.90	20.83	98TH	51.50	20.28
54.30	21.38	99TH	54.00	21.26

(11) CALF CIRCUMFERENCE

FEMALES		
<u>CM</u>		<u>INCHES</u>
41.06	MEAN	16.17
0.37	SE (MEAN)	0.14
4.79	STD. DEVIATION	1.89
0.26	SE (STD.DEV)	0.10
30.30	MINIMUM	11.93
55.60	MAXIMUM	21.89
	SKEWNESS	0.53
	KURTOSIS	0.12
	COEF VAR	11.67%
	N	171

MALES		
<u>CM</u>		<u>INCHES</u>
41.65	MEAN	16.40
0.10	SE (MEAN)	0.04
4.14	STD. DEVIATION	1.63
0.07	SE (STD.DEV)	0.03
29.50	MINIMUM	11.61
63.70	MAXIMUM	25.08
	SKEWNESS	0.60
	KURTOSIS	0.97
	COEF VAR	9.94%
	N	1779

(11) CALF CIRCUMFERENCE

	FEMALES			FREQUENCY TABLE			MALES		
F	**FPct**	**CumF**	**CumFPct**	**CENTIMETERS**		**F**	**FPct**	**CumF**	**CumFPct**
1	0.58	1	0.58	29.50 - 30.50		1	0.07	1	0.07
0	0.00	1	0.58	30.50 - 31.50		1	0.04	2	0.11
1	0.58	2	1.17	31.50 - 32.50		7	0.37	9	0.48
2	1.17	4	2.34	32.50 - 33.50		8	0.47	17	0.95
6	3.51	10	5.85	33.50 - 34.50		21	1.19	38	2.14
13	7.60	23	13.45	34.50 - 35.50		42	2.37	80	4.51
12	7.02	35	20.47	35.50 - 36.50		81	4.57	161	9.08
11	6.43	46	26.90	36.50 - 37.50		102	5.72	263	14.80
11	6.43	57	33.33	37.50 - 38.50		129	7.26	392	22.06
15	8.77	72	42.11	38.50 - 39.50		158	8.87	550	30.93
17	9.94	89	52.05	39.50 - 40.50		195	10.94	745	41.87
17	9.94	106	61.99	40.50 - 41.50		156	8.78	901	50.65
13	7.60	119	69.59	41.50 - 42.50		164	9.20	1065	59.86
7	4.09	126	73.68	42.50 - 43.50		158	8.87	1223	68.73
6	3.51	132	77.19	43.50 - 44.50		149	8.39	1372	77.12
12	7.02	144	84.21	44.50 - 45.50		112	6.28	1484	83.40
5	2.92	149	87.13	45.50 - 46.50		90	5.05	1574	88.45
4	2.34	153	89.47	46.50 - 47.50		61	3.42	1635	91.87
6	3.51	159	92.98	47.50 - 48.50		43	2.44	1678	94.31
5	2.92	164	95.91	48.50 - 49.50		32	1.81	1710	96.12
0	0.00	164	95.91	49.50 - 50.50		19	1.09	1729	97.21
1	0.58	165	96.49	50.50 - 51.50		12	0.69	1741	97.89
2	1.17	167	97.66	51.50 - 52.50		13	0.73	1754	98.62
2	1.17	169	98.83	52.50 - 53.50		3	0.19	1757	98.81
1	0.58	170	99.42	53.50 - 54.50		8	0.42	1765	99.23
0	0.00	170	99.42	54.50 - 55.50		3	0.16	1768	99.39
1	0.58	171	100.00	55.50 - 56.50		5	0.29	1773	99.68
				56.50 - 57.50		4	0.21	1777	99.89
				57.50 - 58.50		0	0.00	1777	99.89
				58.50 - 59.50		0	0.00	1777	99.89
				59.50 - 60.50		1	0.07	1778	99.96
				60.50 - 61.50		0	0.00	1778	99.96
				61.50 - 62.50		0	0.00	1778	99.96
				62.50 - 63.50		0	0.00	1778	99.96
				63.50 - 64.50		1	0.04	1779	100.00

(12) CHEST DEPTH

The horizontal distance between the xiphoidale landmark on the lower edge of the bony part of the sternum and the dorsally most prominent point in the midline of the back at the same level is measured with a beam caliper with curved blades. The subject stands erect with the shoulders relaxed looking straight ahead. The measurement is taken at the maximum point of quiet respiration.

PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
16.80	6.61	1ST	17.50	6.89
16.90	6.65	2ND	18.40	7.24
18.20	7.17	3RD	19.00	7.48
18.60	7.32	5TH	19.90	7.83
19.50	7.68	10TH	21.00	8.27
20.20	7.95	15TH	22.00	8.66
20.80	8.19	20TH	22.70	8.94
21.20	8.35	25TH	23.40	9.21
22.10	8.70	30TH	24.10	9.49
22.50	8.86	35TH	24.70	9.72
22.90	9.02	40TH	25.20	9.92
23.50	9.25	45TH	25.70	10.12
24.40	9.61	50TH	26.10	10.28
24.80	9.76	55TH	26.61	10.48
25.40	10.00	60TH	27.10	10.67
25.80	10.16	65TH	27.60	10.87
26.70	10.51	70TH	28.30	11.14
27.20	10.71	75TH	28.80	11.34
27.50	10.83	80TH	29.60	11.65
27.90	10.98	85TH	30.47	11.99
28.90	11.38	90TH	31.70	12.48
31.60	12.44	95TH	33.50	13.19
32.20	12.68	97TH	34.70	13.66
32.30	12.72	98TH	35.41	13.94
32.50	12.80	99TH	37.49	14.76

(12) CHEST DEPTH

FEMALES		
CM		**INCHES**
24.27	MEAN	9.56
0.29	SE (MEAN)	0.11
3.80	STD. DEVIATION	1.50
0.21	SE (STD.DEV)	0.08
15.40	MINIMUM	6.06
32.50	MAXIMUM	12.80
	SKEWNESS	0.15
	KURTOSIS	-0.58
	COEF VAR	15.66%
	N	171

MALES		
CM		**INCHES**
26.29	MEAN	10.35
0.10	SE (MEAN)	0.04
4.16	STD. DEVIATION	1.64
0.07	SE (STD.DEV)	0.03
15.80	MINIMUM	6.22
43.50	MAXIMUM	17.13
	SKEWNESS	0.35
	KURTOSIS	0.28
	COEF VAR	15.81%
	N	1779

(12) CHEST DEPTH

	FEMALES			FREQUENCY TABLE			MALES		
F	**FPct**	**CumF**	**CumFPct**	**CENTIMETERS**		**F**	**FPct**	**CumF**	**CumFPct**
1	0.58	1	0.58	15.25 - 16.25		3	0.17	3	0.17
3	1.75	4	2.34	16.25 - 17.25		9	0.49	12	0.66
4	2.34	8	4.68	17.25 - 18.25		18	1.02	30	1.68
7	4.09	15	8.77	18.25 - 19.25		33	1.84	63	3.52
13	7.60	28	16.37	19.25 - 20.25		55	3.13	118	6.64
17	9.94	45	26.32	20.25 - 21.25		76	4.29	194	10.93
10	5.85	55	32.16	21.25 - 22.25		106	5.97	300	16.90
19	11.11	74	43.27	22.25 - 23.25		125	7.02	425	23.92
15	8.77	89	52.05	23.25 - 24.25		140	7.88	565	31.80
14	8.19	103	60.23	24.25 - 25.25		150	8.41	715	40.21
12	7.02	115	67.25	25.25 - 26.25		199	11.17	914	51.39
16	9.36	131	76.61	26.25 - 27.25		179	10.05	1093	61.43
19	11.11	150	87.72	27.25 - 28.25		152	8.54	1245	69.97
6	3.51	156	91.23	28.25 - 29.25		133	7.47	1378	77.45
2	1.17	158	92.40	29.25 - 30.25		114	6.42	1492	83.87
5	2.92	163	95.32	30.25 - 31.25		83	4.67	1575	88.54
5	2.92	168	98.25	31.25 - 32.25		52	2.92	1627	91.47
3	1.75	171	100.00	32.25 - 33.25		54	3.05	1681	94.52
				33.25 - 34.25		37	2.07	1718	96.59
				34.25 - 35.25		24	1.35	1742	97.94
				35.25 - 36.25		11	0.60	1753	98.54
				36.25 - 37.25		7	0.41	1760	98.95
				37.25 - 38.25		8	0.43	1768	99.38
				38.25 - 39.25		2	0.13	1770	99.51
				39.25 - 40.25		5	0.30	1775	99.82
				40.25 - 41.25		1	0.04	1776	99.86
				41.25 - 42.25		2	0.10	1778	99.96
				42.25 - 43.25		0	0.00	1778	99.96
				43.25 - 44.25		1	0.04	1779	100.00

(13) CHEST WIDTH

The maximum horizontal distance between the laterally most prominent points of the rib cage at the level of the xiphoidale landmark on the lower edge of the bony part of the sternum is measured with a beam caliper with curved blades. The subject stands erect with the shoulders relaxed. The measurement is taken at the maximum point of quiet respiration.
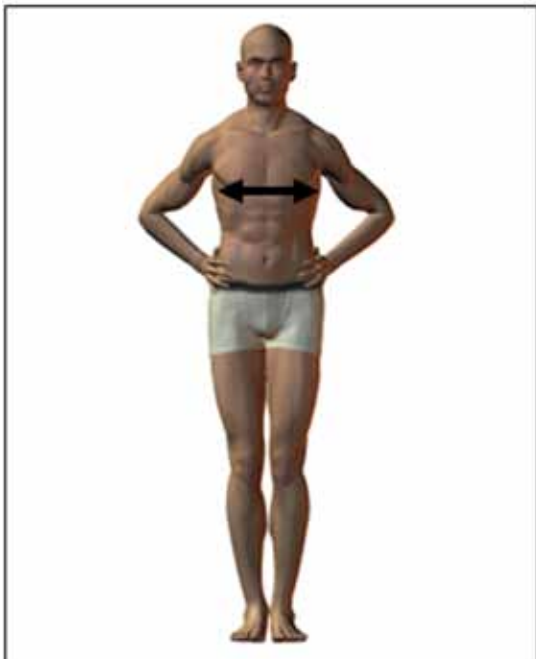
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
25.30	9.96	1ST	27.70	10.91
26.70	10.51	2ND	28.60	11.26
26.90	10.59	3RD	29.20	11.50
27.40	10.79	5TH	29.90	11.77
28.20	11.10	10TH	30.80	12.13
28.80	11.34	15TH	31.60	12.44
29.40	11.57	20TH	32.20	12.68
30.30	11.93	25TH	32.70	12.87
31.00	12.20	30TH	33.20	13.07
31.40	12.36	35TH	33.60	13.23
31.80	12.52	40TH	34.10	13.43
32.10	12.64	45TH	34.50	13.58
32.40	12.76	50TH	34.90	13.74
33.00	12.99	55TH	35.40	13.94
33.30	13.11	60TH	35.90	14.13
33.80	13.31	65TH	36.60	14.41
34.30	13.50	70TH	37.10	14.61
34.80	13.70	75TH	37.80	14.88
35.60	14.02	80TH	38.80	15.28
36.90	14.53	85TH	39.70	15.63
38.30	15.08	90TH	41.02	16.15
39.90	15.71	95TH	43.50	17.13
40.60	15.98	97TH	45.20	17.80
41.00	16.14	98TH	46.80	18.43
42.10	16.57	99TH	48.60	19.13

(13) CHEST WIDTH

FEMALES				MALES		
CM		**INCHES**		**CM**		**INCHES**
32.79	MEAN	12.91		35.59	MEAN	14.01
0.28	SE (MEAN)	0.11		0.10	SE (MEAN)	0.04
3.68	STD. DEVIATION	1.45		4.28	STD. DEVIATION	1.69
0.20	SE (STD.DEV)	0.08		0.07	SE (STD.DEV)	0.03
24.50	MINIMUM	9.65		26.00	MINIMUM	10.24
42.80	MAXIMUM	16.85		56.60	MAXIMUM	22.28
	SKEWNESS	0.40			SKEWNESS	0.99
	KURTOSIS	-0.19			KURTOSIS	1.86
	COEF VAR	11.22%			COEF VAR	12.03%
	N	171			N	1779

(13) CHEST WIDTH

				FREQUENCY TABLE					
	FEMALES						MALES		
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
2	1.17	2	1.17	24.50 - 25.50					
1	0.58	3	1.75	25.50 - 26.50		5	0.29	5	0.29
6	3.51	9	5.26	26.50 - 27.50		7	0.40	12	0.70
11	6.43	20	11.70	27.50 - 28.50		20	1.11	32	1.80
16	9.36	36	21.05	28.50 - 29.50		42	2.36	74	4.16
10	5.85	46	26.90	29.50 - 30.50		69	3.86	143	8.02
18	10.53	64	37.43	30.50 - 31.50		109	6.10	252	14.13
23	13.45	87	50.88	31.50 - 32.50		149	8.39	401	22.51
21	12.28	108	63.16	32.50 - 33.50		183	10.29	584	32.80
12	7.02	120	70.18	33.50 - 34.50		209	11.73	793	44.54
14	8.19	134	78.36	34.50 - 35.50		194	10.93	987	55.46
10	5.85	144	84.21	35.50 - 36.50		151	8.52	1138	63.98
7	4.09	151	88.30	36.50 - 37.50		157	8.85	1295	72.82
4	2.34	155	90.64	37.50 - 38.50		93	5.21	1388	78.03
7	4.09	162	94.74	38.50 - 39.50		97	5.45	1485	83.49
3	1.75	165	96.49	39.50 - 40.50		81	4.56	1566	88.05
3	1.75	168	98.25	40.50 - 41.50		55	3.11	1621	91.15
2	1.17	170	99.42	41.50 - 42.50		36	2.05	1657	93.21
1	0.58	171	100.00	42.50 - 43.50		32	1.77	1689	94.98
				43.50 - 44.50		23	1.28	1712	96.25
				44.50 - 45.50		17	0.97	1729	97.22
				45.50 - 46.50		9	0.51	1738	97.74
				46.50 - 47.50		15	0.84	1753	98.58
				47.50 - 48.50		5	0.30	1758	98.88
				48.50 - 49.50		7	0.37	1765	99.24
				49.50 - 50.50		3	0.16	1768	99.40
				50.50 - 51.50		1	0.05	1769	99.45
				51.50 - 52.50		2	0.11	1771	99.57
				52.50 - 53.50		2	0.11	1773	99.67
				53.50 - 54.50		2	0.11	1775	99.78
				54.50 - 55.50		2	0.12	1777	99.90
				55.50 - 56.50		0	0.00	1777	99.90
				56.50 - 57.50		2	0.10	1779	100.00

(14) ELBOW-FINGERTIP (FOREARM-HAND) LENGTH

The horizontal distance from the back of the tip of the elbow (olecranon, rear) to the tip of the middle finger (dactylion III) is measured with a beam caliper. The subject stands erect with the elbows at 90 degrees.
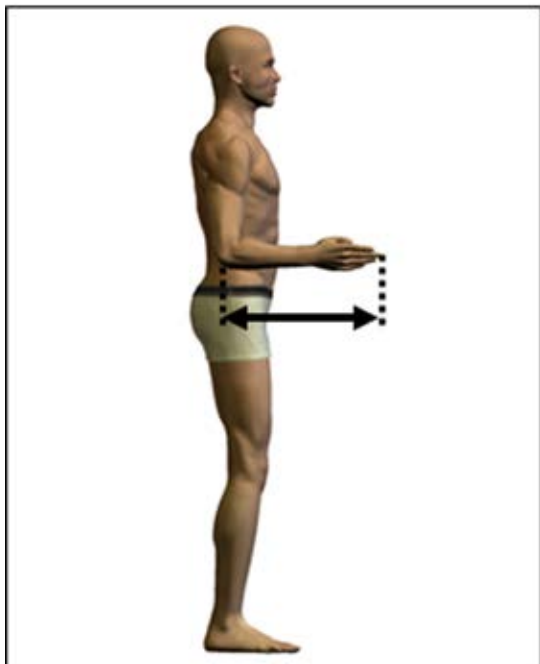
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
39.20	15.43	1ST	43.59	17.16
39.90	15.71	2ND	44.20	17.40
40.00	15.75	3RD	44.50	17.52
40.40	15.91	5TH	44.90	17.68
41.60	16.38	10TH	45.80	18.03
41.80	16.46	15TH	46.30	18.23
42.20	16.61	20TH	46.70	18.39
42.40	16.69	25TH	47.10	18.54
42.70	16.81	30TH	47.40	18.66
43.00	16.93	35TH	47.70	18.78
43.10	16.97	40TH	47.90	18.86
43.50	17.13	45TH	48.25	18.99
43.90	17.28	50TH	48.50	19.09
44.30	17.44	55TH	48.80	19.21
44.70	17.60	60TH	49.20	19.37
44.90	17.68	65TH	49.50	19.49
45.20	17.80	70TH	49.90	19.65
45.50	17.91	75TH	50.30	19.80
45.70	17.99	80TH	50.70	19.96
46.10	18.15	85TH	51.20	20.16
46.60	18.35	90TH	51.70	20.35
47.70	18.78	95TH	52.50	20.67
48.10	18.94	97TH	53.07	20.90
48.30	19.02	98TH	53.67	21.13
49.46	19.47	99TH	54.80	21.57

(14) ELBOW-FINGERTIP (FOREARM-HAND) LENGTH

FEMALES		
CM		**INCHES**
44.00	MEAN	17.32
0.17	SE (MEAN)	0.07
2.19	STD. DEVIATION	0.87
0.12	SE (STD.DEV)	0.05
38.30	MINIMUM	15.08
52.40	MAXIMUM	20.63
	SKEWNESS	0.36
	KURTOSIS	0.83
	COEF VAR	4.89%
	N*	170

MALES		
CM		**INCHES**
48.67	MEAN	19.16
0.06	SE (MEAN)	0.02
2.35	STD. DEVIATION	0.92
0.04	SE (STD.DEV)	0.02
41.30	MINIMUM	16.26
57.80	MAXIMUM	22.76
	SKEWNESS	0.24
	KURTOSIS	0.24
	COEF VAR	4.82%
	N*	1776

* N was reduced due to the missing observations

(14) ELBOW-FINGERTIP (FOREARM-HAND) LENGTH

				FREQUENCY TABLE				
FEMALES					MALES			
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
1	0.59	1	0.59	38.00 - 38.50				
0	0.00	1	0.59	38.50 - 39.00				
1	0.59	2	1.18	39.00 - 39.50				
1	0.59	3	1.76	39.50 - 40.00				
4	2.35	7	4.12	40.00 - 40.50				
1	0.59	8	4.71	40.50 - 41.00				
5	2.94	13	7.65	41.00 - 41.50	1	0.04	1	0.04
14	8.24	27	15.88	41.50 - 42.00	1	0.04	2	0.09
17	10.00	44	25.88	42.00 - 42.50	2	0.10	4	0.19
16	9.41	60	35.29	42.50 - 43.00	7	0.38	11	0.57
15	8.82	75	44.12	43.00 - 43.50	4	0.24	15	0.81
10	5.88	85	50.00	43.50 - 44.00	9	0.49	24	1.30
11	6.47	96	56.47	44.00 - 44.50	28	1.55	52	2.86
14	8.24	110	64.71	44.50 - 45.00	39	2.17	91	5.03
14	8.24	124	72.94	45.00 - 45.50	54	3.02	145	8.04
17	10.00	141	82.94	45.50 - 46.00	59	3.32	204	11.36
8	4.71	149	87.65	46.00 - 46.50	102	5.75	306	17.11
2	1.18	151	88.82	46.50 - 47.00	102	5.74	408	22.86
8	4.71	159	93.53	47.00 - 47.50	145	8.15	553	31.00
2	1.18	161	94.71	47.50 - 48.00	160	9.02	713	40.02
5	2.94	166	97.65	48.00 - 48.50	142	8.02	855	48.04
1	0.59	167	98.24	48.50 - 49.00	160	9.02	1015	57.06
0	0.00	167	98.24	49.00 - 49.50	123	6.91	1138	63.98
1	0.59	168	98.82	49.50 - 50.00	115	6.46	1253	70.44
1	0.59	169	99.41	50.00 - 50.50	124	6.97	1377	77.41
0	0.00	169	99.41	50.50 - 51.00	98	5.51	1475	82.92
0	0.00	169	99.41	51.00 - 51.50	91	5.14	1566	88.06
0	0.00	169	99.41	51.50 - 52.00	74	4.18	1640	92.24
1	0.59	170	100.00	52.00 - 52.50	39	2.28	1679	94.52
				52.50 - 53.00	43	2.41	1722	96.92
				53.00 - 53.50	17	0.96	1739	97.88
				53.50 - 54.00	9	0.53	1748	98.41
				54.00 - 54.50	6	0.36	1754	98.77
				54.50 - 55.00	7	0.41	1761	99.18
				55.00 - 55.50	6	0.36	1767	99.54
				55.50 - 56.00	2	0.09	1769	99.63
				56.00 - 56.50	1	0.05	1770	99.68
				56.50 - 57.00	0	0.00	1770	99.68
				57.00 - 57.50	4	0.23	1774	99.91
				57.50 - 58.00	2	0.09	1776	100.00

(15) ELBOW REST HEIGHT

The vertical distance from the sitting surface to the bottom of the tip of the elbow (olecranon, bottom) is measured with an anthropometer. The subject sits erect with the elbows and knees at 90 degrees. The measurement is taken at the maximum point of quiet respiration.

PERCENTILES				
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
16.70	6.57	1ST	17.90	7.05
17.90	7.05	2ND	18.80	7.40
19.17	7.55	3RD	19.36	7.62
19.70	7.76	5TH	20.23	7.96
20.80	8.19	10TH	21.30	8.39
21.60	8.50	15TH	22.00	8.66
22.10	8.70	20TH	22.57	8.89
22.83	8.99	25TH	23.20	9.13
23.20	9.13	30TH	23.60	9.29
23.80	9.37	35TH	24.00	9.45
24.20	9.53	40TH	24.50	9.65
24.60	9.69	45TH	24.80	9.76
25.20	9.92	50TH	25.30	9.96
25.70	10.12	55TH	25.70	10.12
26.30	10.35	60TH	26.20	10.31
26.50	10.43	65TH	26.60	10.47
27.00	10.63	70TH	27.10	10.67
27.30	10.75	75TH	27.56	10.85
27.60	10.87	80TH	28.10	11.06
28.10	11.06	85TH	28.80	11.34
28.80	11.34	90TH	29.70	11.69
29.60	11.65	95TH	31.20	12.28
29.85	11.75	97TH	32.00	12.60
31.00	12.20	98TH	32.62	12.84
31.30	12.32	99TH	33.68	13.26

(15) ELBOW REST HEIGHT

FEMALES		
CM		**INCHES**
24.94	MEAN	9.82
0.24	SE (MEAN)	0.09
3.16	STD. DEVIATION	1.24
0.17	SE (STD.DEV)	0.07
14.00	MINIMUM	5.51
33.40	MAXIMUM	13.15
	SKEWNESS	-0.37
	KURTOSIS	0.11
	COEF VAR	12.67%
	N	171

MALES		
CM		**INCHES**
25.41	MEAN	10.01
0.08	SE (MEAN)	0.03
3.31	STD. DEVIATION	1.30
0.06	SE (STD.DEV)	0.02
14.40	MINIMUM	5.67
37.30	MAXIMUM	14.69
	SKEWNESS	0.19
	KURTOSIS	0.10
	COEF VAR	13.04%
	N	1779

(15) ELBOW REST HEIGHT

<table>
<tr><th colspan="4">FREQUENCY TABLE</th><th></th><th></th><th></th><th></th></tr>
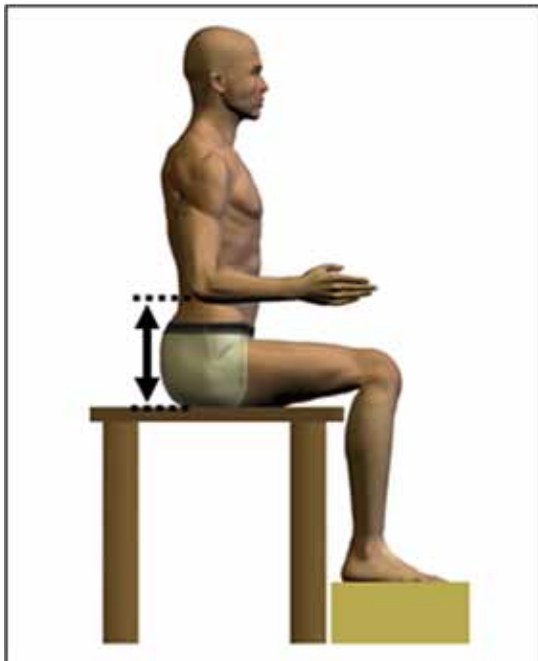<tr><th colspan="4">FEMALES</th><th></th><th colspan="4">MALES</th></tr>
<tr><th>F</th><th>FPct</th><th>CumF</th><th>CumFPct</th><th colspan="3">CENTIMETERS</th><th>F</th><th>FPct</th><th>CumF</th><th>CumFPct</th></tr>
<tr><td>1</td><td>0.58</td><td>1</td><td>0.58</td><td>13.50</td><td>-</td><td>14.00</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0</td><td>0.00</td><td>1</td><td>0.58</td><td>14.00</td><td>-</td><td>14.50</td><td>1</td><td>0.05</td><td>1</td><td>0.05</td></tr>
<tr><td>0</td><td>0.00</td><td>1</td><td>0.58</td><td>14.50</td><td>-</td><td>15.00</td><td>0</td><td>0.00</td><td>1</td><td>0.05</td></tr>
<tr><td>0</td><td>0.00</td><td>1</td><td>0.58</td><td>15.00</td><td>-</td><td>15.50</td><td>1</td><td>0.05</td><td>2</td><td>0.10</td></tr>
<tr><td>0</td><td>0.00</td><td>1</td><td>0.58</td><td>15.50</td><td>-</td><td>16.00</td><td>1</td><td>0.08</td><td>3</td><td>0.18</td></tr>
<tr><td>0</td><td>0.00</td><td>1</td><td>0.58</td><td>16.00</td><td>-</td><td>16.50</td><td>0</td><td>0.00</td><td>3</td><td>0.18</td></tr>
<tr><td>1</td><td>0.58</td><td>2</td><td>1.17</td><td>16.50</td><td>-</td><td>17.00</td><td>1</td><td>0.08</td><td>4</td><td>0.27</td></tr>
<tr><td>0</td><td>0.00</td><td>2</td><td>1.17</td><td>17.00</td><td>-</td><td>17.50</td><td>2</td><td>0.09</td><td>6</td><td>0.35</td></tr>
<tr><td>2</td><td>1.17</td><td>4</td><td>2.34</td><td>17.50</td><td>-</td><td>18.00</td><td>12</td><td>0.66</td><td>18</td><td>1.01</td></tr>
<tr><td>0</td><td>0.00</td><td>4</td><td>2.34</td><td>18.00</td><td>-</td><td>18.50</td><td>8</td><td>0.45</td><td>26</td><td>1.46</td></tr>
<tr><td>2</td><td>1.17</td><td>6</td><td>3.51</td><td>18.50</td><td>-</td><td>19.00</td><td>12</td><td>0.68</td><td>38</td><td>2.14</td></tr>
<tr><td>1</td><td>0.58</td><td>7</td><td>4.09</td><td>19.00</td><td>-</td><td>19.50</td><td>19</td><td>1.08</td><td>57</td><td>3.22</td></tr>
<tr><td>6</td><td>3.51</td><td>13</td><td>7.60</td><td>19.50</td><td>-</td><td>20.00</td><td>20</td><td>1.10</td><td>77</td><td>4.32</td></tr>
<tr><td>5</td><td>2.92</td><td>18</td><td>10.53</td><td>20.00</td><td>-</td><td>20.50</td><td>22</td><td>1.27</td><td>99</td><td>5.59</td></tr>
<tr><td>4</td><td>2.34</td><td>22</td><td>12.87</td><td>20.50</td><td>-</td><td>21.00</td><td>41</td><td>2.30</td><td>140</td><td>7.89</td></tr>
<tr><td>3</td><td>1.75</td><td>25</td><td>14.62</td><td>21.00</td><td>-</td><td>21.50</td><td>54</td><td>3.06</td><td>194</td><td>10.95</td></tr>
<tr><td>7</td><td>4.09</td><td>32</td><td>18.71</td><td>21.50</td><td>-</td><td>22.00</td><td>68</td><td>3.81</td><td>262</td><td>14.76</td></tr>
<tr><td>7</td><td>4.09</td><td>39</td><td>22.81</td><td>22.00</td><td>-</td><td>22.50</td><td>76</td><td>4.29</td><td>338</td><td>19.05</td></tr>
<tr><td>9</td><td>5.26</td><td>48</td><td>28.07</td><td>22.50</td><td>-</td><td>23.00</td><td>71</td><td>3.98</td><td>409</td><td>23.03</td></tr>
<tr><td>9</td><td>5.26</td><td>57</td><td>33.33</td><td>23.00</td><td>-</td><td>23.50</td><td>90</td><td>5.06</td><td>499</td><td>28.09</td></tr>
<tr><td>9</td><td>5.26</td><td>66</td><td>38.60</td><td>23.50</td><td>-</td><td>24.00</td><td>99</td><td>5.59</td><td>598</td><td>33.68</td></tr>
<tr><td>10</td><td>5.85</td><td>76</td><td>44.44</td><td>24.00</td><td>-</td><td>24.50</td><td>111</td><td>6.23</td><td>709</td><td>39.91</td></tr>
<tr><td>8</td><td>4.68</td><td>84</td><td>49.12</td><td>24.50</td><td>-</td><td>25.00</td><td>120</td><td>6.74</td><td>829</td><td>46.65</td></tr>
<tr><td>12</td><td>7.02</td><td>96</td><td>56.14</td><td>25.00</td><td>-</td><td>25.50</td><td>87</td><td>4.87</td><td>916</td><td>51.51</td></tr>
<tr><td>8</td><td>4.68</td><td>104</td><td>60.82</td><td>25.50</td><td>-</td><td>26.00</td><td>110</td><td>6.21</td><td>1026</td><td>57.73</td></tr>
<tr><td>10</td><td>5.85</td><td>114</td><td>66.67</td><td>26.00</td><td>-</td><td>26.50</td><td>101</td><td>5.70</td><td>1127</td><td>63.43</td></tr>
<tr><td>9</td><td>5.26</td><td>123</td><td>71.93</td><td>26.50</td><td>-</td><td>27.00</td><td>92</td><td>5.16</td><td>1219</td><td>68.58</td></tr>
<tr><td>11</td><td>6.43</td><td>134</td><td>78.36</td><td>27.00</td><td>-</td><td>27.50</td><td>98</td><td>5.48</td><td>1317</td><td>74.06</td></tr>
<tr><td>9</td><td>5.26</td><td>143</td><td>83.63</td><td>27.50</td><td>-</td><td>28.00</td><td>82</td><td>4.61</td><td>1399</td><td>78.68</td></tr>
<tr><td>10</td><td>5.85</td><td>153</td><td>89.47</td><td>28.00</td><td>-</td><td>28.50</td><td>68</td><td>3.83</td><td>1467</td><td>82.51</td></tr>
<tr><td>2</td><td>1.17</td><td>155</td><td>90.64</td><td>28.50</td><td>-</td><td>29.00</td><td>67</td><td>3.78</td><td>1534</td><td>86.28</td></tr>
<tr><td>6</td><td>3.51</td><td>161</td><td>94.15</td><td>29.00</td><td>-</td><td>29.50</td><td>44</td><td>2.47</td><td>1578</td><td>88.75</td></tr>
<tr><td>5</td><td>2.92</td><td>166</td><td>97.08</td><td>29.50</td><td>-</td><td>30.00</td><td>43</td><td>2.42</td><td>1621</td><td>91.17</td></tr>
<tr><td>1</td><td>0.58</td><td>167</td><td>97.66</td><td>30.00</td><td>-</td><td>30.50</td><td>32</td><td>1.81</td><td>1653</td><td>92.98</td></tr>
<tr><td>0</td><td>0.00</td><td>167</td><td>97.66</td><td>30.50</td><td>-</td><td>31.00</td><td>24</td><td>1.34</td><td>1677</td><td>94.32</td></tr>
<tr><td>2</td><td>1.17</td><td>169</td><td>98.83</td><td>31.00</td><td>-</td><td>31.50</td><td>28</td><td>1.58</td><td>1705</td><td>95.90</td></tr>
<tr><td>1</td><td>0.58</td><td>170</td><td>99.42</td><td>31.50</td><td>-</td><td>32.00</td><td>17</td><td>0.93</td><td>1722</td><td>96.83</td></tr>
<tr><td>0</td><td>0.00</td><td>170</td><td>99.42</td><td>32.00</td><td>-</td><td>32.50</td><td>20</td><td>1.10</td><td>1742</td><td>97.93</td></tr>
<tr><td>0</td><td>0.00</td><td>170</td><td>99.42</td><td>32.50</td><td>-</td><td>33.00</td><td>7</td><td>0.41</td><td>1749</td><td>98.34</td></tr>
<tr><td>1</td><td>0.58</td><td>171</td><td>100.00</td><td>33.00</td><td>-</td><td>33.50</td><td>8</td><td>0.42</td><td>1757</td><td>98.76</td></tr>
<tr><td></td><td></td><td></td><td></td><td>33.50</td><td>-</td><td>34.00</td><td>6</td><td>0.34</td><td>1763</td><td>99.11</td></tr>
<tr><td></td><td></td><td></td><td></td><td>34.00</td><td>-</td><td>34.50</td><td>4</td><td>0.20</td><td>1767</td><td>99.31</td></tr>
<tr><td></td><td></td><td></td><td></td><td>34.50</td><td>-</td><td>35.00</td><td>7</td><td>0.37</td><td>1774</td><td>99.68</td></tr>
<tr><td></td><td></td><td></td><td></td><td>35.00</td><td>-</td><td>35.50</td><td>1</td><td>0.07</td><td>1775</td><td>99.75</td></tr>
<tr><td></td><td></td><td></td><td></td><td>35.50</td><td>-</td><td>36.00</td><td>2</td><td>0.14</td><td>1777</td><td>99.89</td></tr>
<tr><td></td><td></td><td></td><td></td><td>36.00</td><td>-</td><td>36.50</td><td>1</td><td>0.04</td><td>1778</td><td>99.93</td></tr>
<tr><td></td><td></td><td></td><td></td><td>36.50</td><td>-</td><td>37.00</td><td>0</td><td>0.00</td><td>1778</td><td>99.93</td></tr>
<tr><td></td><td></td><td></td><td></td><td>37.00</td><td>-</td><td>37.50</td><td>1</td><td>0.07</td><td>1779</td><td>100.00</td></tr>
</table>

(16) EYE HEIGHT, SITTING

The vertical distance between a sitting surface and the ectocanthus landmark on the outer corner of the right eye is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane with the knees and elbows at 90 degrees. The measurement is taken at the maximum point of quiet respiration.
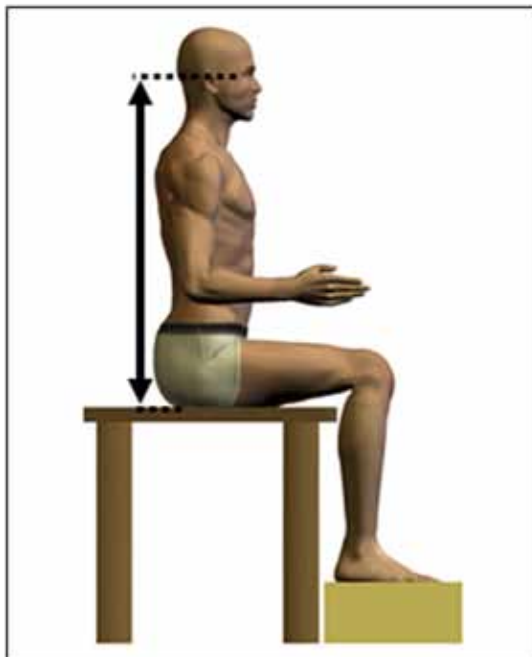
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
66.60	26.22	1ST	72.00	28.35
67.30	26.50	2ND	72.80	28.66
67.70	26.61	3RD	73.40	28.90
69.10	27.20	5TH	74.20	29.21
70.40	27.72	10TH	75.40	29.69
71.40	28.11	15TH	76.30	30.04
72.30	28.46	20TH	76.90	30.28
72.90	28.70	25TH	77.60	30.55
73.40	28.90	30TH	78.10	30.75
74.00	29.13	35TH	78.50	30.91
74.20	29.21	40TH	79.00	31.10
74.50	29.33	45TH	79.40	31.26
75.10	29.57	50TH	79.80	31.42
75.50	29.72	55TH	80.30	31.61
76.20	30.00	60TH	80.80	31.81
76.70	30.20	65TH	81.30	32.01
77.30	30.43	70TH	81.80	32.20
77.70	30.59	75TH	82.30	32.40
78.30	30.83	80TH	82.80	32.60
78.80	31.02	85TH	83.50	32.87
79.50	31.30	90TH	84.40	33.23
81.30	32.01	95TH	85.80	33.78
81.70	32.17	97TH	86.50	34.06
82.40	32.44	98TH	86.91	34.22
84.00	33.07	99TH	88.00	34.65

(16) EYE HEIGHT, SITTING

FEMALES		
CM		**INCHES**
75.18	MEAN	29.60
0.28	SE (MEAN)	0.11
3.63	STD. DEVIATION	1.43
0.20	SE (STD.DEV)	0.08
65.20	MINIMUM	25.67
85.50	MAXIMUM	33.66
	SKEWNESS	-0.05
	KURTOSIS	-0.02
	COEF VAR	4.83%
	N	171

MALES		
CM		**INCHES**
79.90	MEAN	31.46
0.08	SE (MEAN)	0.03
3.49	STD. DEVIATION	1.37
0.06	SE (STD.DEV)	0.02
69.50	MINIMUM	27.36
92.60	MAXIMUM	36.46
	SKEWNESS	0.05
	KURTOSIS	-0.12
	COEF VAR	4.36%
	N	1779

(16) EYE HEIGHT, SITTING

				FREQUENCY TABLE					
	FEMALES					MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	65.00 - 65.50					
0	0.00	1	0.58	65.50 - 66.00					
0	0.00	1	0.58	66.00 - 66.50					
1	0.58	2	1.17	66.50 - 67.00					
2	1.17	4	2.34	67.00 - 67.50					
1	0.58	5	2.92	67.50 - 68.00					
0	0.00	5	2.92	68.00 - 68.50					
2	1.17	7	4.09	68.50 - 69.00					
2	1.17	9	5.26	69.00 - 69.50					
3	1.75	12	7.02	69.50 - 70.00		1	0.09	1	0.09
5	2.92	17	9.94	70.00 - 70.50		0	0.00	1	0.09
6	3.51	23	13.45	70.50 - 71.00		6	0.33	7	0.41
3	1.75	26	15.20	71.00 - 71.50		5	0.26	12	0.67
2	1.17	28	16.37	71.50 - 72.00		4	0.21	16	0.88
8	4.68	36	21.05	72.00 - 72.50		7	0.42	23	1.29
10	5.85	46	26.90	72.50 - 73.00		19	1.10	42	2.39
6	3.51	52	30.41	73.00 - 73.50		14	0.77	56	3.16
6	3.51	58	33.92	73.50 - 74.00		20	1.12	76	4.27
18	10.53	76	44.44	74.00 - 74.50		23	1.32	99	5.59
7	4.09	83	48.54	74.50 - 75.00		43	2.41	142	8.00
9	5.26	92	53.80	75.00 - 75.50		38	2.12	180	10.12
7	4.09	99	57.89	75.50 - 76.00		53	2.98	233	13.10
9	5.26	108	63.16	76.00 - 76.50		56	3.16	289	16.25
10	5.85	118	69.01	76.50 - 77.00		72	4.03	361	20.29
8	4.68	126	73.68	77.00 - 77.50		67	3.76	428	24.05
8	4.68	134	78.36	77.50 - 78.00		71	4.01	499	28.06
9	5.26	143	83.63	78.00 - 78.50		118	6.66	617	34.72
5	2.92	148	86.55	78.50 - 79.00		93	5.22	710	39.94
6	3.51	154	90.06	79.00 - 79.50		101	5.66	811	45.60
1	0.58	155	90.64	79.50 - 80.00		107	6.03	918	51.63
2	1.17	157	91.81	80.00 - 80.50		87	4.87	1005	56.50
4	2.34	161	94.15	80.50 - 81.00		86	4.84	1091	61.34
4	2.34	165	96.49	81.00 - 81.50		92	5.16	1183	66.51
2	1.17	167	97.66	81.50 - 82.00		100	5.64	1283	72.15
1	0.58	168	98.25	82.00 - 82.50		66	3.73	1349	75.88
1	0.58	169	98.83	82.50 - 83.00		96	5.42	1445	81.30
0	0.00	169	98.83	83.00 - 83.50		61	3.42	1506	84.72
0	0.00	169	98.83	83.50 - 84.00		57	3.19	1563	87.91
1	0.58	170	99.42	84.00 - 84.50		42	2.34	1605	90.25
0	0.00	170	99.42	84.50 - 85.00		27	1.52	1632	91.78
0	0.00	170	99.42	85.00 - 85.50		40	2.26	1672	94.04
1	0.58	171	100.00	85.50 - 86.00		28	1.56	1700	95.60
				86.00 - 86.50		24	1.35	1724	96.95
				86.50 - 87.00		19	1.10	1743	98.05
				87.00 - 87.50		13	0.73	1756	98.78
				87.50 - 88.00		4	0.21	1760	98.98
				88.00 - 88.50		6	0.34	1766	99.32
				88.50 - 89.00		3	0.16	1769	99.48
				89.00 - 89.50		4	0.20	1773	99.68
				89.50 - 90.00		2	0.10	1775	99.78
				90.00 - 90.50		1	0.04	1776	99.82
				90.50 - 91.00		1	0.07	1777	99.89
				91.00 - 91.50		1	0.07	1778	99.96
				91.50 - 92.00		0	0.00	1778	99.96
				92.00 - 92.50		0	0.00	1778	99.96
				92.50 - 93.00		1	0.04	1779	100.00

(17) FOREARM CIRCUMFERENCE

The maximum circumference of the forearm is measured with a measuring tape perpendicular to the long axis of the arm.
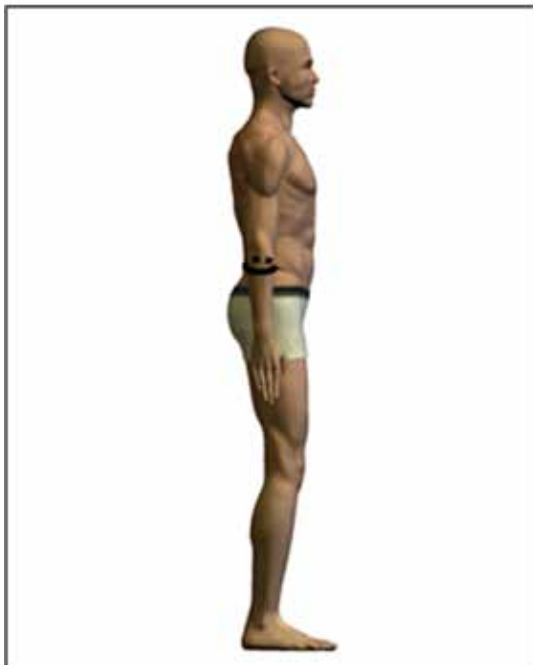
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
22.10	8.70	1ST	25.40	10.00
22.60	8.90	2ND	26.10	10.28
23.70	9.33	3RD	26.40	10.39
24.00	9.45	5TH	27.07	10.66
24.50	9.65	10TH	27.70	10.91
24.58	9.68	15TH	28.30	11.14
25.20	9.92	20TH	28.70	11.30
25.60	10.08	25TH	29.05	11.44
26.00	10.24	30TH	29.40	11.57
26.40	10.39	35TH	29.80	11.73
26.70	10.51	40TH	30.17	11.88
27.00	10.63	45TH	30.45	11.99
27.30	10.75	50TH	30.70	12.09
27.70	10.91	55TH	31.00	12.20
28.30	11.14	60TH	31.30	12.32
28.60	11.26	65TH	31.70	12.48
29.00	11.42	70TH	32.10	12.64
29.40	11.57	75TH	32.50	12.80
30.00	11.81	80TH	33.00	12.99
30.20	11.89	85TH	33.50	13.19
31.50	12.40	90TH	34.27	13.49
32.30	12.72	95TH	35.30	13.90
33.20	13.07	97TH	36.20	14.25
33.60	13.23	98TH	36.79	14.48
33.70	13.27	99TH	37.80	14.88

(17) FOREARM CIRCUMFERENCE

FEMALES		
CM		**INCHES**
27.64	MEAN	10.88
0.20	SE (MEAN)	0.08
2.67	STD. DEVIATION	1.05
0.14	SE (STD.DEV)	0.06
21.80	MINIMUM	8.58
35.30	MAXIMUM	13.90
	SKEWNESS	0.36
	KURTOSIS	-0.38
	COEF VAR	9.66%
	N	171

MALES		
CM		**INCHES**
30.88	MEAN	12.16
0.06	SE (MEAN)	0.02
2.59	STD. DEVIATION	1.02
0.04	SE (STD.DEV)	0.02
23.50	MINIMUM	9.25
46.60	MAXIMUM	18.35
	SKEWNESS	0.45
	KURTOSIS	0.82
	COEF VAR	8.39%
	N	1779

(17) FOREARM CIRCUMFERENCE

				FREQUENCY TABLE				
	FEMA	LES				MA	LES	
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
1	0.58	1	0.58	21.50 - 22.00				
1	0.58	2	1.17	22.00 - 22.50				
1	0.58	3	1.75	22.50 - 23.00				
1	0.58	4	2.34	23.00 - 23.50				
2	1.17	6	3.51	23.50 - 24.00	4	0.20	4	0.20
8	4.68	14	8.19	24.00 - 24.50	2	0.10	6	0.30
17	9.94	31	18.13	24.50 - 25.00	6	0.34	12	0.63
11	6.43	42	24.56	25.00 - 25.50	9	0.52	21	1.16
12	7.02	54	31.58	25.50 - 26.00	11	0.62	32	1.78
13	7.60	67	39.18	26.00 - 26.50	25	1.42	57	3.20
13	7.60	80	46.78	26.50 - 27.00	26	1.48	83	4.68
12	7.02	92	53.80	27.00 - 27.50	55	3.08	138	7.77
9	5.26	101	59.06	27.50 - 28.00	69	3.91	207	11.68
6	3.51	107	62.57	28.00 - 28.50	91	5.12	298	16.79
11	6.43	118	69.01	28.50 - 29.00	112	6.27	410	23.06
11	6.43	129	75.44	29.00 - 29.50	125	7.02	535	30.09
8	4.68	137	80.12	29.50 - 30.00	121	6.78	656	36.87
10	5.85	147	85.96	30.00 - 30.50	145	8.12	801	44.99
2	1.17	149	87.13	30.50 - 31.00	154	8.65	955	53.65
3	1.75	152	88.89	31.00 - 31.50	134	7.56	1089	61.20
5	2.92	157	91.81	31.50 - 32.00	124	6.99	1213	68.20
6	3.51	163	95.32	32.00 - 32.50	106	5.96	1319	74.16
2	1.17	165	96.49	32.50 - 33.00	102	5.72	1421	79.88
1	0.58	166	97.08	33.00 - 33.50	80	4.49	1501	84.37
4	2.34	170	99.42	33.50 - 34.00	71	3.97	1572	88.34
0	0.00	170	99.42	34.00 - 34.50	55	3.10	1627	91.43
0	0.00	170	99.42	34.50 - 35.00	43	2.39	1670	93.83
1	0.58	171	100.00	35.00 - 35.50	27	1.52	1697	95.35
				35.50 - 36.00	20	1.14	1717	96.49
				36.00 - 36.50	18	1.03	1735	97.51
				36.50 - 37.00	11	0.65	1746	98.16
				37.00 - 37.50	8	0.47	1754	98.63
				37.50 - 38.00	8	0.43	1762	99.06
				38.00 - 38.50	8	0.44	1770	99.49
				38.50 - 39.00	2	0.13	1772	99.62
				39.00 - 39.50	1	0.07	1773	99.69
				39.50 - 40.00	2	0.09	1775	99.78
				40.00 - 40.50	2	0.11	1777	99.89
				40.50 - 41.00	1	0.07	1778	99.96
				41.00 - 41.50	0	0.00	1778	99.96
				41.50 - 42.00	0	0.00	1778	99.96
				42.00 - 42.50	0	0.00	1778	99.96
				42.50 - 43.00	0	0.00	1778	99.96
				43.00 - 43.50	0	0.00	1778	99.96
				43.50 - 44.00	0	0.00	1778	99.96
				44.00 - 44.50	0	0.00	1778	99.96
				44.50 - 45.00	0	0.00	1778	99.96
				45.00 - 45.50	0	0.00	1778	99.96
				45.50 - 46.00	0	0.00	1778	99.96
				46.00 - 46.50	0	0.00	1778	99.96
				46.50 - 47.00	1	0.04	1779	100.00

(18) FOREARM-FOREARM BREADTH

The maximum horizontal distance across the upper body between the lateral margins of the forearms is measured with a beam caliper. The subject sits erect with the elbows flexed 90 degrees. The measurement is taken at the maximum point of quiet respiration.
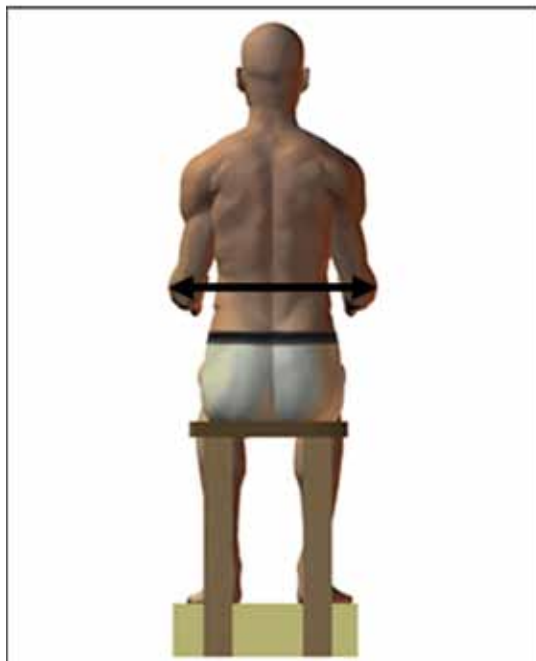
PERCENTILES					
FEMALES				MALES	
CM	**INCHES**			**CM**	**INCHES**
43.80	17.24	1ST		47.30	18.62
45.10	17.76	2ND		48.93	19.26
46.10	18.15	3RD		49.80	19.61
47.50	18.70	5TH		51.60	20.31
49.40	19.45	10TH		53.70	21.14
50.60	19.92	15TH		55.10	21.69
52.30	20.59	20TH		56.10	22.09
53.40	21.02	25TH		57.20	22.52
54.20	21.34	30TH		58.20	22.91
54.50	21.46	35TH		58.90	23.19
55.00	21.65	40TH		59.60	23.46
55.70	21.93	45TH		60.50	23.82
57.10	22.48	50TH		61.30	24.13
57.50	22.64	55TH		62.20	24.49
58.70	23.11	60TH		63.10	24.84
59.50	23.43	65TH		64.00	25.20
60.60	23.86	70TH		64.90	25.55
61.90	24.37	75TH		65.80	25.91
63.10	24.84	80TH		67.10	26.42
64.00	25.20	85TH		68.70	27.05
66.10	26.02	90TH		70.40	27.72
68.40	26.93	95TH		73.01	28.75
70.70	27.83	97TH		75.20	29.61
71.60	28.19	98TH		76.20	30.00
74.10	19.17	99TH		78.74	31.00

(18) FOREARM-FOREARM BREADTH

FEMALES		
CM		**INCHES**
57.40	MEAN	22.60
0.49	SE (MEAN)	0.19
6.47	STD. DEVIATION	2.55
0.35	SE (STD.DEV)	0.14
41.80	MINIMUM	16.46
76.30	MAXIMUM	30.04
	SKEWNESS	0.27
	KURTOSIS	-0.04
	COEF VAR	11.27%
	N	171

MALES		
CM		**INCHES**
61.74	MEAN	24.31
0.16	SE (MEAN)	0.06
6.62	STD. DEVIATION	2.60
0.11	SE (STD.DEV)	0.04
42.00	MINIMUM	16.54
90.00	MAXIMUM	35.43
	SKEWNESS	0.30
	KURTOSIS	0.35
	COEF VAR	10.72%
	N	1779

(18) FOREARM-FOREARM BREADTH

				FREQUENCY TABLE					
	FEM	ALES					MA	LES	
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	41.75 - 42.75		2	0.10	2	0.10
0	0.00	1	0.58	42.75 - 43.75		4	0.22	6	0.32
2	1.17	3	1.75	43.75 - 44.75		0	0.00	6	0.32
3	1.75	6	3.51	44.75 - 45.75		5	0.31	11	0.62
2	1.17	8	4.68	45.75 - 46.75		2	0.09	13	0.71
2	1.17	10	5.85	46.75 - 47.75		9	0.49	22	1.20
6	3.51	16	9.36	47.75 - 48.75		10	0.55	32	1.75
8	4.68	24	14.04	48.75 - 49.75		18	0.99	50	2.74
5	2.92	29	16.96	49.75 - 50.75		19	1.08	69	3.82
6	3.51	35	20.47	50.75 - 51.75		26	1.48	95	5.30
7	4.09	42	24.56	51.75 - 52.75		31	1.76	126	7.06
7	4.09	49	28.65	52.75 - 53.75		54	3.02	180	10.08
18	10.53	67	39.18	53.75 - 54.75		57	3.21	237	13.29
15	8.77	82	47.95	54.75 - 55.75		88	4.93	325	18.22
5	2.92	87	50.88	55.75 - 56.75		84	4.71	409	22.92
14	8.19	101	59.06	56.75 - 57.75		89	4.99	498	27.91
9	5.26	110	64.33	57.75 - 58.75		103	5.80	601	33.71
10	5.85	120	70.18	58.75 - 59.75		121	6.78	722	40.50
4	2.34	124	72.51	59.75 - 60.75		95	5.36	817	45.86
6	3.51	130	76.02	60.75 - 61.75		109	6.16	926	52.02
8	4.68	138	80.70	61.75 - 62.75		110	6.20	1036	58.22
5	2.92	143	83.63	62.75 - 63.75		92	5.16	1128	63.37
6	3.51	149	87.13	63.75 - 64.75		100	5.61	1228	68.99
4	2.34	153	89.47	64.75 - 65.75		97	5.44	1325	74.43
4	2.34	157	91.81	65.75 - 66.75		83	4.67	1408	79.10
4	2.34	161	94.15	66.75 - 67.75		65	3.68	1473	82.78
4	2.34	165	96.49	67.75 - 68.75		43	2.40	1516	85.18
0	0.00	165	96.49	68.75 - 69.75		55	3.10	1571	88.28
2	1.17	167	97.66	69.75 - 70.75		49	2.74	1620	91.02
1	0.58	168	98.25	70.75 - 71.75		33	1.85	1653	92.87
1	0.58	169	98.83	71.75 - 72.75		31	1.77	1684	94.64
0	0.00	169	98.83	72.75 - 73.75		20	1.16	1704	95.80
1	0.58	170	99.42	73.75 - 74.75		16	0.90	1720	96.70
0	0.00	170	99.42	74.75 - 75.75		19	1.05	1739	97.75
1	0.58	171	100.00	75.75 - 76.75		8	0.46	1747	98.22
				76.75 - 77.75		10	0.57	1757	98.79
				77.75 - 78.75		5	0.26	1762	99.04
				78.75 - 79.75		4	0.21	1766	99.25
				79.75 - 80.75		3	0.17	1769	99.42
				80.75 - 81.75		1	0.06	1770	99.48
				81.75 - 82.75		3	0.19	1773	99.68
				82.75 - 83.75		2	0.11	1775	99.79
				83.75 - 84.75		1	0.07	1776	99.86
				84.75 - 85.75		0	0.00	1776	99.86
				85.75 - 86.75		0	0.00	1776	99.86
				86.75 - 87.75		2	0.10	1778	99.96
				87.75 - 88.75		0	0.00	1778	99.96
				88.75 - 89.75		0	0.00	1778	99.96
				89.75 - 90.75		1	0.04	1779	100.00

(19) HAND BREADTH

The breadth of the right hand between the landmarks at metacarpale II and metacarpale V is measured with a sliding caliper. The fingers were placed on a 8mm high finger board while the measurement was taken.

		PERCENTILES		
FEMALES			**MALES**	
CM	**INCHES**		**CM**	**INCHES**
7.20	2.83	1ST	7.90	3.11
7.20	2.83	2ND	8.00	3.15
7.30	2.87	3RD	8.10	3.19
7.40	2.91	5TH	8.20	3.23
7.40	2.91	10TH	8.40	3.31
7.50	2.95	15TH	8.50	3.35
7.60	2.99	20TH	8.60	3.39
7.70	3.03	25TH	8.70	3.43
7.70	3.03	30TH	8.70	3.43
7.70	3.03	35TH	8.80	3.46
7.80	3.07	40TH	8.90	3.50
7.80	3.07	45TH	8.90	3.50
7.90	3.11	50TH	9.00	3.54
7.90	3.11	55TH	9.10	3.58
8.00	3.15	60TH	9.10	3.58
8.00	3.15	65TH	9.20	3.62
8.10	3.19	70TH	9.20	3.62
8.20	3.23	75TH	9.30	3.66
8.20	3.23	80TH	9.40	3.70
8.30	3.27	85TH	9.50	3.74
8.40	3.31	90TH	9.60	3.78
8.70	3.43	95TH	9.80	3.86
8.80	3.46	97TH	9.90	3.90
8.90	3.50	98TH	10.00	3.94
9.00	3.54	99TH	10.20	4.02

(19) HAND BREADTH

FEMALES		
CM		**INCHES**
7.92	MEAN	3.12
0.03	SE (MEAN)	0.01
0.39	STD. DEVIATION	0.15
0.02	SE (STD.DEV)	0.01
6.80	MINIMUM	2.68
9.10	MAXIMUM	3.58
	SKEWNESS	0.46
	KURTOSIS	0.49
	COEF VAR	4.92%
	N	171

MALES		
CM		**INCHES**
8.99	MEAN	3.54
0.01	SE (MEAN)	0.00
0.48	STD. DEVIATION	0.19
0.01	SE (STD.DEV)	0.00
7.40	MINIMUM	2.91
10.70	MAXIMUM	4.21
	SKEWNESS	0.09
	KURTOSIS	-0.07
	COEF VAR	5.36%
	N	1779

(19) HAND BREADTH

				FREQUENCY TABLE				
	FEMALES					MALES		
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
1	0.58	1	0.58	6.75 - 6.85				
0	0.00	1	0.58	6.85 - 6.95				
0	0.00	1	0.58	6.95 - 7.05				
2	1.17	3	1.75	7.05 - 7.15				
2	1.17	5	2.92	7.15 - 7.25				
1	0.58	6	3.51	7.25 - 7.35				
13	7.60	19	11.11	7.35 - 7.45	1	0.06	1	0.06
8	4.68	27	15.79	7.45 - 7.55	0	0.00	1	0.06
16	9.36	43	25.15	7.55 - 7.65	2	0.10	3	0.16
20	11.70	63	36.84	7.65 - 7.75	2	0.11	5	0.27
16	9.36	79	46.20	7.75 - 7.85	5	0.28	10	0.55
18	10.53	97	56.73	7.85 - 7.95	13	0.71	23	1.26
19	11.11	116	67.84	7.95 - 8.05	16	0.92	39	2.18
11	6.43	127	74.27	8.05 - 8.15	19	1.09	58	3.28
16	9.36	143	83.63	8.15 - 8.25	50	2.82	108	6.09
7	4.09	150	87.72	8.25 - 8.35	62	3.52	170	9.61
8	4.68	158	92.40	8.35 - 8.45	68	3.81	238	13.42
3	1.75	161	94.15	8.45 - 8.55	78	4.37	316	17.79
2	1.17	163	95.32	8.55 - 8.65	115	6.47	431	24.26
2	1.17	165	96.49	8.65 - 8.75	117	6.57	548	30.83
2	1.17	167	97.66	8.75 - 8.85	137	7.68	685	38.51
1	0.58	168	98.25	8.85 - 8.95	138	7.76	823	46.27
2	1.17	170	99.42	8.95 - 9.05	153	8.59	976	54.86
1	0.58	171	100.00	9.05 - 9.15	152	8.55	1128	63.41
				9.15 - 9.25	134	7.52	1262	70.92
				9.25 - 9.35	110	6.21	1372	77.14
				9.35 - 9.45	101	5.69	1473	82.82
				9.45 - 9.55	88	4.95	1561	87.77
				9.55 - 9.65	54	3.02	1615	90.79
				9.65 - 9.75	53	2.96	1668	93.75
				9.75 - 9.85	44	2.46	1712	96.22
				9.85 - 9.95	21	1.16	1733	97.37
				9.95 - 10.05	18	1.02	1751	98.39
				10.05 - 10.15	10	0.58	1761	98.97
				10.15 - 10.25	7	0.40	1768	99.37
				10.25 - 10.35	6	0.36	1774	99.73
				10.35 - 10.45	3	0.16	1777	99.89
				10.45 - 10.55	1	0.07	1778	99.96
				10.55 - 10.65	0	0.00	1778	99.96
				10.65 - 10.75	1	0.04	1779	100.00

(20) HAND LENGTH

The length of the right hand between the stylion landmark on the wrist and the tip of the middle finger is measured with a hand caliper. The fingers were placed on a 8mm high finger board while the measurement was taken.
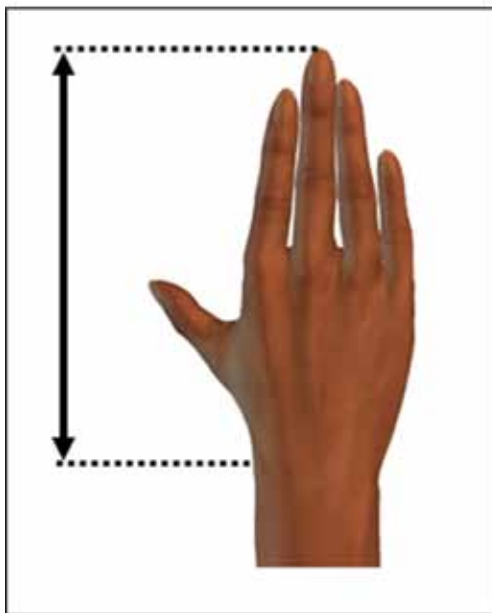
PERCENTILES				
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
15.70	6.18	1ST	17.45	6.87
16.00	6.30	2ND	17.70	6.97
16.00	6.30	3RD	17.90	7.05
16.30	6.42	5TH	18.00	7.09
16.70	6.57	10TH	18.40	7.24
16.90	6.65	15TH	18.60	7.32
17.00	6.69	20TH	18.80	7.40
17.00	6.69	25TH	18.90	7.44
17.20	6.77	30TH	19.10	7.52
17.40	6.85	35TH	19.20	7.56
17.40	6.85	40TH	19.40	7.64
17.50	6.89	45TH	19.50	7.68
17.60	6.93	50TH	19.60	7.72
17.70	6.97	55TH	19.70	7.76
17.80	7.01	60TH	19.90	7.83
17.90	7.05	65TH	20.00	7.87
18.10	7.13	70TH	20.20	7.95
18.20	7.17	75TH	20.30	7.99
18.40	7.24	80TH	20.50	8.07
18.50	7.28	85TH	20.70	8.15
18.70	7.36	90TH	20.90	8.23
19.00	7.48	95TH	21.40	8.43
19.30	7.60	97TH	21.60	8.50
19.90	7.83	98TH	21.80	8.58
20.10	7.91	99TH	22.10	8.70

(20) HAND LENGTH

FEMALES		
CM		**INCHES**
17.66	MEAN	6.95
0.07	SE (MEAN)	0.03
0.85	STD. DEVIATION	0.33
0.05	SE (STD.DEV)	0.02
15.40	MINIMUM	6.06
21.00	MAXIMUM	8.27
	SKEWNESS	0.34
	KURTOSIS	0.83
	COEF VAR	4.81%
	N	171

MALES		
CM		**INCHES**
19.64	MEAN	7.73
0.02	SE (MEAN)	0.01
1.01	STD. DEVIATION	0.40
0.02	SE (STD.DEV)	0.01
16.40	MINIMUM	6.46
24.60	MAXIMUM	9.69
	SKEWNESS	0.27
	KURTOSIS	0.38
	COEF VAR	5.14%
	N	1779

(20) HAND LENGTH

				FREQUENCY TABLE						
	FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS			F	FPct	CumF	CumFPct
1	0.58	1	0.58	15.35	-	15.55				
1	0.58	2	1.17	15.55	-	15.75				
0	0.00	2	1.17	15.75	-	15.95				
2	1.17	4	2.34	15.95	-	16.15				
6	3.51	10	5.85	16.15	-	16.35				
5	2.92	15	8.77	16.35	-	16.55	2	0.09	2	0.09
5	2.92	20	11.70	16.55	-	16.75	0	0.00	2	0.09
7	4.09	27	15.79	16.75	-	16.95	0	0.00	2	0.09
21	12.28	48	28.07	16.95	-	17.15	2	0.13	4	0.21
10	5.85	58	33.92	17.15	-	17.35	7	0.40	11	0.61
19	11.11	77	45.03	17.35	-	17.55	11	0.59	22	1.20
21	12.28	98	57.31	17.55	-	17.75	19	1.09	41	2.30
11	6.43	109	63.74	17.75	-	17.95	27	1.53	68	3.82
14	8.19	123	71.93	17.95	-	18.15	59	3.31	127	7.13
9	5.26	132	77.19	18.15	-	18.35	47	2.63	174	9.76
13	7.60	145	84.80	18.35	-	18.55	72	4.07	246	13.83
11	6.43	156	91.23	18.55	-	18.75	102	5.72	348	19.55
4	2.34	160	93.57	18.75	-	18.95	102	5.73	450	25.28
3	1.75	163	95.32	18.95	-	19.15	118	6.63	568	31.91
1	0.58	164	95.91	19.15	-	19.35	125	7.04	693	38.95
2	1.17	166	97.08	19.35	-	19.55	167	9.39	860	48.34
1	0.58	167	97.66	19.55	-	19.75	135	7.60	995	55.94
1	0.58	168	98.25	19.75	-	19.95	120	6.77	1115	62.71
1	0.58	169	98.83	19.95	-	20.15	124	6.99	1239	69.70
0	0.00	169	98.83	20.15	-	20.35	132	7.40	1371	77.10
1	0.58	170	99.42	20.35	-	20.55	93	5.21	1464	82.30
0	0.00	170	99.42	20.55	-	20.75	83	4.67	1547	86.97
0	0.00	170	99.42	20.75	-	20.95	56	3.16	1603	90.13
1	0.58	171	100.00	20.95	-	21.15	53	2.97	1656	93.10
				21.15	-	21.35	34	1.89	1690	94.99
				21.35	-	21.55	34	1.91	1724	96.90
				21.55	-	21.75	18	1.03	1742	97.94
				21.75	-	21.95	11	0.63	1753	98.56
				21.95	-	22.15	9	0.53	1762	99.09
				22.15	-	22.35	6	0.31	1768	99.40
				22.35	-	22.55	2	0.09	1770	99.49
				22.55	-	22.75	3	0.18	1773	99.67
				22.75	-	22.95	1	0.04	1774	99.71
				22.95	-	23.15	0	0.00	1774	99.71
				23.15	-	23.35	2	0.13	1776	99.84
				23.35	-	23.55	1	0.04	1777	99.89
				23.55	-	23.75	0	0.00	1777	99.89
				23.75	-	23.95	1	0.07	1778	99.96
				23.95	-	24.15	0	0.00	1778	99.96
				24.15	-	24.35	0	0.00	1778	99.96
				24.35	-	24.55	0	0.00	1778	99.96
				24.55	-	24.75	1	0.04	1779	100.00

(21) HIP BREADTH, SITTING

The maximum horizontal distance between the lateral points of the hips is measured with a beam caliper.

PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
38.00	14.96	1ST	34.50	13.58
38.10	15.00	2ND	35.10	13.82
38.30	15.08	3RD	35.70	14.06
38.80	15.28	5TH	36.60	14.41
40.10	15.79	10TH	37.60	14.80
40.70	16.02	15TH	38.43	15.13
41.50	16.34	20TH	39.10	15.39
42.30	16.65	25TH	39.70	15.63
43.00	16.93	30TH	40.20	15.83
43.50	17.13	35TH	40.70	16.02
44.30	17.44	40TH	41.10	16.18
44.90	17.68	45TH	41.50	16.34
45.70	17.99	50TH	42.10	16.57
45.90	18.07	55TH	42.50	16.73
46.70	18.39	60TH	43.27	17.03
47.30	18.62	65TH	43.80	17.24
48.20	18.98	70TH	44.50	17.52
49.00	19.29	75TH	45.30	17.83
50.40	19.84	80TH	46.20	18.19
51.20	20.16	85TH	47.20	18.58
52.90	20.83	90TH	48.70	19.17
55.90	22.01	95TH	51.30	20.20
57.50	22.64	97TH	53.00	20.87
58.50	23.03	98TH	53.91	21.22
61.00	24.02	99TH	55.70	21.93

(21) HIP BREADTH, SITTING

FEMALES		
CM		**INCHES**
45.99	MEAN	18.11
0.39	SE (MEAN)	0.15
5.12	STD. DEVIATION	2.02
0.28	SE (STD.DEV)	0.11
32.80	MINIMUM	12.91
61.30	MAXIMUM	24.13
	SKEWNESS	0.57
	KURTOSIS	0.31
	COEF VAR	11.13%
	N	171

MALES		
CM		**INCHES**
42.77	MEAN	16.84
0.11	SE (MEAN)	0.04
4.60	STD. DEVIATION	1.81
0.08	SE (STD.DEV)	0.03
31.80	MINIMUM	12.52
74.00	MAXIMUM	29.13
	SKEWNESS	1.04
	KURTOSIS	2.48
	COEF VAR	10.76%
	N	1779

(21) HIP BREADTH, SITTING

				FREQUENCY TABLE				
	FEMALES					MALES		
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
				31.75 - 32.75	3	0.16	3	0.16
1	0.58	1	0.58	32.75 - 33.75	6	0.35	9	0.51
0	0.00	1	0.58	33.75 - 34.75	16	0.93	25	1.44
0	0.00	1	0.58	34.75 - 35.75	30	1.71	55	3.14
0	0.00	1	0.58	35.75 - 36.75	42	2.39	97	5.53
0	0.00	1	0.58	36.75 - 37.75	96	5.40	193	10.94
8	4.68	9	5.26	37.75 - 38.75	118	6.62	311	17.55
5	2.92	14	8.19	38.75 - 39.75	151	8.52	462	26.07
16	9.36	30	17.54	39.75 - 40.75	177	9.96	639	36.03
8	4.68	38	22.22	40.75 - 41.75	197	11.05	836	47.09
10	5.85	48	28.07	41.75 - 42.75	168	9.45	1004	56.54
17	9.94	65	38.01	42.75 - 43.75	139	7.81	1143	64.34
12	7.02	77	45.03	43.75 - 44.75	139	7.81	1282	72.15
13	7.60	90	52.63	44.75 - 45.75	97	5.43	1379	77.58
14	8.19	104	60.82	45.75 - 46.75	94	5.28	1473	82.86
11	6.43	115	67.25	46.75 - 47.75	80	4.48	1553	87.34
12	7.02	127	74.27	47.75 - 48.75	49	2.75	1602	90.09
8	4.68	135	78.95	48.75 - 49.75	41	2.31	1643	92.40
9	5.26	144	84.21	49.75 - 50.75	29	1.65	1672	94.05
5	2.92	149	87.13	50.75 - 51.75	29	1.61	1701	95.66
4	2.34	153	89.47	51.75 - 52.75	17	0.96	1718	96.62
4	2.34	157	91.81	52.75 - 53.75	24	1.32	1742	97.94
5	2.92	162	94.74	53.75 - 54.75	9	0.53	1751	98.47
1	0.58	163	95.32	54.75 - 55.75	10	0.58	1761	99.06
1	0.58	164	95.91	55.75 - 56.75	1	0.07	1762	99.13
3	1.75	167	97.66	56.75 - 57.75	1	0.04	1763	99.17
1	0.58	168	98.25	57.75 - 58.75	2	0.11	1765	99.28
1	0.58	169	98.83	58.75 - 59.75	1	0.05	1766	99.33
0	0.00	169	98.83	59.75 - 60.75	5	0.28	1771	99.61
2	1.17	171	100.00	60.75 - 61.75	3	0.14	1774	99.75
				61.75 - 62.75	0	0.00	1774	99.75
				62.75 - 63.75	1	0.04	1775	99.79
				63.75 - 64.75	1	0.05	1776	99.84
				64.75 - 65.75	1	0.07	1777	99.91
				65.75 - 66.75	1	0.04	1778	99.96
				66.75 - 67.75	0	0.00	1778	99.96
				67.75 - 68.75	0	0.00	1778	99.96
				68.75 - 69.75	0	0.00	1778	99.96
				69.75 - 70.75	0	0.00	1778	99.96
				70.75 - 71.75	0	0.00	1778	99.96
				71.75 - 72.75	0	0.00	1778	99.96
				72.75 - 73.75	0	0.00	1778	99.96
				73.75 - 74.75	1	0.04	1779	100.00

(22) KNEE HEIGHT, SITTING

The vertical distance from the footrest surface to the top of the knee at the center of the widest part of the calf is measured with an anthropometer. The subject sits with the thighs parallel, the knees flexed 90 degrees, and the feet in line with the thighs.
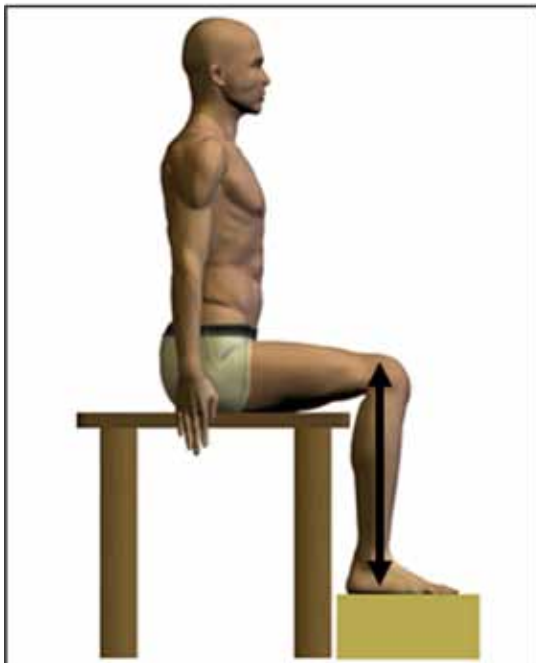
PERCENTILES				
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
47.70	18.78	1ST	50.40	19.84
47.80	18.82	2ND	51.40	20.24
48.00	18.90	3RD	51.80	20.39
48.70	19.17	5TH	52.30	20.59
49.00	19.29	10TH	53.30	20.98
49.80	19.61	15TH	54.10	21.30
50.30	19.80	20TH	54.50	21.46
50.90	20.04	25TH	54.90	21.61
51.30	20.20	30TH	55.30	21.77
51.70	20.35	35TH	55.70	21.93
51.80	20.39	40TH	56.20	22.13
52.10	20.51	45TH	56.50	22.24
52.40	20.63	50TH	56.80	22.36
52.70	20.75	55TH	57.20	22.52
53.00	20.87	60TH	57.60	22.68
53.20	20.94	65TH	58.10	22.87
53.70	21.14	70TH	58.50	23.03
54.30	21.38	75TH	58.90	23.19
54.70	21.54	80TH	59.40	23.39
55.20	21.73	85TH	59.80	23.54
56.30	22.17	90TH	60.50	23.82
57.10	22.48	95TH	61.53	24.22
58.10	22.87	97TH	62.40	24.57
58.60	23.07	98TH	62.90	24.76
59.00	23.22	99TH	64.00	25.20

(22) KNEE HEIGHT, SITTING

FEMALES		
CM		**INCHES**
52.56	MEAN	20.69
0.20	SE (MEAN)	0.08
2.57	STD. DEVIATION	1.01
0.14	SE (STD.DEV)	0.06
46.40	MINIMUM	18.27
60.50	MAXIMUM	23.82
	SKEWNESS	0.30
	KURTOSIS	-0.04
	COEF VAR	4.89%
	N	171

MALES		
CM		**INCHES**
56.92	MEAN	22.41
0.07	SE (MEAN)	0.03
2.84	STD. DEVIATION	1.12
0.05	SE (STD.DEV)	0.02
47.90	MINIMUM	18.86
66.70	MAXIMUM	26.26
	SKEWNESS	0.08
	KURTOSIS	0.02
	COEF VAR	4.99%
	N	1779

(22) KNEE HEIGHT, SITTING

				FREQUENCY TABLE					
	FEMALES						MALES		
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	46.00 - 46.50					
0	0.00	1	0.58	46.50 - 47.00					
1	0.58	2	1.17	47.00 - 47.50					
2	1.17	4	2.34	47.50 - 48.00		3	0.14	3	0.14
2	1.17	6	3.51	48.00 - 48.50		0	0.00	3	0.14
10	5.85	16	9.36	48.50 - 49.00		3	0.17	6	0.32
7	4.09	23	13.45	49.00 - 49.50		1	0.04	7	0.36
5	2.92	28	16.37	49.50 - 50.00		6	0.35	13	0.71
10	5.85	38	22.22	50.00 - 50.50		6	0.34	19	1.05
10	5.85	48	28.07	50.50 - 51.00		6	0.32	25	1.37
12	7.02	60	35.09	51.00 - 51.50		15	0.87	40	2.24
15	8.77	75	43.86	51.50 - 52.00		21	1.20	61	3.44
14	8.19	89	52.05	52.00 - 52.50		34	1.90	95	5.34
13	7.60	102	59.65	52.50 - 53.00		41	2.32	136	7.66
13	7.60	115	67.25	53.00 - 53.50		56	3.15	192	10.81
8	4.68	123	71.93	53.50 - 54.00		61	3.42	253	14.23
9	5.26	132	77.19	54.00 - 54.50		78	4.40	331	18.62
11	6.43	143	83.63	54.50 - 55.00		116	6.53	447	25.15
6	3.51	149	87.13	55.00 - 55.50		125	7.02	572	32.18
2	1.17	151	88.30	55.50 - 56.00		91	5.10	663	37.27
5	2.92	156	91.23	56.00 - 56.50		132	7.43	795	44.70
5	2.92	161	94.15	56.50 - 57.00		130	7.31	925	52.01
2	1.17	163	95.32	57.00 - 57.50		105	5.93	1030	57.94
2	1.17	165	96.49	57.50 - 58.00		100	5.62	1130	63.56
2	1.17	167	97.66	58.00 - 58.50		95	5.36	1225	68.92
1	0.58	168	98.25	58.50 - 59.00		112	6.28	1337	75.20
1	0.58	169	98.83	59.00 - 59.50		108	6.08	1445	81.28
1	0.58	170	99.42	59.50 - 60.00		83	4.65	1528	85.93
0	0.00	170	99.42	60.00 - 60.50		72	4.05	1600	89.98
1	0.58	171	100.00	60.50 - 61.00		49	2.73	1649	92.72
				61.00 - 61.50		37	2.07	1686	94.79
				61.50 - 62.00		23	1.27	1709	96.06
				62.00 - 62.50		21	1.17	1730	97.24
				62.50 - 63.00		16	0.89	1746	98.12
				63.00 - 63.50		11	0.61	1757	98.73
				63.50 - 64.00		4	0.23	1761	98.96
				64.00 - 64.50		12	0.66	1773	99.61
				64.50 - 65.00		1	0.04	1774	99.66
				65.00 - 65.50		2	0.14	1776	99.79
				65.50 - 66.00		0	0.00	1776	99.79
				66.00 - 66.50		2	0.14	1778	99.93
				66.50 - 67.00		1	0.07	1779	100.00

(23) POPLITEAL HEIGHT, SITTING

The vertical distance from the footrest surface to the back of the right knee (the popliteal fossa at the dorsal juncture of the right calf and thigh) is measured with an anthropometer. The subject sits with the thighs parallel; the knees flexed 90 degrees, and the feet in line with the thighs.

PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
34.40	13.54	1ST		38.03	14.97
34.70	13.66	2ND		38.50	15.16
35.70	14.06	3RD		38.90	15.31
36.00	14.17	5TH		39.70	15.63
36.70	14.45	10TH		40.70	16.02
37.20	14.65	15TH		41.30	16.26
37.30	14.69	20TH		41.70	16.42
37.70	14.84	25TH		42.20	16.61
38.10	15.00	30TH		42.60	16.77
38.40	15.12	35TH		42.90	16.89
38.70	15.24	40TH		43.30	17.05
39.10	15.39	45TH		43.60	17.17
39.30	15.47	50TH		43.90	17.28
39.60	15.59	55TH		44.20	17.40
40.00	15.75	60TH		44.60	17.56
40.70	16.02	65TH		45.00	17.72
41.00	16.14	70TH		45.30	17.83
41.60	16.38	75TH		45.70	17.99
41.80	16.46	80TH		46.14	18.16
42.20	16.61	85TH		46.50	18.31
43.30	17.05	90TH		47.20	18.58
44.30	17.44	95TH		48.30	19.02
44.80	17.64	97TH		48.90	19.25
45.50	17.91	98TH		49.35	19.43
45.70	17.99	99TH		49.99	19.68

(23) POPLITEAL HEIGHT, SITTING

FEMALES		
CM		**INCHES**
39.63	MEAN	15.60
0.19	SE (MEAN)	0.08
2.52	STD. DEVIATION	0.99
0.14	SE (STD.DEV)	0.05
34.20	MINIMUM	13.46
46.20	MAXIMUM	18.19
	SKEWNESS	0.39
	KURTOSIS	-0.27
	COEF VAR	6.36%
	N	171

MALES		
CM		**INCHES**
43.94	MEAN	17.30
0.06	SE (MEAN)	0.02
2.59	STD. DEVIATION	1.02
0.04	SE (STD.DEV)	0.02
32.60	MINIMUM	12.83
52.70	MAXIMUM	20.75
	SKEWNESS	0.01
	KURTOSIS	0.19
	COEF VAR	5.89%
	N	1779

(23) POPLITEAL HEIGHT, SITTING

				FREQUENCY TABLE					
FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
				32.50 - 33.00		1	0.04	1	0.04
				33.00 - 33.50		0	0.00	1	0.04
				33.50 - 34.00		0	0.00	1	0.04
2	1.17	2	1.17	34.00 - 34.50		0	0.00	1	0.04
3	1.75	5	2.92	34.50 - 35.00		1	0.04	2	0.09
0	0.00	5	2.92	35.00 - 35.50		0	0.00	2	0.09
3	1.75	8	4.68	35.50 - 36.00		1	0.06	3	0.15
6	3.51	14	8.19	36.00 - 36.50		1	0.04	4	0.19
4	2.34	18	10.53	36.50 - 37.00		3	0.20	7	0.39
21	12.28	39	22.81	37.00 - 37.50		3	0.16	10	0.55
6	3.51	45	26.32	37.50 - 38.00		7	0.37	17	0.92
20	11.70	65	38.01	38.00 - 38.50		18	1.02	35	1.93
12	7.02	77	45.03	38.50 - 39.00		19	1.07	54	3.00
17	9.94	94	54.97	39.00 - 39.50		15	0.85	69	3.85
9	5.26	103	60.23	39.50 - 40.00		26	1.46	95	5.32
7	4.09	110	64.33	40.00 - 40.50		57	3.19	152	8.51
11	6.43	121	70.76	40.50 - 41.00		60	3.36	212	11.87
8	4.68	129	75.44	41.00 - 41.50		89	4.98	301	16.85
13	7.60	142	83.04	41.50 - 42.00		83	4.64	384	21.49
9	5.26	151	88.30	42.00 - 42.50		112	6.32	496	27.81
2	1.17	153	89.47	42.50 - 43.00		134	7.52	630	35.33
4	2.34	157	91.81	43.00 - 43.50		137	7.73	767	43.05
1	0.58	158	92.40	43.50 - 44.00		126	7.11	893	50.16
4	2.34	162	94.74	44.00 - 44.50		134	7.56	1027	57.71
3	1.75	165	96.49	44.50 - 45.00		127	7.14	1154	64.85
2	1.17	167	97.66	45.00 - 45.50		117	6.56	1271	71.41
3	1.75	170	99.42	45.50 - 46.00		108	6.07	1379	77.48
1	0.58	171	100.00	46.00 - 46.50		112	6.31	1491	83.79
				46.50 - 47.00		95	5.32	1586	89.10
				47.00 - 47.50		42	2.39	1628	91.50
				47.50 - 48.00		32	1.81	1660	93.30
				48.00 - 48.50		43	2.40	1703	95.70
				48.50 - 49.00		25	1.41	1728	97.11
				49.00 - 49.50		19	1.06	1747	98.17
				49.50 - 50.00		15	0.84	1762	99.01
				50.00 - 50.50		6	0.36	1768	99.37
				50.50 - 51.00		3	0.18	1771	99.55
				51.00 - 51.50		4	0.20	1775	99.75
				51.50 - 52.00		1	0.07	1776	99.82
				52.00 - 52.50		1	0.07	1777	99.89
				52.50 - 53.00		2	0.11	1779	100.00

(24) SHOE LENGTH

The length of the right shoe parallel to its long axis is measured with a beam caliper.

PERCENTILES				
FEMALES			**MALES**	
CM	**INCHES**		**CM**	**INCHES**
24.30	9.57	1ST	27.50	10.83
24.70	9.72	2ND	28.00	11.02
24.90	9.80	3RD	28.20	11.10
25.00	9.84	5TH	28.54	11.24
25.80	10.16	10TH	29.20	11.50
26.10	10.28	15TH	29.50	11.61
26.40	10.39	20TH	29.80	11.73
26.50	10.43	25TH	30.00	11.81
26.70	10.51	30TH	30.20	11.89
26.80	10.55	35TH	30.40	11.97
27.00	10.63	40TH	30.60	12.05
27.20	10.71	45TH	30.80	12.13
27.60	10.87	50TH	30.90	12.17
27.60	10.87	55TH	31.10	12.24
27.80	10.94	60TH	31.20	12.28
27.90	10.98	65TH	31.40	12.36
28.00	11.02	70TH	31.70	12.48
28.20	11.10	75TH	31.90	12.56
28.50	11.22	80TH	32.20	12.68
28.90	11.38	85TH	32.50	12.80
29.70	11.69	90TH	32.80	12.91
30.30	11.93	95TH	33.40	13.15
30.40	11.97	97TH	33.70	13.27
31.10	12.24	98TH	34.00	13.39
32.75	12.89	99TH	34.46	13.57

(24) SHOE LENGTH

FEMALES				MALES		
CM		**INCHES**		**CM**		**INCHES**
27.51	MEAN	10.83		30.95	MEAN	12.18
0.14	SE (MEAN)	0.06		0.04	SE (MEAN)	0.01
1.56	STD. DEVIATION	0.61		1.45	STD. DEVIATION	0.57
0.10	SE (STD.DEV)	0.04		0.03	SE (STD.DEV)	0.01
24.20	MINIMUM	9.53		26.50	MINIMUM	10.43
33.30	MAXIMUM	13.11		37.00	MAXIMUM	14.57
	SKEWNESS	0.74			SKEWNESS	0.12
	KURTOSIS	1.46			KURTOSIS	0.25
	COEF VAR	5.67%			COEF VAR	4.68%
	N*	130			N*	1523

* N was reduced because shoe width was measured only if the individuals were wearing shoes that were normally worn while driving.

(24) SHOE LENGTH

				FREQUENCY TABLE					
		FEMALES					MALES		
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
2	1.54	2	1.54	24.15 - 24.45					
1	0.77	3	2.31	24.45 - 24.75					
4	3.08	7	5.38	24.75 - 25.05					
2	1.54	9	6.92	25.05 - 25.35					
3	2.31	12	9.23	25.35 - 25.65					
5	3.85	17	13.08	25.65 - 25.95					
9	6.92	26	20.00	25.95 - 26.25					
11	8.46	37	28.46	26.25 - 26.55		1	0.07	1	0.07
13	10.00	50	38.46	26.55 - 26.85		1	0.06	2	0.12
9	6.92	59	45.38	26.85 - 27.15		4	0.26	6	0.38
7	5.38	66	50.77	27.15 - 27.45		6	0.41	12	0.79
14	10.77	80	61.54	27.45 - 27.75		9	0.56	21	1.36
14	10.77	94	72.31	27.75 - 28.05		18	1.16	39	2.51
10	7.69	104	80.00	28.05 - 28.35		21	1.36	60	3.88
4	3.08	108	83.08	28.35 - 28.65		24	1.61	84	5.48
5	3.85	113	86.92	28.65 - 28.95		33	2.16	117	7.64
1	0.77	114	87.69	28.95 - 29.25		49	3.20	166	10.84
2	1.54	116	89.23	29.25 - 29.55		81	5.30	247	16.14
5	3.85	121	93.08	29.55 - 29.85		82	5.39	329	21.53
3	2.31	124	95.38	29.85 - 30.15		100	6.55	429	28.08
3	2.31	127	97.69	30.15 - 30.45		135	8.86	564	36.94
0	0.00	127	97.69	30.45 - 30.75		120	7.91	684	44.85
0	0.00	127	97.69	30.75 - 31.05		145	9.51	829	54.36
1	0.77	128	98.46	31.05 - 31.35		134	8.77	963	63.13
0	0.00	128	98.46	31.35 - 31.65		96	6.33	1059	69.46
0	0.00	128	98.46	31.65 - 31.95		100	6.55	1159	76.02
1	0.77	129	99.23	31.95 - 32.25		84	5.55	1243	81.57
0	0.00	129	99.23	32.25 - 32.55		70	4.59	1313	86.16
0	0.00	129	99.23	32.55 - 32.85		62	4.05	1375	90.21
0	0.00	129	99.23	32.85 - 33.15		46	3.03	1421	93.25
1	0.77	130	100.00	33.15 - 33.45		38	2.49	1459	95.73
				33.45 - 33.75		27	1.78	1486	97.51
				33.75 - 34.05		9	0.61	1495	98.12
				34.05 - 34.35		10	0.69	1505	98.81
				34.35 - 34.65		6	0.43	1511	99.24
				34.65 - 34.95		5	0.36	1516	99.60
				34.95 - 35.25		2	0.10	1518	99.70
				35.25 - 35.55		0	0.00	1518	99.70
				35.55 - 35.85		2	0.12	1520	99.82
				35.85 - 36.15		1	0.08	1521	99.90
				36.15 - 36.45		1	0.05	1522	99.95
				36.45 - 36.75		0	0.00	1522	99.95
				36.75 - 37.05		1	0.05	1523	100.00

(25) SHOE WIDTH

The width of the right shoe perpendicular to its long axis is measured with a beam caliper.
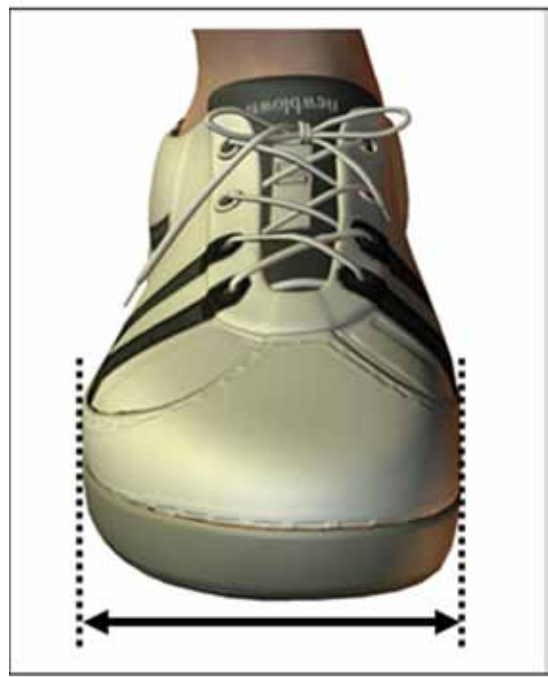
PERCENTILES				
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
8.90	3.50	1ST	10.10	3.98
9.10	3.58	2ND	10.20	4.02
9.20	3.62	3RD	10.40	4.09
9.50	3.74	5TH	10.60	4.17
9.70	3.82	10TH	10.80	4.25
9.90	3.90	15TH	11.00	4.33
10.10	3.98	20TH	11.10	4.37
10.20	4.02	25TH	11.20	4.41
10.30	4.06	30TH	11.30	4.45
10.40	4.09	35TH	11.40	4.49
10.40	4.09	40TH	11.50	4.53
10.50	4.13	45TH	11.50	4.53
10.50	4.13	50TH	11.60	4.57
10.60	4.17	55TH	11.70	4.61
10.70	4.21	60TH	11.80	4.65
10.70	4.21	65TH	11.90	4.69
10.90	4.29	70TH	12.00	4.72
11.00	4.33	75TH	12.00	4.72
11.20	4.41	80TH	12.20	4.80
11.40	4.49	85TH	12.30	4.84
11.60	4.57	90TH	12.40	4.88
11.80	4.65	95TH	12.60	4.96
11.90	4.69	97TH	12.80	5.04
11.90	4.69	98TH	12.90	5.08
12.05	4.74	99TH	13.20	5.20

(25) SHOE WIDTH

FEMALES		
__CM__		__INCHES__
10.60	MEAN	4.17
0.06	SE (MEAN)	0.02
0.69	STD. DEVIATION	0.27
0.04	SE (STD.DEV)	0.02
8.60	MINIMUM	3.39
12.20	MAXIMUM	4.80
	SKEWNESS	-0.07
	KURTOSIS	-0.02
	COEF VAR	6.51%
	N*	130

MALES		
__CM__		__INCHES__
11.62	MEAN	4.58
0.02	SE (MEAN)	0.01
0.63	STD. DEVIATION	0.25
0.01	SE (STD.DEV)	0.00
9.60	MINIMUM	3.78
14.00	MAXIMUM	5.51
	SKEWNESS	0.01
	KURTOSIS	0.20
	COEF VAR	5.43%
	N*	1523

* N was reduced because shoe width was measured only if the individuals were wearing shoes that were normally worn while driving.

(25) SHOE WIDTH

				FREQUENCY TABLE					
FEMALES						**MALES**			
F	FPct	CumF	CumFPct	**CENTIMETERS**		F	FPct	CumF	CumFPct
1	0.77	1	0.77	8.55	- 8.65				
1	0.77	2	1.54	8.65	- 8.75				
0	0.00	2	1.54	8.75	- 8.85				
1	0.77	3	2.31	8.85	- 8.95				
0	0.00	3	2.31	8.95	- 9.05				
1	0.77	4	3.08	9.05	- 9.15				
1	0.77	5	3.85	9.15	- 9.25				
0	0.00	5	3.85	9.25	- 9.35				
1	0.77	6	4.62	9.35	- 9.45				
4	3.08	10	7.69	9.45	- 9.55				
2	1.54	12	9.23	9.55	- 9.65	1	0.05	1	0.05
5	3.85	17	13.08	9.65	- 9.75	1	0.07	2	0.12
2	1.54	19	14.62	9.75	- 9.85	0	0.00	2	0.12
3	2.31	22	16.92	9.85	- 9.95	3	0.22	5	0.34
5	3.85	27	20.77	9.95	- 10.05	7	0.49	12	0.83
2	1.54	29	22.31	10.05	- 10.15	9	0.61	21	1.44
6	4.62	35	26.92	10.15	- 10.25	10	0.63	31	2.06
7	5.38	42	32.31	10.25	- 10.35	7	0.46	38	2.53
11	8.46	53	40.77	10.35	- 10.45	12	0.78	50	3.30
11	8.46	64	49.23	10.45	- 10.55	23	1.54	73	4.84
9	6.92	73	56.15	10.55	- 10.65	13	0.84	86	5.68
14	10.77	87	66.92	10.65	- 10.75	32	2.10	118	7.78
3	2.31	90	69.23	10.75	- 10.85	40	2.62	158	10.40
6	4.62	96	73.85	10.85	- 10.95	54	3.52	212	13.91
7	5.38	103	79.23	10.95	- 11.05	54	3.54	266	17.45
3	2.31	106	81.54	11.05	- 11.15	78	5.10	344	22.56
5	3.85	111	85.38	11.15	- 11.25	81	5.35	425	27.90
1	0.77	112	86.15	11.25	- 11.35	76	5.00	501	32.90
3	2.31	115	88.46	11.35	- 11.45	91	5.95	592	38.84
2	1.54	117	90.00	11.45	- 11.55	96	6.32	688	45.17
5	3.85	122	93.85	11.55	- 11.65	93	6.12	781	51.29
2	1.54	124	95.38	11.65	- 11.75	94	6.15	875	57.43
2	1.54	126	96.92	11.75	- 11.85	97	6.37	972	63.81
3	2.31	129	99.23	11.85	- 11.95	81	5.34	1053	69.15
0	0.00	129	99.23	11.95	- 12.05	104	6.84	1157	75.99
0	0.00	129	99.23	12.05	- 12.15	59	3.89	1216	79.89
1	0.77	130	100.00	12.15	- 12.25	76	4.97	1292	84.86
				12.25	- 12.35	52	3.42	1344	88.27
				12.35	- 12.45	40	2.62	1384	90.89
				12.45	- 12.55	33	2.18	1417	93.07
				12.55	- 12.65	33	2.15	1450	95.23
				12.65	- 12.75	21	1.39	1471	96.61
				12.75	- 12.85	18	1.18	1489	97.80
				12.85	- 12.95	5	0.32	1494	98.11
				12.95	- 13.05	9	0.62	1503	98.73
				13.05	- 13.15	4	0.23	1507	98.96
				13.15	- 13.25	7	0.45	1514	99.41
				13.25	- 13.35	3	0.16	1517	99.58
				13.35	- 13.45	1	0.06	1518	99.63
				13.45	- 13.55	1	0.05	1519	99.69
				13.55	- 13.65	1	0.05	1520	99.74
				13.65	- 13.75	2	0.18	1522	99.92
				13.75	- 13.85	0	0.00	1522	99.92
				13.85	- 13.95	0	0.00	1522	99.92
				13.95	- 14.05	1	0.08	1523	100.00

(26) SHOULDER—ELBOW LENGTH

The distance between the acromion landmark on the tip of the right shoulder and the bottom of the right elbow (olecranon, bottom) is measured with a beam caliper. The subject stands erect with the right elbow flexed 90 degrees.
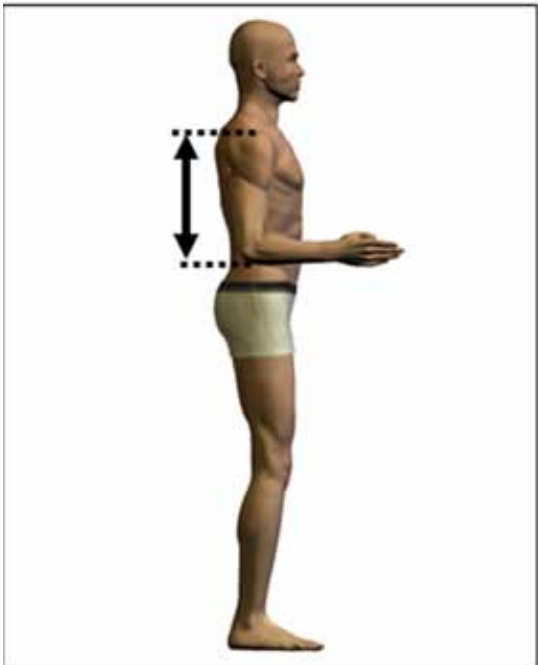
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
29.00	11.42	1ST	31.80	12.52
29.30	11.54	2ND	32.35	12.73
29.80	11.73	3RD	32.80	12.91
30.40	11.97	5TH	33.10	13.03
31.00	12.20	10TH	33.70	13.27
31.50	12.40	15TH	34.20	13.46
31.80	12.52	20TH	34.62	13.63
31.90	12.56	25TH	34.90	13.74
32.30	12.72	30TH	35.20	13.86
32.50	12.80	35TH	35.50	13.98
32.80	12.91	40TH	35.70	14.06
33.00	12.99	45TH	35.90	14.13
33.20	13.07	50TH	36.10	14.21
33.50	13.19	55TH	36.40	14.33
33.90	13.35	60TH	36.70	14.45
34.10	13.43	65TH	37.00	14.57
34.30	13.50	70TH	37.20	14.65
34.50	13.58	75TH	37.50	14.76
34.80	13.70	80TH	37.70	14.84
35.10	13.82	85TH	38.20	15.04
35.50	13.98	90TH	38.60	15.20
36.40	14.33	95TH	39.30	15.47
37.00	14.57	97TH	39.60	15.59
37.00	14.57	98TH	39.90	15.71
38.35	15.10	99TH	40.50	15.94

(26) SHOULDER—ELBOW LENGTH

FEMALES		
CM		**INCHES**
33.31	MEAN	13.11
0.14	SE (MEAN)	0.06
1.85	STD. DEVIATION	0.73
0.10	SE (STD.DEV)	0.04
28.80	MINIMUM	11.34
40.70	MAXIMUM	16.02
	SKEWNESS	0.16
	KURTOSIS	0.12
	COEF VAR	5.52%
	N*	170

MALES		
CM		**INCHES**
36.19	MEAN	14.25
0.04	SE (MEAN)	0.02
1.88	STD. DEVIATION	0.74
0.03	SE (STD.DEV)	0.01
29.50	MINIMUM	11.61
43.70	MAXIMUM	17.20
	SKEWNESS	0.04
	KURTOSIS	0.12
	COEF VAR	5.20%
	N*	1776

* N was reduced due to the missing observations

(26) SHOULDER—ELBOW LENGTH

FREQUENCY TABLE

FEMALES				CENTIMETERS			MALES			
F	FPct	CumF	CumFPct				F	FPct	CumF	CumFPct
2	1.18	2	1.18	28.75	-	29.05				
1	0.59	3	1.76	29.05	-	29.35				
0	0.00	3	1.76	29.35	-	29.65	1	0.04	1	0.04
2	1.18	5	2.94	29.65	-	29.95	0	0.00	1	0.04
1	0.59	6	3.53	29.95	-	30.25	1	0.07	2	0.11
4	2.35	10	5.88	30.25	-	30.55	0	0.00	2	0.11
5	2.94	15	8.82	30.55	-	30.85	3	0.19	5	0.30
4	2.35	19	11.18	30.85	-	31.15	3	0.15	8	0.45
6	3.53	25	14.71	31.15	-	31.45	4	0.22	12	0.68
6	3.53	31	18.24	31.45	-	31.75	4	0.23	16	0.90
12	7.06	43	25.29	31.75	-	32.05	10	0.58	26	1.48
10	5.88	53	31.18	32.05	-	32.35	9	0.50	35	1.98
11	6.47	64	37.65	32.35	-	32.65	8	0.45	43	2.43
13	7.65	77	45.29	32.65	-	32.95	24	1.34	67	3.77
13	7.65	90	52.94	32.95	-	33.25	37	2.10	104	5.87
7	4.12	97	57.06	33.25	-	33.55	33	1.87	137	7.73
6	3.53	103	60.59	33.55	-	33.85	60	3.38	197	11.11
11	6.47	114	67.06	33.85	-	34.15	47	2.62	244	13.74
11	6.47	125	73.53	34.15	-	34.45	61	3.42	305	17.16
7	4.12	132	77.65	34.45	-	34.75	80	4.52	385	21.68
7	4.12	139	81.76	34.75	-	35.05	99	5.60	484	27.28
9	5.29	148	87.06	35.05	-	35.35	98	5.54	582	32.82
4	2.35	152	89.41	35.35	-	35.65	110	6.17	692	38.99
3	1.76	155	91.18	35.65	-	35.95	124	6.97	816	45.97
3	1.76	158	92.94	35.95	-	36.25	105	5.93	921	51.90
4	2.35	162	95.29	36.25	-	36.55	104	5.88	1025	57.78
1	0.59	163	95.88	36.55	-	36.85	104	5.87	1129	63.65
3	1.76	166	97.65	36.85	-	37.15	91	5.12	1220	68.77
1	0.59	167	98.24	37.15	-	37.45	104	5.84	1324	74.61
0	0.00	167	98.24	37.45	-	37.75	99	5.56	1423	80.17
0	0.00	167	98.24	37.75	-	38.05	64	3.60	1487	83.78
0	0.00	167	98.24	38.05	-	38.35	59	3.34	1546	87.12
1	0.59	168	98.82	38.35	-	38.65	60	3.38	1606	90.50
0	0.00	168	98.82	38.65	-	38.95	45	2.54	1651	93.04
0	0.00	168	98.82	38.95	-	39.25	28	1.59	1679	94.63
1	0.59	169	99.41	39.25	-	39.55	34	1.91	1713	96.53
0	0.00	169	99.41	39.55	-	39.85	25	1.42	1738	97.95
0	0.00	169	99.41	39.85	-	40.15	10	0.55	1748	98.50
0	0.00	169	99.41	40.15	-	40.45	8	0.42	1756	98.93
1	0.59	170	100.00	40.45	-	40.75	6	0.35	1762	99.28
				40.75	-	41.05	2	0.13	1764	99.40
				41.05	-	41.35	3	0.16	1767	99.57
				41.35	-	41.65	1	0.04	1768	99.61
				41.65	-	41.95	2	0.09	1770	99.69
				41.95	-	42.25	3	0.18	1773	99.87
				42.25	-	42.55	1	0.04	1774	99.91
				42.55	-	42.85	0	0.00	1774	99.91
				42.85	-	43.15	0	0.00	1774	99.91
				43.15	-	43.45	0	0.00	1774	99.91
				43.45	-	43.75	2	0.09	1776	100.00

(27) SITTING HEIGHT

The vertical distance between a sitting surface and the top of the head is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane and the elbows and knees at 90 degrees. The measurement is made at the maximum point of quiet respiration.
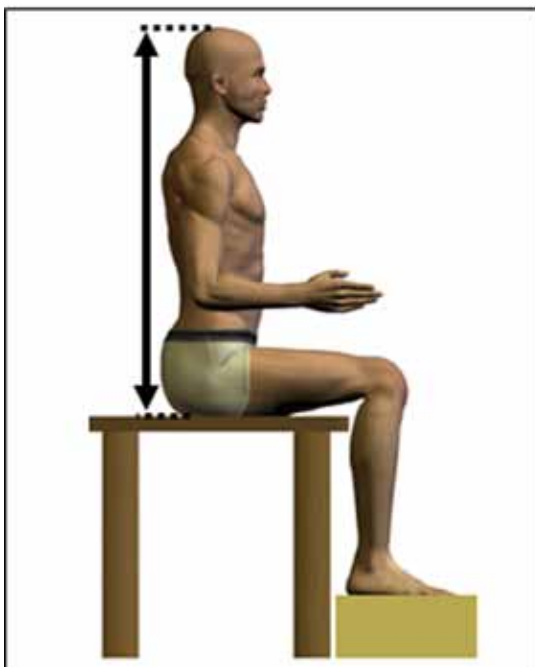
FEMALES		PERCENTILES	MALES	
CM	INCHES		CM	INCHES
77.20	30.39	1ST	83.92	33.04
77.50	30.51	2ND	84.50	33.27
78.20	30.79	3RD	85.20	33.54
80.35	31.63	5TH	85.82	33.79
82.20	32.36	10TH	87.10	34.29
82.60	32.52	15TH	88.00	34.65
83.50	32.87	20TH	88.70	34.92
84.20	33.15	25TH	89.40	35.20
84.80	33.39	30TH	89.90	35.39
85.30	33.58	35TH	90.33	35.56
85.60	33.70	40TH	90.90	35.79
86.10	33.90	45TH	91.40	35.98
86.40	34.02	50TH	91.90	36.18
86.70	34.13	55TH	92.30	36.34
87.10	34.29	60TH	92.90	36.57
87.70	34.53	65TH	93.30	36.73
88.10	34.69	70TH	93.70	36.89
88.50	34.84	75TH	94.40	37.17
89.00	35.04	80TH	95.00	37.40
89.90	35.39	85TH	95.60	37.64
90.60	35.67	90TH	96.50	37.99
92.20	36.30	95TH	97.80	38.50
93.10	36.65	97TH	98.37	38.73
94.00	37.01	98TH	99.30	39.09
94.60	37.24	99TH	100.31	39.49

(27) SITTING HEIGHT

FEMALES		
CM		**INCHES**
86.31	MEAN	33.98
0.27	SE (MEAN)	0.11
3.55	STD. DEVIATION	1.40
0.19	SE (STD.DEV)	0.07
76.90	MINIMUM	30.28
97.10	MAXIMUM	38.23
	SKEWNESS	-0.13
	KURTOSIS	0.35
	COEF VAR	4.11%
	N	171

MALES		
CM		**INCHES**
91.85	MEAN	36.16
0.09	SE (MEAN)	0.03
3.61	STD. DEVIATION	1.42
0.06	SE (STD.DEV)	0.02
81.60	MINIMUM	32.13
104.00	MAXIMUM	40.94
	SKEWNESS	0.05
	KURTOSIS	-0.17
	COEF VAR	3.93%
	N	1779

(27) SITTING HEIGHT

				FREQUENCY TABLE				
FEMALES					MALES			
F	FPct	CumF	CumFPct	CENTIMETERS	F	FPct	CumF	CumFPct
1	0.58	1	0.58	76.50 - 77.00				
1	0.58	2	1.17	77.00 - 77.50				
2	1.17	4	2.34	77.50 - 78.00				
1	0.58	5	2.92	78.00 - 78.50				
0	0.00	5	2.92	78.50 - 79.00				
1	0.58	6	3.51	79.00 - 79.50				
1	0.58	7	4.09	79.50 - 80.00				
1	0.58	8	4.68	80.00 - 80.50				
2	1.17	10	5.85	80.50 - 81.00				
2	1.17	12	7.02	81.00 - 81.50				
4	2.34	16	9.36	81.50 - 82.00	1	0.04	1	0.04
7	4.09	23	13.45	82.00 - 82.50	5	0.28	6	0.32
4	2.34	27	15.79	82.50 - 83.00	3	0.19	9	0.51
6	3.51	33	19.30	83.00 - 83.50	1	0.04	10	0.56
8	4.68	41	23.98	83.50 - 84.00	8	0.43	18	0.99
7	4.09	48	28.07	84.00 - 84.50	14	0.79	32	1.78
9	5.26	57	33.33	84.50 - 85.00	13	0.71	45	2.49
7	4.09	64	37.43	85.00 - 85.50	24	1.36	69	3.85
14	8.19	78	45.61	85.50 - 86.00	26	1.48	95	5.33
11	6.43	89	52.05	86.00 - 86.50	33	1.85	128	7.18
9	5.26	98	57.31	86.50 - 87.00	37	2.10	165	9.27
9	5.26	107	62.57	87.00 - 87.50	45	2.52	210	11.79
10	5.85	117	68.42	87.50 - 88.00	55	3.08	265	14.87
10	5.85	127	74.27	88.00 - 88.50	54	3.03	319	17.90
9	5.26	136	79.53	88.50 - 89.00	62	3.48	381	21.37
5	2.92	141	82.46	89.00 - 89.50	67	3.77	448	25.15
7	4.09	148	86.55	89.50 - 90.00	99	5.58	547	30.73
5	2.92	153	89.47	90.00 - 90.50	92	5.16	639	35.89
3	1.75	156	91.23	90.50 - 91.00	78	4.40	717	40.28
4	2.34	160	93.57	91.00 - 91.50	95	5.31	812	45.60
2	1.17	162	94.74	91.50 - 92.00	92	5.17	904	50.76
2	1.17	164	95.91	92.00 - 92.50	98	5.51	1002	56.27
1	0.58	165	96.49	92.50 - 93.00	85	4.80	1087	61.08
2	1.17	167	97.66	93.00 - 93.50	97	5.46	1184	66.53
0	0.00	167	97.66	93.50 - 94.00	87	4.88	1271	71.42
2	1.17	169	98.83	94.00 - 94.50	70	3.95	1341	75.36
1	0.58	170	99.42	94.50 - 95.00	79	4.46	1420	79.82
0	0.00	170	99.42	95.00 - 95.50	74	4.14	1494	83.96
0	0.00	170	99.42	95.50 - 96.00	52	2.95	1546	86.91
0	0.00	170	99.42	96.00 - 96.50	45	2.55	1591	89.45
0	0.00	170	99.42	96.50 - 97.00	47	2.63	1638	92.09
1	0.58	171	100.00	97.00 - 97.50	37	2.10	1675	94.19
				97.50 - 98.00	30	1.69	1705	95.87
				98.00 - 98.50	22	1.23	1727	97.10
				98.50 - 99.00	8	0.46	1735	97.56
				99.00 - 99.50	10	0.56	1745	98.12
				99.50 - 100.00	11	0.64	1756	98.76
				100.00 - 100.50	7	0.41	1763	99.16
				100.50 - 101.00	5	0.26	1768	99.42
				101.00 - 101.50	2	0.11	1770	99.53
				101.50 - 102.00	3	0.15	1773	99.69
				102.00 - 102.50	1	0.04	1774	99.73
				102.50 - 103.00	2	0.11	1776	99.84
				103.00 - 103.50	1	0.07	1777	99.91
				103.50 - 104.00	0	0.00	1777	99.91
				104.00 - 104.50	2	0.09	1779	100.00

(28) STATURE/NO SHOES

The vertical distance from a standing surface to the top of the head is measured with an anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration and with the subject's shoes off.
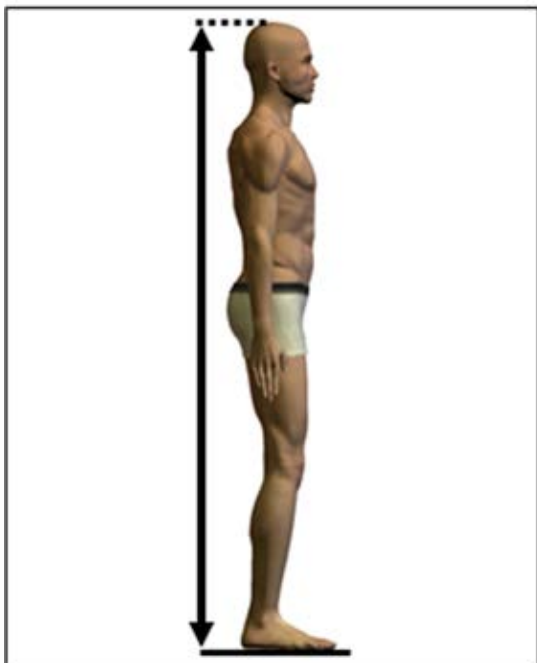
PERCENTILES					
FEMALES				MALES	
CM	INCHES			CM	INCHES
148.30	58.39	1ST		160.30	63.11
150.00	59.06	2ND		161.56	63.61
150.50	59.25	3RD		162.41	63.94
151.00	59.45	5TH		164.50	64.76
153.70	60.51	10TH		166.80	65.67
155.50	61.22	15TH		168.64	66.40
157.00	61.81	20TH		169.80	66.85
157.90	62.17	25TH		171.00	67.32
159.45	62.78	30TH		172.10	67.76
160.10	63.03	35TH		173.00	68.11
160.70	63.27	40TH		173.70	68.39
161.20	63.46	45TH		174.60	68.74
162.10	63.82	50TH		175.50	69.09
163.10	64.21	55TH		176.50	69.49
163.90	64.53	60TH		177.40	69.84
164.90	64.92	65TH		178.40	70.24
165.90	65.31	70TH		179.40	70.63
166.70	65.63	75TH		180.40	71.02
167.80	66.06	80TH		181.56	71.48
169.30	66.65	85TH		183.00	72.05
172.10	67.76	90TH		184.80	72.76
176.30	69.41	95TH		186.90	73.58
176.90	69.65	97TH		189.10	74.45
177.30	69.80	98TH		190.41	74.96
180.00	70.87	99TH		192.60	75.83

(28) STATURE/NO SHOES

FEMALES		
CM		**INCHES**
162.63	MEAN	64.03
0.53	SE (MEAN)	0.21
6.92	STD. DEVIATION	2.72
0.37	SE (STD.DEV)	0.15
146.40	MINIMUM	57.64
181.90	MAXIMUM	71.61
	SKEWNESS	0.28
	KURTOSIS	0.00
	COEF VAR	4.26%
	N	171

MALES		
CM		**INCHES**
175.70	MEAN	69.18
0.16	SE (MEAN)	0.06
6.96	STD. DEVIATION	2.74
0.12	SE (STD.DEV)	0.05
153.90	MINIMUM	60.59
205.00	MAXIMUM	80.71
	SKEWNESS	0.09
	KURTOSIS	0.07
	COEF VAR	3.96%
	N	1779

(28) STATURE/NO SHOES

	FEMALES			FREQUENCY TABLE			MALES			
F	**FPct**	**CumF**	**CumFPct**	**CENTIMETERS**			**F**	**FPct**	**CumF**	**CumFPct**
1	0.58	1	0.58	146.00	-	147.50				
1	0.58	2	1.17	147.50	-	149.00				
2	1.17	4	2.34	149.00	-	150.50				
7	4.09	11	6.43	150.50	-	152.00				
4	2.34	15	8.77	152.00	-	153.50				
7	4.09	22	12.87	153.50	-	155.00	3	0.19	3	0.19
8	4.68	30	17.54	155.00	-	156.50	0	0.00	3	0.19
13	7.60	43	25.15	156.50	-	158.00	5	0.30	8	0.49
9	5.26	52	30.41	158.00	-	159.50	5	0.28	13	0.77
18	10.53	70	40.94	159.50	-	161.00	9	0.48	22	1.25
23	13.45	93	54.39	161.00	-	162.50	31	1.75	53	3.00
13	7.60	106	61.99	162.50	-	164.00	19	1.08	72	4.08
12	7.02	118	69.01	164.00	-	165.50	44	2.47	116	6.55
14	8.19	132	77.19	165.50	-	167.00	68	3.85	184	10.39
10	5.85	142	83.04	167.00	-	168.50	73	4.12	257	14.51
3	1.75	145	84.80	168.50	-	170.00	111	6.23	368	20.74
6	3.51	151	88.30	170.00	-	171.50	107	6.01	475	26.75
5	2.92	156	91.23	171.50	-	173.00	146	8.20	621	34.95
4	2.34	160	93.57	173.00	-	174.50	160	9.00	781	43.94
3	1.75	163	95.32	174.50	-	176.00	157	8.86	938	52.80
5	2.92	168	98.25	176.00	-	177.50	129	7.24	1067	60.04
1	0.58	169	98.83	177.50	-	179.00	144	8.10	1211	68.14
1	0.58	170	99.42	179.00	-	180.50	124	6.94	1335	75.08
1	0.58	171	100.00	180.50	-	182.00	121	6.78	1456	81.86
				182.00	-	183.50	81	4.55	1537	86.41
				183.50	-	185.00	72	4.04	1609	90.44
				185.00	-	186.50	67	3.76	1676	94.20
				186.50	-	188.00	36	2.01	1712	96.22
				188.00	-	189.50	23	1.29	1735	97.51
				189.50	-	191.00	16	0.92	1751	98.43
				191.00	-	192.50	10	0.56	1761	98.99
				192.50	-	194.00	12	0.68	1773	99.66
				194.00	-	195.50	2	0.11	1775	99.77
				195.50	-	197.00	0	0.00	1775	99.77
				197.00	-	198.50	2	0.11	1777	99.89
				198.50	-	200.00	1	0.04	1778	99.93
				200.00	-	201.50	0	0.00	1778	99.93
				201.50	-	203.00	0	0.00	1778	99.93
				203.00	-	204.50	0	0.00	1778	99.93
				204.50	-	206.00	1	0.07	1779	100.00

(29) STATURE WITH SHOES

The vertical distance from a standing surface to the top of the head is measured with an anthropometer. The subject stands erect with heels together and the head in the Frankfort plane. The measurement is taken at the maximum point of quiet respiration with the subject's shoes on.
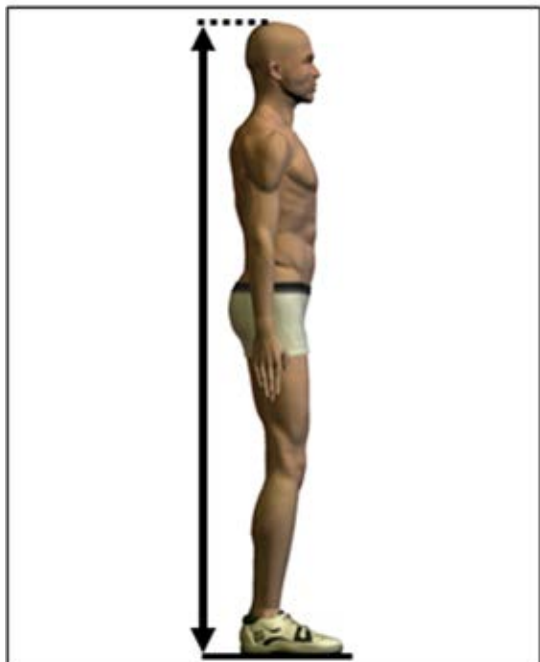
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
150.76	59.35	1ST	163.25	64.27
152.10	59.88	2ND	164.50	64.76
152.40	60.00	3RD	165.50	65.16
153.00	60.24	5TH	167.23	65.84
156.00	61.42	10TH	169.70	66.81
157.90	62.17	15TH	171.30	67.44
159.40	62.76	20TH	172.70	67.99
160.30	63.11	25TH	173.80	68.43
161.30	63.50	30TH	174.80	68.82
162.00	63.78	35TH	175.70	69.17
162.40	63.94	40TH	176.70	69.57
163.00	64.17	45TH	177.60	69.92
163.70	64.45	50TH	178.30	70.20
164.40	64.72	55TH	179.10	70.51
165.74	65.25	60TH	180.20	70.94
166.70	65.63	65TH	181.20	71.34
167.80	66.06	70TH	182.20	71.73
168.60	66.38	75TH	183.30	72.17
170.20	67.01	80TH	184.40	72.60
170.80	67.24	85TH	185.70	73.11
174.20	68.58	90TH	187.70	73.90
178.90	70.43	95TH	190.00	74.80
179.80	70.79	97TH	191.81	75.52
181.50	71.46	98TH	193.40	76.14
184.08	72.47	99TH	195.30	76.89

(29) STATURE WITH SHOES

FEMALES		
__CM__		__INCHES__
164.66	MEAN	64.83
0.61	SE (MEAN)	0.24
7.00	STD. DEVIATION	2.76
0.43	SE (STD.DEV)	0.17
150.50	MINIMUM	59.25
185.00	MAXIMUM	72.83
	SKEWNESS	0.50
	KURTOSIS	0.29
	COEF VAR	4.25%
	N*	130

MALES		
__CM__		__INCHES__
178.54	MEAN	70.29
0.18	SE (MEAN)	0.07
6.99	STD. DEVIATION	2.75
0.13	SE (STD.DEV)	0.05
156.90	MINIMUM	61.77
207.90	MAXIMUM	81.85
	SKEWNESS	0.12
	KURTOSIS	0.10
	COEF VAR	3.91%
	N*	1524

* N was reduced because shoe width was measured only if the individuals were wearing shoes that were normally worn while driving.

(29) STATURE WITH SHOES

				FREQUENCY TABLE					
FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
2	1.54	2	1.54	150.00 - 151.50					
3	2.31	5	3.85	151.50 - 153.00					
3	2.31	8	6.15	153.00 - 154.50					
3	2.31	11	8.46	154.50 - 156.00					
5	3.85	16	12.31	156.00 - 157.50		2	0.11	2	0.11
7	5.38	23	17.69	157.50 - 159.00		2	0.12	4	0.22
11	8.46	34	26.15	159.00 - 160.50		2	0.12	6	0.34
11	8.46	45	34.62	160.50 - 162.00		6	0.38	12	0.73
15	11.54	60	46.15	162.00 - 163.50		6	0.39	18	1.12
14	10.77	74	56.92	163.50 - 165.00		16	1.03	34	2.15
11	8.46	85	65.38	165.00 - 166.50		31	2.03	65	4.18
6	4.62	91	70.00	166.50 - 168.00		30	1.97	95	6.15
9	6.92	100	76.92	168.00 - 169.50		43	2.85	138	9.00
10	7.69	110	84.62	169.50 - 171.00		77	5.07	215	14.07
3	2.31	113	86.92	171.00 - 172.50		81	5.29	296	19.36
2	1.54	115	88.46	172.50 - 174.00		90	5.89	386	25.25
4	3.08	119	91.54	174.00 - 175.50		122	8.00	508	33.24
4	3.08	123	94.62	175.50 - 177.00		119	7.83	627	41.07
0	0.00	123	94.62	177.00 - 178.50		158	10.36	785	51.44
3	2.31	126	96.92	178.50 - 180.00		110	7.22	895	58.65
1	0.77	127	97.69	180.00 - 181.50		118	7.78	1013	66.43
1	0.77	128	98.46	181.50 - 183.00		113	7.40	1126	73.83
1	0.77	129	99.23	183.00 - 184.50		95	6.26	1221	80.09
1	0.77	130	100.00	184.50 - 186.00		83	5.48	1304	85.57
				186.00 - 187.50		61	4.03	1365	89.60
				187.50 - 189.00		46	3.04	1411	92.64
				189.00 - 190.50		51	3.33	1462	95.97
				190.50 - 192.00		17	1.09	1479	97.06
				192.00 - 193.50		15	1.01	1494	98.07
				193.50 - 195.00		11	0.69	1505	98.76
				195.00 - 196.50		8	0.55	1513	99.31
				196.50 - 198.00		7	0.43	1520	99.74
				198.00 - 199.50		0	0.00	1520	99.74
				199.50 - 201.00		2	0.13	1522	99.87
				201.00 - 202.50		1	0.05	1523	99.92
				202.50 - 204.00		0	0.00	1523	99.92
				204.00 - 205.50		0	0.00	1523	99.92
				205.50 - 207.00		0	0.00	1523	99.92
				207.00 - 208.50		1	0.08	1524	100.00

(30) THIGH CIRCUMFERENCE

The maximum circumference of the upper leg is measured with a measuring tape perpendicular to the long axis of the leg. The subject stands erect with the head in the Frankfort plane.

PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
51.20	20.18	1ST	49.96	19.67
55.00	21.65	2ND	51.40	20.24
55.30	21.77	3RD	52.50	20.67
56.00	22.05	5TH	53.50	21.06
57.60	22.68	10TH	55.50	21.85
58.90	23.19	15TH	56.80	22.36
60.10	23.66	20TH	57.71	22.72
61.00	24.01	25TH	58.60	23.07
61.90	24.37	30TH	59.50	23.43
62.70	24.69	35TH	60.20	23.70
64.00	25.20	40TH	61.00	24.02
64.80	25.51	45TH	61.90	24.37
66.50	26.18	50TH	62.80	24.72
67.30	26.50	55TH	63.50	25.00
68.90	27.13	60TH	64.30	25.31
70.30	27.68	65TH	65.33	25.72
71.50	28.15	70TH	66.45	26.16
73.20	28.82	75TH	67.40	26.54
74.20	29.21	80TH	68.56	26.99
75.80	29.84	85TH	70.19	27.63
77.50	30.51	90TH	72.48	28.53
79.80	31.42	95TH	76.40	30.08
81.90	32.24	97TH	78.90	31.06
83.05	32.70	98TH	80.98	31.88
87.50	34.45	99TH	82.96	32.66

(30) THIGH CIRCUMFERENCE

FEMALES		
CM		**INCHES**
67.05	MEAN	26.40
0.60	SE (MEAN)	0.24
7.87	STD. DEVIATION	3.10
0.43	SE (STD.DEV)	0.17
47.60	MINIMUM	18.74
90.30	MAXIMUM	35.55
	SKEWNESS	0.33
	KURTOSIS	-0.32
	COEF VAR	11.74%
	N	171

MALES		
CM		**INCHES**
63.46	MEAN	24.98
0.17	SE (MEAN)	0.07
6.99	STD. DEVIATION	2.75
0.12	SE (STD.DEV)	0.05
45.40	MINIMUM	17.87
105.00	MAXIMUM	41.34
	SKEWNESS	0.82
	KURTOSIS	1.61
	COEF VAR	11.02%
	N	1779

(30) THIGH CIRCUMFERENCE

				FREQUENCY TABLE					
	FEMALES						**MALES**		
F	**FPct**	**CumF**	**CumFPct**	**CENTIMETERS**		**F**	**FPct**	**CumF**	**CumFPct**
				45.25 - 46.75		3	0.14	3	0.14
1	0.58	1	0.58	46.75 - 48.25		2	0.12	5	0.26
0	0.00	1	0.58	48.25 - 49.75		11	0.62	16	0.89
1	0.58	2	1.17	49.75 - 51.25		16	0.90	32	1.79
0	0.00	2	1.17	51.25 - 52.75		28	1.59	60	3.38
1	0.58	3	1.75	52.75 - 54.25		59	3.32	119	6.70
6	3.51	9	5.26	54.25 - 55.75		69	3.91	188	10.61
9	5.26	18	10.53	55.75 - 57.25		121	6.78	309	17.39
9	5.26	27	15.79	57.25 - 58.75		156	8.77	465	26.16
12	7.02	39	22.81	58.75 - 60.25		168	9.47	633	35.62
14	8.19	53	30.99	60.25 - 61.75		149	8.35	782	43.97
12	7.02	65	38.01	61.75 - 63.25		161	9.07	943	53.04
13	7.60	78	45.61	63.25 - 64.75		171	9.62	1114	62.66
7	4.09	85	49.71	64.75 - 66.25		120	6.75	1234	69.41
11	6.43	96	56.14	66.25 - 67.75		133	7.49	1367	76.90
9	5.26	105	61.40	67.75 - 69.25		96	5.41	1463	82.31
11	6.43	116	67.84	69.25 - 70.75		68	3.80	1531	86.11
6	3.51	122	71.35	70.75 - 72.25		64	3.61	1595	89.72
9	5.26	131	76.61	72.25 - 73.75		39	2.18	1634	91.90
11	6.43	142	83.04	73.75 - 75.25		40	2.22	1674	94.12
8	4.68	150	87.72	75.25 - 76.75		24	1.32	1698	95.45
4	2.34	154	90.06	76.75 - 78.25		20	1.13	1718	96.57
7	4.09	161	94.15	78.25 - 79.75		14	0.81	1732	97.39
2	1.17	163	95.32	79.75 - 81.25		12	0.69	1744	98.07
3	1.75	166	97.08	81.25 - 82.75		16	0.91	1760	98.98
2	1.17	168	98.25	82.75 - 84.25		3	0.18	1763	99.16
1	0.58	169	98.83	84.25 - 85.75		3	0.16	1766	99.32
0	0.00	169	98.83	85.75 - 87.25		3	0.15	1769	99.48
1	0.58	170	99.42	87.25 - 88.75		3	0.19	1772	99.66
0	0.00	170	99.42	88.75 - 90.25		3	0.15	1775	99.81
1	0.58	171	100.00	90.25 - 91.75		0	0.00	1775	99.81
				91.75 - 93.25		0	0.00	1775	99.81
				93.25 - 94.75		1	0.05	1776	99.86
				94.75 - 96.25		1	0.05	1777	99.91
				96.25 - 97.75		0	0.00	1777	99.91
				97.75 - 99.25		0	0.00	1777	99.91
				99.25 - 100.75		1	0.04	1778	99.96
				100.75 - 102.25		0	0.00	1778	99.96
				102.25 - 103.75		0	0.00	1778	99.96
				103.75 - 105.25		1	0.04	1779	100.00

(31) THIGH CLEARANCE

The vertical distance from the sitting surface to the highest point of the thigh is measured with an anthropometer. The subject sits erect with the thighs parallel, the feet in line with the thighs, and with the knees flexed 90 degrees.
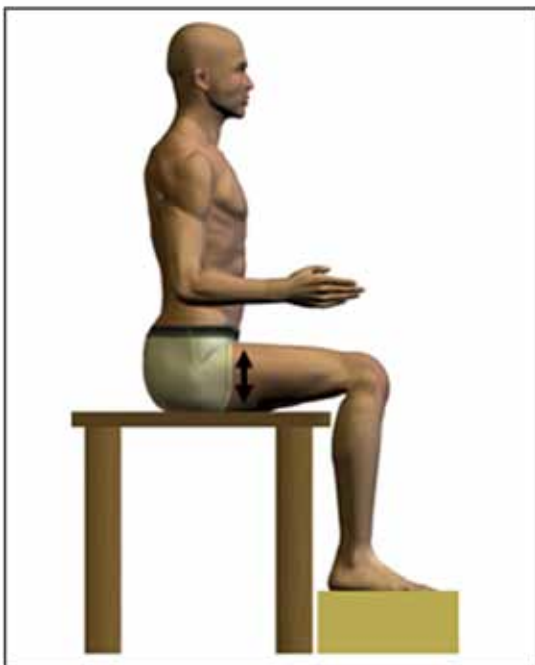
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
13.20	5.20	1ST	14.30	5.63
13.30	5.24	2ND	14.60	5.75
13.50	5.31	3RD	14.80	5.83
14.30	5.63	5TH	15.20	5.98
14.70	5.79	10TH	15.70	6.18
15.20	5.98	15TH	16.10	6.34
15.60	6.14	20TH	16.40	6.46
15.70	6.18	25TH	16.70	6.57
16.00	6.30	30TH	17.00	6.69
16.10	6.34	35TH	17.30	6.81
16.40	6.46	40TH	17.40	6.85
16.60	6.54	45TH	17.62	6.94
17.10	6.73	50TH	17.90	7.05
17.50	6.89	55TH	18.10	7.13
17.80	7.01	60TH	18.40	7.24
18.30	7.20	65TH	18.70	7.36
18.70	7.36	70TH	19.00	7.48
19.00	7.48	75TH	19.30	7.60
19.30	7.60	80TH	19.60	7.72
19.80	7.80	85TH	20.20	7.95
20.40	8.03	90TH	20.70	8.15
21.20	8.35	95TH	21.60	8.50
21.70	8.54	97TH	22.30	8.78
21.80	8.58	98TH	22.71	8.94
23.50	9.25	99TH	23.45	9.23

(31) THIGH CLEARANCE

FEMALES		
CM		**INCHES**
17.37	MEAN	6.84
0.17	SE (MEAN)	0.07
2.23	STD. DEVIATION	0.88
0.12	SE (STD.DEV)	0.05
12.20	MINIMUM	4.80
25.20	MAXIMUM	9.92
	SKEWNESS	0.45
	KURTOSIS	-0.02
	COEF VAR	12.84%
	N	171

MALES		
CM		**INCHES**
18.09	MEAN	7.12
0.05	SE (MEAN)	0.02
1.97	STD. DEVIATION	0.78
0.03	SE (STD.DEV)	0.01
13.20	MINIMUM	5.20
26.80	MAXIMUM	10.55
	SKEWNESS	0.60
	KURTOSIS	0.65
	COEF VAR	10.90%
	N	1779

(31) THIGH CLEARANCE

FREQUENCY TABLE

F	FPct	CumF	CumFPct	CENTIMETERS			F	FPct	CumF	CumFPct
		FEMALES							MALES	
1	0.58	1	0.58	12.05	-	12.35				
0	0.00	1	0.58	12.35	-	12.65				
0	0.00	1	0.58	12.65	-	12.95				
2	1.17	3	1.75	12.95	-	13.25	1	0.04	1	0.04
2	1.17	5	2.92	13.25	-	13.55	1	0.04	2	0.08
2	1.17	7	4.09	13.55	-	13.85	5	0.32	7	0.40
1	0.58	8	4.68	13.85	-	14.15	6	0.33	13	0.73
5	2.92	13	7.60	14.15	-	14.45	13	0.76	26	1.50
5	2.92	18	10.53	14.45	-	14.75	20	1.14	46	2.63
7	4.09	25	14.62	14.75	-	15.05	28	1.55	74	4.19
6	3.51	31	18.13	15.05	-	15.35	39	2.18	113	6.36
10	5.85	41	23.98	15.35	-	15.65	51	2.87	164	9.24
10	5.85	51	29.82	15.65	-	15.95	56	3.14	220	12.37
15	8.77	66	38.60	15.95	-	16.25	75	4.20	295	16.58
10	5.85	76	44.44	16.25	-	16.55	105	5.90	400	22.48
5	2.92	81	47.37	16.55	-	16.85	92	5.15	492	27.63
6	3.51	87	50.88	16.85	-	17.15	93	5.25	585	32.88
6	3.51	93	54.39	17.15	-	17.45	133	7.47	718	40.35
8	4.68	101	59.06	17.45	-	17.75	129	7.24	847	47.60
4	2.34	105	61.40	17.75	-	18.05	106	5.99	953	53.58
9	5.26	114	66.67	18.05	-	18.35	109	6.13	1062	59.71
5	2.92	119	69.59	18.35	-	18.65	84	4.73	1146	64.44
6	3.51	125	73.10	18.65	-	18.95	90	5.05	1236	69.50
9	5.26	134	78.36	18.95	-	19.25	92	5.19	1328	74.68
5	2.92	139	81.29	19.25	-	19.55	86	4.83	1414	79.51
8	4.68	147	85.96	19.55	-	19.85	57	3.23	1471	82.75
4	2.34	151	88.30	19.85	-	20.15	38	2.13	1509	84.88
4	2.34	155	90.64	20.15	-	20.45	56	3.18	1565	88.06
4	2.34	159	92.98	20.45	-	20.75	40	2.24	1605	90.30
2	1.17	161	94.15	20.75	-	21.05	33	1.85	1638	92.15
2	1.17	163	95.32	21.05	-	21.35	31	1.74	1669	93.89
2	1.17	165	96.49	21.35	-	21.65	22	1.24	1691	95.13
2	1.17	167	97.66	21.65	-	21.95	15	0.83	1706	95.96
1	0.58	168	98.25	21.95	-	22.25	17	0.94	1723	96.90
0	0.00	168	98.25	22.25	-	22.55	14	0.79	1737	97.68
0	0.00	168	98.25	22.55	-	22.85	12	0.70	1749	98.38
1	0.58	169	98.83	22.85	-	23.15	6	0.32	1755	98.70
0	0.00	169	98.83	23.15	-	23.45	6	0.33	1761	99.03
1	0.58	170	99.42	23.45	-	23.75	5	0.27	1766	99.30
0	0.00	170	99.42	23.75	-	24.05	2	0.11	1768	99.41
0	0.00	170	99.42	24.05	-	24.35	0	0.00	1768	99.41
0	0.00	170	99.42	24.35	-	24.65	2	0.10	1770	99.51
0	0.00	170	99.42	24.65	-	24.95	2	0.14	1772	99.65
1	0.58	171	100.00	24.95	-	25.25	2	0.12	1774	99.77
				25.25	-	25.55	1	0.05	1775	99.82
				25.55	-	25.85	1	0.04	1776	99.86
				25.85	-	26.15	0	0.00	1776	99.41
				26.15	-	26.45	0	0.00	1776	99.41
				26.45	-	26.75	2	0.09	1778	99.96
				26.75	-	27.05	1	0.04	1779	100.00

(32) THUMBTIP REACH

The distance between the surface of the back and the tip of the right thumb is measured with a beam caliper. The subject sits erect with both arms raised horizontally forward, the elbows straight, and the thumbs on top.
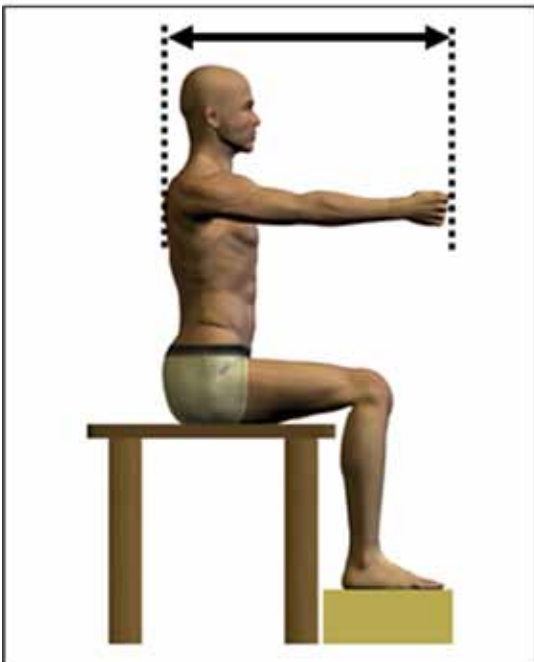
PERCENTILES				
FEMALES			MALES	
CM	INCHES		CM	INCHES
69.80	27.48	1ST	74.42	29.30
70.50	27.76	2ND	75.40	29.69
71.10	27.99	3RD	76.08	29.95
71.60	28.19	5TH	77.10	30.35
72.90	28.70	10TH	78.40	30.87
73.50	28.94	15TH	79.30	31.22
73.80	29.06	20TH	80.00	31.50
74.20	29.21	25TH	80.70	31.77
74.90	29.49	30TH	81.20	31.97
75.10	29.57	35TH	81.70	32.17
75.60	29.76	40TH	82.10	32.32
76.50	30.12	45TH	82.70	32.56
77.00	30.31	50TH	83.10	32.72
77.50	30.51	55TH	83.60	32.91
78.20	30.79	60TH	84.10	33.11
78.50	30.91	65TH	84.70	33.35
79.00	31.10	70TH	85.20	33.54
79.60	31.34	75TH	85.80	33.78
80.00	31.50	80TH	86.60	34.09
80.60	31.73	85TH	87.30	34.37
81.70	32.17	90TH	88.40	34.80
84.50	33.27	95TH	90.20	35.51
84.90	33.43	97TH	91.20	35.91
85.00	33.46	98TH	91.98	36.21
85.00	33.46	99TH	93.16	36.68

(32) THUMBTIP REACH

FEMALES		
__CM__		__INCHES__
77.10	MEAN	30.35
0.27	SE (MEAN)	0.11
3.59	STD. DEVIATION	1.41
0.19	SE (STD.DEV)	0.07
68.20	MINIMUM	26.85
86.50	MAXIMUM	34.06
	SKEWNESS	0.25
	KURTOSIS	-0.35
	COEF VAR	4.66%
	N	171

MALES		
__CM__		__INCHES__
83.28	MEAN	32.79
0.09	SE (MEAN)	0.04
3.94	STD. DEVIATION	1.55
0.07	SE (STD.DEV)	0.03
68.50	MINIMUM	26.97
95.20	MAXIMUM	37.48
	SKEWNESS	0.14
	KURTOSIS	0.09
	COEF VAR	4.73%
	N	1778

(32) THUMBTIP REACH

				FREQUENCY TABLE					
	FEMALES						MALES		
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
2	1.17	2	1.17	68.00	-	68.50				
0	0.00	2	1.17	68.50	-	69.00	1	0.07	1	0.07
0	0.00	2	1.17	69.00	-	69.50	0	0.00	1	0.07
1	0.58	3	1.75	69.50	-	70.00	0	0.00	1	0.07
0	0.00	3	1.75	70.00	-	70.50	0	0.00	1	0.07
2	1.17	5	2.92	70.50	-	71.00	0	0.00	1	0.07
1	0.58	6	3.51	71.00	-	71.50	0	0.00	1	0.07
3	1.75	9	5.26	71.50	-	72.00	0	0.00	1	0.07
6	3.51	15	8.77	72.00	-	72.50	1	0.04	2	0.11
6	3.51	21	12.28	72.50	-	73.00	2	0.09	4	0.20
6	3.51	27	15.79	73.00	-	73.50	4	0.20	8	0.41
12	7.02	39	22.81	73.50	-	74.00	4	0.23	12	0.63
12	7.02	51	29.82	74.00	-	74.50	6	0.33	18	0.97
6	3.51	57	33.33	74.50	-	75.00	13	0.74	31	1.71
10	5.85	67	39.18	75.00	-	75.50	6	0.33	37	2.03
6	3.51	73	42.69	75.50	-	76.00	13	0.70	50	2.74
6	3.51	79	46.20	76.00	-	76.50	20	1.10	70	3.84
8	4.68	87	50.88	76.50	-	77.00	16	0.89	86	4.73
8	4.68	95	55.56	77.00	-	77.50	20	1.14	106	5.87
6	3.51	101	59.06	77.50	-	78.00	42	2.36	148	8.23
9	5.26	110	64.33	78.00	-	78.50	36	2.05	184	10.28
9	5.26	119	69.59	78.50	-	79.00	42	2.39	226	12.67
7	4.09	126	73.68	79.00	-	79.50	65	3.67	291	16.34
9	5.26	135	78.95	79.50	-	80.00	56	3.14	347	19.48
5	2.92	140	81.87	80.00	-	80.50	58	3.26	405	22.73
7	4.09	147	85.96	80.50	-	81.00	89	5.00	494	27.73
5	2.92	152	88.89	81.00	-	81.50	91	5.15	585	32.88
1	0.58	153	89.47	81.50	-	82.00	74	4.19	659	37.07
3	1.75	156	91.23	82.00	-	82.50	99	5.58	758	42.65
2	1.17	158	92.40	82.50	-	83.00	92	5.19	850	47.83
2	1.17	160	93.57	83.00	-	83.50	94	5.30	944	53.13
1	0.58	161	94.15	83.50	-	84.00	93	5.25	1037	58.38
1	0.58	162	94.74	84.00	-	84.50	82	4.63	1119	63.01
4	2.34	166	97.08	84.50	-	85.00	76	4.26	1195	67.27
3	1.75	169	98.83	85.00	-	85.50	86	4.83	1281	72.09
1	0.58	170	99.42	85.50	-	86.00	70	3.96	1351	76.06
0	0.00	170	99.42	86.00	-	86.50	57	3.18	1408	79.24
1	0.58	171	100.00	86.50	-	87.00	57	3.21	1465	82.45
				87.00	-	87.50	64	3.61	1529	86.07
				87.50	-	88.00	36	2.00	1565	88.06
				88.00	-	88.50	44	2.46	1609	90.52
				88.50	-	89.00	29	1.63	1638	92.15
				89.00	-	89.50	29	1.62	1667	93.77
				89.50	-	90.00	15	0.84	1682	94.61
				90.00	-	90.50	17	0.93	1699	95.54
				90.50	-	91.00	21	1.19	1720	96.74
				91.00	-	91.50	13	0.73	1733	97.46
				91.50	-	92.00	10	0.54	1743	98.00
				92.00	-	92.50	7	0.40	1750	98.40
				92.50	-	93.00	9	0.50	1759	98.90
				93.00	-	93.50	6	0.35	1765	99.25
				93.50	-	94.00	3	0.18	1768	99.43
				94.00	-	94.50	2	0.11	1770	99.55
				94.50	-	95.00	4	0.25	1774	99.80
				95.00	-	95.50	4	0.20	1778	100.00

(33) UPPER ARM CIRCUMFERENCE

The circumference of the upper arm at the biceps point (relaxed), located one-half the distance between acromion and the elbow crease, is measured with a measuring tape perpendicular to the long axis of the upper arm. The subject stands erect with the head in the Frankfort plane.

PERCENTILES				
FEMALES			**MALES**	
CM	**INCHES**		**CM**	**INCHES**
24.90	9.80	1ST	27.04	10.65
26.80	10.55	2ND	28.52	11.23
26.90	10.59	3RD	29.50	11.61
27.80	10.94	5TH	30.50	12.01
29.00	11.42	10TH	31.80	12.52
30.20	11.89	15TH	32.40	12.76
31.10	12.24	20TH	33.00	12.99
31.50	12.40	25TH	33.60	13.23
32.20	12.68	30TH	34.20	13.46
33.00	12.99	35TH	34.73	13.67
33.80	13.31	40TH	35.30	13.90
34.10	13.43	45TH	35.70	14.06
34.50	13.58	50TH	36.20	14.25
34.90	13.74	55TH	36.70	14.45
36.00	14.17	60TH	37.20	14.65
37.00	14.57	65TH	37.70	14.84
37.80	14.88	70TH	38.20	15.04
38.80	15.28	75TH	39.00	15.35
39.80	15.67	80TH	39.80	15.67
40.50	15.94	85TH	40.50	15.94
42.00	16.54	90TH	41.60	16.38
45.30	17.83	95TH	43.60	17.17
45.90	18.07	97TH	45.05	17.74
46.20	18.19	98TH	46.00	18.11
48.30	19.02	99TH	47.33	18.63

(33) UPPER ARM CIRCUMFERENCE

FEMALES		
CM		**INCHES**
35.29	MEAN	13.89
0.39	SE (MEAN)	0.15
5.11	STD. DEVIATION	2.01
0.27	SE (STD.DEV)	0.11
23.10	MINIMUM	9.09
50.30	MAXIMUM	19.80
	SKEWNESS	0.43
	KURTOSIS	0.02
	COEF VAR	14.48%
	N	171

MALES		
CM		**INCHES**
36.48	MEAN	14.36
0.10	SE (MEAN)	0.04
4.10	STD. DEVIATION	1.61
0.07	SE (STD.DEV)	0.03
24.30	MINIMUM	9.57
60.20	MAXIMUM	23.70
	SKEWNESS	0.48
	KURTOSIS	1.06
	COEF VAR	11.23%
	N	1779

(33) UPPER ARM CIRCUMFERENCE

	FEMALES				FREQUENCY TABLE			MALES		
F	**FPct**	**CumF**	**CumFPct**		**CENTIMETERS**		**F**	**FPct**	**CumF**	**CumFPct**
1	0.58	1	0.58	23.00	-	24.00				
1	0.58	2	1.17	24.00	-	25.00	3	0.14	3	0.14
1	0.58	3	1.75	25.00	-	26.00	4	0.25	7	0.39
2	1.17	5	2.92	26.00	-	27.00	7	0.38	14	0.77
5	2.92	10	5.85	27.00	-	28.00	12	0.66	26	1.43
5	2.92	15	8.77	28.00	-	29.00	14	0.81	40	2.24
8	4.68	23	13.45	29.00	-	30.00	26	1.43	66	3.67
9	5.26	32	18.71	30.00	-	31.00	45	2.52	111	6.19
15	8.77	47	27.49	31.00	-	32.00	88	4.97	199	11.16
15	8.77	62	36.26	32.00	-	33.00	140	7.88	339	19.04
14	8.19	76	44.44	33.00	-	34.00	149	8.39	488	27.43
19	11.11	95	55.56	34.00	-	35.00	166	9.35	654	36.77
8	4.68	103	60.23	35.00	-	36.00	192	10.79	846	47.56
9	5.26	112	65.50	36.00	-	37.00	187	10.52	1033	58.09
9	5.26	121	70.76	37.00	-	38.00	157	8.80	1190	66.88
8	4.68	129	75.44	38.00	-	39.00	140	7.86	1330	74.74
10	5.85	139	81.29	39.00	-	40.00	106	5.98	1436	80.73
13	7.60	152	88.89	40.00	-	41.00	107	6.04	1543	86.77
3	1.75	155	90.64	41.00	-	42.00	81	4.56	1624	91.32
3	1.75	158	92.40	42.00	-	43.00	36	2.02	1660	93.34
2	1.17	160	93.57	43.00	-	44.00	37	2.05	1697	95.39
2	1.17	162	94.74	44.00	-	45.00	26	1.45	1723	96.84
5	2.92	167	97.66	45.00	-	46.00	20	1.15	1743	97.99
1	0.58	168	98.25	46.00	-	47.00	14	0.81	1757	98.80
0	0.00	168	98.25	47.00	-	48.00	11	0.63	1768	99.43
1	0.58	169	98.83	48.00	-	49.00	2	0.13	1770	99.56
1	0.58	170	99.42	49.00	-	50.00	3	0.17	1773	99.73
1	0.58	171	100.00	50.00	-	51.00	1	0.04	1774	99.77
				51.00	-	52.00	0	0.00	1774	99.77
				52.00	-	53.00	2	0.09	1776	99.86
				53.00	-	54.00	0	0.00	1776	99.86
				54.00	-	55.00	1	0.05	1777	99.91
				55.00	-	56.00	0	0.00	1777	99.91
				56.00	-	57.00	1	0.04	1778	99.96
				57.00	-	58.00	0	0.00	1778	99.96
				58.00	-	59.00	0	0.00	1778	99.96
				59.00	-	60.00	0	0.00	1778	99.96
				60.00	-	61.00	1	0.04	1779	100.00

(34) WAIST CIRCUMFERENCE (Natural Indentation)

The horizontal circumference at the level of greatest indentation of the torso is measured with a measuring tape. The subject stands erect looking forward with heels together and the shoulders and arms relaxed. The measurement is made at the maximum point of quiet respiration.
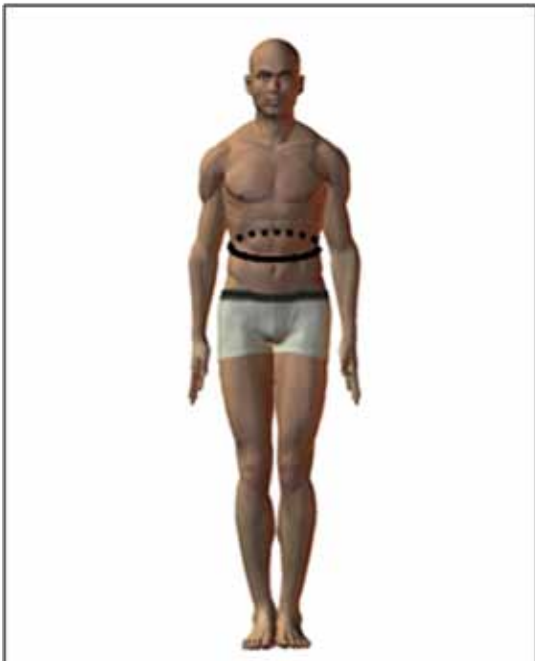
FEMALES			MALES	
CM	**INCHES**		**CM**	**INCHES**
72.00	28.35	1ST	77.10	30.35
72.90	28.70	2ND	80.62	31.74
74.60	29.37	3RD	83.20	32.76
78.70	30.98	5TH	85.56	33.69
82.00	32.28	10TH	90.46	35.61
84.40	33.23	15TH	93.40	36.77
88.10	34.69	20TH	96.10	37.84
90.30	35.55	25TH	98.33	38.71
94.50	37.20	30TH	100.20	39.45
95.70	37.68	35TH	101.84	40.10
97.80	38.50	40TH	103.80	40.87
99.52	39.18	45TH	105.60	41.57
104.00	40.94	50TH	107.40	42.28
105.40	41.50	55TH	109.20	42.99
106.40	41.89	60TH	111.28	43.81
108.20	42.60	65TH	113.30	44.61
109.60	43.15	70TH	115.80	45.59
111.50	43.90	75TH	118.30	46.57
115.50	45.47	80TH	121.19	47.71
117.60	46.30	85TH	125.00	49.21
121.20	47.72	90TH	129.90	51.14
124.90	49.17	95TH	137.14	53.99
127.00	50.00	97TH	141.10	55.55
129.30	50.91	98TH	144.41	56.86
133.90	52.72	99TH	149.30	58.78

PERCENTILES

(34) WAIST CIRCUMFERENCE (Natural Indentation)

FEMALES		
CM		**INCHES**
101.97	MEAN	40.15
1.13	SE (MEAN)	0.44
14.77	STD. DEVIATION	5.81
0.80	SE (STD.DEV)	0.31
66.80	MINIMUM	26.30
142.40	MAXIMUM	56.06
	SKEWNESS	-0.01
	KURTOSIS	-0.51
	COEF VAR	14.48%
	N	171

MALES		
CM		**INCHES**
108.88	MEAN	42.87
0.37	SE (MEAN)	0.14
15.43	STD. DEVIATION	6.08
0.26	SE (STD.DEV)	0.10
69.70	MINIMUM	27.44
168.10	MAXIMUM	66.18
	SKEWNESS	0.48
	KURTOSIS	0.32
	COEF VAR	14.17%
	N	1779

(34) WAIST CIRCUMFERENCE (Natural Indentation)

				FREQUENCY TABLE					
FEMALES						MALES			
F	FPct	CumF	CumFPct	CENTIMETERS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	66.50 - 68.50					
0	0.00	1	0.58	68.50 - 70.50		1	0.07	1	0.07
1	0.58	2	1.17	70.50 - 72.50		4	0.22	5	0.29
2	1.17	4	2.34	72.50 - 74.50		6	0.34	11	0.63
2	1.17	6	3.51	74.50 - 76.50		4	0.24	15	0.87
1	0.58	7	4.09	76.50 - 78.50		8	0.48	23	1.35
6	3.51	13	7.60	78.50 - 80.50		10	0.58	33	1.92
6	3.51	19	11.11	80.50 - 82.50		7	0.37	40	2.30
7	4.09	26	15.20	82.50 - 84.50		29	1.60	69	3.90
7	4.09	33	19.30	84.50 - 86.50		27	1.50	96	5.40
6	3.51	39	22.81	86.50 - 88.50		34	1.91	130	7.31
7	4.09	46	26.90	88.50 - 90.50		47	2.66	177	9.97
1	0.58	47	27.49	90.50 - 92.50		64	3.62	241	13.60
7	4.09	54	31.58	92.50 - 94.50		62	3.47	303	17.06
9	5.26	63	36.84	94.50 - 96.50		65	3.67	368	20.73
9	5.26	72	42.11	96.50 - 98.50		79	4.42	447	25.15
12	7.02	84	49.12	98.50 - 100.50		95	5.32	542	30.47
7	4.09	91	53.22	100.50 - 102.50		99	5.55	641	36.01
6	3.51	97	56.73	102.50 - 104.50		103	5.78	744	41.79
11	6.43	108	63.16	104.50 - 106.50		111	6.25	855	48.04
8	4.68	116	67.84	106.50 - 108.50		95	5.34	950	53.37
11	6.43	127	74.27	108.50 - 110.50		86	4.84	1036	58.21
5	2.92	132	77.19	110.50 - 112.50		87	4.90	1123	63.11
5	2.92	137	80.12	112.50 - 114.50		72	4.02	1195	67.13
4	2.34	141	82.46	114.50 - 116.50		69	3.86	1264	70.99
6	3.51	147	85.96	116.50 - 118.50		79	4.43	1343	75.42
4	2.34	151	88.30	118.50 - 120.50		59	3.33	1402	78.75
6	3.51	157	91.81	120.50 - 122.50		58	3.28	1460	82.03
4	2.34	161	94.15	122.50 - 124.50		46	2.59	1506	84.62
4	2.34	165	96.49	124.50 - 126.50		43	2.41	1549	87.03
2	1.17	167	97.66	126.50 - 128.50		38	2.11	1587	89.14
0	0.00	167	97.66	128.50 - 130.50		25	1.42	1612	90.56
1	0.58	168	98.25	130.50 - 132.50		28	1.60	1640	92.15
2	1.17	170	99.42	132.50 - 134.50		20	1.12	1660	93.28
0	0.00	170	99.42	134.50 - 136.50		22	1.24	1682	94.51
0	0.00	170	99.42	136.50 - 138.50		28	1.58	1710	96.09
0	0.00	170	99.42	138.50 - 140.50		11	0.65	1721	96.74
1	0.58	171	100.00	140.50 - 142.50		14	0.80	1735	97.54
				142.50 - 144.50		9	0.48	1744	98.02
				144.50 - 146.50		12	0.68	1756	98.70
				146.50 - 148.50		2	0.13	1758	98.83
				148.50 - 150.50		4	0.25	1762	99.08
				150.50 - 152.50		2	0.11	1764	99.19
				152.50 - 154.50		3	0.18	1767	99.37
				154.50 - 156.50		2	0.09	1769	99.45
				156.50 - 158.50		4	0.22	1773	99.67
				158.50 - 160.50		1	0.04	1774	99.71
				160.50 - 162.50		1	0.07	1775	99.78
				162.50 - 164.50		2	0.10	1777	99.88
				164.50 - 166.50		1	0.07	1778	99.95
				166.50 - 168.50		1	0.05	1779	100.00

(35) WEIGHT

The subject's weight is measured on a digital scale.

PERCENTILES				
FEMALES			MALES	
KG	LB		KG	LB
54.80	120.81	1ST	60.90	134.26
58.60	129.19	2ND	66.06	145.64
60.50	133.38	3RD	68.08	150.08
62.60	138.00	5TH	72.12	159.00
66.10	145.73	10TH	75.93	167.39
68.50	151.02	15TH	79.80	175.93
71.90	158.51	20TH	83.10	183.20
75.00	165.35	25TH	85.70	188.93
76.90	169.54	30TH	88.00	194.00
80.20	176.81	35TH	90.60	199.74
81.90	180.56	40TH	93.10	205.25
86.30	190.26	45TH	95.60	210.76
88.60	195.33	50TH	98.80	217.81
92.10	203.05	55TH	101.60	223.99
96.10	211.86	60TH	104.20	229.72
98.40	216.93	65TH	107.30	236.55
102.00	224.87	70TH	111.20	245.15
103.90	229.06	75TH	115.40	254.41
107.70	237.44	80TH	120.39	265.42
113.90	251.11	85TH	126.13	278.06
120.10	264.78	90TH	134.60	296.74
126.10	278.00	95TH	146.41	322.78
135.80	299.38	97TH	154.28	340.12
147.30	324.74	98TH	165.98	365.92
157.40	347.01	99TH	175.08	385.98

(35) WEIGHT

FEMALES		
KG		**LB**
91.00	MEAN	200.62
1.62	SE (MEAN)	3.57
21.14	STD. DEVIATION	46.61
1.14	SE (STD.DEV)	2.51
43.00	MINIMUM	94.80
163.40	MAXIMUM	360.23
	SKEWNESS	0.61
	KURTOSIS	0.34
	COEF VAR	23.23%
	N	171

MALES		
KG		**LB**
102.55	MEAN	226.07
0.57	SE (MEAN)	1.25
23.93	STD. DEVIATION	52.75
0.40	SE (STD.DEV)	0.88
52.20	MINIMUM	115.08
263.00	MAXIMUM	579.81
	SKEWNESS	1.10
	KURTOSIS	2.23
	COEF VAR	23.33%
	N	1779

(35) WEIGHT

	FEMALES			FREQUENCY TABLE			MALES		
F	FPct	CumF	CumFPct	KILOGRAMS		F	FPct	CumF	CumFPct
1	0.58	1	0.58	42.00 - 46.00					
0	0.00	1	0.58	46.00 - 50.00					
0	0.00	1	0.58	50.00 - 54.00		1	0.04	1	0.04
1	0.58	2	1.17	54.00 - 58.00		8	0.43	9	0.47
5	2.92	7	4.09	58.00 - 62.00		12	0.66	21	1.13
11	6.43	18	10.53	62.00 - 66.00		14	0.81	35	1.94
11	6.43	29	16.96	66.00 - 70.00		31	1.73	66	3.67
11	6.43	40	23.39	70.00 - 74.00		61	3.42	127	7.09
17	9.94	57	33.33	74.00 - 78.00		89	5.01	216	12.09
16	9.36	73	42.69	78.00 - 82.00		106	5.96	322	18.06
8	4.68	81	47.37	82.00 - 86.00		139	7.80	461	25.86
10	5.85	91	53.22	86.00 - 90.00		140	7.87	601	33.73
15	8.77	106	61.99	90.00 - 94.00		141	7.90	742	41.63
7	4.09	113	66.08	94.00 - 98.00		120	6.75	862	48.38
10	5.85	123	71.93	98.00 - 102.00		135	7.60	997	55.99
11	6.43	134	78.36	102.00 - 106.00		117	6.56	1114	62.55
7	4.09	141	82.46	106.00 - 110.00		108	6.06	1222	68.61
5	2.92	146	85.38	110.00 - 114.00		82	4.63	1304	73.24
7	4.09	153	89.47	114.00 - 118.00		79	4.45	1383	77.68
8	4.68	161	94.15	118.00 - 122.00		66	3.72	1449	81.40
1	0.58	162	94.74	122.00 - 126.00		62	3.48	1511	84.88
2	1.17	164	95.91	126.00 - 130.00		43	2.44	1554	87.32
1	0.58	165	96.49	130.00 - 134.00		44	2.50	1598	89.82
2	1.17	167	97.66	134.00 - 138.00		38	2.15	1636	91.96
0	0.00	167	97.66	138.00 - 142.00		25	1.40	1661	93.36
0	0.00	167	97.66	142.00 - 146.00		26	1.47	1687	94.83
2	1.17	169	98.83	146.00 - 150.00		20	1.14	1707	95.98
0	0.00	169	98.83	150.00 - 154.00		19	1.04	1726	97.02
1	0.58	170	99.42	154.00 - 158.00		5	0.31	1731	97.33
0	0.00	170	99.42	158.00 - 162.00		6	0.35	1737	97.69
1	0.58	171	100.00	162.00 - 166.00		6	0.35	1743	98.03
				166.00 - 170.00		8	0.42	1751	98.46
				170.00 - 174.00		9	0.50	1760	98.96
				174.00 - 178.00		4	0.24	1764	99.20
				178.00 - 182.00		1	0.06	1765	99.27
				182.00 - 186.00		0	0.00	1765	99.27
				186.00 - 190.00		2	0.09	1767	99.36
				190.00 - 194.00		2	0.11	1769	99.47
				194.00 - 198.00		1	0.07	1770	99.54
				198.00 - 202.00		4	0.22	1774	99.76
				202.00 - 206.00		1	0.04	1775	99.81
				206.00 - 210.00		3	0.15	1778	99.96
				210.00 - 214.00		0	0.00	1778	99.96
				214.00 - 218.00		0	0.00	1778	99.96
				218.00 - 222.00		0	0.00	1778	99.96
				222.00 - 226.00		0	0.00	1778	99.96
				226.00 - 230.00		0	0.00	1778	99.96
				230.00 - 234.00		0	0.00	1778	99.96
				234.00 - 238.00		0	0.00	1778	99.96
				238.00 - 242.00		0	0.00	1778	99.96
				242.00 - 246.00		0	0.00	1778	99.96
				246.00 - 250.00		0	0.00	1778	99.96
				250.00 - 254.00		0	0.00	1778	99.96
				254.00 - 258.00		0	0.00	1778	99.96
				258.00 - 262.00		0	0.00	1778	99.96
				262.00 - 266.00		1	0.04	1779	100.00

MULTIVARIATE ACCOMMODATION MODELS

In recent years, major truck manufacturers in the United States and other countries have begun a transition from using the traditional percentile approach toward using the multivariate accommodation model (MAM) approach in cab design. The 5th–95th percentile approach has been criticized for the decrease in accommodation when two or more dimensions are involved in a design [Zehner et al., 1993] and for its inability to generate biofidelitic models [Robinette & McConville, 1981]. The MAM approach offers a superior solution to the workstation design because of its ability to circumvent both problems. The MAM uses principal component analysis (PCA) to reduce a large number of body dimensions to a smaller number (e.g., two or three) of variables or principal components (PCs). These PCs approximate an ellipse or ellipsoid in distribution, which enable designers to select the desired level (e.g., 95%) of accommodation for the user population. Then, a small set of body models can be identified on the boundary of the ellipse or on the surface of the ellipsoid. This cadre of body models is comprised of not only the overall large or small individuals, but also individuals of different body configurations [Zehner et al., 1993]. Designers may rely on these more realistic multivariate body models, instead of the traditional percentile values, in cab design.

Method

The MAM method started with a PCA procedure run by SAS (Version 9 series, SAS Institute, SAS Campus Drive, Cary, NC) to reduce a set of 12 dimensions to a smaller and more manageable number of variables or principal components (PCs). The selection of the 12 dimensions was based on their utility in facilitating cab designs. In the present study, a decision was made to use the first three PCs to define body models based on a scree plot. These three PCs were found to account for 87%–88% of the total variance.

Although the PCA does not require a multivariate normality assumption, PCs derived for multivariate normal populations would ensure a constant-density ellipsoid (Johnson & Wichern, 2007). Accuracy of body model selection relies on the ellipsoid of constant density. The multivariate normal distribution was checked by inspecting Q-Q plots along with Kolmogorov-Smirnov test for males (large sample) and Shairo-Wilk test for females (small sample). Kolmogorov-Smirnov test showed that PC2 and PC3 did not meet the normality assumption ($p < 0.01$) in the male sample. As a result, The 12 original variables were first transformed by natural log and one participant (Number 488) was removed as an outlier before the PCA procedure was applied. On the other hand, the female sample was able to meet the normality assumption without any transformation after just four participants (Numbers 408, 750, 1172, and 1529) were removed from the dataset. The Shapiro-Wilk test showed a p-value of 0.33, 0.26, and 0.33 for PC1, PC2, and PC3, respectively.

By definition, the PCs are orthogonal to one another and their distributions can be described as approximating an ellipse or ellipsoid. Then, the desired level of accommodation (e.g., 95%) can be selected by determining the appropriate confidence level in an ellipse or ellipsoid [Zehner et. al., 1993]. In this study, we used the Bonferroni method to determine the 95% enclosure [Johnson & Wichern, 2007]. Since the three PCs were standardized to z-scores, we were able to apply a single radius value (RAD = 2.40 for males and RAD = 2.42 for females) for selecting 95% of the data points in the enclosure.

Once the 95% enclosure criterion was determined, the next step was to identify the 14 models (6 intercepts, 8 octant midpoints) on the surface of the ellipsoid. The six intercept points were obtained on the ellipsoid surface where the three axes intercept. In addition, each of the eight octant midpoints was located at the surface center

of each of eight sections (octants) divided by the three axes of this ellipsoid. These 14 points (8 octant points and 6 intercept points), along with the centroid of ellipsoid, were the basis for the selection of the anthropometric models (Figure 8).
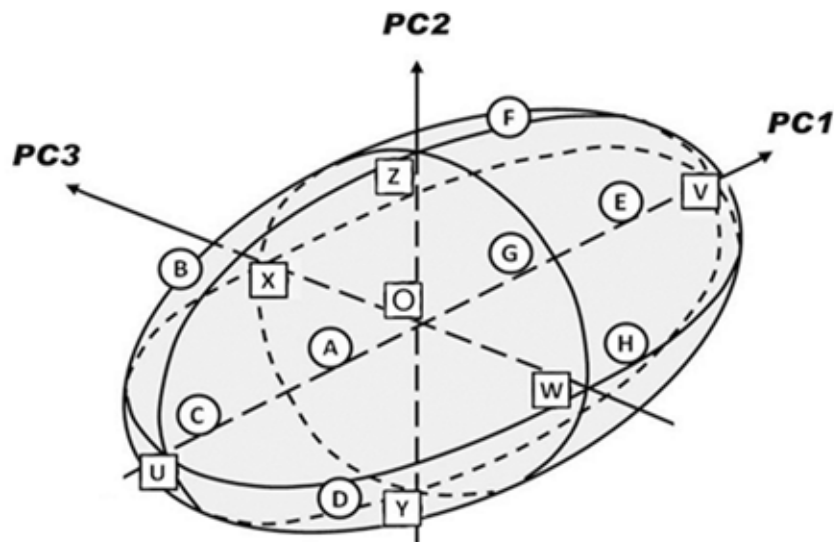
FIGURE 8.
The centroid, intercept points (square) and octant midpoints (circle) of a 95% enclosure ellipsoid.

The corresponding 12 anthropometric values of these 14 models can be calculated first by linearly transforming the coordinates of the models scaled by the Bonferroni factor and making use of the reduced matrices of the eigenvalues and eigenvectors. Then, these calculated values are multiplied by the weighted standard deviations before being added to the weighted means to obtain the final values. To determine the closest neighbor participants to these models, the Euclidean distance from each participant to each model point was computed. One closest neighbor participant to each model was chosen. These 14 participants, along with the average individual, represent 15 different body models, each of which has a set of 12 derived anthropometric dimensions.

Since a truck cab workspace is designed for both male and female drivers, a recombined set of male and female models, after they have been derived separately, is useful for the design process. To obtain these recombined male and female models, the models of each gender were put into the other gender's 95% enclosure space, and those who are identified to be within the enclosure space of the opposite gender were considered redundant and discarded. For example, to identify a redundant female model, the 12 derived body dimensions of that female model were first converted into z-scores using the means and standard deviations of the corresponding variables in the male sample. Then, the three PCs were derived by multiplying the set of z-scores with the matrix of component score coefficients. Then, the Euclidean distance of this female model to the centroid of the 95% male enclosure was determined by using the three PCs. If the distance was smaller than the Radius (RAD) = 2.40 enclosure criterion, this female model was considered redundant and discarded. Otherwise, this model was retained for the joint male and female space. Other female models were evaluated in the same way. After all the female models have been evaluated, the male models were placed into the female 95% enclosure (RAD = 2.42) and evaluated for possible redundancy.

Results

Table 8 presents Pearson's product-moment correlation coefficient matrix involving the 12 anthropometric dimensions for the male truck drivers. Two correlation coefficients (between elbow rest height and elbow fingertip length and between shoulder elbow length and elbow rest height) were negative. The lowest correlation was found between elbow rest height and elbow fingertip length (*r* = -0.054), while the highest correlation was found between sitting height and eye height (*r* = 0.956).

Table 8. Pearson's correlation coefficient matrix involving 12 anthropometric dimensions for the male truck drivers

	Abd Dp, Sit	Acro Ht, Sit	Bidelt Brth	Butt-Knee Lgth	Ebw-Fngrtip Lgth	Ebw Rest Ht	Eye Ht, Sit	Hip Brth, Sit	Knee Ht, Sit	Shldr-Ebw Lgth	Sit. Ht
Acro Ht, Sit	0.423										
Bidelt Brth	0.823	0.480									
Butt-Knee Lgth	0.481	0.411	0.508								
Ebw-Fngrtip Lgth	0.165	0.352	0.251	0.692							
Ebw Rest Ht	0.449	0.809	0.501	0.091	-0.054						
Eye Ht, Sit	0.156	0.801	0.286	0.396	0.419	0.564					
Hip Brth, Sit	0.838	0.494	0.835	0.584	0.282	0.478	0.321				
Knee Ht, Sit	0.332	0.500	0.419	0.819	0.817	0.113	0.529	0.464			
Shldr-Ebw Lgth	0.122	0.403	0.142	0.622	0.718	-0.125	0.419	0.195	0.694		
Sit. Ht	0.191	0.822	0.305	0.434	0.454	0.568	0.956	0.343	0.567	0.462	
Stature/ No Shoe	0.150	0.611	0.247	0.749	0.778	0.181	0.741	0.291	0.877	0.733	0.781

Table 9 presents Pearson's product-moment correlation coefficient matrix involving the 12 anthropometric dimensions for the female truck drivers. Again, there were two negative correlation coefficients—between elbow rest height and elbow fingertip length and between shoulder elbow length and elbow rest height. The lowest correlation was found between shoulder elbow length and abdominal depth sitting ($r = 0.013$), while the highest correlation was found between sitting height and eye height sitting ($r = 0.961$).

Table 9. Pearson's correlation coefficient matrix involving 12 anthropometric dimensions for the female truck drivers

	Abd Dp, Sit	Acro Ht, Sit	Bidelt Brth	Butt-Knee Lgth	Ebw-Fngrtip Lgth	Ebw Rest Ht	Eye Ht, Sit	Hip Brth, Sit	Knee Ht, Sit	Shldr-Ebw Lgth	Sit. Ht
Acro Ht, Sit	0.319										
Bidelt Brth	0.870	0.474									
Butt-Knee Lgth	0.452	0.550	0.572								
Ebw-Fngrtip Lgth	0.095	0.440	0.231	0.578							
Ebw Rest Ht	0.479	0.762	0.554	0.257	-0.023						
Eye Ht, Sit	0.078	0.852	0.306	0.517	0.492	0.533					
Hip Brth, Sit	0.652	0.426	0.739	0.663	0.205	0.485	0.314				
Knee Ht, Sit	0.279	0.620	0.412	0.777	0.791	0.210	0.612	0.446			
Shldr-Ebw Lgth	0.013	0.446	0.112	0.565	0.745	-0.156	0.445	0.110	0.707		
Sit. Ht	0.094	0.865	0.327	0.541	0.509	0.542	0.961	0.338	0.621	0.470	
Stature/ No Shoe	0.018	0.720	0.211	0.668	0.754	0.213	0.818	0.201	0.828	0.737	0.849

Table 10 presents the principal component score coefficient matrix involving the 12 anthropometric dimensions for the male and female truck drivers. The PCA output for the males consisted of three PCs, the combination of which accounted for 88% of the total variation. PC1, which were all positive and accounted for 53% of total variation, predicted the overall body size. PC2, accounting for 20% of the variation, showed a contrast between dimensions correlated with body heights and those correlated with body width and depth. PC3, accounting for 15% of the variation, contrasted the measurements of stature and torso height with the remaining seven body dimensions.

The PCA output for females also consisted of three PCs, the combination of which accounted for 87% of the total variation. The three PCs, which followed the same patterns as in the male sample in revealing the relationships among body dimensions, accounted for 53%, 21%, and 13% of the variation, respectively.

Table 10. Component score coefficient matrix, eigenvalues, and total variance explained for male and female truck drivers

Variables	Principal Component (PC)		
	PC 1	PC 2	PC 3
Males			
Stature No Shoes	0.137	-0.180	-0.099
Shoulder-Elbow Length	0.103	-0.229	0.147
Elbow-Fingertip Length	0.112	-0.209	0.238
Bideltoid Breadth	0.099	0.240	0.371
Abdominal Depth, Sit	0.084	0.259	0.460
Hip Breadth, Sit	0.106	0.222	0.383
Sitting Height	0.129	-0.017	-0.521
Knee Height, Sit	0.134	-0.137	-0.552
Buttock-Knee Length	0.126	-0.078	-0.428
Elbow Rest Height	0.077	0.272	-0.494
Eye Height, Sit	0.123	-0.013	0.231
Acromial Height, Sit	0.128	0.106	0.415
Eigenvalues	6.333	2.417	1.813
Percent of Variation	53%	20%	15%
Total Percent of Variation	88%		

Variables	Principal Component (PC)		
	PC 1	**PC 2**	**PC 3**
Females			
Stature No Shoes	0.134	-0.178	-0.041
Shoulder-Elbow Length	0.099	-0.215	0.229
Elbow-Fingertip Length	0.109	-0.174	0.228
Bideltoid Breadth	0.094	0.269	0.153
Abdominal Depth, Sit	0.066	0.301	0.214
Hip Breadth, Sit	0.092	0.235	0.159
Sitting Height	0.133	-0.065	-0.279
Knee Height, Sit	0.134	-0.086	0.184
Buttock-Knee Length	0.128	0.028	0.240
Elbow Rest Height	0.082	0.227	-0.362
Eye Height, Sit	0.130	-0.067	-0.292
Acromial Height, Sit	0.136	0.029	-0.262
Eigenvalues	6.426	2.531	1.526
Percent of Variation	53%	21%	13%
Total Percent of Variation	87%		

Table 11 describes the 15 male representative body models and their corresponding closest neighbor human participants for the male and female truck drivers. A graphical representation of the 15 male figures in both standing and sitting postures can be found in Guan and associates [2012]. Model O, which was at the center of the ellipsoid, represented an "average" person in all body dimensions. Model U described a small size individual whereas Model V represented a large size individual. Model W had a relatively long stature but a short torso. In contrast, Model X was relatively short in stature and torso length but large in abdominal depth and hip breadth. Model C was characterized by a relatively short stature and short limbs but a long torso, whereas Model E was characterized by a relatively long stature and long limbs but a short torso. These 15 body models represented all body sizes and types for the male truck driver population.

Table 11. Multivariate accommodation models and closest neighbor participants for male truck drivers

	Abd Dp, Sit	Acro Ht, Sit	Bidelt Brth	Butt-Knee Lgth	Ebw-Fngrtip Lgth	Ebw Rest Ht	Eye Ht, Sit	Hip Brth, Sit	Knee Ht, Sit	Shldr-Ebw Lgth	Sit. Ht	Stature No Shoe
Model O	324	614	535	631	486	252	798	425	568	361	918	1756
Participant	323	606	534	633	473	253	797	435	562	351	923	1748
Model A	288	552	497	630	490	189	737	392	562	364	855	1709
Participant	289	533	500	628	498	176	743	391	553	352	864	1726
Model B	387	570	563	614	462	232	734	447	540	340	851	1640
Participant	371	588	542	627	477	228	740	461	545	355	857	1633
Model C	285	616	503	568	445	289	797	391	519	331	913	1662
Participant	277	621	498	581	460	279	783	373	528	339	901	1667
Model D	212	596	445	582	471	235	800	342	540	355	916	1732
Participant	215	594	466	599	472	260	794	354	531	340	923	1735
Model E	370	612	569	700	532	220	800	463	622	395	923	1855
Participant	412	618	573	693	529	234	799	449	617	386	910	1866
Model F	497	632	644	683	502	270	797	528	598	368	919	1780
Participant	486	630	647	692	518	248	797	538	601	405	923	1764
Model G	365	682	576	631	482	337	865	462	575	359	986	1804
Participant	375	666	562	637	472	304	869	462	580	356	978	1820
Model H	272	661	508	647	511	274	868	404	598	385	989	1880
Participant	282	641	492	649	511	264	858	417	603	373	974	1873
Model U	252	554	468	567	448	216	736	360	513	333	850	1617
Participant	261	567	458	560	460	236	751	360	518	333	861	1635
Model V	417	680	612	701	528	294	866	502	629	392	991	1906
Participant	442	663	597	717	522	277	861	500	625	385	992	1907
Model W	241	594	473	646	515	205	801	372	592	387	921	1829
Participant	257	622	488	645	518	232	799	373	594	386	916	1810
Model X	436	634	606	615	459	310	796	486	546	337	914	1685
Participant	419	631	569	620	457	313	778	498	542	345	894	1682
Model Y	261	648	494	597	473	294	846	387	553	355	964	1772
Participant	248	652	489	599	482	283	852	366	544	365	964	1773
Model Z	403	581	579	666	500	216	753	468	584	368	874	1739
Participant	409	585	565	665	500	215	728	463	578	373	863	1727

Note: All values are in mm.

Table 12 describes the 15 female representative body models and their corresponding closest neighbor human participants. Similar patterns in body dimensions found in the male representative models apply to the female representative models.

Table 12. Multivariate accommodation models and closest neighbor participants for female truck drivers

	Abd Dp, Sit	Acro Ht, Sit	Bidelt Brth	Butt-Knee Lgth	Ebw-Fngrtip Lgth	Ebw Rest Ht	Eye Ht, Sit	Hip Brth, Sit	Knee Ht, Sit	Shldr-Ebw Lgth	Sit. Ht	Stature No Shoe
Model O	325	580	499	606	440	251	753	460	526	333	864	1627
Participant	317	597	512	619	445	280	772	467	527	322	883	1638
Model A	271	525	442	591	446	183	697	407	518	342	809	1585
Participant	252	515	428	589	448	167	705	410	526	345	817	1599
Model B	386	531	523	597	423	224	682	481	504	318	795	1509
Participant	375	550	528	573	419	238	700	468	517	318	835	1545
Model C	316	571	484	556	397	281	737	438	479	295	846	1523
Participant	318	561	460	567	383	272	735	430	486	298	832	1510
Model D	201	566	402	551	420	239	751	364	493	320	860	1599
Participant	210	546	439	576	422	216	747	407	503	325	856	1601
Model E	335	588	514	655	483	221	769	481	572	370	882	1730
Participant	353	585	506	655	471	225	776	476	551	354	886	1736
Model F	449	593	596	660	460	262	754	555	558	346	868	1654
Participant	415	608	602	667	461	269	784	574	565	333	885	1682
Model G	380	634	557	620	434	319	809	512	533	324	919	1668
Participant	381	649	555	604	457	313	809	458	544	332	909	1683
Model H	265	628	475	615	457	277	823	438	547	348	933	1745
Participant	271	620	454	615	459	280	802	403	548	331	917	1721
Model U	262	517	426	542	403	213	681	386	472	304	791	1482
Participant	258	528	417	538	392	226	708	388	478	293	817	1519
Model V	389	642	572	669	477	289	825	534	580	361	937	1772
Participant	405	623	614	647	472	293	817	534	577	326	932	1743
Model W	211	574	417	600	463	209	767	385	539	357	878	1703
Participant	261	577	435	593	454	220	753	388	532	361	880	1690
Model X	440	585	581	611	416	292	738	534	512	309	850	1550
Participant	446	583	552	592	431	275	740	547	519	329	855	1563
Model Y	275	608	471	577	421	291	791	429	508	317	900	1637
Participant	269	594	456	572	432	282	762	402	510	343	870	1642
Model Z	375	551	527	634	458	211	714	490	543	349	828	1616
Participant	384	573	528	610	473	232	724	484	553	347	835	1621

Note: All values are in mm.

To recombine the male and female body models, the 14 female body models (excluding the female Model O) were first projected into the 95% male enclosure space. Four female models (E, H, V, and W) were found to coincide with the male space because their respective distance to the centroid of the 95% male enclosure was smaller than the $r = 2.40$ inclusion criterion. These four female body models were considered redundant

and, therefore, were excluded from the final set of recombined male and female body models. The remaining female models were retained. Then the 14 male body models (excluding the male Model O) were projected into the 95% female enclosure space. The distance of four male models (B, C, U, and X) to the centroid of the 95% female enclosure was smaller than the $r = 2.42$ inclusion criterion. These four models were excluded from the final set of recombined male and female body models, and the remaining male models were retained. Finally, the recombination procedure resulted in a joint male and female enclosure space that included the male Models A, D, E, F, G, H, V, W, Y, and Z and the female Models A, B, C, D, F, G, U, X, Y, and Z.

Discussion and Conclusion

Traditionally, a 95th percentile male and a 5th percentile female manikins are used in the cab design and evaluation process. By designing to accommodate these manikins, it is assumed that at least 95% of males and 95% of females will be accommodated. However, this percentile approach has deficiencies because percentile values are nonadditive, no persons are small or large in all body dimensions, and using only two extreme manikins fails to account for the large range of variability in key anthropometric dimensions [Robinette & McConville, 1981]. The MAM approach provides a way to represent boundary values of a larger number of body dimensions using a relatively small number of manikins [Meindl et al., 1993].

One important assumption in developing the MAM models is multivariate normality. Although the PCA does not require such an assumption, principal components, based on multivariate normal populations, will be beneficial in terms of constant density ellipsoid (Johnson and Wichern, 2007). Large departures from the ellipsoidal pattern will negatively influence the accuracy of the representative models selected. In this study, a Kolmogorov-Smirnov test showed that PC2 and PC3 did not meet the normality assumption ($p < 0.01$) in the male sample. As a result, the 12 original variables were first transformed by natural log before the PCA procedure was applied. With the natural log transformation and the removal of an outlier, PC2 was able to approximate normality ($p = 0.12$) whereas PC3 was still not ($p < 0.01$). To ensure that the violation of the normality on PC3 was not serious, a comparison was made between the 12 dimensions of the two intercepts on PC3 (Models Y and Z) and the 12 dimensions derived from multiplying ±1.64 to the standard deviation on PC3 (Models Y* and Z*). Of the 12 dimensions, the absolute difference between respective models (Models Y and Y*; Models Z and Z*) was equal to or lower than 5 mm for seven or eight dimensions and ranged from 5.5 mm to 6.3 mm for three or four other dimensions. The abdominal depth had the largest absolute difference of 7.2 mm and 11.5 mm between the same respective models on PC3. Although the violation of normality on PC3 affected some dimensions, the effects on most of the dimensions were in the acceptable range.

This study used the MAM approach to select 15 body models each for male and female truck drivers. Each of the 15 body models represents a unique combination of body size and physique. These models, together with the anthropometric values of their closest neighbor participants, should benefit the design of the next-generation truck cabs. However, if a combined set of the male and female models are more desirable, the 20 male and female models selected in this study can be used for the same purposes.

The concept of recombining the male and female models has been applied to the design of radar operator workstations in military aircrafts by the U.S. Air Force [Hudson & Zehner, 2010]. In their study, Hudson and Zehner considered the six intercept points in the final recombination procedure and relied on logic to eliminate those cases between the two genders. For example, the largest overall female was removed because she was eclipsed by the overall larger males. This study followed the same concept, but introduced a mathematical rigor to the recombination process. For the purpose of model completeness, this study also included the eight mid-octant points in the joint male and female model space. This recombination technique represents the first attempt to generate representative body models of both genders in a rigorously scientific way.

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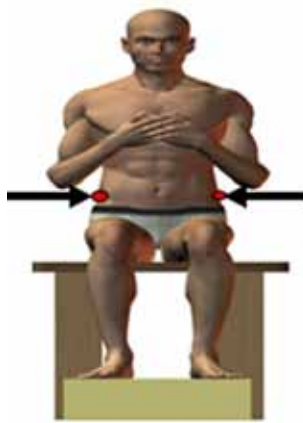
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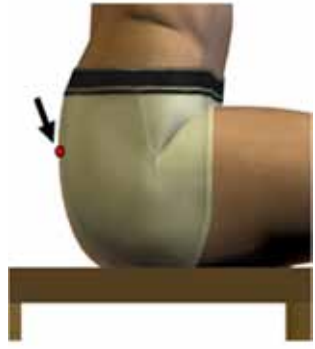
APPENDIX A

LANDMARKS

The landmarks are illustrated with minimal clothing for clarity of illustration. The measurements in the survey were taken with the drivers' own clothing on.

DESCRIPTION	ILLUSTRATION
LANDMARKS UNMARKED	
Abdominal point, anterior (sitting): The most anterior point of the relaxed abdomen between the xiphoid process of the sternum and the top of the thigh of a seated subject.	
Abdominal point, lateral, left and right (sitting): The most lateral points of the relaxed abdomen between the xiphoid process of the sternum and the top of the thigh of a seated subject.	
Biceps point, right, relaxed: A point on the anterior surface of a relaxed right arm, one-half the distance between acromion and the elbow crease in the cubital fossa. The landmark is located visually by estimating the distance.	

Buttock point, posterior: Point of maximum posterior protrusion of either buttock of a sitting subject, determined by contact with the buttock plate.	
Dactylion III, right: The tip of the right middle finger.	
Deltoid point, right and left: The lateral point of the right deltoid muscle, and the margin of the left deltoid muscle at the level of the right deltoid point.	

Dorsal juncture of the calf and thigh, right: The juncture between the right calf and thigh behind the knee of a subject sitting with the knee flexed 90 degrees.	
Ectocanthus, right: The outside corner of the right eye formed by the meeting of the upper and lower eyelids.	
Iliocristale: The highest palpable point of the right iliac crest of the pelvis, one half the distance between the anterior superior iliac and posterior superior iliac spines.	
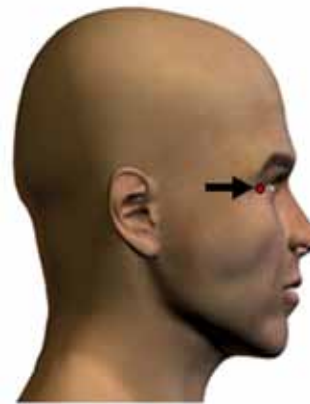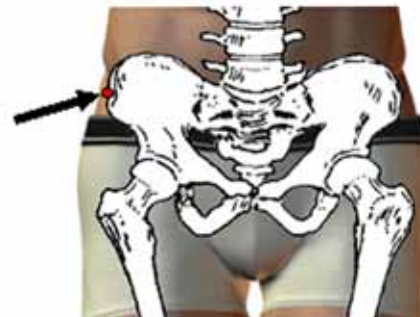
Infraorbitale, right: The lowest point on the anterior border of the bony eye socket.	
Knee point, anterior, right: The most protruding point of the right kneecap of a seated subject.	
Lateral malleolus, right: The lateral point of the right lateral malleolus (outside ankle bone).	

Metacarpale II, right: The lateral point of the right metacarpophalangeal joint II (at the base of the index finger on the outer edge of the hand).	
Metacarpale V, right: The medial point of the right metacarpophalangeal joint V (at the base of the little finger on the outer edge of the hand).	
Olecranon, bottom and rear, right: The lowest and rearmost points of the elbow with the elbow flexed 90 degrees.	

Tenth rib: The inferior point of the right tenth rib (bottom of the rib cage).	
Thigh point, top, right: The highest point of the top of the right thigh of a seated subject.	
Top of head (vertex): The highest point on the head when the head is in the Frankfurt plane.	

Tragion, right: The superior point on the juncture of the right cartilaginous flap (tragus) of the ear with the head.
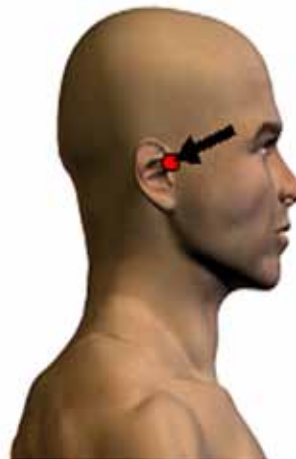
Waist (natural indentation), right and left: The point of greatest indentation on the profile of the torso. The landmark is located by palpation. If no indentation can be identified, the landmark is one-half the distance between the lower edge of the rib cage and the upper edge of the pelvis.
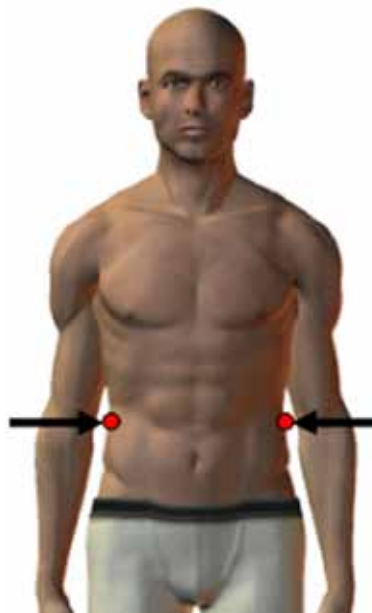
LANDMARKS MARKED

Acromion, right and left: The most lateral point on the border of the acromial process of the scapula.

Subject stands erect looking forward with heels together and shoulders and arms relaxed. Stand behind the subject and palpate the tips of both shoulders simultaneously. Place a dot on the most lateral point of the bony border of each shoulder.

Stylion, right: The lowest point of the bottom of the right radius.

Subject stands with arms relaxed. Stand in front of the subject and grasp the subject's right hand. Place your thumb on the thumb side of the subject's hand and palpate up toward the wrist until you locate the end of the radius. Place a dot over the landmark.

CAUTION: This area is crossed by tendons so it may be necessary to bend the hand up and down at the wrist to find the landmark.

Xiphoidale: The lower edge of the body of the sternum.

Subject stands erect looking forward with heels together and the shoulders and arms relaxed. Stand in front of the subject and find the landmark by palpation. Place a dot on the landmark.

APPENDIX B

NIOSH TRUCK DRIVER STUDY DATA FORM

	DIMENSION	MEASUREMENT
1	Shoe Width	
2	Shoe Length	
3	Stature	
4	Stature without shoes	
5	Acromial Height	
6	Ankle Height	
7	Weight	
8	Chest Width	
9	Chest Depth	
10	Arm Length	
11	Shoulder-Elbow Length	
12	Elbow-Fingertip Length	
13	Upper Arm Circ	
14	Forearm Circ	
15	Thigh Circ	
16	Calf Circ	
17	Waist Circ, NI	
18	Hand Breadth	
19	Hand Length	
20	Biacromial Breadth	
21	Bideltoid Breadth	
22	Forearm-Forearm Breadth	
23	Abdominal Depth, Sitting	
24	Abdominal Breadth, Sitting	
25	Hip Breadth, Sitting	
26	Thumbtip Reach	
27	Sitting Height	
28	Eye Height, Sitting	
29	Acromial Height, Sitting	
30	Elbow Rest Height	
31	Thigh Clearance	
32	Knee Height, Sitting	
33	Popliteal Height	
34	Buttock Knee Length	
35	Buttock-Popliteal Length	

APPENDIX C

Consent Form

PHASE I CONSENT FORM

NATIONAL INSTITUTE for OCCUPATIONAL SAFETY and HEALTH
CENTERS FOR DISEASE CONTROL and PREVENTION
U.S. PUBLIC HEALTH SERVICE
U.S. DEPARTMENT OF HEALTH and HUMAN SERVICES

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

You have been asked to participate in a research study. This section explains what you will have to do to participate. It describes your rights and specifies how NIOSH will treat your records. Your participation or non-participation will not affect your employment.

I. DESCRIPTION

Title: ***Improved Truck Cab Design through Applied Anthropometry***

A. Sponsor and/or Project Officer: National Institute for Occupational Safety and Health, Division of Safety Research, Protective Technology Branch, Jinhua Guan, PhD, Project Officer.

B. Purpose and Benefit: the purpose of this study is to collect truck drivers' body size information so that better truck cabs can be developed in the future. You will not benefit directly from being in the study, but your participation in this study will provide data to help truck manufacturers build better trucks that will:
   1. be more comfortable and safer to operate;
   2. give drivers a better view of their surroundings;
   3. provide more comfortable seating and seatbelt.

II. CONDITIONS OF THE STUDY

Testing procedure

A. Upon arriving at the data collection site, the investigator will give you this consent form that explains to you the test procedures. You may ask questions if you have any. If you decide to participate in the study, you will be asked to sign this form.

B. You will remain in your street clothes. A researcher who is trained in body measurement will identify some bony points that will serve as reference points for taking measurements. These points will be marked with small adhesive dots, which are removed when you are done. If you are a female, you will be dotted and measured by a female researcher. After the dots are placed an investigator will measure your body dimensions with a tape measure, anthropometer, and calipers. This will take approximately 30 minutes.

C. After the measurements are completed, the dots are removed. You will be asked to fill out a nine-question post-test questionnaire that will ask you to assess your comfort in your own truck cab during your daily operation. After you finished with the questionnaire and the measurements, you will be compensated, and you can then go. This procedure will take about 10 minutes.

D. The risk of injury is very low since you only need to sit or stand and be measured. Some subjects may be uncomfortable when measurements are taken on the face. Investigators will advise you in advance of these measurements to minimize this potential effect. There is a slight risk that the caliper may slip into the eye, but the instrument is not sharp and investigators cover the instrument tips with their fingers for additional safety. The researcher will be extremely gentle and careful when conducting measurements on your face.

E. If you have any reaction to the tests/procedures, you should contact Jinhua Guan, Ph.D., Protective Technology, Division of Safety Research, NIOSH, (304) 285-6333.

F. The risk of injury from this project is small. Emergency first-aid treatment is available immediately. If medical care beyond simple first-aid treatment is needed, research personnel will call the building Safety Coordinator or 911 for help. If you are injured

through the negligence of a NIOSH contractor, you may have a claim against the contractor, not the federal government. If an injury should occur to you as the result of your participation, you should also contact: Jinhua Guan, Ph.D., Protective Technology Branch, Division of Safety Research, (304) 285-6333, or Dr. Michael J. Colligan, Chairperson, NIOSH Human Subjects Review Board, (513) 533-8222.

G. If you have questions about this research contact Jinhua Guan, Ph.D., Protective Technology Branch, Division of Safety Research , (304) 285-6333. If you have any questions about your rights as a participant in this study, contact Dr. Michael Colligan, Chair of the NIOSH Human Subjects Review Board at (513) 533-8222.

H. Your participation is voluntary and you may withdraw your consent and your participation in this study at any time without penalty or loss of benefits to which you are otherwise entitled.

I. If you withdraw early you will receive partial compensation. Partial payment is $15 per 10 measurements completed. If you finish the measurement session you will receive compensation of $50.

J. The overall results of the study will be documented in a journal article or a NIOSH research report. No results that might identify you as an individual will be published. Copies will be provided to you upon publication at your request. Please call Dr. Guan, the project officer, at the end of 2009, if you would like a copy of the summary report.

III. USE OF INFORMATION

The National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention (CDC), an agency of the Department of Health and Human Services, is authorized to collect this information, including your name, contact information and social security number (if applicable), under provisions of the Public Service Act, Section 301 (42 U.S.C. 241); Occupational Safety and Health Act, Section 20 (29 U.S.C. 669); and the Federal Mine Safety and Health Act of 1977, Section 501 (30 U.S.C. 95).

The information you supply is voluntary and there is no penalty for not providing it. The data will be used to improve truck cab design. Data will become part of the CDC Privacy Act system 09-20-0117, Medical and Test Records Results of Individuals Involved in NIOSH Laboratory Studies, and may be disclosed: to collaborating researchers under certain limited circumstances to conduct further investigations, to the Department of Justice in the event of litigation, and to a Congressional Office assisting individuals in obtaining their records. An accounting of the disclosures made by NIOSH will be made available to you upon request. Except for these and other permissible disclosures expressly authorized by the Privacy Act, or in limited circumstances when required by the Freedom of Information Act, no other disclosure may be made without your written consent.

NIOSH plans to conduct follow up research on a subset of the participants of this study. NIOSH will use the contact information you provide to contact you if you are chosen for this additional research.

IV. SIGNATURES

I have read this consent form and I agree to participate in this study.

PARTICIPANT _____ AGE _____

_____ DATE _____
         (signature)

I, the Anthrotech representative, under contract to NIOSH have accurately described this study to the participant.

REPRESENTATIVE _____ DATE _____
         (signature)

1 copy to participant
1 copy to project officer

APPENDIX D

NIOSH TRUCK DRIVER STUDY

BIOGRAPHICAL DATA FORM

Subject No: _____ Location: _____ Date: _____

Male   Female   Age: _____   *Please print clearly.*
   Please circle one.

Race/Ethnicity: African-American   Hispanic   Asian/Pacific Islander   Caucasian
Other _____   *Please circle one.*
        Please print clearly.

Name: _____ Email: _____ Phone: _____
        Please print clearly.   *Please print clearly.*   *Please print clearly.*

Address: _____
        Please print clearly.

Number of years driving: _____
        Please print clearly

Number of miles driven per year: _____   Owner/Operator *or* Fleet Driver
                Please print clearly.   *Please circle one.*

Type of driving: _____ Long Haul *(stay out for multiple days)*
                        _____ Regional Haul *(back home every night)*

Driving shoe type: Tennis Shoes   Oxfords   Loafers/Slip Ons

                        High Heels   Cowboy Boots Work Boots/Shoes

                        Work Boot/Shoes w/Steel Toes   *Circle all that may apply.*

                        Other _____
                            Please print clearly.

The shoe you have on today, typical driving shoe: Yes   No

Type worn today: _____

APPENDIX E

Comparability of NIOSH Truck Driver Anthropometric Study Data with NHANES Data

One of the operating assumptions of the study based on anecdotal evidence from the industry was that U.S. truck drivers are anthropometrically distinct from the general U.S. population. This data set offers us the opportunity to test that assumption. The best current data set representing U.S. civilians is that available from the National Center for Health Statistics, National Health and Nutrition Examination Study (NHANES, CDC, 2004). Measurements from the current study were compared to relevant measurements from the U.S. general population represented by NHANES.

Method

For this analysis, a male sample and a female sample between 20 to 65 years of age were taken from a combined 4-year (2003–2006) NHANES dataset (McDowell et al., 2008). This age range consists of the majority of the U.S. working population. The NHANES sample weights were applied to adjust for unequal probability sampling, noncoverage, and nonresponses to produce national estimates. Standard errors were estimated using SUDAAN by Taylor series linearization because of the complex sample design (McDowell et al., 2008). Before the two samples are compared, the same 20–65 age group criterion was applied to the NIOSH truck driver sample, resulting in a male sample of 1,749 participants and a female sample of 171 participants. One difficulty in comparing these two datasets is that there are few comparable dimensions. Stature and weight are measured comparably. The definitions of waist circumference and thigh circumference differ slightly but are generally comparable. As a result, these four dimensions are involved in this analysis.

Bonferroni t was used to compare the relevant measurements from both studies. With four comparisons, each t value was evaluated at $\alpha = .05/4 = .0125$ critical level.

Result

Table E1 shows the results of Bonferroni t comparing the means of four body dimensions between the current data and the U.S. general population. For the males, differences in the means of all four dimensions were found to be statistically significant. While the male truck drivers were on average shorter than males in the U.S. general population, they were nonetheless heavier. The truck drivers were, on average, 13.5 kg heavier than those in the U.S general population, and their thigh and waist circumferences were larger than those in the U.S. general population. For the females, the mean stature was not statistically different. However, the female truck drivers were significantly heavier than those in the general population – by15.4 kg on average. Besides, their thigh and waist circumferences were larger than those in the U.S. general population. These results showed that the size and physique of the truck driving population are not well represented by the U.S. general population.

Table E1. Independent t-Test (Bonferroni) on Four Dimensions- Truck Drivers in NIOSH Study versus U.S. General Population

Dimensions	NIOSH		U. S. General Population			
Males	*N*	*Mean (SD)*	*N*	*Mean (SD)*	*Difference in Means*	*t*
Stature (mm)	1779	1757 (69.58)	3335	1769 (98.15)	-12	-6.53*
Waist Circ. (mm)	1779	1089 (154.31)	3333	1002 (266.91)	87	18.55*
Thigh Circ. (mm)	1779	635 (69.91)	3225	545 (90.41)	90	53.59*
Weight (kg)	1779	102.6 (23.93)	3193	89.1 (31.18)	13.5	23.61*
Females						
Stature (mm)	171	1626 (69.19)	3206	1629 (96.26)	-3	-1.09
Waist Circ. (mm)	171	1020 (147.68)	3121	936 (290.50)	84	11.93*
Thigh Circ. (mm)	171	671 (78.66)	3067	536 (138.45)	135	39.90*
Weight (kg)	171	91.0 (21.14)	3207	75.6 (35.68)	15.4	18.03*

Note. All values are in mm except for weight.
*$p < .05/4 = .0125$, two-tailed; equivalently $t_{0.05}(4, >120) = \pm2.50$.

Discussion and Conclusion

The current U.S. truck driver population is significantly heavier than the U.S. general population of working age. The body width and circumference measurements are also larger among truck drivers than those in the U.S. general population. However, the male truck drivers are shorter in stature and the female truck drivers are not different from the U.S. general working-age population. The results are consistent with the Hsiao et al. (2002) findings that different occupational groups have distinctive anthropometric characteristics from the general population. These findings lend support to the view that the design of next generation truck cabs should not rely on anthropometric data from the general population.

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APPENDIX F

COMPARABILITY OF CURRENT TRUCK DRIVER ANTHROPOMETRIC STUDY WITH PREVIOUS TRUCK DRIVER ANTHROPOMETRIC STUDY

The current truck driver populations are different in key anthropometric measurement from the general population. They may also be different from the truck driver population of 25–30 years ago when the last systematic truck driver anthropometric studies took place. As pointed out earlier in this report, this important anthropometric change may be due to both changes in demographic composition that occurred in the truck driver population in the past 25–30 years and secular changes as a result of the obesity epidemic witnessed in recent decades [Sieber et al., 2014; Korelitz et al., 1993]. This dataset offers a good opportunity to examine this issue.

Method

This analysis employed Bonferroni t to compare the male samples from this truck driver anthropometric study data and earlier truck driver anthropometric data collected 25–30 years ago [Sanders, 1977, 1983]. The female samples were not involved in this analysis because the number of female participants in the earlier two studies was very small [Sanders, 1977, 1983; Shaw & Sanders, 1984]. There are 10 dimensions comparably measured between the current study and the two earlier studies, and these 10 dimensions were submitted to statistical analysis by Bonferroni t. With 10 comparisons, each t value was evaluated at $\alpha = .05/10 = .005$ critical level.

Table F1. Independent t-Test (Bonferroni) on 10 Dimensions for Male Truck Drivers—NIOSH Study versus Sanders Study

Dimensions	NIOSH		Sanders			
	N	*Mean (SD)*	*N*	*Mean (SD)*	*Difference in Means*	*t*
Stature (No Shoes, mm)	1779	1757 (69.58)	183 [b]	1756 (124)	1	0.48
Sitting Height (mm)	1779	919 (36.14)	267 [a]	927 (267)	-8	-7.51*
Buttock-Knee Length (mm)	1779	632 (35.04)	183 [b]	636 (32)	-4	-3.98*
Hand Breadth (mm)	1779	90 (4.82)	183 [b]	89 (5)	1	6.08*
Hand Length (mm)	1779	196 (10.10)	183 [b]	189 (10)	7	22.84*
Abdominal Depth, Sit. (mm)	1779	331 (66.03)	183 [b]	299 (45)	32	15.44*
Forearm-Forearm Breadth (mm)	1779	617 (66.17)	183 [b]	502 (48)	115	55.85*
Hip Breadth, Sit. (mm)	1779	428 (46.04)	267 [a]	353 (35)	75	53.39*
Waist Circ., Natural Indentation (mm)	1779	1089 (154.31)	183 [b]	1027 (124)	62	12.76*
Weight (kg)	1779	102.6 (23.93)	183 [b]	90.6 (17.11)	12	16.07*

Note. All values are in mm except for weight. [a]Sanders, 1977 [b]Sanders, 1983. *$p < .05/10 = .005$, two-tailed; equivalently $t_{0.05}$ (10, >120) = ±3.29.

Result

As Table F1 shows, the male truck drivers in this study were larger in abdominal depth (seated), forearm-forearm breadth, hip breadth (seated), waist circumference, and body weight compared with the previously available male truck driver data [Sanders, 1977, 1983]. They were also statistically larger in hand length, hand width, and buttock-

knee length, but only by 7 mm, 1 mm, and 4 mm, respectively, which is not likely to be important in cab design. The sitting height in the present study was shorter than that in earlier studies, though the stature was the same. They were heavier by about 12 kg on average, and larger in body width and girth, even though they were not taller. This suggests that the current male drivers are different in physique from their counterparts of 25–30 years ago.

Discussion and Conclusion

Compared to the earlier truck driver anthropometric studies [Sanders, 1977, 1983], this study shows a significant change in the truck drivers' anthropometric profile over a quarter century. The current male truck drivers are, on average, 12 kg heavier than their earlier counterparts, and they are also larger in abdominal depth sitting, forearm-forearm breadth, hip breadth sitting, and waist circumference-natural indentation. This change in body width and circumference may reflect the sedentary nature of the trucking occupation and the ongoing obesity epidemic in the United States.

There is also a noticeable discrepancy in the finding on stature between this study and the Sanders study (1983). Sanders indicated that both male and female truck drivers were taller than the U.S. general population, while this study reported that male truck drivers are shorter than the general population and the female truck drivers are not significantly different from the general population. The difference can be explained by the fact that this survey included a more representative Hispanic sample (14% of the total sample) whereas the Sanders study did not (0% of the total sample). As an ethnic group, Hispanics have a shorter stature than non-Hispanic Whites. For example, for those 20 years and over, Hispanic males and females were reported to be, on average, 72 mm and 53 mm shorter than their non-Hispanic White counterparts, respectively (McDowell et al., 2008). Our truck driver anthropometric study found that male Hispanic truck drivers are, on average, 56 mm shorter than male non-Hispanic white drivers ($t = 12.93$, $p < .01$, 2-tailed). The female Hispanic drivers are, on average, 44 mm shorter than the female non-Hispanic white drivers ($t = 7.0$, $p < .01$, 2-tailed). The inclusion of a representative Hispanic subsample has enabled this study to yield a more accurate estimate on the true stature in the truck driver population.

Given the substantial differences in key demensions between the current truck driver population and that of 25–30 years ago, the current data will be an important resource for future truck cab designs.

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APPENDIX G

Driver Biographical Data

OVERALL		
NUMBER YEARS DRIVING (CODED)		
	Frequency	**Percent**	**Cumulative Percent**
---	---	---	---
< 1 year	40	2.1	2.1
1–1.99 years	142	7.4	9.4
2–2.99 years	107	5.5	15.0
3–3.99 years	80	4.1	19.1
4–4.99 years	90	4.7	23.8
5–9.99 years	327	16.9	40.7
10–14.99 years	321	16.6	57.4
15–19.99 years	247	12.8	70.2
20–24.99 years	168	8.7	78.9
25–29.99 years	152	7.9	86.7
30–34.99 years	122	6.3	93.1
35–39.99 years	89	4.6	97.7
40–44.99 years	30	1.6	99.2
> 45 years	15	0.8	100.0
Total	1,930	100.0	

MEN		
NUMBER YEARS DRIVING (CODED)		
	Frequency	**Percent**	**Cumulative Percent**
---	---	---	---
< 1 year	34	1.9	1.9
1–1.99 years	125	7.1	9.0
2–2.99 years	93	5.3	14.3
3–3.99 years	65	3.7	18.0
4–4.99 years	79	4.5	22.5
5–9.99 years	291	16.5	39.0
10–14.99 years	291	16.5	55.5
15–19.99 years	223	12.7	68.2
20–24.99 years	162	9.2	77.4
25–29.99 years	149	8.5	85.8
30–34.99 years	117	6.6	92.5
35–39.99 years	88	5.0	97.4
40–44.99 years	30	1.7	99.1
> 45 years	15	0.9	100.0
Total	1,762	100.0	

WOMEN			
NUMBER YEARS DRIVING (CODED)			
	Frequency	**Percent**	**Cumulative Percent**
< 1 year	6	3.6	3.6
1–1.99 years	17	10.1	13.7
2–2.99 years	14	8.3	22.0
3–3.99 years	15	8.9	31.0
4–4.99 years	11	6.5	37.5
5–9.99 years	36	21.4	58.9
10–14.99 years	30	17.9	76.8
15–19.99 years	24	14.3	91.1
20–24.99 years	6	3.6	94.6
25–29.99 years	3	1.8	96.4
30–34.99 years	5	3.0	99.4
35–39.99 years	1	0.6	100.0
Total	168	100.0	

OVERALL

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	14	0.7	0.7
10,000–19,999 miles	33	1.8	2.5
20,000–49,999 miles	102	5.4	7.9
50,000–99,999 miles	354	18.9	26.8
100,000–149,999 miles	929	49.5	76.3
150,000–199,999 miles	292	15.6	91.8
> 200,000 miles	153	8.2	100.0
Total	1,877	100.0	

MEN

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	11	0.6	0.6
10,000–19,999 miles	30	1.7	2.4
20,000–49,999 miles	96	5.6	8.0
50,000–99,999 miles	325	18.9	26.9
100,000–149,999 miles	850	49.4	76.3
150,000–199,999 miles	272	15.8	92.1
> 200,000 miles	136	7.9	100.0
Total	1,720	100.0	

WOMEN

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	3	1.9	1.9
10,000–19,999 miles	3	1.9	3.8
20,000–49,999 miles	6	3.8	7.6
50,000–99,999 miles	29	18.5	26.1
100,000–149,999 miles	79	50.3	76.4
150,000–199,999 miles	20	12.7	89.2
> 200,000 miles	17	10.8	100.0
Total	157	100.0	

OVERALL - EXCLUDING INEXPERIENCED DRIVERS
(1 year or less driving experience)

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	7	0.4	0.4
10,000–19,999 miles	28	1.6	2.0
20,000–49,999 miles	89	5.1	7.2
50,000–99,999 miles	311	18.0	25.2
100,000–149,999 miles	877	50.7	75.9
150,000–199,999 miles	279	16.1	92.0
> 200,000 miles	138	8.0	100.0
Total	1,729	100.0	

MEN - EXCLUDING INEXPERIENCED DRIVERS
(1 year or less driving experience)

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	5	0.3	0.3
10,000–19,999 miles	26	1.6	2.0
20,000–49,999 miles	84	5.3	7.2
50,000–99,999 miles	285	18.0	25.2
100,000–149,999 miles	801	50.5	75.7
150,000–199,999 miles	263	16.6	92.2
> 200,000 miles	123	7.8	100.0
Total	1,587	100.0	

WOMEN -EXCLUDING INEXPERIENCED DRIVERS
(1 year or less driving experience)

NUMBER MILES PER YEAR (CODED)

	Frequency	Percent	Cumulative Percent
< 10,000 miles	2	1.4	1.4
10,000–19,999 miles	2	1.4	2.8
20,000–49,999 miles	5	3.5	6.3
50,000–99,999 miles	26	18.3	24.6
100,000–149,999 miles	76	53.5	78.2
150,000–199,999 miles	16	11.3	89.4
> 200,000 miles	15	10.6	100.0
Total	142	100.0	

OVERALL

TYPE OF DRIVING

	Frequency	Percent
Long Haul	1404	72.7
Regional Haul	468	24.2
Other	2	0.1
Both	56	2.9
Total	1,930	100.0

MEN

TYPE OF DRIVING

	Frequency	Percent
Long Haul	1259	71.4
Regional Haul	447	25.4
Other	2	0.1
Both	55	3.1
Total	1,763	100.0

WOMEN

TYPE OF DRIVING

	Frequency	Percent
Long Haul	145	86.8
Regional Haul	21	12.6
Both	1	0.6
Total	167	100.0

OVERALL			
Shoe Frequencies			
	Responses		**Percent of Cases**
	N	**Percent**	
Tennis Shoe	961	33.7	49.6
Oxfords	52	1.8	2.7
Loafers/Slip Ons	218	7.6	11.2
High Heels	1	0.0	0.1
Cowboy Boots	247	8.7	12.7
Work Boots/Shoes	841	29.5	43.4
Work Boot/Shoes w/ Steel Toes	450	15.8	23.2
Other	84	2.9	4.3
Total	2,854	100.0	147.3

DRIVING SHOE TYPE - OTHER		
	Frequency	**Percent**
Bare feet	25	31.3
Sandals	24	30.0
Hiking boots	9	11.3
Slippers	5	6.3
Flip Flops	3	3.8
Crocks	2	2.5
Motorcycle boots	2	2.5
Casual shoes	1	1.3
Clogs with holes on top	1	1.3
Closed sandals	1	1.3
Combat boots	1	1.3
Dress shoes	1	1.3
Low shoes	1	1.3
Shoes for crews	1	1.3
Tennis shoes w/ Steel Toes	1	1.3
Work Boots w/ and w/o steel toes	1	1.3
Work boots with composite toes	1	1.3
Total	80	100.0

MEN			
Shoe Frequencies			
	Responses		Percent of Cases
	N	Percent	
Tennis Shoe	847	32.6	47.9
Oxfords	47	1.8	2.7
Loafers/Slip Ons	179	6.9	10.1
Cowboy Boots	238	9.2	13.5
Work Boots/Shoes	782	30.1	44.2
Work Boot/Shoes w/ Steel Toes	436	16.8	24.7
Other	66	2.5	3.7
Total	2,595	100.0	146.8

DRIVING SHOE TYPE - OTHER		
	Frequency	Percent
Bare feet	19	30.2
Sandals	16	25.4
Hiking boots	9	14.3
Slippers	4	6.3
Flip Flops	2	3.2
Motorcycle boots	2	3.2
Casual shoes	1	1.6
Clogs with holes on top	1	1.6
Closed sandals	1	1.6
Combat boots	1	1.6
Crocks	1	1.6
Dress shoes	1	1.6
Low shoes	1	1.6
Shoes for crews	1	1.6
Tennis shoes w/ Steel Toes	1	1.6
Work Boots w/ and w/o steel toes	1	1.6
Work boots with composite toes	1	1.6
Total	63	100.0

WOMEN			

Shoe Frequencies

	Responses		Percent of Cases
	N	Percent	
Tennis Shoe	114	44.0	67.1
Oxfords	5	1.9	2.9
Loafers/Slip Ons	39	15.1	22.9
High Heels	1	0.4	0.6
Cowboy Boots	9	3.5	5.3
Work Boots/Shoes	59	22.8	34.7
Work Boot/Shoes w/ Steel Toes	14	5.4	8.2
Other	18	6.9	10.6
Total	259	100.0	152.4

DRIVING SHOE TYPE - OTHER		
	Frequency	Percent
Sandals	8	47.1
Bare feet	6	35.3
Crocks	1	5.9
Flip Flops	1	5.9
Slippers	1	5.9
Total	17	100.0

APPENDIX H

Further Issues on Observer Error

In reviewing a manuscript of this report, a reviewer raised an issue on observer error relative to measuring fully clothed (shirts and pants) participants. It is a legitimate concern that must be addressed in this report. As mentioned in the Participant Processing section, the participants remained in street clothes during the measurement. Measuring over clothing generally increases measurement error for breadths, depths, and circumferences, but typically not for heights. A study by Paquette and associates [1999] showed that adding a layer of clothing for breadths and depths would increase the error from 0.2% (biacromial breadth sitting and bideltoid breadth) to 2.3% (waist depth). When measurement was done over clothing, the observer errors for breadth and depth measurements ranged from 0.7% (biacromial breadth sitting) to 3.7% (waist depth). For height dimensions, the increase of observer error over clothed measurements typically ranged from 0% to 0.2%.

Although measuring over clothing increases measurement error on some dimensions, this measuring technique is still considered the preferred approach in a study like this one. Our prior experiences showed that some potential subjects would refuse to participate if they were told they had to take off their clothes in a field measuring station. Had we insisted on them wearing running shorts or similar attire during measurement, we would have biased the volunteer sample against those who refused to do so. In this case, we believe that the benefits of a less biased sample outweigh the costs of increased observer error.

References

Paquette SP, Case HW, Annis JF, Mayfield TL, Kristensen S, Mountjoy DN [1999]. The Effects of multilayered military clothing ensembles on body size: A pilot study. Technical Report Natick/TR-99/012, U.S. Army Soldier and Biological Chemical Command, Soldier Systems Center, Natick MA 01760-5020.

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