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**Anthropometric Measurements of Aviators
Within the Aviation Epidemiology Data Register**

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By

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March 1989

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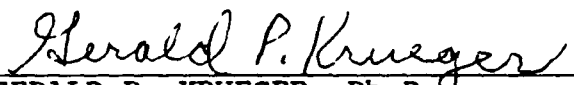
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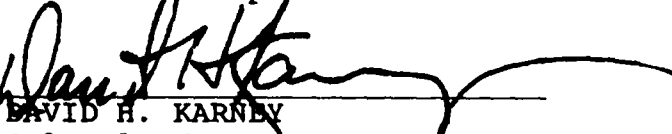
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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S) USAARL Report No. 89-5		
6a. NAME OF PERFORMING ORGANIZATION Universal Energy Systems, Inc.		6b. OFFICE SYMBOL (if applicable)	7a. NAME OF MONITORING ORGANIZATION U.S. Army Aeromedical Research Laboratory		
6c. ADDRESS (City, State, and ZIP Code) 4401 Dayton-Xenia Dayton, OH 45432			7b. ADDRESS (City, State, and ZIP Code) P.O. Box 577 Fort Rucker, AL 36362-5292		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO. 62787A		PROJECT NO. 3E162787A87
			TASK NO. 00		WORK UNIT ACCESSION NO. 170
11. TITLE (Include Security Classification) Anthropometric measurements of aviators within the aviation epidemiology data register					
12. PERSONAL AUTHOR(S) Robert H. Schrimsher, Thomas J. Burke					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) 1989 March	
15. PAGE COUNT 40					
16. SUPPLEMENTARY NOTATION <i>For AEDR, Vol. 1</i>					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
05	09		Anthropometrics, body measurements, Aviation Epidemiology Data Register, AEDR		
06	04				
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Twenty anthropometric measurements on 22,000 male flight school applicants, 29,000 male aviators, 800 female flight school applicants, and 600 female aviators are recorded in the Aviation Epidemiology Data Register (AEDR). Summary statistics for the anthropometric measurements of these four populations, including mean, standard deviation, and the 1, 5, 50, 95, and 99 percentile values, are reported. These values are reported in a tabular format with the corresponding values from five other Department of Defense anthropometric studies.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Chief, Scientific Information Center			22b. TELEPHONE (Include Area Code) (205) 255-6907		22c. OFFICE SYMBOL SGRD-UAX-SI

Acknowledgments

The authors wish to thank Ms. Jean Anderson for her editorial assistance in producing this document.



Accession For	
NTIS CPA 21	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

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Introduction

Beginning in 1983, the U.S. Army Aviation Epidemiology Data Register (AEDR) was developed as a joint effort of the U.S. Army Aeromedical Research Laboratory (USAARL) and the U.S. Army Aeromedical Activity (USAAMA) at Fort Rucker, Alabama. The AEDR is a permanent, computer-accessible repository of medical information on the Army aviation population. This automated database system provides data for developing and evaluating aviation medical selection and retention standards, for conducting epidemiologic studies on health risk factors, and the natural history of disease in the aviation environment, for evaluating health hazards in the aviation environment, and for providing human factors input to engineers developing aircraft, weapons, and life support equipment.

As of 1st Quarter, FY 89, the AEDR contained approximately 110,000 records on over 52,000 individuals. The medical information is taken from flying duty medical examinations (FDME, flight physicals) which are recorded on Standard Forms 88 (Report of physical examination), 93 (Report of medical history), and 520 (Electrocardiographic record), and an auxiliary form of health risk factors, family history, and flight experience. Medical transcribers enter the data from these forms into the AEDR database, entering each record twice to minimize transcription errors. Each record is composed of 178 fields containing administrative data, patient medical history, medical history by physician, screening test results, physical findings, health risk factors, anthropometric measurements, diagnoses, and dispositions. This information is gathered in medical examination facilities for the purpose of determining medical fitness for flying duty.

This report describes the anthropometric measurements within the AEDR, tabulates some summary statistics on those values, and provides selected measurements from other anthropometric studies for comparison. This report does not seek to establish anthropometric standards or mass distribution data for constructing human analogues, mathematical models, or test dummies. These types of data are contained in a tri-service publication Anthropometry and mass distribution for human analogues, vol I: Military male aviators, USAARL Report No. 88-5.

During the past few decades, the majority of military anthropometric studies were accomplished by the U.S. Air Force (USAF). Four major USAF studies occurred in 1950, 1965, 1967, and 1968. The 1950 survey was conducted on rated and nonrated,

male aviation personnel and was reported in 1954 by Hertzberg, Daniels, and Churchill. The 1965 study performed on male recruits, enlisted personnel and officers (nonrated), was reported with complete summary statistics and correlation coefficients in 1978 by Churchill, Churchill, and Kikta. In 1967, USAF rated male aviation officers and cadets were measured. A total of 182 anthropometric dimensions were measured on 2,420 USAF males. A summary of 55 dimensions from this study also was reported in 1978 by McConville and Laubach (Anthropometric source book, vol I). The 1968 study was reported in 1972 by Clauser, et al., and was conducted on 1,905 nonrated female officers, officer trainees, and enlisted personnel. Although there were no measurements taken on aviation-rated female officers in this study, an artificial subset of female data was calculated by selecting only those female personnel who met the USAF body size criteria for entry into pilot and navigator training. This artificial subset was not part of the 1968 report.

The principal U.S. Army anthropometric study on aviators was reported by Churchill, et al., in 1970 (Anthropometry of U.S. Army aviators - 1970). This study obtained data for 85 body-size measurements on a sample of 1,482 male aviation personnel. The results of U.S. Army female (nonaviation) anthropometric studies were published in a series of four reports. The second report (Anthropometry of women of the U.S. Army - 1977. Report no 2. - the basic univariate statistics) summarizes univariate statistics of the Army female study. The U.S. Army Natick Research, Development and Engineering Center, Natick, Massachusetts, is currently updating the anthropometric data of Army personnel, which will include aviation personnel.

An anthropometric study of U.S. Naval aviation personnel was reported in 1965 by Gifford, Provost and Lazo. This study was performed in 1964 and over 1,500 men were surveyed for 96 body measurements.

The Department of Defense in 1980 published an anthropometry handbook titled Military handbook-743, anthropometry of U.S. military personnel. Most of the studies mentioned above, plus several others, are contained within that handbook. The handbook presents body size information on military personnel and is suitable for human factors engineering applications and systems design.

Method

The data for the U.S. Army AEDR anthropometric measurements initially were gathered at aviation physical examination facilities for approximately a 1-year period from June 1986 to June 1987. The data was gathered for 1 year in an attempt to measure as many aviators as possible during their annual FDME, and minimize the number of aviators who would be measured twice. A team from Biodynamics Research Division, USAARL went to several of the most active physical examination facilities and taught the technicians the correct method of taking the measurements. After June 1987, per U.S. Army aeromedical consultant advisory panel policy letter 11-87, the only linear anthropometric measurements required on the FDME were leg length (crotch height), total arm reach (arm span), and sitting height.

A class 1 or 1A physical examination is a prerequisite for entry into Army flight training. Leg length, total arm reach, and sitting height are gathered on all class 1 and 1A FDME at all examination facilities. Before entering flight training, all new flight students receive a repeat class 1 or 1A FDME after arriving at Fort Rucker. Leg length, total arm reach, functional arm reach, and sitting height are measured during repeat class 1 and 1A flight physicals. All pilots receive a class 2 or 2A flight physical annually after receiving their aeronautical rating. There are no required anthropometric measurements for class 2 or 2A FDME.

The 20 anthropometric fields in the AEDR are listed in Table 1. Each anthropometric dimension is explained in Appendix A. Height (stature) and weight are considered anthropometric measurements within this study.

Table 1.
Anthropometric measurements
within the AEDR

Bitragion-coronal arc	Head breadth
Butt-heel length	Head circumference
Butt-knee length	Head length
Chest circumference	Height (stature)
Crotch height (leg length) circumference	Hip (buttock)
Foot circumference (ball)	Sitting height
Foot length	Total arm reach (arm span)
Functional arm reach circumference	Vertical trunk
Hand circumference	Waist circumference
Hand length	Weight

The anthropometric measurements were taken from the AEDR database using a utility computer program which extracts the data from specified fields within specified records and stores it in a separate file for later analysis. This reduces the amount of data manipulated and speeds processing. The selected data were then analyzed using SPSS-X.*

Initial examination of the data showed a number of extreme values. We assumed these were errors in measurement, recording, or transcription. Because the data were gathered at many sites other than Fort Rucker, the original documents on which the data were recorded had been returned to the aviators' medical records. It was impractical, if not impossible, to call the individual in to have a suspect measurement repeated. Values for the lower and

* See manufacturers' list

higher percentiles are most affected by extreme values, as is the standard deviation. In order to avoid including erroneous data in the analysis and generating misleading values for the percentiles and the standard deviation, range limits were established for each anthropometric measurement except two, and data which fell outside of those range limits were not included in the analysis. Range limits for this study were derived by selecting the minimum and the maximum value of each anthropometric measurement from any of the cited studies within the DoD military handbook-743. Elimination of extreme values in this manner may have excluded some valid data points and may be a limitation on application of this study to exceptionally large or small aviators. The two measures that had no range limits were total arm reach and butt-heel length. Total arm reach is a measurement unique to the Army, therefore, there is no comparable measure in DoD data. The butt-heel length measurement was not depicted within the DoD military handbook-743, therefore, no DoD comparisons were made. On these two measurements, all data were included in the analysis.

As of the 1st Quarter, FY 89, the AEDR currently had approximately 110,000 records (flight physicals) of several different classes (1, 1A, 2, 2A, etc.). Only records with values 1, 1A, 2 and 2A in field "CLAS" (class of FDME) were selected for analysis. This restricts the analysis to measurements done on officer, enlisted, and civilian applicants to flight school, whether selected for training or not, and rated aviators.

Each annual FDME is recorded as a separate record, and many individuals have more than one record in the AEDR. In order to have each individual represented only once in the analysis, the earliest entry in each field was selected, regardless of which record the entry was in. This means that, for some individuals, not all measurements were performed at the same time, or by the same observer.

For male applicants, anthropometric data were available on approximately 22,000 individuals and for female applicants, approximately 800 individuals. For male pilots, anthropometric data were available on approximately 29,000 individuals and for female pilots, approximately 600. This study included data from all components of the Army: active duty, reserve, and national guard.

The descriptive statistics calculated for each measurement were the mean (X), standard deviation (SD) and the 1, 5, 50, 95, and 99 percentiles (%).

The AEDR data are displayed in Tables 2 - 21 with five DoD studies cited within the DoD military handbook-743.

Summary statistics and descriptions of dimensions for the variables in the 1967 male USAF study were reported in A review of anthropometric data of German Air Force and United States Air Force personnel, 1967-1968, edited by H.J. Grunhofer and G. Kroh, published in AGARD-AG-205, 1975. These findings are labeled "USAF pilots, 1967" (Tables 2-21).

The 1970 U.S. Army male study was reported in Anthropometry of U.S. Army aviators - 1970 by Churchill, et al. These findings are labeled "USA aviation personnel, 1970."

The 1964 U.S. Navy male study was reported by Gifford, et al., in Anthropometry of naval aviators - 1964 and these findings are labeled "USN aviation personnel, 1964."

The first cited study involving females is the 1968 USAF reported by Clauser, et al., in Anthropometric survey of Air Force women - 1968. These findings are labeled "USAF women, 1968."

The 1977 USA female study was reported by Churchill, et al., in Anthropometry of women of the U.S. Army - 1977. Report no 2. The basic univariate statistics. These findings are labeled "USA women, 1977."

Results and discussion

The results of the 20 anthropometric measurements are illustrated in the following tables. The order of presentation is alphabetized and follows the same sequence as Appendix A. Each table has two distinct sections. The upper section describes the measurement and its definition, along with a pictorial display of the measurement.

The lower section shows the sample, date, and the descriptive statistics of the measurement. The data are aggregated on the sex of the individual and on the class of the FDME, grouping classes 1 and 1A together, and 2 and 2A together. "Applicants" refers to data from class 1 or 1A FDME. "Pilots" refers to data from class 2 or 2A FDME. The other referenced studies with which the AEDR data are displayed remain constant throughout the tables, unless specifically noted within the text. The mean (X) and standard deviation (SD) are rounded to the nearest tenth. The 1, 5, 50, 95 and 99 percentiles (%) also are presented. Values for the percentiles are truncated to whole units.

Table 2 depicts the bitragion coronal arc (BCA) measurement. The BCA was not portrayed in the 1977 USA women's study.

Table 3 presents the butt-heel length measurement. There were no other comparable studies containing this measurement within the DoD military handbook-743.

Table 4 illustrates the butt-knee length.

Table 5 depicts the chest circumference measurement. For both male and female AEDR personnel, the chest circumference appears to be slightly smaller (mean and percentile) than the other referenced DoD studies. Other studies within the NASA anthropometric source book: volume II indicate considerable variability of this measurement. There appear to be differences in measurement techniques, specifically regarding when the measurement is taken during the breathing cycle. For example, some studies measured the chest at either the respiratory relaxation point or inhalation point. Other studies measured the average between inhalation and exhalation points. In the AEDR data, the point in the respiratory cycle at which the measurement was taken is unspecified.

The crotch height (leg length) is illustrated in Table 6.

Table 7 presents the foot circumference (ball), Table 8 depicts the foot length, and Table 9 shows the functional arm reach (thumb-tip) measurement.

The hand circumference measurement is illustrated in Table 10 and the hand length in Table 11.

Tables 12, 13, and 14 depict the measurements of head breadth, head circumference, and head length respectively.

In Table 15, the anthropometric measurement of height (stature) is presented. Caution should be exercised when interpreting this table. It appears the U.S. Army AEDR pilots and applicants are slightly larger than the other services, except for the 1970 U.S. Army male study. However, from 1983 to 1987, the Army had a minimum initial flight entry height requirement of 64 inches (162.6 cm) and a maximum height requirement of 76 inches (193 cm). Beginning about July 1987, the minimum and maximum height requirements were revoked and linear anthropometric standards were established (U.S. Army aeromedical consultant advisory panel policy letter 11-87). The linear measurements for initial entry into flight training were established at: minimum total arm reach-164 cm; minimum leg length-75 cm; and maximum sitting height-102 cm. The previous years minimum/maximum height requirements, combined with the current linear measurement selection policy, could have resulted in selection bias in this data sample.

Table 16 depicts the hip anthropometric measurement.

The sitting height measurement is presented in Table 17. The possible effect of regulatory selection bias on descriptive statistics and interpretation for this measurement is similar to the height (stature) data in Table 15.

Total arm reach (arm span) is illustrated in Table 18. This anthropometric measurement is somewhat unique to the U.S. Army, therefore, there were no other comparable studies within DoD military handbook-743. Since there were no studies from which to draw high and low values, minimum and maximum range limits were not established. Consequently, the descriptive statistics include all reported data, including suspect outliers.

Table 19 displays the vertical trunk circumference measurement.

The waist measurement is depicted in Table 20. There is considerable variability among several of the studies and no clear explanation for the variability.

The last anthropometric measurement presented is weight. The original data were collected in pounds and converted to kilograms for ease of comparison with other studies.

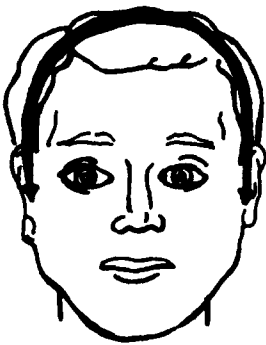


Table 2.

Bitracion coronal arc (BCA)

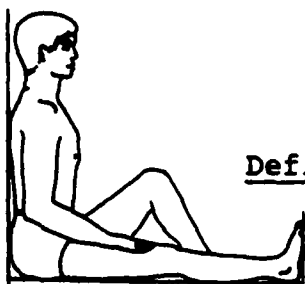
Definition: The distance from right to left tracion measured with the tape passing over the top of the head.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	35.4	1.8	30	33	35	38	39
USA AEDR pilots	1988	35.3	1.8	30	32	35	38	40
USAF pilots	1967	35.8	1.3	32	33	35	37	38
USA aviation personnel	1970	35.5	1.2	32	33	35	37	38
USN aviation personnel	1964	35.5	1.3	32	33	35	37	38
Females								
USA AEDR applicants	1988	34.0	1.7	30	31	34	37	38
USA AEDR pilots	1988	35.8	1.9	29	31	34	37	38
USAF women	1968	34.0	1.4	30	31	33	36	37
USA women	1977	**						

* Data given in centimeters.

** Data not depicted in DoD handbook-743.

Table 3.



Butt-heel length

Definition: The distance from the base of the heel to a wall against which the subject sits erect with his leg maximally extended forward along the sitting surface.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	106.9	7.5	93	98	107	117	121
USA AEDR pilots	1988	106.0	7.0	93	97	106	115	119
USAF pilots	1967	**						
USA aviation personnel	1970	**						
USN aviation personnel	1964	**						
Females								
USA AEDR applicants	1988	100.3	5.2	85	92	100	108	110
USA AEDR pilots	1988	99.2	5.5	83	89	99	108	111
USAF women	1968	**						
USA women	1977	**						

* Data given in centimeters.

** Data not depicted in DoD handbook-743.



Table 4.

Butt-knee length

Definition: The horizontal distance from the rearmost surface of the buttocks to front of the kneecaps, measured with the subject sitting.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	61.0	3.1	54	56	61	66	68
USA AEDR pilots	1988	61.0	3.1	54	56	61	66	69
USAF pilots	1967	60.4	2.7	54	56	60	65	67
USA aviation personnel	1970	60.2	2.6	54	55	60	64	66
USN aviation personnel	1964	61.2	2.5	55	57	61	65	67
Females								
USA AEDR applicants	1988	57.8	2.6	52	53	58	62	64
USA AEDR pilots	1988	57.8	2.7	51	53	58	63	64
USAF women	1968	57.4	2.6	51	53	57	61	63
USA women	1977	57.8	3.0	51	53	57	63	65

* Data given in centimeters.

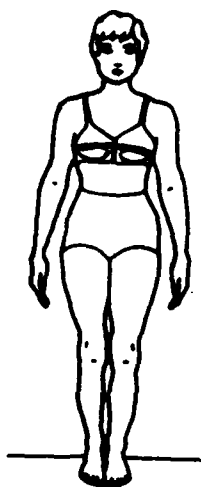


Table 5.

Chest circumference

Definition: The circumference of the torso measured at nipple level.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	94.5	5.7	82	85	94	104	109
USA AEDR pilots	1988	94.7	5.6	82	86	95	104	108
USAF pilots	1967	98.5	6.3	84	88	98	109	114
USA aviation personnel	1970	98.4	6.9	84	87	98	109	115
USN aviation personnel	1964	98.8	5.8	85	89	98	108	114
Females								
USA AEDR applicants	1988	85.5	5.0	75	78	85	95	99
USA AEDR pilots	1988	85.2	5.1	72	76	85	95	99
USAF women	1968	89.7	5.7	78	81	89	100	106
USA women	1977	88.2	6.4	76	78	87	99	105

* Data given in centimeters.

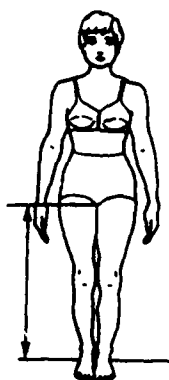


Table 6.

Crotch height (leg length)

Definition: The vertical distance between the standing surface and the mid point of the crotch.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	84.1	4.7	74	76	84	92	96
USA AEDR pilots	1988	83.8	5.0	72	76	84	92	96
USAF pilots	1967	85.1	4.1	75	78	85	92	94
USA aviation personnel	1970	81.9	4.4	72	74	81	89	92
USN aviation personnel	1964	84.4	4.1	75	77	84	91	93
Females								
USA AEDR applicants	1988	79.7	4.2	71	73	79	87	91
USA AEDR pilots	1988	79.6	4.5	70	73	79	88	91
USAF women	1968	74.5	4.0	65	68	74	81	84
USA women	1977	76.4	4.4	66	69	76	83	86

* Data given in centimeters.

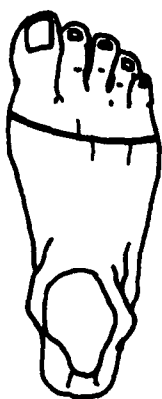


Table 7.

Foot circumference (ball)

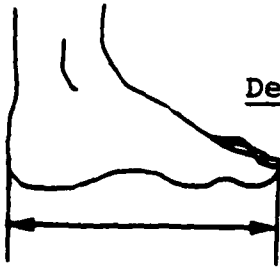
Definition: The maximum circumference of the foot measured around the distal ends of the protuberance of the metatarsal bones.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	24.3	1.4	21	22	24	27	28
USA AEDR pilots	1988	24.4	1.4	21	22	24	27	28
USAF pilots	1967	24.8	1.2	22	22	24	27	28
USA aviation personnel	1970	24.5	1.2	21	22	24	26	27
USN aviation personnel	1964	**						
Females								
USA AEDR applicants	1988	22.1	1.3	19	20	22	24	25
USA AEDR pilots	1988	22.1	1.2	19	20	22	24	25
USAF women	1968	**						
USA women	1977	22.6	1.1	20	20	22	24	25

* Data given in centimeters.

** Data not depicted in DoD handbook-743.

Table 8.



Foot length

Definition: The length of the foot measured parallel to its long axis.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	26.5	1.3	24	25	27	29	30
USA AEDR pilots	1988	26.6	1.3	24	25	27	29	30
USAF pilots	1967	27.0	1.2	24	25	27	29	29
USA aviation personnel	1970	26.5	1.3	23	24	26	28	29
USN aviation personnel	1964	26.6	1.2	24	24	26	28	29
Females								
USA AEDR applicants	1988	24.1	1.2	21	22	24	26	27
USA AEDR pilots	1988	24.1	1.2	21	22	24	26	27
USAF women	1968	24.1	1.1	21	22	24	26	26
USA women	1977	24.3	1.2	21	22	24	26	27

* Data given in centimeters.

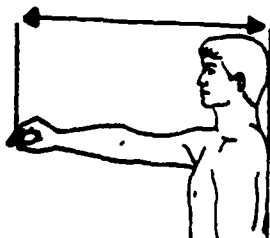


Table 9.

Functional arm reach (thumb-tip)

Definition: The horizontal distance from the back of a wall to the tip of the thumb, with both shoulders against the back wall and the right arm stretched, and the index finger touching the tip of the thumb.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males USA AEDR applicants	1988	78.1	5.3	67	70	78	87	92
USA AEDR pilots	1988	77.7	4.9	68	70	77	86	91
USAF pilots	1967	80.3	4.0	71	73	80	87	90
USA aviation personnel	1970	79.3	4.1	70	73	79	86	90
USN aviation personnel	1964	80.0	3.6	72	74	79	86	89
Females USA AEDR applicants	1988	72.3	4.9	62	65	72	81	86
USA AEDR pilots	1988	71.2	3.8	62	65	71	77	80
USAF women	1968	74.1	3.9	65	67	74	80	83
USA women	1977	**						

* Data given in centimeters.

** Data not depicted in DoD handbook-743.



Table 10.

Hand circumference

Definition: The circumference of the hand measured along the knuckles.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	21.2	1.2	18	19	21	23	24
USA AEDR pilots	1988	21.2	1.3	18	19	21	23	24
USAF pilots	1967	21.5	0.9	18	20	21	23	23
USA aviation personnel	1970	21.2	1.0	18	19	21	22	23
USN aviation personnel	1964	21.4	1.0	19	19	21	23	23
Females								
USA AEDR applicants	1988	18.4	1.1	15	17	19	20	21
USA AEDR pilots	1988	18.3	1.1	15	17	18	20	21
USAF women	1968	18.3	0.9	16	16	18	19	20
USA women	1977	18.4	0.9	16	17	18	19	20

* Data given in centimeters.

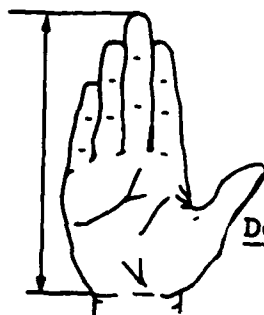


Table 11.

Hand length

Definition: The distance from the base of the hand at the wrist crease to the top of the middle finger measured along the long axis of the hand.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	19.3	1.1	17	18	19	21	22
USA AEDR pilots	1988	19.2	1.0	17	18	19	21	22
USAF pilots	1967	19.1	0.8	17	17	19	20	21
USA aviation personnel	1970	19.2	0.9	17	17	19	20	21
USN aviation personnel	1964	19.1	0.9	17	17	19	20	21
Females								
USA AEDR applicants	1988	17.8	1.0	15	16	18	19	20
USA AEDR pilots	1988	17.6	1.0	15	16	18	19	20
USAF women	1968	18.4	1.0	16	16	18	20	20
USA women	1977	17.4	0.9	15	16	17	19	19

* Data given in centimeters.

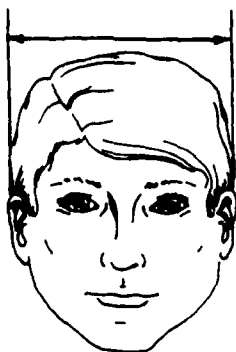


Table 12.

Head breadth

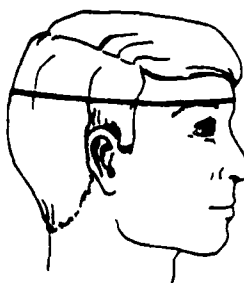
Definition: The maximum breadth of the head.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	15.0	0.8	13	14	15	16	17
USA AEDR pilots	1988	14.9	0.7	13	14	15	16	17
USAF pilots	1967	15.6	0.5	14	14	15	16	16
USA aviation personnel	1970	15.3	0.5	14	14	15	16	16
USN aviation personnel	1964	15.6	0.5	14	14	15	16	16
Females								
USA AEDR applicants	1988	14.2	0.6	13	13	14	15	16
USA AEDR pilots	1988	14.2	0.6	13	13	14	15	16
USAF women	1968	14.5	0.6	13	13	14	15	16
USA women	1977	14.6	0.5	13	13	14	15	16

* Data given in centimeters.

Table 13.

Head circumference



Definition: The maximum circumference of the head measured with the tape passing above, but not including the brow ridges.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	56.7	1.6	53	54	57	59	60
USA AEDR pilots	1988	57.2	1.7	53	54	57	60	61
USAF pilots	1967	57.5	1.4	54	55	57	59	61
USA aviation personnel	1970	56.3	1.5	52	53	56	58	60
USN aviation personnel	1964	57.5	1.4	54	55	57	59	61
Females								
USA AEDR applicants	1988	54.8	1.6	51	52	55	57	59
USA AEDR pilots	1988	54.9	1.8	51	52	55	58	59
USAF women	1968	54.9	1.6	51	52	54	57	58
USA women	1977	54.9	1.6	51	52	54	57	59

* Data given in centimeters.

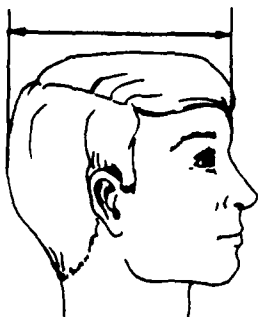


Table 14.

Head length

Definition: The maximum length of the head as measured from the glabella to the back of the head.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	19.4	0.9	17	18	19	21	22
USA AEDR pilots	1988	19.3	0.9	17	18	19	21	21
USAF pilots	1967	19.9	0.7	18	18	19	21	21
USA aviation personnel	1970	19.7	0.7	18	18	19	20	21
USN aviation personnel	1964	19.8	0.7	18	18	19	20	21
Females								
USA AEDR applicants	1988	18.4	0.8	15	17	19	20	20
USA AEDR pilots	1988	18.5	0.8	16	17	19	20	20
USAF women	1968	18.4	0.7	16	17	18	19	20
USA women	1977	18.7	0.7	17	17	18	19	20

* Data given in centimeters.

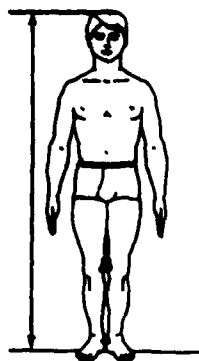


Table 15.

Height (stature)

Definition: The vertical distance between the standing surface and the top of the head.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	178.3	6.4	162	167	177	190	193
USA AEDR pilots	1988	179.0	6.3	165	170	180	190	193
USAF pilots	1967	177.3	6.2	163	167	177	187	191
USA aviation personnel	1970	174.6	6.3	160	164	174	185	190
USN aviation personnel	1964	177.6	5.9	165	168	177	187	191
Females								
USA AEDR applicants	1988	166.7	5.9	152	157	167	177	180
USA AEDR pilots	1988	167.0	5.9	154	157	167	177	180
USAF women	1968	162.1	6.0	149	152	162	172	176
USA women	1977	163.0	6.5	148	152	162	174	178

* Data given in centimeters.

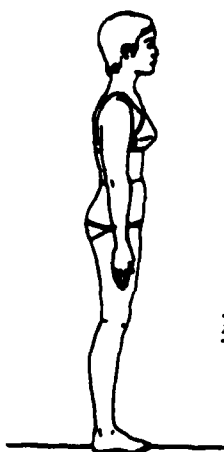


Table 16.

Hip (buttock circumference)

Definition: The circumference of the hips at the level of the maximum posterior protrusion of the buttocks measured with the subject standing.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	96.9	5.4	85	88	97	106	110
USA AEDR pilots	1988	97.4	5.4	85	89	97	106	111
USAF pilots	1967	98.6	5.5	86	89	98	107	112
USA aviation personnel	1970	97.8	6.5	84	87	97	108	113
USN aviation personnel	1964	98.0	5.0	86	89	98	106	110
Females								
USA AEDR applicants	1988	94.0	4.8	83	86	94	102	106
USA AEDR pilots	1988	94.2	4.7	83	87	94	102	106
USAF women	1968	95.3	6.0	82	85	95	105	112
USA women	1977	95.5	6.4	81	85	95	106	112

* Data given in centimeters.



Table 17.

Sitting height

Definition: The vertical distance from the sitting surface to the top of the head.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	92.3	3.8	82	86	92	98	100
USA AEDR pilots	1988	92.5	4.0	81	86	93	99	101
USAF pilots	1967	93.2	3.2	86	88	93	98	100
USA aviation personnel	1970	90.9	3.2	83	85	90	96	98
USN aviation personnel	1964	92.1	3.2	85	87	92	97	100
Females								
USA AEDR applicants	1988	87.6	3.4	79	82	88	93	96
USA AEDR pilots	1988	87.6	3.6	75	82	88	93	96
USAF women	1968	85.6	3.2	78	80	85	90	93
USA women	1977	85.0	3.6	76	79	85	90	92

* Data given in centimeters.

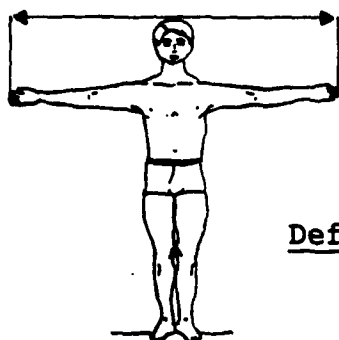


Table 18.

Total arm reach (arm span)

Definition: The horizontal distance between each fingertip of the out-stretched arms with the subject's back and arms flat against the wall.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	180.0	13.7	114	167	181	194	200
USA AEDR pilots	1988	180.3	14.1	88	168	181	194	200
USAF pilots	1967							
USA aviation personnel	1970							
USN aviation personnel	1964							
Females								
USA AEDR applicants	1988	165.6	13.6	73	154	166	179	185
USA AEDR pilots	1988	165.2	15.2	68	155	166	180	194
USAF women	1968							
USA women	1977							

* Data given in centimeters.

** This measurement is unique to the U.S. Army

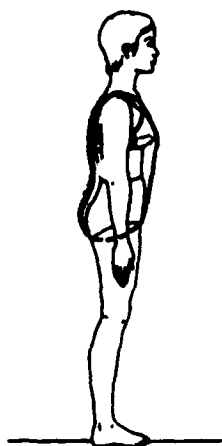


Table 19.

Vertical trunk circumference (standing)

Definition: The circumference of the torso measured with the tape passing diagonally across the front of the body from the midpoint of the shoulder to the crotch, through the crotch, over the posterior protuberance of the buttock and along the small of the back, with the subject standing.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	167.6	7.6	150	156	167	180	186
USA AEDR pilots	1988	168.1	7.7	150	156	168	181	187
USAF pilots	1967	168.1	7.2	151	156	167	180	185
USA aviation personnel	1970	169.4	7.6	152	157	169	181	187
USN aviation personnel	1964	167.3	6.6	152	156	167	178	183
Females								
USA AEDR applicants	1988	151.2	6.1	139	140	151	161	166
USA AEDR pilots	1988	152.0	6.1	136	142	152	161	168
USAF women	1968	154.4	6.9	140	143	154	166	172
USA women	1977	153.8	7.3	136	142	153	166	171

* Data given in centimeters.

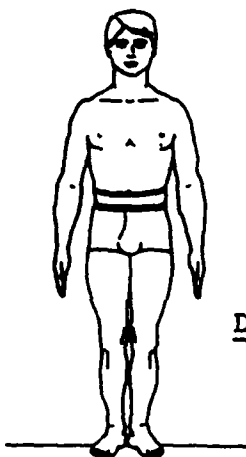


Table 20.

Waist

Definition: The circumference of the torso at waist level.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	80.8	6.3	67	71	81	92	97
USA AEDR pilots	1988	81.1	6.3	67	71	81	92	97
USAF pilots	1967	87.6	7.4	71	75	87	100	105
USA aviation personnel	1970	87.1	8.6	70	73	86	101	108
USN aviation personnel	1964	85.4	6.6	70	74	85	96	101
Females								
USA AEDR applicants	1988	68.6	6.7	57	59	68	80	97
USA AEDR pilots	1988	68.4	7.4	56	59	67	82	99
USAF** women	1968	67.2	5.5	57	59	66	77	84
USA** women	1977	71.0	6.9	59	61	70	83	92

* Data given in centimeters.

** Waist circumference at "natural" waist level. All other referenced studies at level of omphalion (navel).

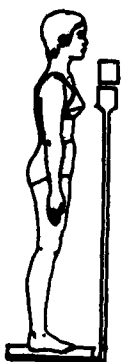


Table 21.

Weight

Definition: The amount of weight standing in the center of the scale wearing shorts.

Sample & reference	Survey date	Descriptive statistics*						
		$\bar{X}$	SD	1%ile	5%ile	50%ile	95%ile	99%ile
Males								
USA AEDR applicants	1988	75.3	9.0	56	61	75	90	98
USA AEDR pilots	1988	79.2	9.1	59	64	79	94	101
USAF pilots	1967	78.7	9.7	57	63	78	95	103
USA aviation personnel	1970	77.6	10.8	55	60	77	96	104
USN aviation personnel	1964	77.7	8.7	58	63	77	92	100
Females								
USA AEDR applicants	1988	59.4	6.4	46	49	59	70	78
USA AEDR pilots	1988	59.7	7.2	45	49	59	71	81
USAF women	1968	57.7	7.5	43	46	57	70	79
USA women	1977	60.0	8.7	42	46	59	74	83

* Data given in kilograms.

Conclusions

The AEDR was used as a repository for the anthropometric data reported in this study. This report was written as part of the data analysis portion of the AEDR project, and serves only to document the contents of this portion of the database. This documentation was accomplished by providing selected descriptive statistics for each anthropometric measurement within the AEDR on both male and female Army aviation personnel. The results of other anthropometric studies were provided so the reader could compare the AEDR data with that in other major anthropometric studies conducted by agencies within the Department of Defense. It was not the intent of this report to make a quantitative comparison of the cited studies, nor establish any type of anthropometric standards for mass body types or modeling efforts.

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Appendix A

Anthropometric dimension descriptions

Bitragion-coronal arc: The distance from right to left trasion measured with the tape passing over the top of the head.

Butt-heel length: The distance from the base of the heel to a wall against which the subject sits erect with his leg maximally extended forward along the sitting surface.

Butt-knee length: The horizontal distance from the rearmost surface of the buttocks to the front of the kneecaps with the subject sitting.

Chest circumference: The circumference of the torso measured at nipple level.

Crotch height (leg length): The vertical distance between the standing surface and the midpoint of the crotch.

Foot circumference (ball): The maximum circumference of the foot measured around the distal ends of the protuberances of the metatarsal bones.

Foot length: The length of the foot measured parallel to its long axis.

Functional arm reach (thumb-tip): The horizontal distance from the back of a wall to the tip of the thumb with both shoulders against the back of a wall and the right arm stretched, and the index finger touching the tip of the thumb.

Hand circumference: The circumference of the hand measured along the knuckles.

Hand length: The distance from the base of the hand at the wrist crease to the top of the middle finger measured along the long axis of the hand.

Head breadth: The maximum breadth of the head.

Head circumference: The maximum circumference of the head measured with the tape passing above, but not including the brow ridges.

Head length: The maximum length of the head as measured from the glabella to the back of the head.

Height (stature): The vertical distance between the standing surface and the top of the head.

Hip (buttock) circumference: The circumference of the hips at the level of the maximum posterior protrusion of the buttocks measured with the subject standing.

Sitting height: The vertical distance from the sitting surface to the top of the head.

Total arm reach (arm span): The horizontal distance between each fingertip of the out-stretched arms with the subject's back and arms flat against the wall.

Vertical trunk circumference: The circumference of the torso measured with the tape passing diagonally across the front of the body from the midpoint of the shoulder to the crotch, through the crotch, over the posterior protuberance of the buttock and along the small of the back with the subject standing.

Waist: The circumference of the torso at waist level.

Weight: The amount of weight standing in the center of the scale wearing shorts.

Appendix B

Glossary of selected terms

Glabella: The most anterior point of the forehead between the brow ridges in the midsagittal plane.

Midsagittal plane: The vertical plane which divides the body into right and left halves.

Metatarsal: One of the five bones in the foot.

Tragion: The superior point of the tragus (the cartilaginous flap in front of the ear).

Trochanterion: The highest point of the greater trochanter (a large, blunt bony process on the lateral side of the proximal end of the femur).

Appendix C

Manufacturers' List

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