Anthropometry of Saudi Arabian male workers

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Abstract

This paper presents the results of anthropometric data collected for Saudi male workers working in different occupations in Riyadh the capital city of the kingdom. A set of 15 body measurements are collected for 154 subjects aged 25-60. Anthropometric tables were constructed that can be utilized by designers, healthcare professionals and private and government agencies. It is believed that this is the first anthropometric study for the working men in the country and availability of such data will allow for safe and convenient work place design.

Keywords: Male, anthropometry, Saudi Arabia, ergonomics

1. Introduction

Anthropometry is the human science that deals with collecting and documenting human body measurements. Employing such data during the design stages would produce safer and more usable product (Pentikis, 2002). Anthropometry in product and workplace design has been applied by many researchers (Al-Ansari and Mokdad, 2009; Oyewole et al, 2010; Ghaderi et al, 2014; Reis et al, 2012; Sutalaksana and Widyanti, 2016). Anthropometric measurements are mainly varies by race and ethnicity. Anthropometric data have been collected for many countries. Examples of anthropometric studies for different countries can be seen in (Wang et al, 2002; Chuan et al, 2010; Hu et al, 2007; Iseri and Arslan, 2009; Kothiyal and Tettey, 2000; Barroso et al, 2005). Anthropometry was also used to design tools and equipment for different occupations as seen in (Agrawal et al, 2010; Dewangan et al, 2010; Chan and Jiao, 1996; Prado-Lu, 2007).

Saudi Arabia is one of the top twenty world economies and the world's leading oil exporter. The government undergoes many reforms to reduce its dependence on oil. Industrialization is one of the efforts exerted by the government to convert its wealth of crude oil into lasting industrial development. This initiative demanded the construction of infrastructure and a supply of the necessary devices, equipment and machinery from different parts of the world. Moreover, Oil wealth has increased the standard of living of most Saudis increasing the demands on importing consumer goods such as electronics and furniture from China, Russia, Europe and North America. Lack of anthropometric data will likely create a mismatch between the imported products and Saudi body sizes. Saudi Arabia like other developing countries has limited anthropometric data. There are some attempts to collect anthropometric data for different Saudi populations for product design applications (Al-Hazzaa, 1990; Alrashdan et al, 2014). Other studies were mainly conducted in the medical field as seen in (Al-Qattan et al, 2012; Al-Shehri et al, 2005).

The main objective of this study is to determine the anthropometric dimensions for Saudi male working population aged 25-65. The data was collected from individual working in different occupations. This study is believed to be the first to report Saudi body sizes for this age group.

2. Method

2.1 Subjects

One hundred and fifty four Saudi male living in Riyadh were selected to participate in the study. All subjects were informed in Arabic about the goal and procedure of the study. The subjects were 20-65 years of age. The age domain under study was divided into 5-year age groups. Seven different age groups were formed (20-25, 26-31, 32-37, 38-43, 44-49, and 50-55, 51-55, 56-65). 22 subjects for each group were selected to participate in the study. The subjects were professionals from different occupations. All subjects were participated in voluntary basis so fully randomized data was not quietly applicable. Subjects were recruited from public places such as hospitals, banks, fitness centers and public parks.

2.2 Body Dimension

The body measurements in standing and sitting postures are shown in Figure 1. Fifteen common anthropometric body dimensions were selected as reported in literature and relevant to engineering designs.
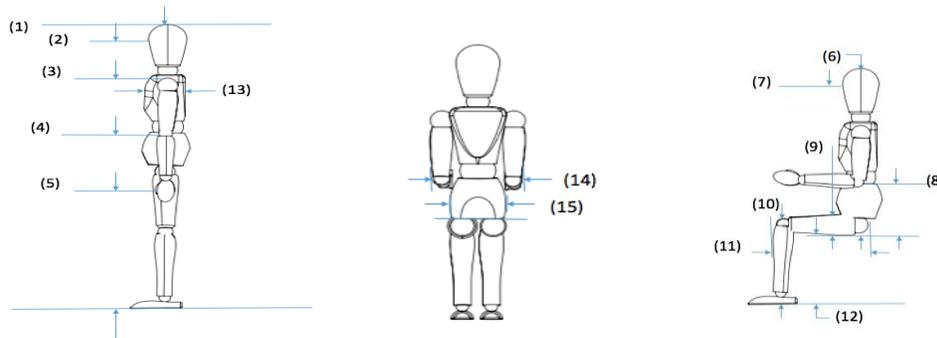

Figure 1. Body measurements in standing and sitting posture

2.3 Equipment

A kit which includes (Calipers, Segmometer, Tapes, measuring tapes and Stadiometer) from Ross Craft Anthropometric was used to collect the data.

2.4 Procedure

Three males were trained to take the measurements. The subjects were informed about the purpose of the study and procedure of taking the measurements and only one measurement was taken per body size. The subject was asked to stand straight against a wall to take the standing measurements. Adjustable chair was used to take the sitting measurement to insure subject's feet touching the floor while seated. The subjects wear the traditional clothing as shown in Figure 2. Measurements were recorded in centimeters.

Figure 2. Body measurements posture in traditional clothing

3. Results and Discussion

Descriptive statistics are used to describe the data in the study. The Mean and standard deviation of the standing and sitting posture measurements for each age group are shown in Table 1 and 2.

Table 1. Descriptive statistics for standing posture body measurements

Age Group	Mean/STD	stature height	eye height	shoulder height	elbow height	knuckle height	chest depth
I(20-25)	Mean	172.96	162.22	143.46	107.80	78.44	25.17
	STD	6.88	6.63	6.35	4.78	6.58	5.40
II(26-31)	Mean	174.20	162.85	140.84	108.01	78.55	25.24
	STD	7.59	8.10	8.35	9.16	9.30	3.43
III(32-37)	Men	175.48	162.27	143.62	108.98	79.90	26.15
	STD	6.83	4.41	7.43	5.79	6.18	2.88
IV(38-43)	Men	175.45	163.77	139.34	107.29	80.08	27.22
	STD	4.91	5.54	5.36	6.05	5.14	2.50
V(44-49)	Men	176.00	163.83	144.60	106.42	80.30	25.05
	STD	6.68	6.35	5.55	3.46	4.26	2.07
VI(50-55)	Men	176.05	164.38	143.36	106.31	80.33	24.92
	STD	3.56	3.25	4.21	2.75	2.91	2.41
VI(56-65)	Men	171.81	161.39	141.49	106.15	76.51	26.08
	STD	4.78	3.98	6.90	4.02	4.12	5.34

Table 2. Descriptive statistics for sitting posture body measurements

Age Group	Mean/STD	sitting height	eye height	elbow height	thigh clearance	knee height	buttock-knee length	popliteal height	elbow to elbow breadth	Hip breadth
I(20-25)	Mean	83.16	69.25	17.91	17.32	55.19	56.38	50.55	55.01	36.51
	STD	8.14	9.55	2.39	2.28	4.36	3.71	6.36	7.45	7.98
II(26-31)	Mean	82.91	67.26	18.93	17.87	56.31	53.37	53.52	48.84	32.51
	STD	6.55	7.29	2.58	2.89	7.28	7.41	7.94	8.58	10.97
III(32-37)	Men	84.85	72.41	19.54	17.42	57.39	54.50	51.65	47.91	34.57
	STD	5.31	5.09	2.27	3.58	4.87	4.96	6.11	5.37	5.92

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IV(38-43)	Men	82.88	70.17	18.75	18.90	56.82	55.75	53.51	49.16	35.49
	STD	4.11	4.07	1.25	2.38	3.57	3.50	5.81	3.96	5.78
V(44-49)	Men	83.78	72.18	18.29	17.17	56.15	56.41	53.32	58.01	35.53
	STD	4.32	6.07	1.77	2.34	2.00	4.27	4.12	5.37	3.54
VI(50-55)	Men	84.54	71.64	18.89	18.24	56.76	56.75	54.09	56.06	35.81
	STD	2.57	5.08	0.82	2.35	1.81	4.32	3.13	5.41	3.82
VI(56-65)	Men	82.22	68.46	18.52	20.00	54.70	54.78	50.49	47.10	33.79
	STD	2.38	5.25	1.14	6.94	4.00	3.00	5.51	5.18	3.34

The data suggests that the sample averages are changing with age. Figure 3 depicts the changes for the stature measurement. Other measurements have similar behavior. Using ANOVA, the means of all measurements were tested for any significant differences. The ANOVA results for the Stature measurement is shown in Table 3. The stature means of the 7 age groups are considered statistically equal (P=0.145 > α=0.05). The same conclusion was found for the other 14 measurements. Accordingly, the collected data of each measurement is combined and the results are presented using a standard anthropometric table as shown in in Table 4.
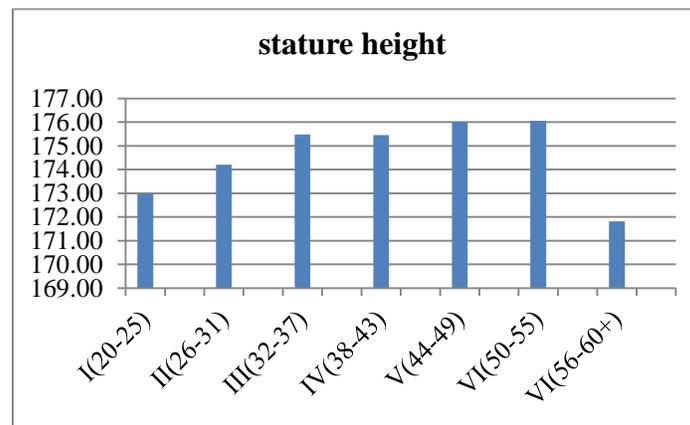

Figure 3. Average stature variations across age groups

Table 3. ANOVA output for stature

Source	DF	SS	MS	F	P
age-group	6	355.9	59.32	1.62	0.145
Error	147	5373.4	36.55		
Total	153	5729.3			

Table 4. Anthropometric table for the 15 body measurements

Body measurement	Mean	SD	5th	95th
1-Stature height	174.57	6.12	164.53	184.60
2-Eye height	162.96	5.66	153.67	172.25
3-Shoulder height	142.39	6.54	131.65	153.12
4-Elbow height	107.28	5.49	98.28	116.28
5-Knuckle height	79.16	5.86	69.54	88.77
6-Sitting height, erect	83.48	5.12	75.08	91.87
7-Eye height sitting	70.20	6.43	59.64	80.75
8-Elbow rest height	18.69	1.89	15.60	21.78
9-Thigh clearance height	18.13	3.66	12.13	24.13
10-Knee height	56.19	4.34	49.07	63.31
11-Buttock-knee length	55.42	4.70	47.71	63.13
12-Popliteal height	52.45	5.81	42.91	61.98
13-Chest depth	25.69	3.67	19.66	31.72
14-Elbow-to-elbow breadth	51.73	7.26	39.82	63.64
15-Hip breadth	34.89	6.44	24.32	45.46

4. Conclusion

Body dimensions of Saudi working males aged 20-65 years are presented. 15 standard body dimensions were collected. The subjects were arranged in 7 groups of 5 years a part to detect any measurement differences among subjects as age increases. It was found that the changes of means across age groups are not statistically significant for all of the 15 measurements. Consequently, data are combined for each measurement across all age groups. The extreme values (5th, 95th) percentiles were found and documented in a standard anthropometric table. Data is expected to be utilized by ergonomists to design safe and appropriately fit products for the Saudi males. Furthermore, this data is believed to be the first to present body dimensions for the age domain under study. It can be used a reference for future study.

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