

ORIGINAL ARTICLE

An Assessment of the Anthropometric Data of Iranian University Students

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ABSTRACT

Anthropometric data are used for proper design of workstation, equipment, furniture. Mismatch between anthropometric dimensions and consumer products may cause health problems in human body. In this study we measured anthropometric dimensions of Iranian university students in order to create a data bank for furniture design. The purpose was to measure some anthropometric dimensions of university students for furniture design. In this cross-sectional study, we measured 20 anthropometric dimensions of 911 university students aged 18-25 years (475 males and 436 females) in Iran. Their mean age (\pm standard deviation) was 20.45 ± 1.24 . Mean \pm SD weight was 70.14 ± 12.44 kg and 58.10 ± 8.63 kg in males and females, and mean \pm SD height was 1741.89 ± 63.09 mm and 1594.91 ± 59.88 mm, respectively. All dimensions measured were significantly different between two genders except for buttock-knee length. This study showed a significant difference between anthropometric dimensions of our population with other populations.

Keywords: Anthropometry, Ergonomics, Product Design, University Student

INTRODUCTION

Anthropometric data are used for proper design of workstation, equipment, furniture and so on in order to decrease awkward postures and stresses on human body due to improper design [1-3]. Mismatch between anthropometric dimensions and consumer products may cause such health problems in human body as musculoskeletal disorders, concentration deficit, and so on [4]. Some studies have shown a significant mismatch between consumer products and users' anthropometric dimensions [5, 6].

University students constitute a large group of people who spend a lot of time on the university chairs and desks in a static or awkward posture [4].

Schlossberg showed a high prevalence of neck and upper extremity complaints among university students [7]. A proper posture is an important factor for prevention of musculoskeletal disorders [8]. Therefore, anthropometric dimensions are very important for designing university furniture [9, 10].

There are some differences in anthropometric dimensions among different ages, genders, races, and ethnicities [11]. These dimensions may temporally differ by changes in nutritional status, socioeconomic situation and geographical factors, as well. Students' weight and height changed 1-4 kg and 6-12 cm after about 22 years [12]. So there is a need to update the measurement of anthropometric dimensions after a period of time. In some countries anthropometric dimensions are being updated after a period of time, for example each 10 years in Check Republic [13].

Many studies have been performed in different parts of the world for measuring anthropometric dimensions

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Table 1. Definition of anthropometric data

Anthropometric dimensions	Definition
Stature	Vertical distance from the floor to the vertex (i.e. the crown of the head)
Standing eye height	Vertical distance from the standing surface to the inner canthus of the eye
Standing shoulder height	Vertical distance from the standing surface to the shoulder
Standing elbow height	Vertical distance from the standing surface to the underside of the elbow
Arm length	Difference between shoulder height and elbow height..
Forearm length	Distance between acromion and tip of the middle finger.
Elbow-elbow distance	Distance between two acromions in standard sitting position
Shoulder width	Maximum shoulder width in standing position
Buttock width	Maximum buttock width in sitting position
One- thigh thickness	Maximum thickness of the thigh
Sitting popliteal height	Vertical distance from the floor to the popliteal angle at the underside of the knee where the tendon of the biceps femoris muscle is inserted into the lower leg
Sitting knee height	Vertical distance from the floor to the upper surface of the knee in sitting position
Sitting height	Vertical distance from the sitting surface to the vertex
Sitting eye height	Vertical distance from the sitting surface to the inner canthus of the eye
Sitting elbow height	Vertical distance from the seat surface to the underside of the elbow
Abdominal depth	Maximum horizontal distance from the vertical reference surface to abdominal front in sitting position.
Chest depth	Maximum horizontal distance from the vertical reference plane to the front of the chest in men or breast in women
Buttock-knee length	Horizontal distance from the back of the uncompressed buttocks to the front of the kneecap
Buttock-popliteal length	Horizontal distance from the back uncompressed buttocks to the popliteal angle, at the back of the knee, where the back of the lower legs meet the underside of the thigh

in different populations (students, university students, workers, *etc*), e.g. Bolstad in Norway [2], Lin et al. in east Asia [14], Barli in Turkey [15], Prado-Leon in Mexico [16], Rosnah in Malaysia [17], Deros in Malaysia [18] and Tunay in Turkey [19]. Some of these works were performed in university students, e.g. Deros et al. in Malaysia measured 12 anthropometric dimensions for chair and video display terminal (VDT) station design among university students [18].

The first study on anthropometric dimensions in Iran was performed on 9414 military personnel in 1968-69, where 68 anthropometric dimensions were measured and recorded [20]. Another study was performed on 179 university students in Tehran and 28 anthropometric dimensions were measured [21]. In a recent study in Iran, anthropometric data for designing school furniture was measured among 2030 primary school children [22].

We designed this study to measure important anthropometric dimensions of university students in Iran in order to use these data for university furniture design.

MATERIALS AND METHODS

In this cross-sectional study to measure some anthropometric dimensions, we studied university students aged 18-25 years in Iran.

Our sample included 911 cases (475 males and 436 females). Cases were selected by simple random sampling from students studying in Shahid Sadoughi University of Medical Sciences (394 persons), Yazd university (302 persons) and Azad university of Yazd (215 persons). Measurements were made from April 2010 till June 2010 in a 2 months period.

Nineteen static anthropometric dimensions were measured, including stature, elbow height (sitting and standing), sitting height, knee height (sitting), popliteal height (sitting), buttock-popliteal length, buttock-knee length, shoulder height (standing), eye height (sitting and standing), arm length, forearm length, buttock width, shoulder width, elbow-elbow distance, chest depth, abdominal depth, and one-thigh thickness. We chose those dimensions which are mostly used for furniture design. Dimensions were measured by an anthropometer designed by researchers and validated by a pilot study on 30 volunteer participants (accuracy: 5 millimeters, this device was composed of a flat surface with two perpendicular scaled plates); and a digital 75 cm calipers (LG, China, accuracy: 0.01 millimeters); which would have calibrated each week. Weight was measured by a digital weight scale (Laica, Italy, accuracy: 100 grams).

Table 1 shows the definition of anthropometric dimensions [23]. All measurements were conducted by trained technicians using similar techniques. Five

Table 2. Mean± SD and key percentiles of anthropometric dimensions in two genders

Dimension (mm)	Males					Females					p value
	Mean	SD*	5 th	50 th	95 th	Mean	SD	5 th	50 th	95 th	
1	1741.89	63.09	1635	1745	1835	1594.91	59.88	1493	1595	1697	<0.001
2	1624.58	66.81	1515	1630	1720	1473.07	61.35	1370	1470	1575	<0.001
3	1446.54	68.91	1345	1450	1545	1323.10	60.52	1228	1320	1412	<0.001
4	1079.66	47.61	1005	1080	1155	1008.32	56.55	908	980	1070	0.010
5	897.11	35.39	840	900	990	839.55	37.73	780	840	895	<0.001
6	778.03	40.18	715	775	840	716.20	365.60	655	715	775	<0.001
7	251.50	30.02	195	250	295	242.61	27.99	195	240	290	<0.001
8	537.54	27.23	495	540	580	486.87	38.56	448	485	527	<0.001
9	422.31	22.23	385	425	460	384.90	42.16	343	380	430	<0.001
10	470.32	31.06	420	470	515	461.59	31.92	415	460	517	<0.001
11	584.33	32.54	535	580	635	583.89	41.75	523	580	650	0.850
12	350.42	29.74	308	348	402	362.78	36.33	307	363	417	<0.001
13	428.28	43.03	365	425	507	379.01	37.14	327	377	441	<0.001
14	421.31	24.49	379	422	460	374.16	24.03	341	374	412	<0.001
15	135.19	20.98	106	133	170	118.82	27.27	88	116	151	<0.001
16	218.53	37.95	167	212	288	204.94	43.70	161	202	248	<0.001
17	217.23	24.13	182	214	264	223.49	27.03	187	223	273	<0.001
18	372.50	30.53	334	370	409	335.14	28.43	308	337	367	<0.001
19	471.74	26.49	428	472	510	424.86	27.99	390	425	461	<0.001

1: stature, 2: sitting eye height, 3: standing shoulder height, 4: sitting elbow height, 5: sitting height, 6: sitting eye height, 7: sitting elbow height, 8: sitting knee height, 9: sitting popliteal height, 10: buttock-popliteal length, 11: buttock-knee length, 12: buttock width, 13: elbow-elbow distance, 14: shoulder width, 15: thigh thickness, 16: abdominal depth, 17: chest depth, 18: arm length, 19: forearm length

* SD: standard deviation

percent of measurements were rechecked by another observer. All subjects wore light clothing without shoes. For standing dimensions, subjects were asked to stand upright on the base of the anthropometer, facing forward, and arms hanging beside the body. For sitting dimensions, subjects were asked to seat erect on a chair without armrests and rollers, with knees bent 90°, and feet flat on the surface, facing forward, and arms hanging beside the body [23].

Mean±SD and key percentiles were measured for each dimension. The measurements were compared between two genders. Data was analyzed using independent samples *t*-tests by SPSS (Ver. 18). For assurance of normal distribution of data we used Kolmogorov-Smirnov test.

RESULTS

Twenty anthropometric dimensions were measured in 911 university students (475 males and 436 females). Their mean age (±standard deviation) was 20.45±1.24 years. There was not any significant difference in age between two genders ($p=0.25$). Mean±SD of weight was 70.14±12.44 kg and 58.10±8.63 kg in males and females, respectively.

All dimensions measured were significantly different between two genders except for buttock-knee length. Table 2 shows descriptive statistics of the anthropometric dimensions and the comparison of them between two genders.

We compared the results of our study with the results of 4 other populations from Iran [21], Turkey [20], China [20] and Portugal [24]. Figs 1 and 2 compare four vertical dimensions (stature, eye height, knee height, popliteal length) between two genders, and figs 3 and 4 compare 3 horizontal dimensions (shoulder width, buttock width and buttock-knee length) between two genders.

DISCUSSION

Many studies have shown a mismatch between anthropometric dimensions and the furniture and equipment which are produced and used especially in schools and universities. It is documented that anthropometric dimensions differ by age, time, ethnicity and geographical area. In order to properly design equipment and furniture we should know the anthropometric characteristics of the target population. Therefore, measurement of anthropometric dimensions

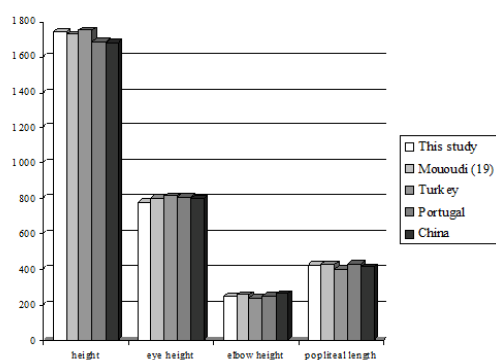


Fig 1. Comparison of some vertical dimensions among 4 populations in males

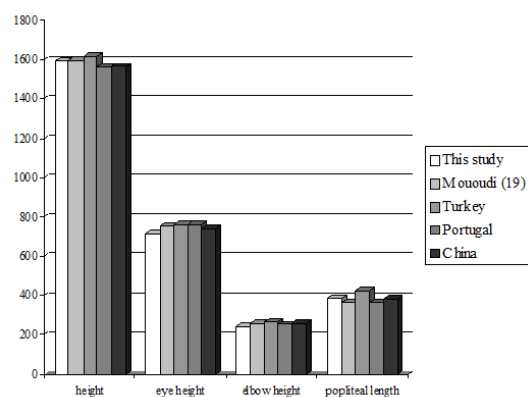


Fig 2. Comparison of some vertical dimensions among 4 populations in females

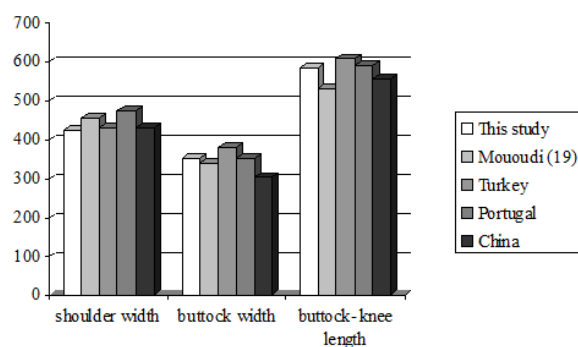


Fig 3. Comparison of some horizontal dimensions among 4 populations in males

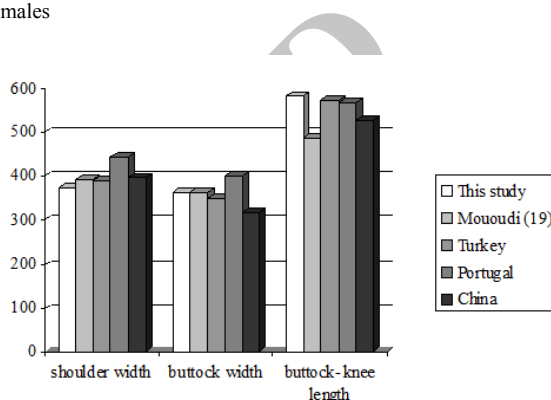


Fig 4. Comparison of some horizontal dimensions among 4 populations in females

is a critical issue in different populations, age groups and genders.

In this study, we measured anthropometric dimensions of university students in Yazd, Iran in order to create a data bank for future designs. These students were chosen from different ethnicities. This is the first wide sample anthropometric data of Iranian university students.

Nineteen anthropometric dimensions (especially those are used in the design of school furniture) were measured in 911 university students from three universities in Yazd. Most dimensions were significantly higher in males than females, but this difference was not significant in buttock-knee length which is probably due to higher fat tissue in females. Two dimensions were significantly higher in females than males (i.e. buttock width and chest depth, $p < 0.001$ for both), which is probably due to higher fat tissue and breast tissue in females.

In comparison with other countries we found some differences between the dimensions of our university students and university students in other countries. Our data was most similar to the Turk population with some minor differences (e.g. most vertical dimensions were higher in Turks but most horizontal dimensions were higher in our population) [15, 20]. Most dimensions were significantly higher in Portuguese subjects [24]. In comparison to Chinese population most dimensions

especially vertical dimensions were higher in our population [20]. These differences should be considered for designing and buying university furniture.

Repeating these kinds of studies will show temporal trends in Iranian people's anthropometric dimensions. Finally, due to changes in measures of the human body, this kind of study should be repeated periodically.

Our study had some limitations. Our samples were included subjects from different ethnicities in Iran, but we couldn't compare the dimensions between groups. We had two separate groups of technicians for measuring dimensions for males and females which may have affected the results, although we trained them and rechecked some of the measurements to reduce this bias.

The data of the current study derived from the 18-25 year-old university students can be used as measures in the design of furniture, especially chair and desk on which students spend a long time. These data also could be used for designing of other products.

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