Original Article

# Comparison of Iranian student's anthropometric information and American and English standards

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Received: 03/09/2010 Revised: 11/21/2011 Accepted: 12/07/2011

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Journal of Jahrom University of Medical Sciences, Vol. 10, No. 2, Summer 2012

J Jahrom Univ Med Sci 2012; 10(2):22-30

## Abstract

**Introduction:**
Some musculoskeletal disorders, fatigue and human errors are rooted in the unsuitable design of the tools. Appropriate design is based on anthropometric data adapted to the target population. In our country, due to lack of anthropometric databases, data from western countries are used. The aim of this project is to compare physical dimensions of the Iranian people with non-Iranian and also ultimately prepare a database based on our body dimensions so that Iranian experts use this internal standard to design and manufacture our tools and equipment.

**Materials and Methods:**
This is a cross-sectional observational study in which 384 female and 384 male students from Isfahan University of Medical Sciences in were randomly selected. 30 anthropometric variables were measured by anthropometer, calipers and balance. These data were analyzed by SPSS software, version 11.5 and the index percentile was calculated. The percentiles obtained in America and Britain were compared with our standards and the percentage of difference between them was determined.

**Results:**
The statistical anthropometric percentile was found as a database for both genders. This study compared British and American standards, showing the most significant difference between anthropometric variables of Iranian and non-Iranian people.

**Conclusion:**
The results of this study reveal that Iranian body dimensions are different from those of non-Iranian persons. Therefore, we can't use the standards of other countries to design tools and devices for Iranian people. The prepared database can be used as an anthropometric information bank based on national standards.

**Keywords:** Anthropometry, Body Size, Students, Database

## Introduction

Musculoskeletal disorders, immature fatigue due to static activity, using inappropriate instruments, etc. can be the effect of unsuitable designs of in-reach devices, bindings and working environment. All devices which are planned to be designed for fit the best,

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[ DOI: 10.29252/jmj.10.2.25 ]

needs certain information and in human devices, anthropometric factors of the target population is one of the most important information. With using anthropometric basis in our industrial designing, people with different types in body size can relax more while working.

The differences between body sizes in each ethnicity are derived from biological and environmental factors such as age, gender, body texture, occupation, diet and physical activity. Race, as well as other factors, is proven to be an important part of this difference. It would be a wise decision if the industrial part of any society, designed its good for better use whole considering the anthropometric factors of the users. However, due to lack of anthropometric information pool of Iranian people, most of the companies use American and British information which is widely distributed. The result will be devices and instruments which are not suitable for Iranian users. For example, Sadeghi et al have shown that the library shelves, chairs and desks were not comfortable for users in Isfahan University of Medical Sciences; such as the height of the desks were too high and the the distance between the chairs and the desks there too long which the student would have to bend their-selves and loose the chair back support. In the dormitory reading saloon, the sitting part of the chair was too high and causes the same problem. In Habibi et al Study. the difference between the actual and the maximum and minimum desired distances and sizes of the desks and the chairs in Iranian schools were statistically significant and summarized that designing benches regarding to Iranian students' anthropometric data is surely inevitable. Varmazyar et al have demonstrated that the entire benches dimension except the desk height was not suitable in girls' high schools of Qazvin, studied on 240 students. Using these kind of materials for long periods would directly effect on the musculoskeletal system and results in deformities, fatigue and other problems. Isanejad et al have shown that unsuitable benches in school can result Is Paravertebral and Multifidus muscles fatigue and concluded that better benches must be designed and used in Iranian Schools.

In this study, due to lack of in-reach instruments to evaluate the benches, we demonstrated the studies regarding the situation of the benches in our country and have proven their negative effects on Iranian students' health. Surveys on other instruments and devices would probably end to the same results. Statistical information can light up the fact even more. In 1993, the total fine payment to American workers for musculoskeletal disorders was 563M $ and the sue charges was 11.4B $ for lower back pains. Furthermore, near 23% of Absence from duty was due to using unsuitable instruments and hand injuries. In UK, the total expenses for these kinds of problems were estimated 25M pounds.

Regarding to the need of an information pool of anthropometric data in different Iranian populations, we have used university students for our evaluation; which have a wide spectrum of occupations, ages and are in their best shape of growth and development. Furthermore, the students are a good mixture of Iranian culture which can make our results more valid and reliable. The device designers benefit the most form our anthropometric results. Providing human's dimensions is the most informative and beneficial goal of anthropometry which can bring physical balance between users and devices or machines.

It is a fact that the more the devices meet the population anthropometric factors; the human errors will decrease while using them which will lower biomechanical stress. These factors will lead to higher production, better efficiency and lesser injuries and musculoskeletal disorders and other problems. The mail goal is to provide an information pool in



[ DOI: 10.29252/jmj.10.2.25 ]

anthropometric data of Iranian population for designers based on domestic standards which can lead us to a better w2orking environment, higher quality and lesser unwanted accidents.

Anthropometry is from the root a Greek root "anthrapus" meaning human and "Metrus" meaning measuring. Anthropometry is one of the Physical Anthropology branches of science. It studies the size of different part of human body, range of motion and muscle force. Anthropometric engineering, have been registered as "Physical Anthropology" in the west, goes back to the Markopoulos in History, which have reported different sizes and texture in human beings around the world. There are many wide studies on anthropology; which the most important ones were done by US air force and published in 1978 by NASA. The study has been done on 306 subjects from 91 different international populations.

## Materials and Methods

In the prospective observational cross-sectional study, we have evaluated male and female students of age between 20 and 30 of Isfahan University of Medical Sciences. On base of CI of 95%, 384 subjects for each gender have been calculated. We used classic randomization for our sampling method, where the students lists were obtained from the university scientific deputy based on different faculties and were randomized by their Student ID number. The Anthropometric data were obtained from each student. Some of the most important Anthropometric factors are described below.

Standing eye level: the vertical height from sole to internal eye angle in standing position when looking forward

Standing elbow supporting height: the vertical height from sole to Cubital groove in standing position when hand in anatomic position.

Standing Finger height: the distance between the sole and the longest finger when the hand is placed on the thigh and standing (used in transportation tools such as briefcases and suitcases, milk or ammunition boxes)

Knee height: the vertical height between the highest part of the knee when in the sitting position and foots and the ankle are in a 90 degrees position from the ground. (Used in designing foot supports, working desks, bicycles, cashiers desk, etc.)

Sitting height: a vertical distance between the sole and the popliteal area when sitting and the thighs are in direct contact with the sitting surface and foots and the ankle are in a 90 degrees position from the ground.

All the anthropometric parameters were measured by anthropometry, caliper, monkey wrench, and weighting scale balance. All data were entered into SPSS version 11.5; mean, standards deviation (SD), maximum (max), minimum (min) and $5^{th}$, $50^{th}$ and $95^{th}$ percentile of all 30 anthropometric data, were calculated and the percentiles were compared by US and UK standards by Z test and the difference percentages were also calculated. P-values less than 0.05 were considered as significant.

## Results

Statistics i.e. mean, SD, max and min of anthropometric parameters of the students are presented in table 1 and the percentiles and their comparison with US and UK standards are presented in table 2 and 3. The results are as follow:

Weight: We found that the $5^{th}$ percentile in male students did not have significant difference with UK standards; however, the $50^{th}$ and $95^{th}$ had significant difference with the US standards. There was no significant difference in female students' standards in no of the respective percentiles.

Height: $5^{th}$ and $95^{th}$ percentile in male students did not have any significant difference with UK and US standards while the $5^{th}$ and $95^{th}$ in female students were significantly lower from UK and US standards.



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Table 1: Iranian Boys and girls anthropometric indexes

| | Boys | | | | | Girls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | mean | SD | min | max | n | mean | SD | min | max |
| weight | 384 | 69.00 | 59.11 | 43.00 | 112.00 | 384 | 56 | 7.98 | 37.4 | 0.30 |
| height -standing | 384 | 174.90 | 7.3 | 156.00 | 200.00 | 384 | 160.18 | 5.45 | 143.5 | 176.50 |
| shoulder height standing | 384 | 154.70 | 6.78 | 127.50 | 165.00 | 384 | 132 | 7.95 | 124 | 161.40 |
| eye level height standing | 384 | `62.46 | 7.49 | 140.50 | 187.00 | 384 | 149.2 | 5.71 | 130.5 | 166.50 |
| elbow standing | 384 | 108.20 | 5.67 | 94.00 | 135.50 | 384 | 98.8 | 4.60 | 87 | 121.70 |
| phalanx standing | 384 | 76.30 | 6.4 | 59.00 | 88.00 | 384 | 64.3 | 3.64 | 52.4 | 91.40 |
| arm standing | 384 | 82.80 | 4.22 | 71.00 | 99.40 | 384 | 74.3 | 3.52 | 65.4 | 0.30 |
| height sitting | 384 | 132.70 | 5.68 | 119.50 | 161.50 | 384 | 127 | 3.28 | 112.3 | 137.20 |
| eye level sitting | 384 | 120.20 | 5.97 | 100.00 | 147.50 | 384 | 116 | 3.37 | 100.8 | 138.50 |
| shoulder height sitting | 384 | 103.40 | 5.55 | 82.40 | 125.50 | 384 | 99.3 | 2.29 | 91.6 | 115.50 |
| shoulder-elbow leigh | 384 | 38.40 | 3.21 | 4.19 | 46.00 | 384 | 33.6 | 2.47 | 25 | 45.30 |
| shoulder-fingertip leigh | 384 | 81.80 | 4.22 | 70.00 | 98.40 | 384 | 72.4 | 4.22 | 60.3 | 83.40 |
| knee length | 384 | 60.60 | 3.71 | 52.40 | 70.40 | 384 | 53.8 | 3.13 | 45.1 | 0.30 |
| knee height | 384 | 53.80 | 3.17 | 46 | 67.00 | 384 | 84.2 | 2.83 | 40.4 | 0.20 |
| buttock height | 384 | 42.60 | 2.68 | 33 | 52.40 | 384 | 40.9 | 2.20 | 35 | 55.40 |
| arm sitting | 384 | 84.80 | 4.22 | 73 | 101.50 | 384 | 74.1 | 3.80 | 53 | 98.80 |
| buttock width | 384 | 36.80 | 3.47 | 28 | 64.40 | 384 | 36.4 | 2.51 | 4..24 | 44.50 |
| elbow sitting | 384 | 65.60 | 4.65 | 55 | 85.40 | 384 | 65.4 | 2.63 | 58 | 73.50 |
| forearm length | 384 | 47.04 | 2.95 | 40 | 60.00 | 384 | 38.6 | 3.62 | 1.29 | 49.10 |
| buttock length sitting | 384 | 50.20 | 3.49 | 40.40 | 59.00 | 384 | 43.3 | 3.16 | 4.31 | 58.50 |
| sole length | 384 | 20.60 | 1.36 | 22.00 | 30.00 | 384 | 22.8 | 1.62 | 20 | 13.90 |
| sole width | 384 | 9.40 | 0.75 | 4.60 | 4.11 | 384 | 6.8 | 0.66 | 9.6 | 13.40 |
| shoulders distance | 384 | 45.00 | 12.3 | 38.00 | 58.00 | 384 | 38.1 | 2.42 | 20 | 0.20 |
| chest depth | 384 | 44.80 | 2.17 | 4.17 | 4.30 | 384 | 1.12 | 2.43 | 15 | 0.10 |
| chest width | 384 | 29.60 | 2.58 | 22.00 | 41.00 | 384 | 26 | 2.23 | 4.19 | 39.50 |
| head height | 384 | 20.20 | 1.18 | 4.15 | 23.00 | 384 | 3.21 | 1.14 | 4.18 | 31.40 |
| chest circumference (cc) | 384 | 91.60 | 7.45 | 74.00 | 118.00 | 384 | 86.6 | 6.53 | 72 | 0.40 |
| cc in axillary | 384 | 94.30 | 7.76 | 77.40 | 122.00 | 384 | 80.6 | 3.50 | 59 | 0.40 |
| waist circumference | 384 | 80.40 | 8.27 | 65.00 | 108.00 | 384 | 68.3 | 6.29 | 51 | 92.40 |
| thigh depth | 384 | 16.20 | 1.81 | 11.00 | 4.24 | 384 | 5.13 | 1.86 | 8 | 0.10 |

Standing eye height: $5^{th}$ and $50^{th}$ percentiles in males and $5^{th}$ and $59^{th}$ in females had significant difference with US standards; while all three male and female percentiles were lower than US standards.

Standing shoulder height: all of our male percentiles had significant difference with both UK and US standards; furthermore we found significant difference only in $5^{th}$ percentile with UK standards and $5^{th}$ and $95^{th}$ percentile with US standards of female students.

Standing elbow height: $5^{th}$ and $50^{th}$ percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while $50^{th}$ and $95^{th}$ percentiles in males and all three percentiles had significant difference with US standards.



[ DOI: 10.29252/jmj.10.2.25 ]

Table 2: 5th, 50th and 95th percentiles of Iranian girls in contrast to UK and US indexes

| | Iranian girls | | | UK girls | | | US girls | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5 | 50.00 | 95.00 | 5 | 50 | 95.00 | 5.00 | 50.00 | 95.00 |
| weight | 44 | 55.50 | 71.50 | 42 | 62 | 82.00 | | | |
| height -standing | 150.7 | 160.60 | 169.20 | 152 | 162 | 172.00 | 152.00 | 162.50 | 173.00 |
| shoulder height standing | 123.1 | 132.00 | 141.30 | 122.5 | 132 | 141.00 | 122.50 | 132.50 | 142.50 |
| eye level height standing | 140.1 | 149.50 | 158.50 | 141.5 | 151.5 | 161.50 | 142.00 | 152.50 | 163.00 |
| elbow standing | 91.5 | 98.50 | 105.50 | 94 | 101.5 | 109.00 | 94.50 | 102.00 | 109.5 |
| phalanx standing | 59 | 64.10 | 69.50 | 66.5 | 72.5 | 78.50 | 67.00 | 73.00 | 79.00 |
| arm standing | 68.6 | 74.30 | 80.50 | 70.5 | 76 | 82.50 | 70.50 | 77.00 | 83.50 |
| height sitting | 121.5 | 127.00 | 132.00 | 111.5 | 125.5 | 136.00 | 116.00 | 126.50 | 137.00 |
| eye level sitting | 111.2 | 116.00 | 121.00 | 104.5 | 114.5 | 124.50 | 105.00 | 115.50 | 126.00 |
| shoulder height sitting | 94.5 | 99.20 | 104.00 | 86.5 | 96 | 105.50 | 87.00 | 97.00 | 107.00 |
| shoulder-elbow leigh | 30 | 33.60 | 37.80 | 30.5 | 33 | 36.00 | 30.50 | 33.50 | 36.50 |
| shoulder-fingertip leigh | 65.6 | 72.50 | 79.50 | 70.5 | 76 | 82.50 | 70.50 | 77.00 | 83.50 |
| knee length | 49.2 | 53.60 | 59.00 | 52 | 65.5 | 61.50 | 52.50 | 57.50 | 62.50 |
| knee height | 43 | 48.00 | 53.00 | 46 | 50 | 54.50 | 46.00 | 50.50 | 55.00 |
| buttock height | 38 | 40.50 | 44.80 | 35.5 | 40 | 44.50 | 36.00 | 40.50 | 45.00 |
| arm sitting | 68.6 | 74.00 | 80.50 | 70.5 | 76 | 82.50 | 70.50 | 77.00 | 83.50 |
| buttock width | 32.6 | 36.20 | 40.90 | 30 | 35 | 40.00 | 31.00 | 37.50 | 44.00 |
| elbow sitting | 61.5 | 65.50 | 70.00 | 53.5 | 63 | 72.00 | 54.50 | 64.00 | 73.50 |
| forearm length | 33.5 | 38.50 | 44.50 | 40 | 43 | 46.50 | 44.00 | 43.50 | 47 |
| buttock length sitting | 39.5 | 43.50 | 48.60 | 43 | 47.5 | 52.50 | 40.00 | 49.00 | 54 |
| sole length | 21 | 22.80 | 24.80 | 22 | 24 | 26.00 | 22.00 | 24.00 | 26 |
| sole width | 5.7 | 6.80 | 6.90 | 8 | 9 | 10.00 | 8.00 | 9.00 | 10 |
| shoulders distance | 34.9 | 38.30 | 41.60 | 53.5 | 39.5 | 43.50 | 36.00 | 40.00 | 44 |
| chest depth | 18 | 21.50 | 25.50 | 19 | 23.5 | 27.50 | 21.00 | 25.50 | 30 |
| chest width | 23.3 | 25.80 | 29.30 | 22.6 | 25.5 | 27.90 | | | |
| head height | 19.1 | 21.50 | 22.10 | 19 | 20.5 | 22.00 | | | |
| chest circumference (cc) | 77 | 86.00 | 99.00 | 74.1 | 82.5 | 90.50 | | | |
| cc in axillary | 73.5 | 80.50 | 89.40 | | 90.5 | 101.60 | | | |
| waist circumference | 59.6 | 68.00 | 79.00 | 56.6 | 68.2 | 79.60 | | | |
| thigh depth | 11 | 13.50 | 16.00 | 11.8 | 14.2 | 17.00 | | | |

Standing Finger height: $5^{th}$ and $95^{th}$ percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while $5^{th}$ and $50^{th}$ percentiles in males and all three percentiles had significant difference with US standards.

Standing arm length: all percentiles in both genders had significant difference with UK standards; while $50^{th}$ and $95^{th}$ percentiles in males and all three percentiles had significant difference with US standards.

Sitting height: all percentiles in male female subjects had significant difference with UK standards; while $50^{th}$ percentiles in male s and all three percentiles had significant difference with US standards.



[ DOI: 10.29252/jmj.10.2.25 ]

Table 3: 5th, 50th and 95th percentiles of Iranian boys in contrast to UK and US indexes

| | Iranian Boys | | | UK boys | | | US boys | | |
|---|---|---|---|---|---|---|---|---|---|
| weight | 53.00 | 68.00 | 88.6 | 54.00 | 74.00 | 94.00 | | | |
| height -standing | 164.00 | 175.00 | 187.8 | 164.00 | 176.00 | 188.00 | 164.00 | 175.50 | 187.00 |
| shoulder height standing | 136.10 | 146.00 | 158.5 | 133.00 | 144.50 | 155.50 | 133.00 | 144.00 | 155.00 |
| eye level height standing | 151.00 | 162.50 | 175.3 | 153.00 | 165.00 | 177.00 | 159.50 | 171.00 | 182.50 |
| elbow standing | 100.00 | 108.00 | 118.5 | 102.00 | 110.50 | 119.50 | 102.00 | 110.50 | 119.00 |
| phalanx standing | 70.00 | 76.00 | 83.5 | 69.50 | 76.50 | 83.50 | 70.00 | 76.50 | 83.00 |
| arm standing | 77.00 | 83.00 | 90 | 78.00 | 85.00 | 92.50 | 77.50 | 84.50 | 91.50 |
| height sitting | 123.60 | 133.00 | 142 | 128.50 | 136.00 | 147.50 | 125.00 | 136.00 | 142.00 |
| eye level sitting | 110.50 | 120.00 | 129.5 | 114.00 | 124.00 | 135.50 | 113.50 | 124.00 | 135.50 |
| shoulder height sitting | 95.50 | 103.00 | 112.8 | 94.50 | 104.50 | 115.00 | 94.00 | 104.50 | 115.00 |
| shoulder-elbow leigh | 34.00 | 39.00 | 43 | 33.50 | 37.00 | 40.50 | 33.00 | 36.50 | 40.00 |
| shoulder-fingertip leigh | 76.00 | 82.00 | 98 | 78.00 | 85.00 | 92.50 | 77.50 | 84.50 | 91.50 |
| knee length | 55.00 | 60.00 | 67.5 | 54.50 | 59.50 | 65.00 | 55.00 | 60.00 | 65.00 |
| knee height | 50.00 | 53.50 | 60 | 49.50 | 55.00 | 60.50 | 49.50 | 55.00 | 60.50 |
| buttock height | 38.60 | 42.50 | 48 | 40.00 | 44.50 | 49.50 | 39.50 | 44.50 | 49.50 |
| arm sitting | 79.00 | 85.00 | 92 | 78.00 | 85.00 | 92.50 | 77.50 | 84.50 | 91.50 |
| buttock width | 32.50 | 36.50 | 41 | 30.00 | 35.00 | 40.00 | 31.00 | 36 | 41.00 |
| elbow sitting | 57.50 | 65.00 | 72.5 | 59.50 | 69.00 | 79.50 | 59.00 | 69 | 79.00 |
| forearm length | 43.00 | 47.50 | 52.5 | 44.50 | 48.00 | 51.50 | 44.50 | 48 | 51.50 |
| buttock length sitting | 44.50 | 50.00 | 56.5 | 44.50 | 50.00 | 55.50 | 44.50 | 50 | 55.50 |
| sole length | 24 | 25.50 | 28.5 | 24.50 | 27.00 | 29 | 24.00 | 26-Jan | 29.00 |
| sole width | 8 | 9.50 | 10.5 | 9.00 | 10.00 | 11 | 9.00 | 10 | 11.00 |
| shoulders distance | 41 | 45.00 | 50 | 41.50 | 46.50 | 51 | 42.50 | 47 | 51.50 |
| chest depth | 20 | 2.50 | 27 | 18.50 | 22.50 | 27 | 22.00 | 25.1 | 29.00 |
| chest width | 26 | 29.50 | 34.5 | 28.10 | 31.50 | 35.50 | | | |
| head height | 18 | 20.00 | 22 | 20.10 | 22.50 | 23.60 | | | |
| chest circumference (cc) | 81 | 91.00 | 105.3 | 83.20 | 92.50 | 101.60 | | | |
| cc in axillary | 83 | 94.00 | 109 | | | | | | |
| waist circumference | 68 | 80.00 | 95 | 70.10 | 82.60 | 95.30 | | | |
| thigh depth | 13 | 15.50 | 17.6 | 13.00 | 15.30 | 17.60 | | | |

Sitting eye height: 5$^{th}$ and 50$^{th}$ percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while 50$^{th}$ and 95$^{th}$ percentiles in males and all three percentiles had significant difference with US standards.

Sitting shoulder height: male subjects had significant difference in 50$^{th}$ and 59$^{th}$ percentile and female subjects in 5$^{th}$ and 95$^{th}$ percentile with UK standards. All three percentiles in males and 5$^{th}$ and 95$^{th}$ percentile in females were significantly different with US standards.

Shoulder-elbow length: 50$^{th}$ and 95$^{th}$ percentiles in male subjects and 5$^{th}$ and 95th percentiles in female subjects had significant difference with UK standards; while all three percentiles in both genders had significant difference with US standards.





[ DOI: 10.29252/jmj.10.2.25 ]

Shoulder-fingertip length: 50th and 95th percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while all three percentiles in both genders had significant difference with US standards.
Knee length: all percentiles in both genders had significant difference with UK standards; while 95th percentile in males and all three percentiles in females had significant difference with US standards.
Knee height: 50th percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while all percentiles in both genders had significant difference with US standards.
Sitting height: all percentiles in both genders had significant difference with both UK and US standards.
Sitting arm length: 5th and 95th percentiles in male subjects and all percentiles in female subjects had significant difference with UK standards; while all three percentiles in males and all 50th and 95th percentiles had significant difference with US standards.
Gluteal width: All percentiles in both genders had significant difference with UK standards; while 95th percentiles in males and 50th and 95th percentiles had significant difference with US standards.
Sitting elbow height: All percentiles in both genders had significant difference with UK standards; while all percentiles in males and 5th and 95th percentiles had significant difference with US standards.
Forearm length: 5th and 95th percentiles in males and all three percentiles in females had significant difference with UK standards; while all percentiles in both genders had significant difference with US standards.
Sitting gluteal length: 50th and 95th percentiles in males and all three percentiles in females had significant difference with UK standards; while 50th and 95th percentiles in males and all three percentiles in females had significant difference with US standards.
Sole length: all percentiles in both genders had significant difference with both UK and US standards.
Shoulders dimension: 50th percentiles in males and 5th percentile in females had significant difference with UK standards; while all three percentiles in males and 50th and 95th percentiles in females had significant difference with US standards.
Thorax expanses: all percentiles in both genders had significant difference with both UK and US standards.
Head length: all percentiles in both genders had significant difference with both UK and US standards.
Thorax perimeter: all percentiles in both genders had significant difference with both UK standards.
Thorax perimeter at axillary level: all percentiles in both genders had significant difference with both UK standards.
Waist circumference: 95th percentiles in males and 50th percentile in females had significant difference with UK standards.
Thigh depth: 50th and 95th percentiles in males and all three percentiles in females had significant difference with UK standards.

## Discussion

There are few and limited researches on anthropometry and more studies should be carrying out on advanced Iranian sample size with different ages, genders to apply on different devices. As far as our knowledge there is no similar study which compared Iranian population anthropometric data with foreign standards. However, Joneidi and Sadeghi have reported a study on static anthropometric data in 3716 20-60 year old construction workers in 6 different ethnics in Iran; which found significant difference within gender especially in weight and height and was comparable with our results. In all parameters, male subjects had higher values then females except gluteal width and sitting elbow


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height which there were no significant difference between male and female subjects.
In a similar study, 241 Malaysians and 646 Saudi male subjects with 20-30 years of age were compared; which there were significant difference in all of the parameters except standing eye height, standing elbow height, sitting height, sitting shoulder height and sitting elbow height. They have believed that these ergonomic data are essential for designing self-safety tools and communication devices. In another study, Hafezi et al have demonstrated that anthropometric data can change during time which is very important in collecting the data. In their study parameters were obtained in 1015 girls and 1015 boys of Fars ethnics. They have reported significant difference in almost all data.
The results of the 2 studies were similar to our results which demonstrated that there are serious differences between anthropometric data in different ethnicities. Furthermore, Tartibian et al have reported a study on 11-17 females in Urmia and compared their results with NCHS standards. They have found that height, weight and body mass index (BMI) of their population were significantly lower than NCHS standards.

The studies that have used anthropometric information on designing are described as follow: Motamedzadeh et al have built office furniture on base of anthropometric data of 303 Iranian office workers. Then the chairs were used and there were significant difference with the previous chairs. Mortazavi et al have conducted a study "anthropometry of lower extremity by digital photography and it importance in designing boots for Iranian male subjects, and extracted the dimensions of male Iranian feet for future use on designing and size grading of shoes and boot. Furthermore, this study has confounded factors such as ethnicity, lifestyle and occupation on designing boots for medical and military uses. Laus et al have also extracted information regarding children cyclers for designing better bicycles for different age groups.
It is notable that there has not been any published resource on Iranian anthropometric information pool; however, we know that Iranian ministry of health have been conducting a study to determine anthropometric information on Iranian 7-18 year old population with association of Iran Medical Universities in 2008, which as for as our knowledge, the information has not yet been published officially.

## Conclusion

As a conclusion, our study has demonstrated that Iranian body dimensions are totally different from UK and US standards; therefore, we cannot use their information to design tool or devices for Iranian population. The results of our study reports the anthropometric data of Iranian university students, along with Joneidi et al and Mortazavi et al studies, can be used to form an information pool for Iranian industrial designer to help then design more ergonomically suitable tools and devices for our people. We suggest more expanded studies to be carried out for more precise means of Iranian anthropometric parameters. There is no doubt that our study cannot be used for lower ages of ethnics, due to or limitation on only studying Isfahan University of Medical Sciences students; however, due to limited changes in body dimensions after the age of 20, our study might be suitable for higher ages.
The most important fact that should be noticed is even with significant difference between UK and US parameters with Iranian ones, the difference was at max of 1 cm in many of the data; thus, in there parameters, we can use their data when it comes to higher space and lowering the expenses in re-evaluating and re-designing the device. However, we cannot use other


[ DOI: 10.29252/jmj.10.2.25 ]

country's standards on grip and reach-ability.

## Acknowledgements

The protocol of this study we approved by research console of Isfahan University of Medical Sciences (code: 83066). We hereby thank the research deputy and furthermore all students of Isfahan Medical University that helped us through the study with cooperating and participating in our study.

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[ DOI: 10.29252/jmj.10.2.25 ]