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### An epidemiologic study on anthropometric dimensions of 7-11-year-old Iranian children: considering ethnic differences

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## An epidemiologic study on anthropometric dimensions of 7–11-year-old Iranian children: considering ethnic differences

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Anthropometric data can be used to identify the physical dimensions of equipment, furniture, clothing and workstations. The use of poorly designed furniture that fails to fulfil the users' anthropometric dimensions, has a negative impact on human health. In this study, we measured some anthropometric dimensions of Iranian children from different ethnicities. A total of 12,731 Iranian primary school children aged 7–11 years were included in the study and their static anthropometric dimensions were measured. Descriptive statistics such as mean, standard deviation and key percentiles were calculated. All dimensions were compared among different ethnicities and different genders. This study showed significant differences in a set of 22 anthropometric dimensions with regard to gender, age and ethnicity. Turk boys and Arab girls were larger than their contemporaries in different ages. According to the results of this study, difference between genders and among different ethnicities should be taken into account by designers and manufacturers of school furniture.

**Practitioner Summary:** In this study, we measured 22 static anthropometric dimensions of 12,731 Iranian primary school children aged 7–11 years from different ethnicities. Descriptive statistics such as mean, standard deviation and key percentiles were measured for each dimension. This study showed significant differences in a set of 22 anthropometric dimensions in different genders, ages and ethnicities.

**Keywords:** anthropometry; children; ethnicity; school furniture

### 1. Introduction

In order to properly design different products, it is important to have access to anthropometric dimensions of the potential users (Jeong and Park 1990, Kayis and Ozok 1991, Lin *et al.* 2004, Wickens *et al.* 2004, Liu 2007).

Inappropriate dimensions of furniture and other products which do not match the users' body dimensions may lead to many adverse effects (Kayis and Ozok 1991, Diep 2003, Lin *et al.* 2004, Milanese and Grimmer 2004, Geldhof *et al.* 2007). Children are among the populations at risk for musculoskeletal disorders as a result of incorrect posture, frequently caused by inappropriate school furniture (Freudenthal *et al.* 1991, Paulsen and Hensen 1994, Diep 2003). Many studies have shown a high prevalence of low back pain among school children (Burton *et al.* 1996, Grimes and Legg 2004).

Appropriate design according to the target user groups and identification of the most important body dimensions are key issues in the design process (Lee and Shin 2004). There is a high prevalence of mismatch between anthropometric data and school furniture which is a factor implicated in causing low back pain (Lin and Kang 2000, Milanese and Grimmer 2004, Gouvali and Boudolos 2006, Chung and Wong 2007, Savanur *et al.* 2007, Agha 2010, Musa and Ismaila 2011).

Anthropometric dimensions have been measured in many countries with different races or ethnicities (Snyder *et al.* 1977, Steenbekkers and Molenbroeka 1990, Bolstad *et al.* 2001, Prado-Leon *et al.* 2001, Wang *et al.* 2002, Diep 2003, Panagiotopoulou *et al.* 2004, Van Lierop *et al.* 2008). These dimensions widely vary with age, gender, race and ethnicity (Jeong and Park 1990, Shrestha *et al.* 2009, Hisham *et al.* 2012). The concept of ethnicity differs from the closely related term *race* in that 'race' refers to grouping based mostly upon criteria

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that in the past have been presumed to be biological, while 'ethnicity' also encompasses additional cultural factors (American Anthropological Association 1997). There may be different ethnicities in each race which are different with regard to their geographical, cultural, nutritional and economic properties. Various nations of the same race may also have different body sizes and bodily proportions due to the differences in social and economic environment (Lin *et al.* 2004). There have been remarkable changes in anthropometric dimensions due to geographical, cultural, genetic and environmental factors (Hamill *et al.* 1979, Jahanshahi *et al.* 2008, Tunay and Melemez 2008). Anthropometric dimensions in a population may change continuously (Bolstad *et al.* 2001). For example, body sizes of the UK child population have been changed over the past three decades (Smith and Norris 2004). Sirajuddin *et al.* (1994) found strong effects of geography on both anthropometry and genetics.

There are six ethnicities in different parts of Iran (i.e. Fars, Baluch, Kurd, Lor, Arab and Turk) each owning different cultural, economic and nutritional characteristics. They live in different parts of Iran. For example, Baluches live in a deprived area in southeast of Iran with a dry and hot climate, but Turks and Kurds live in a naturally rich area in west and northwest of Iran with cold and damp climate. It is said that Kurds and Turks have larger anthropometric dimensions than other ethnicities. So it is possible that there is a real difference in anthropometric dimensions among these ethnicities.

There is only one study in Iran about anthropometric data in one ethnicity with a limited sample size (Mououdi and Choobineh 1997).

### 1.1. Purpose

In countries lacking national anthropometric data, equipment, clothing, shoes and furniture design are based on anthropometric data from other countries which do not inevitably represent the body measurements of the real population. Therefore, this study was designed to measure some important anthropometric dimensions in Iranian population considering ethnic differences.

## 2. Material and methods

In a cross-sectional study to measure main anthropometric dimensions, we studied 7–11-year-old children in different ethnicities in Iran. The children were assigned in each age category according to the information of their identity card, e.g. a child was considered to be seven years old when he (she) was born in the year 1382 *Anno Persico* (between 21 March 2003 and 20 March 2004 AD).

Twenty-two static anthropometric dimensions were measured. Eleven dimensions, i.e. body height, sitting height, knee height (sitting), popliteal height (sitting), buttock–popliteal length, buttock–knee length, shoulder height (standing), eye height (sitting and standing) and elbow height (sitting and standing) were measured by six anthropometric boards designed by researchers. Its accuracy was  $\pm 0.5$  mm. Six anthropometric boards were manufactured and compared with a Martin's anthropometer. For comparison, the anthropometric dimensions of 30 subjects were measured by the manufactured boards and the Martin's anthropometer in the similar situations and the difference between the two devices in all measurements were not larger than 1 mm. Ten dimensions, i.e. arm length, forearm length, buttock width, shoulder width, elbow–elbow distance, forearm–forearm distance, chest depth, abdominal depth, one-thigh thickness and two-thigh thickness were measured by a digital 75 cm caliper (LG, China, accuracy:  $\pm 0.01$  mm); which was calibrated each week. Weight was measured by a digital weight scale (Laica, Italy, accuracy:  $\pm 100$  g).

The subject posture and the definitions of each anthropometric parameter (standing and sitting) were based on standard guidelines (Hertzberg 1968, Rempel and Janowitz 2007). Table 1 shows the definitions of anthropometric data which were measured in this survey. Figure 1 is a schematic illustration of the dimensions.

All measurements were conducted by trained, experienced technicians using similar techniques. All technicians were trained for measurement before the study. In order to ensure quality control, two recorders and an observer participated in all measurements in each centre, and dimensions were measured again for 7% of subjects in each centre by two other observers blinded to the previous measurements.

All subjects wore light clothing without shoes. For standing dimensions, subjects were asked to stand upright on the base of the anthropometric board, facing forward, and arms hanging beside the body. For sitting dimensions, subjects were asked to sit on a chair without armrests and rollers, with adjustable height, knees bent  $90^\circ$ , feet flat on the surface, facing forward, and arms hanging beside the body (Hertzberg 1968, Van't Loo 1975).

Table 1. Definition of anthropometric data.

| Anthropometric dimensions      | Definition  |
|--------------------------------|---|
| 1. Weight                      | Body weight   |
| 2. Body height                 | Vertical distance from the floor to the vertex (i.e. the crown of the head)   |
| 3. Eye height (standing)       | Vertical distance from the standing surface to the inner canthus of the eye   |
| 4. Shoulder height (standing)  | Vertical distance from the standing surface to the shoulder   |
| 5. Elbow height (standing)     | Vertical distance from the standing surface to the underside of the elbow   |
| 6. Arm length                  | Difference between shoulder height and elbow height   |
| 7. Forearm length              | Distance between acromion and tip of the middle finger  |
| 8. Forearm–forearm distance    | Maximum distance between two forearms   |
| 9. Elbow–elbow distance        | Distance between two acromions in standard sitting position   |
| 10. Shoulder width             | Maximum shoulder width in standing position   |
| 11. Buttock width              | Maximum buttock width in sitting position   |
| 12. One-thigh thickness        | Maximum thickness of the thigh  |
| 13. Two-thigh thickness        | Maximum two thigh thickness when right thigh rests over left thigh  |
| 14. Popliteal height (sitting) | 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         |
| 15. Knee height (sitting)      | Vertical distance from the floor to the upper surface of the knee in sitting position   |
| 16. Sitting height             | Vertical distance from the sitting surface to the vertex  |
| 17. Eye height (sitting)       | Vertical distance from the sitting surface to the inner canthus of the eye  |
| 18. Elbow height (sitting)     | Vertical distance from the seat surface to the underside of the elbow   |
| 19. Abdominal depth            | Maximum horizontal distance from the vertical reference surface to abdominal front in sitting position  |
| 20. Chest depth                | Maximum horizontal distance from the vertical reference plane to the front of the chest in men or breast in women   |
| 21. Buttock–knee length        | Horizontal distance from the back of the uncompressed buttocks to the front of the kneecap  |
| 22. 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 |

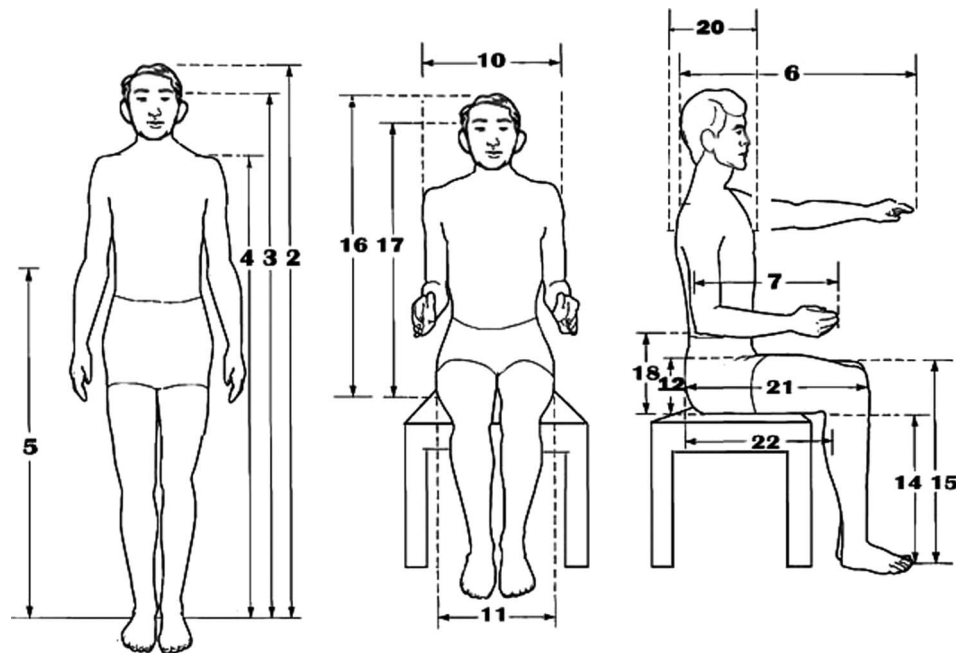


Figure 1. Schematic illustration of the anthropometric dimensions.

### 2.1. Subjects

The study sample included 12,731 subjects (6342 boys and 6389 girls) from six ethnicities (2101 Fars, 1998 Kurd, 2012 Lor, 2390 Baluch, 2211 Turk and 2019 Arab). Table 2 shows detailed information of the subjects. Measurements were made from 20 April 2009 to 12 February 2010.

Table 2. Detailed information of the subjects.

| Ethnicity | Age  |       |      |       |      |       |      |       |      |       | Total |
|-----------|------|-------|------|-------|------|-------|------|-------|------|-------|-------|
|           | 7    |       | 8    |       | 9    |       | 10   |       | 11   |       |       |
|           | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |       |
| Fars      | 214  | 206   | 211  | 210   | 210  | 200   | 218  | 206   | 216  | 210   | 2101  |
| Kurd      | 202  | 200   | 204  | 198   | 202  | 191   | 205  | 203   | 198  | 195   | 1998  |
| Lor       | 206  | 198   | 200  | 198   | 202  | 200   | 205  | 200   | 205  | 198   | 2012  |
| Baluch    | 228  | 229   | 244  | 240   | 251  | 235   | 243  | 236   | 245  | 239   | 2390  |
| Turk      | 217  | 223   | 227  | 219   | 221  | 217   | 224  | 217   | 224  | 222   | 2211  |
| Arab      | 205  | 200   | 200  | 202   | 206  | 199   | 204  | 199   | 207  | 197   | 2019  |
| Total     | 1272 | 1256  | 1286 | 1267  | 1292 | 1242  | 1299 | 1261  | 1295 | 1261  | 12731 |

Subjects were selected by multistage random cluster sampling from different parts of Iran. We selected a province as the representative of each ethnicity: Yazd (Fars), Sistan (Baluch), Kurdistan (kurd), Lorestan (Lor), Zanjan (Turk) and Khoozestan (Arab). In each province, persons who were native (those whose grandparents were from that ethnicity according to their parents' testimony) were selected; non-native children and those with doubtful ethnicity were excluded from the study.

We obtained an informed written consent from parents and oral consent from children after explanation of the procedure.

## 2.2. Analysis

Descriptive statistics and key percentiles (5, 50 and 95) were measured for each dimension with regard to gender, age and ethnicity. The measurements were compared between two genders in each age group. A comparison regarding ethnicity was also performed. Independent samples T-test was used for comparison of means between two genders and one-way ANOVA was used for the comparison of means among different ethnicities.

## 3. Results

In this study, 12,731 subjects (6342 boys and 6389 girls) aged 7–11 years in six ethnicities were assessed. Table 3 shows the means of 22 anthropometric dimensions in six different Iranian ethnicities.

Table 4 shows the key percentiles (i.e. 5, 50 and 95) for six most important anthropometric dimensions (i.e. weight, body height, standing eye height, standing shoulder height, standing elbow height and buttock-popliteal length) in different ethnicities.

The anthropometric dimensions were compared between males and females. Most dimensions were significantly different with regard to gender. Table 5 shows the comparison of dimensions regarding gender.

The dimensions of boys and girls in each age group were compared separately as well. There was a significant difference between ethnicities in all anthropometric dimensions regarding gender and age. *P* values for difference among ethnicities were less than 0.001 for all dimensions except for body height in 7-year-old girls ( $P=0.001$ ), body height in 11-year-old girls ( $P=0.001$ ), and sitting eye height in 11-year-old girls ( $P=0.004$ ).

## 4. Discussion

Today, measurement of anthropometric dimensions is one of the key steps for product design. Since age, gender and ethnicity are major contributors to these dimensions, for the preparation of anthropometric databases, it is important to consider these variables.

In this study, we gathered the anthropometric dimensions of children aged 7–11 years from different ethnicities in Iran. We found a significant difference between two genders in all age groups and all ethnicities.

This was the first large-scale study on anthropometric dimensions of different ethnicities in Iran. In this study, Turk boys had the highest weight and height in all age groups except for 7-year-old boys; in this age group Arab boys showed the highest weight. Among girls, weight was highest in Arabs in all ages, but Baluch girls and boys showed the lowest weight in all age groups.

Table 3. Mean of anthropometric dimensions in Iranian ethnicities.

| Dimensions                    | Sex<br>Age | Ethnicity |         |         |         | Lor     |         |         |         | Baluch  |         |         |         | Turk    |         |         |         | Arab    |         |         |         |
|-------------------------------|------------|-----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|                               |            | Fars      |         | Kurd    |         | Boys    |         | Girls   |         | Boys    |         | Girls   |         | Boys    |         | Girls   |         | Boys    |         | Girls   |         |
| Weight (kg)                   | 7          | 22.23     | 20.89   | 21.87   | 21.51   | 21.52   | 22.44   | 20.81   | 20.52   | 24.31   | 22.12   | 22.68   | 23.05   | 24.31   | 22.12   | 22.68   | 23.05   | 24.31   | 22.12   | 22.68   | 23.05   |
|                               | 8          | 25.45     | 23.83   | 24.60   | 24.00   | 25.50   | 25.50   | 23.50   | 22.82   | 28.05   | 24.29   | 25.67   | 27.07   | 28.05   | 24.29   | 25.67   | 27.07   | 28.05   | 24.29   | 25.67   | 27.07   |
|                               | 9          | 29.06     | 27.49   | 27.41   | 27.03   | 28.79   | 28.48   | 26.56   | 26.48   | 31.38   | 29.53   | 29.89   | 30.90   | 31.38   | 29.53   | 29.89   | 30.90   | 31.38   | 29.53   | 29.89   | 30.90   |
|                               | 10         | 31.09     | 30.23   | 30.51   | 31.80   | 33.96   | 32.19   | 28.75   | 28.94   | 35.26   | 32.93   | 33.35   | 33.60   | 35.26   | 32.93   | 33.35   | 33.60   | 35.26   | 32.93   | 33.35   | 33.60   |
|                               | 11         | 37.69     | 36.27   | 33.30   | 36.39   | 37.20   | 36.34   | 30.21   | 32.87   | 40.98   | 36.97   | 36.61   | 39.55   | 40.98   | 36.97   | 36.61   | 39.55   | 40.98   | 36.97   | 36.61   | 39.55   |
| Body height (mm)              | 7          | 1200.31   | 1175.49 | 1189.40 | 1193.60 | 1198.42 | 1198.67 | 1203.69 | 1201.64 | 1230.22 | 1198.77 | 1208.18 | 1203.68 | 1230.22 | 1198.77 | 1208.18 | 1203.68 | 1230.22 | 1198.77 | 1208.18 | 1203.68 |
|                               | 8          | 1268.06   | 1241.39 | 1246.72 | 1240.08 | 1255.76 | 1248.03 | 1257.54 | 1270.00 | 1292.93 | 1256.31 | 1266.14 | 1267.15 | 1292.93 | 1256.31 | 1266.14 | 1267.15 | 1292.93 | 1256.31 | 1266.14 | 1267.15 |
|                               | 9          | 1322.11   | 1297.51 | 1306.18 | 1299.95 | 1325.73 | 1309.38 | 1319.90 | 1330.56 | 1347.90 | 1325.34 | 1344.02 | 1329.26 | 1347.90 | 1325.34 | 1344.02 | 1329.26 | 1347.90 | 1325.34 | 1344.02 | 1329.26 |
|                               | 10         | 1358.75   | 1346.06 | 1353.51 | 1367.87 | 1389.41 | 1361.87 | 1356.40 | 1372.81 | 1399.95 | 1381.17 | 1383.78 | 1383.51 | 1399.95 | 1381.17 | 1383.78 | 1383.51 | 1399.95 | 1381.17 | 1383.78 | 1383.51 |
|                               | 11         | 1431.09   | 1428.14 | 1404.49 | 1431.62 | 1433.68 | 1426.51 | 1395.60 | 1424.12 | 1470.12 | 1442.12 | 1460.93 | 1450.52 | 1470.12 | 1442.12 | 1460.93 | 1450.52 | 1470.12 | 1442.12 | 1460.93 | 1450.52 |
| Standing eye height (mm)      | 7          | 1075.75   | 1064.58 | 1074.00 | 1079.82 | 1079.89 | 1068.01 | 1083.91 | 1077.87 | 1109.27 | 1080.01 | 1097.42 | 1096.18 | 1109.27 | 1080.01 | 1097.42 | 1096.18 | 1109.27 | 1080.01 | 1097.42 | 1096.18 |
|                               | 8          | 1149.69   | 1131.37 | 1128.07 | 1126.11 | 1138.88 | 1130.38 | 1146.95 | 1146.51 | 1174.43 | 1140.92 | 1161.46 | 1162.68 | 1174.43 | 1140.92 | 1161.46 | 1162.68 | 1174.43 | 1140.92 | 1161.46 | 1162.68 |
|                               | 9          | 1201.82   | 1189.45 | 1190.11 | 1188.76 | 1209.81 | 1185.69 | 1202.01 | 1205.94 | 1230.50 | 1209.98 | 1237.10 | 1219.64 | 1230.50 | 1209.98 | 1237.10 | 1219.64 | 1230.50 | 1209.98 | 1237.10 | 1219.64 |
|                               | 10         | 1241.68   | 1235.81 | 1234.15 | 1252.57 | 1273.09 | 1241.40 | 1241.88 | 1259.56 | 1284.38 | 1264.84 | 1276.04 | 1275.80 | 1284.38 | 1264.84 | 1276.04 | 1275.80 | 1284.38 | 1264.84 | 1276.04 | 1275.80 |
|                               | 11         | 1316.55   | 1316.30 | 1283.45 | 1314.47 | 1315.25 | 1308.82 | 1282.80 | 1312.44 | 1352.36 | 1323.56 | 1348.46 | 1335.35 | 1352.36 | 1323.56 | 1348.46 | 1335.35 | 1352.36 | 1323.56 | 1348.46 | 1335.35 |
| Standing shoulder height (mm) | 7          | 959.26    | 944.55  | 945.81  | 949.32  | 951.00  | 956.03  | 959.98  | 961.15  | 984.02  | 944.53  | 963.49  | 965.00  | 984.02  | 944.53  | 963.49  | 965.00  | 984.02  | 944.53  | 963.49  | 965.00  |
|                               | 8          | 1021.67   | 1007.08 | 995.95  | 991.36  | 1008.47 | 1003.15 | 1017.57 | 1026.03 | 1042.00 | 998.77  | 1011.80 | 1026.04 | 1042.00 | 998.77  | 1011.80 | 1026.04 | 1042.00 | 998.77  | 1011.80 | 1026.04 |
|                               | 9          | 1070.86   | 1059.90 | 1049.24 | 1049.76 | 1073.38 | 1061.17 | 1066.04 | 1074.82 | 1094.44 | 1059.46 | 1090.57 | 1084.13 | 1094.44 | 1059.46 | 1090.57 | 1084.13 | 1094.44 | 1059.46 | 1090.57 | 1084.13 |
|                               | 10         | 1101.91   | 1106.62 | 1093.93 | 1110.06 | 1136.95 | 1114.89 | 1101.05 | 1116.48 | 1141.68 | 1108.23 | 1126.82 | 1138.12 | 1141.68 | 1108.23 | 1126.82 | 1138.12 | 1141.68 | 1108.23 | 1126.82 | 1138.12 |
|                               | 11         | 1172.44   | 1182.43 | 1136.48 | 1164.15 | 1174.02 | 1171.43 | 1140.89 | 1165.98 | 1205.52 | 1166.32 | 1188.92 | 1194.30 | 1205.52 | 1166.32 | 1188.92 | 1194.30 | 1205.52 | 1166.32 | 1188.92 | 1194.30 |
| Standing elbow height (mm)    | 7          | 711.32    | 702.08  | 699.55  | 711.03  | 719.67  | 708.20  | 743.63  | 744.52  | 738.14  | 712.59  | 740.68  | 723.51  | 738.14  | 712.59  | 740.68  | 723.51  | 738.14  | 712.59  | 740.68  | 723.51  |
|                               | 8          | 751.18    | 750.67  | 741.05  | 743.27  | 762.11  | 742.57  | 780.60  | 790.57  | 782.10  | 745.84  | 780.68  | 766.46  | 782.10  | 745.84  | 780.68  | 766.46  | 782.10  | 745.84  | 780.68  | 766.46  |
|                               | 9          | 791.85    | 789.58  | 774.71  | 787.00  | 813.92  | 787.71  | 820.28  | 828.04  | 824.49  | 799.56  | 841.05  | 810.89  | 824.49  | 799.56  | 841.05  | 810.89  | 824.49  | 799.56  | 841.05  | 810.89  |
|                               | 10         | 818.50    | 823.55  | 810.98  | 831.23  | 860.64  | 825.72  | 852.67  | 863.20  | 861.33  | 833.95  | 882.13  | 846.92  | 861.33  | 833.95  | 882.13  | 846.92  | 861.33  | 833.95  | 882.13  | 846.92  |
|                               | 11         | 875.31    | 876.03  | 845.81  | 873.79  | 895.46  | 867.33  | 878.00  | 905.56  | 911.85  | 878.79  | 935.98  | 890.37  | 911.85  | 878.79  | 935.98  | 890.37  | 911.85  | 878.79  | 935.98  | 890.37  |
| Chest depth (mm)              | 7          | 145.18    | 143.88  | 146.88  | 145.53  | 137.26  | 144.83  | 142.79  | 132.19  | 155.83  | 146.19  | 146.00  | 146.40  | 155.83  | 146.19  | 146.00  | 146.40  | 155.83  | 146.19  | 146.00  | 146.40  |
|                               | 8          | 151.60    | 144.27  | 148.91  | 150.39  | 148.15  | 150.00  | 152.38  | 138.12  | 161.64  | 149.67  | 157.50  | 155.35  | 161.64  | 149.67  | 157.50  | 155.35  | 161.64  | 149.67  | 157.50  | 155.35  |
|                               | 9          | 156.19    | 150.09  | 158.65  | 154.86  | 152.31  | 151.48  | 157.41  | 140.25  | 166.81  | 161.31  | 155.52  | 159.35  | 166.81  | 161.31  | 155.52  | 159.35  | 166.81  | 161.31  | 155.52  | 159.35  |
|                               | 10         | 158.70    | 155.36  | 163.60  | 167.11  | 161.92  | 159.57  | 158.30  | 147.13  | 170.93  | 171.53  | 163.64  | 174.18  | 170.93  | 171.53  | 163.64  | 174.18  | 170.93  | 171.53  | 163.64  | 174.18  |
|                               | 11         | 168.51    | 167.80  | 167.56  | 180.79  | 161.86  | 165.10  | 160.03  | 160.17  | 181.32  | 181.26  | 166.52  | 185.65  | 181.32  | 181.26  | 166.52  | 185.65  | 181.32  | 181.26  | 166.52  | 185.65  |
| Abdominal depth (mm)          | 7          | 141.00    | 137.46  | 141.90  | 139.78  | 134.01  | 143.28  | 135.07  | 145.14  | 131.15  | 142.33  | 141.05  | 138.77  | 131.15  | 142.33  | 141.05  | 138.77  | 131.15  | 142.33  | 141.05  | 138.77  |
|                               | 8          | 148.09    | 137.97  | 144.69  | 145.81  | 144.05  | 149.20  | 139.83  | 150.35  | 141.38  | 143.44  | 150.79  | 148.76  | 141.38  | 143.44  | 150.79  | 148.76  | 141.38  | 143.44  | 150.79  | 148.76  |
|                               | 9          | 152.35    | 140.55  | 148.73  | 148.16  | 146.63  | 152.48  | 142.56  | 153.39  | 142.38  | 152.51  | 143.03  | 151.72  | 142.38  | 152.51  | 143.03  | 151.72  | 142.38  | 152.51  | 143.03  | 151.72  |
|                               | 10         | 155.51    | 149.09  | 155.64  | 158.17  | 158.77  | 162.11  | 145.35  | 151.61  | 147.76  | 158.74  | 148.04  | 158.76  | 147.76  | 158.74  | 148.04  | 158.76  | 147.76  | 158.74  | 148.04  | 158.76  |
|                               | 11         | 166.94    | 152.55  | 158.79  | 167.46  | 155.80  | 164.27  | 146.04  | 154.63  | 160.73  | 161.98  | 148.77  | 162.33  | 160.73  | 161.98  | 148.77  | 162.33  | 160.73  | 161.98  | 148.77  | 162.33  |
| Arm length (mm)               | 7          | 232.38    | 239.72  | 246.89  | 244.41  | 236.07  | 241.08  | 245.14  | 234.80  | 248.15  | 235.21  | 239.74  | 248.72  | 248.15  | 235.21  | 239.74  | 248.72  | 248.15  | 235.21  | 239.74  | 248.72  |
|                               | 8          | 250.63    | 252.94  | 257.61  | 255.62  | 249.47  | 255.77  | 260.70  | 250.81  | 262.36  | 248.16  | 252.81  | 264.74  | 262.36  | 248.16  | 252.81  | 264.74  | 262.36  | 248.16  | 252.81  | 264.74  |
|                               | 9          | 261.23    | 267.87  | 276.41  | 267.72  | 265.95  | 259.67  | 278.91  | 262.66  | 276.03  | 264.01  | 256.65  | 274.56  | 276.03  | 264.01  | 256.65  | 274.56  | 276.03  | 264.01  | 256.65  | 274.56  |
|                               | 10         | 267.82    | 278.68  | 281.76  | 284.65  | 281.75  | 279.53  | 284.12  | 279.31  | 290.19  | 277.73  | 272.14  | 292.65  | 290.19  | 277.73  | 272.14  | 292.65  | 290.19  | 277.73  | 272.14  | 292.65  |
|                               | 11         | 288.26    | 298.49  | 296.10  | 300.57  | 295.88  | 294.03  | 292.27  | 291.09  | 303.19  | 291.72  | 269.16  | 307.31  | 303.19  | 291.72  | 269.16  | 307.31  | 303.19  | 291.72  | 269.16  | 307.31  |

(continued)

Table 3. (Continued).

| Dimensions                    | Sex<br>Age | Ethnicity |        | Fars   |        | Kurd   |        | Lor    |        | Baluch |        | Turk   |         | Arab   |         |
|-------------------------------|------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|---------|
|                               |            | Boys      | Girls  | Boys   | Girls  | Boys   | Girls  | Boys   | Girls  | Boys   | Girls  | Boys   | Girls   | Boys   | Girls   |
| Forearm length (mm)           | 7          | 303.45    | 298.27 | 314.14 | 309.29 | 303.37 | 302.40 | 314.67 | 302.14 | 321.48 | 312.61 | 306.17 | 316.84  | 306.17 | 316.84  |
|                               | 8          | 318.08    | 310.24 | 329.00 | 323.31 | 323.61 | 318.87 | 327.67 | 320.85 | 338.13 | 328.16 | 325.19 | 336.53  | 325.19 | 336.53  |
|                               | 9          | 333.79    | 328.46 | 347.85 | 338.36 | 344.85 | 328.43 | 349.60 | 333.74 | 350.94 | 346.10 | 334.45 | 354.14  | 334.45 | 354.14  |
|                               | 10         | 340.40    | 341.20 | 356.52 | 359.92 | 360.35 | 351.96 | 360.30 | 349.43 | 370.39 | 364.24 | 351.40 | 369.32  | 351.40 | 369.32  |
|                               | 11         | 367.31    | 365.42 | 374.10 | 378.27 | 378.30 | 369.20 | 366.56 | 366.53 | 387.95 | 381.91 | 356.36 | 393.01  | 356.36 | 393.01  |
| Forearm-forearm distance (mm) | 7          | 318.23    | 321.91 | 284.63 | 289.71 | 295.44 | 273.65 | 285.07 | 289.90 | 324.97 | 333.24 | 268.54 | 300.05  | 268.54 | 300.05  |
|                               | 8          | 329.92    | 321.33 | 297.28 | 298.96 | 317.89 | 279.97 | 296.84 | 303.48 | 340.13 | 341.07 | 284.96 | 322.30  | 284.96 | 322.30  |
|                               | 9          | 346.05    | 337.63 | 311.37 | 308.96 | 328.38 | 291.07 | 305.62 | 313.51 | 352.36 | 361.90 | 281.68 | 326.03  | 281.68 | 326.03  |
|                               | 10         | 353.82    | 343.17 | 321.98 | 330.96 | 338.07 | 294.18 | 311.20 | 314.46 | 359.61 | 377.06 | 301.91 | 332.173 | 301.91 | 332.173 |
|                               | 11         | 371.92    | 363.76 | 339.29 | 339.51 | 357.33 | 303.01 | 313.60 | 324.58 | 387.70 | 386.17 | 284.92 | 299.25  | 284.92 | 299.25  |
| Elbow-elbow distance (mm)     | 7          | 285.87    | 251.32 | 307.28 | 294.95 | 296.22 | 297.83 | 283.64 | 277.14 | 306.36 | 289.43 | 255.55 | 299.25  | 255.55 | 299.25  |
|                               | 8          | 302.00    | 254.27 | 314.79 | 306.08 | 310.95 | 304.54 | 294.69 | 285.11 | 318.97 | 296.61 | 273.83 | 317.89  | 273.83 | 317.89  |
|                               | 9          | 316.46    | 270.38 | 329.34 | 312.94 | 320.93 | 311.72 | 305.12 | 296.34 | 329.08 | 316.45 | 276.40 | 326.40  | 276.40 | 326.40  |
|                               | 10         | 322.44    | 278.53 | 340.27 | 333.49 | 339.70 | 325.07 | 307.61 | 300.59 | 342.42 | 331.10 | 297.21 | 335.45  | 297.21 | 335.45  |
|                               | 11         | 345.05    | 294.54 | 352.08 | 347.04 | 346.94 | 334.67 | 308.05 | 316.28 | 358.46 | 346.73 | 289.00 | 352.10  | 289.00 | 352.10  |
| Shoulder width (mm)           | 7          | 274.26    | 277.02 | 281.57 | 270.38 | 268.10 | 274.20 | 271.94 | 264.71 | 278.53 | 262.28 | 255.87 | 277.04  | 255.87 | 277.04  |
|                               | 8          | 287.08    | 285.50 | 291.75 | 279.05 | 286.54 | 282.01 | 284.58 | 279.92 | 293.27 | 267.37 | 279.13 | 295.36  | 279.13 | 295.36  |
|                               | 9          | 302.36    | 300.81 | 308.22 | 292.86 | 300.24 | 293.01 | 299.11 | 289.14 | 303.28 | 286.00 | 275.88 | 307.53  | 275.88 | 307.53  |
|                               | 10         | 309.41    | 315.46 | 317.17 | 309.16 | 318.24 | 308.55 | 303.65 | 302.10 | 317.20 | 296.14 | 301.08 | 318.22  | 301.08 | 318.22  |
|                               | 11         | 331.79    | 335.46 | 325.21 | 324.60 | 325.80 | 319.70 | 309.43 | 314.65 | 335.97 | 311.20 | 291.89 | 336.54  | 291.89 | 336.54  |
| Buttock width (mm)            | 7          | 207.16    | 221.39 | 228.16 | 229.70 | 218.11 | 224.51 | 212.55 | 212.34 | 233.95 | 230.92 | 212.10 | 228.12  | 212.10 | 228.12  |
|                               | 8          | 218.15    | 226.31 | 235.08 | 237.74 | 235.73 | 233.11 | 223.20 | 225.19 | 248.94 | 241.69 | 227.65 | 243.40  | 227.65 | 243.40  |
|                               | 9          | 232.45    | 238.57 | 255.90 | 247.80 | 247.81 | 239.05 | 235.90 | 239.34 | 260.62 | 265.81 | 229.36 | 257.09  | 229.36 | 257.09  |
|                               | 10         | 237.36    | 247.35 | 264.33 | 265.50 | 263.91 | 252.01 | 242.34 | 244.10 | 273.06 | 277.71 | 249.17 | 268.73  | 249.17 | 268.73  |
|                               | 11         | 255.10    | 266.25 | 271.13 | 284.65 | 278.85 | 263.16 | 248.07 | 253.49 | 285.39 | 290.66 | 239.36 | 284.23  | 239.36 | 284.23  |
| One-thigh thickness (mm)      | 7          | 68.37     | 67.78  | 76.70  | 91.83  | 75.53  | 62.52  | 72.21  | 63.65  | 75.70  | 85.05  | 67.29  | 71.08   | 67.29  | 71.08   |
|                               | 8          | 74.02     | 68.69  | 81.53  | 97.48  | 88.58  | 58.98  | 75.18  | 66.26  | 80.43  | 89.09  | 74.35  | 78.40   | 74.35  | 78.40   |
|                               | 9          | 81.04     | 72.86  | 91.38  | 102.76 | 92.29  | 63.47  | 76.59  | 69.73  | 86.56  | 96.09  | 79.00  | 87.90   | 79.00  | 87.90   |
|                               | 10         | 86.11     | 78.38  | 91.46  | 111.21 | 99.00  | 69.03  | 79.88  | 73.39  | 90.21  | 101.10 | 86.34  | 94.63   | 86.34  | 94.63   |
|                               | 11         | 96.05     | 87.76  | 100.49 | 118.53 | 104.52 | 73.21  | 82.06  | 78.41  | 101.22 | 104.91 | 89.43  | 103.59  | 89.43  | 103.59  |
| Two-thigh thickness (mm)      | 7          | 185.89    | 157.07 | 156.93 | 180.04 | 147.80 | 150.15 | 174.34 | 159.35 | 168.39 | 159.18 | 183.69 | 148.34  | 183.69 | 148.34  |
|                               | 8          | 204.51    | 157.85 | 161.56 | 186.88 | 165.67 | 163.44 | 179.09 | 164.00 | 182.34 | 164.98 | 196.48 | 159.22  | 196.48 | 159.22  |
|                               | 9          | 223.29    | 172.72 | 171.00 | 188.41 | 170.32 | 163.26 | 183.00 | 169.18 | 189.97 | 180.78 | 203.52 | 168.80  | 203.52 | 168.80  |
|                               | 10         | 223.06    | 176.78 | 180.98 | 203.65 | 178.53 | 174.77 | 187.51 | 173.80 | 204.72 | 187.91 | 218.16 | 177.41  | 218.16 | 177.41  |
|                               | 11         | 231.56    | 189.39 | 187.11 | 211.78 | 187.58 | 182.07 | 183.36 | 175.12 | 216.47 | 192.72 | 211.40 | 186.67  | 211.40 | 186.67  |
| Popliteal height (mm)         | 7          | 278.97    | 278.91 | 282.72 | 282.88 | 300.96 | 313.20 | 312.58 | 296.43 | 297.70 | 294.89 | 316.54 | 312.07  | 294.89 | 312.07  |
|                               | 8          | 295.00    | 291.87 | 298.54 | 298.14 | 316.29 | 324.88 | 335.39 | 318.60 | 310.56 | 312.03 | 319.80 | 328.25  | 319.80 | 328.25  |
|                               | 9          | 306.95    | 306.27 | 315.94 | 310.89 | 340.09 | 336.25 | 350.84 | 338.10 | 322.98 | 330.96 | 337.31 | 336.85  | 337.31 | 336.85  |
|                               | 10         | 320.68    | 321.25 | 334.08 | 329.66 | 361.16 | 350.15 | 374.23 | 353.20 | 336.02 | 347.39 | 342.09 | 356.15  | 342.09 | 356.15  |
|                               | 11         | 340.01    | 339.65 | 351.31 | 347.66 | 371.18 | 351.64 | 380.77 | 361.31 | 361.64 | 361.33 | 356.45 | 366.95  | 356.45 | 366.95  |

(continued)

Table 3. (Continued).

| Dimensions               | Ethnicity<br>Sex<br>Age | Fars   |               | Kurd          |               | Lor           |        | Baluch |               | Turk          |               | Arab          |               |
|--------------------------|-------------------------|--------|---------------|---------------|---------------|---------------|--------|--------|---------------|---------------|---------------|---------------|---------------|
|                          |                         | Boys   | Girls         | Boys          | Girls         | Boys          | Girls  | Boys   | Girls         | Boys          | Girls         | Boys          | Girls         |
| Knee height (mm)         | 7                       | 349.35 | 348.51        | 359.06        | 353.55        | 356.32        | 360.83 | 387.60 | <b>362.77</b> | 371.60        | 356.32        | <b>395.19</b> | 346.35        |
|                          | 8                       | 370.46 | 370.78        | 380.64        | 369.63        | 378.47        | 369.98 | 392.09 | <b>373.03</b> | 394.57        | 375.61        | <b>407.53</b> | 368.58        |
|                          | 9                       | 389.48 | 390.84        | 403.71        | 389.54        | 406.58        | 385.42 | 403.00 | 386.67        | <b>415.55</b> | <b>399.40</b> | 428.57        | 381.74        |
|                          | 10                      | 403.77 | 410.16        | 422.41        | 418.66        | 430.11        | 409.12 | 419.77 | 412.10        | 435.65        | <b>418.94</b> | <b>438.20</b> | 401.68        |
|                          | 11                      | 430.56 | <b>438.10</b> | 441.26        | 435.68        | <b>445.21</b> | 429.40 | 442.98 | 433.88        | 462.8         | 434.90        | 452.24        | 427.77        |
|                          | 7                       | 276.14 | 299.20        | <b>312.15</b> | <b>310.61</b> | 285.52        | 298.75 | 298.64 | 284.39        | 299.51        | 306.51        | 290.62        | 301.46        |
|                          | 8                       | 295.94 | 320.30        | <b>332.88</b> | 322.19        | 309.55        | 311.00 | 317.25 | <b>303.04</b> | 319.67        | 326.15        | 308.66        | <b>327.48</b> |
|                          | 9                       | 314.72 | 334.75        | <b>362.43</b> | 341.71        | 335.45        | 327.77 | 334.86 | 314.45        | 338.63        | <b>346.22</b> | 336.27        | 342.91        |
|                          | 10                      | 327.75 | 351.71        | <b>372.17</b> | 365.67        | 352.45        | 348.75 | 345.39 | 335.15        | 356.47        | 366.00        | 354.03        | <b>368.45</b> |
|                          | 11                      | 352.93 | 378.33        | <b>392.41</b> | 386.47        | 375.21        | 369.98 | 355.45 | 358.58        | 378.57        | 381.28        | 365.10        | <b>390.84</b> |
|                          | 7                       | 356.03 | 373.42        | 379.46        | <b>385.05</b> | 363.30        | 377.91 | 370.63 | 357.29        | <b>388.36</b> | 376.09        | 380.05        | 378.00        |
| Buttock-knee length (mm) | 8                       | 386.42 | 399.00        | 407.20        | 402.96        | 387.04        | 404.69 | 394.65 | 378.36        | <b>413.78</b> | 398.57        | 408.02        | <b>410.65</b> |
|                          | 9                       | 410.24 | 417.37        | <b>439.85</b> | 425.18        | 416.52        | 420.43 | 416.26 | 415.48        | <b>459.92</b> | 425.47        | 438.73        | <b>436.07</b> |
|                          | 10                      | 426.11 | 440.55        | 454.08        | 455.63        | 437.25        | 451.85 | 428.00 | 415.48        | <b>459.92</b> | 451.08        | 458.82        | <b>461.78</b> |
|                          | 11                      | 459.53 | 468.31        | 470.97        | 478.82        | 463.51        | 475.77 | 441.27 | 442.94        | <b>489.30</b> | 467.65        | 470.46        | <b>482.75</b> |
|                          | 7                       | 639.76 | 628.21        | 652.27        | 643.84        | 643.11        | 615.18 | 627.05 | 646.82        | <b>662.50</b> | 646.38        | 639.65        | <b>647.22</b> |
|                          | 8                       | 665.68 | 659.68        | 673.67        | 666.68        | 684.11        | 666.79 | 653.19 | 681.47        | <b>686.85</b> | 667.34        | 669.90        | <b>681.70</b> |
|                          | 9                       | 682.29 | 698.07        | 698.10        | 689.51        | 716.86        | 681.89 | 687.48 | <b>719.17</b> | <b>711.45</b> | 702.53        | 696.69        | 699.58        |
|                          | 10                      | 702.88 | 721.82        | 717.43        | 722.93        | 721.11        | 703.38 | 700.48 | 715.32        | <b>733.38</b> | 727.24        | 713.33        | <b>727.80</b> |
|                          | 11                      | 738.09 | 759.54        | 740.31        | 749.01        | 748.85        | 735.58 | 713.28 | 732.60        | <b>756.75</b> | 757.92        | 725.55        | <b>768.06</b> |
|                          | 7                       | 521.59 | 520.61        | 541.08        | 531.77        | 530.35        | 501.18 | 510.65 | 527.02        | <b>545.19</b> | <b>540.51</b> | 535.84        | 538.41        |
|                          | 8                       | 546.75 | 553.38        | 558.47        | 554.77        | 571.52        | 547.36 | 541.40 | 558.47        | <b>571.69</b> | 564.16        | 563.00        | <b>573.76</b> |
| Sitting eye height (mm)  | 9                       | 563.75 | 591.65        | 580.15        | 579.06        | <b>603.08</b> | 564.71 | 570.45 | <b>599.00</b> | 595.20        | 595.06        | 593.55        | 589.82        |
|                          | 10                      | 588.16 | 612.13        | 600.86        | 607.54        | 609.88        | 587.23 | 591.62 | 601.63        | <b>617.38</b> | <b>618.05</b> | 607.58        | 613.85        |
|                          | 11                      | 622.95 | <b>652.29</b> | 622.50        | 631.29        | 637.58        | 618.82 | 601.53 | 620.59        | <b>640.52</b> | 647.66        | 623.91        | 650.91        |
|                          | 7                       | 154.98 | 149.80        | 158.51        | 163.33        | 166.32        | 140.18 | 164.87 | <b>188.03</b> | 171.81        | 161.27        | <b>186.38</b> | 157.82        |
|                          | 8                       | 149.95 | 162.37        | 162.34        | 163.24        | <b>183.82</b> | 160.33 | 174.57 | <b>196.44</b> | 177.69        | 168.09        | 158.90        | 167.56        |
|                          | 9                       | 146.53 | 178.43        | 174.76        | 171.38        | 189.50        | 161.28 | 182.08 | <b>208.68</b> | 188.31        | 177.64        | <b>197.60</b> | 174.15        |
|                          | 10                      | 147.92 | 191.87        | 181.92        | 182.07        | 190.05        | 169.73 | 190.25 | <b>212.68</b> | 191.59        | 184.26        | <b>212.54</b> | 175.83        |
|                          | 11                      | 158.88 | 200.80        | 186.88        | 183.02        | 199.19        | 179.43 | 187.72 | <b>217.58</b> | 199.88        | 199.78        | <b>207.39</b> | 186.55        |

Note: Italicised values show the lowest measurements with regard to gender and age. Bold values show the highest measurements with regard to gender and age.

Table 4. Key percentiles of anthropometric dimensions.

| Dimension                     | Percentile<br>Ethnicity | Sex   | Age     |         |         |         |         |         |         |         |         |         |         |         |
|-------------------------------|-------------------------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|                               |                         |       | 7       |         |         | 8       |         |         | 9       |         |         | 10      |         |         |
|                               |                         |       | 5       | 50      | 95      | 5       | 50      | 95      | 5       | 50      | 95      | 5       | 50      | 95      |
| Weight (kg)                   | Fars                    | Boys  | 17.30   | 21.40   | 30.10   | 18.70   | 24.60   | 36.50   | 21.90   | 27.10   | 45.30   | 22.80   | 22.20   | 47.50   |
|                               |                         | Girls | 16.50   | 20.15   | 28.50   | 18.35   | 23.15   | 32.65   | 20.80   | 25.90   | 38.80   | 21.50   | 28.20   | 45.10   |
|                               | Lor                     | Boys  | 17.00   | 20.00   | 31.10   | 22.00   | 27.00   | 41.75   | 19.00   | 24.00   | 40.00   | 24.60   | 31.00   | 49.00   |
|                               |                         | Girls | 17.00   | 20.00   | 31.10   | 22.00   | 27.00   | 41.75   | 21.00   | 26.00   | 42.60   | 23.00   | 30.00   | 49.00   |
|                               | Kurd                    | Boys  | 17.60   | 21.50   | 27.70   | 21.20   | 26.35   | 39.00   | 19.70   | 24.10   | 32.70   | 22.30   | 29.30   | 44.00   |
|                               |                         | Girls | 16.80   | 20.80   | 29.10   | 18.30   | 23.30   | 33.40   | 20.90   | 25.70   | 37.40   | 23.30   | 30.80   | 45.30   |
|                               | Turk                    | Boys  | 20.10   | 24.00   | 34.00   | 23.50   | 29.75   | 44.00   | 20.60   | 26.40   | 42.80   | 26.30   | 33.50   | 50.10   |
|                               |                         | Girls | 17.50   | 21.70   | 29.90   | 18.60   | 23.70   | 32.20   | 21.50   | 28.00   | 44.80   | 24.40   | 31.10   | 46.70   |
|                               | Baluch                  | Boys  | 16.65   | 21.00   | 26.00   | 20.00   | 25.00   | 38.00   | 18.00   | 23.00   | 32.00   | 22.00   | 28.00   | 39.00   |
|                               |                         | Girls | 17.00   | 20.00   | 27.70   | 17.05   | 22.00   | 30.00   | 20.00   | 25.00   | 38.60   | 22.00   | 27.00   | 40.00   |
|                               | Arab                    | Boys  | 18.10   | 22.00   | 29.70   | 21.50   | 29.00   | 41.70   | 18.40   | 24.80   | 37.90   | 24.50   | 31.00   | 50.40   |
|                               |                         | Girls | 17.60   | 22.00   | 31.60   | 19.70   | 25.70   | 41.70   | 22.50   | 28.50   | 47.70   | 24.10   | 32.50   | 48.90   |
| Body height (mm)              | Fars                    | Boys  | 1110.75 | 1200.00 | 1310.00 | 1162.00 | 1270.00 | 1365.00 | 1233.30 | 1315.00 | 1437.00 | 1258.80 | 1360.00 | 1456.30 |
|                               |                         | Girls | 1090.00 | 1175.00 | 1260.00 | 1160.00 | 1240.00 | 1338.75 | 1200.00 | 1290.00 | 1417.00 | 1225.00 | 1345.00 | 1450.00 |
|                               | Lor                     | Boys  | 1104.50 | 1200.00 | 1300.00 | 1240.00 | 1320.00 | 1410.00 | 1165.50 | 1260.00 | 1360.00 | 1300.00 | 1390.00 | 1480.00 |
|                               |                         | Girls | 1110.00 | 1190.00 | 1350.50 | 1130.00 | 1250.00 | 1365.00 | 1208.00 | 1310.00 | 1410.00 | 1250.00 | 1360.00 | 1493.50 |
|                               | Kurd                    | Boys  | 1095.75 | 1190.00 | 1270.00 | 1210.00 | 1307.50 | 1417.25 | 1155.00 | 1250.00 | 1337.50 | 1243.30 | 1360.00 | 1455.00 |
|                               |                         | Girls | 1104.75 | 1185.00 | 1300.25 | 1155.00 | 1240.00 | 1325.00 | 1215.00 | 1295.00 | 1405.00 | 1274.00 | 1370.00 | 1475.30 |
|                               | Turk                    | Boys  | 1170.00 | 1240.00 | 1328.25 | 1250.00 | 1350.00 | 1460.00 | 1183.30 | 1292.50 | 1400.00 | 1305.30 | 1395.00 | 1514.30 |
|                               |                         | Girls | 1125.00 | 1205.00 | 1307.25 | 1151.00 | 1255.00 | 1354.00 | 1228.30 | 1320.00 | 1441.80 | 1282.80 | 1375.00 | 1490.00 |
|                               | Baluch                  | Boys  | 1116.50 | 1200.00 | 1343.50 | 1220.00 | 1310.00 | 1484.00 | 1160.00 | 1240.00 | 1378.50 | 1230.00 | 1360.00 | 1460.00 |
|                               |                         | Girls | 1110.00 | 1200.00 | 1340.00 | 1165.25 | 1270.00 | 1380.00 | 1210.00 | 1320.00 | 1495.00 | 1242.50 | 1370.00 | 1480.00 |
|                               | Arab                    | Boys  | 1111.25 | 1202.50 | 1303.75 | 1220.00 | 1340.00 | 1464.50 | 1140.00 | 1270.00 | 1397.00 | 1280.50 | 1380.00 | 1500.00 |
|                               |                         | Girls | 1120.00 | 1200.00 | 1313.75 | 1175.75 | 1260.00 | 1370.00 | 1223.50 | 1330.00 | 1443.30 | 1276.50 | 1380.00 | 1502.00 |
| Standing eye height (mm)      | Fars                    | Boys  | 985.75  | 1075.00 | 1185.00 | 1040.00 | 1150.00 | 1253.00 | 1115.00 | 1195.00 | 1311.80 | 1133.80 | 1240.00 | 1340.00 |
|                               |                         | Girls | 980.00  | 1065.00 | 1145.00 | 1045.00 | 1145.00 | 1223.80 | 1090.00 | 1190.00 | 1317.00 | 1123.50 | 1235.00 | 1340.50 |
|                               | Lor                     | Boys  | 980.00  | 1080.00 | 1200.00 | 1120.00 | 1200.00 | 1300.00 | 1050.00 | 1140.00 | 1240.00 | 1190.00 | 1280.00 | 1370.00 |
|                               |                         | Girls | 970.00  | 1050.00 | 1242.00 | 1025.00 | 1130.00 | 1250.00 | 1080.00 | 1190.00 | 1280.00 | 1130.00 | 1240.00 | 1370.00 |
|                               | Kurd                    | Boys  | 985.75  | 1075.00 | 1150.00 | 1087.75 | 1190.00 | 1297.25 | 1040.00 | 1130.00 | 1212.50 | 1120.00 | 1240.00 | 1340.00 |
|                               |                         | Girls | 999.75  | 1075.00 | 1180.00 | 1045.00 | 1130.00 | 1210.00 | 1110.00 | 1185.00 | 1290.00 | 1149.80 | 1250.00 | 1355.00 |
|                               | Turk                    | Boys  | 1050.00 | 1120.00 | 1210.00 | 1130.00 | 1230.00 | 1340.00 | 1070.00 | 1170.00 | 1280.00 | 1190.00 | 1280.00 | 1390.00 |
|                               |                         | Girls | 1010.00 | 1090.00 | 1180.00 | 1036.00 | 1145.00 | 1234.00 | 1120.00 | 1205.00 | 1321.80 | 1170.00 | 1260.00 | 1375.00 |
|                               | Baluch                  | Boys  | 990.00  | 1087.50 | 1210.00 | 1100.00 | 1200.00 | 1354.00 | 1050.00 | 1130.00 | 1280.00 | 1110.00 | 1240.00 | 1350.00 |
|                               |                         | Girls | 985.00  | 1070.00 | 1200.00 | 1030.00 | 1150.00 | 1269.80 | 1077.00 | 1200.00 | 1363.00 | 1137.50 | 1260.00 | 1382.50 |
|                               | Arab                    | Boys  | 1001.25 | 1100.00 | 1190.00 | 1120.00 | 1230.00 | 1360.00 | 1020.00 | 1160.00 | 1297.00 | 1171.00 | 1270.00 | 1409.00 |
|                               |                         | Girls | 1005.00 | 1090.00 | 1213.75 | 1070.00 | 1160.00 | 1268.50 | 1120.00 | 1217.50 | 1333.30 | 1160.00 | 1275.00 | 1380.00 |
| Standing shoulder height (mm) | Fars                    | Boys  | 870.00  | 960.00  | 1060.00 | 934.00  | 1020.00 | 1118.00 | 998.30  | 1060.00 | 1171.80 | 1010.00 | 1100.00 | 1192.50 |
|                               |                         | Girls | 870.00  | 940.00  | 1025.00 | 926.30  | 1005.00 | 1093.80 | 971.50  | 1060.00 | 1178.50 | 995.00  | 1105.00 | 1200.00 |
|                               | Lor                     | Boys  | 850.00  | 950.00  | 1055.50 | 992.50  | 1065.00 | 1160.00 | 920.00  | 1010.00 | 1100.00 | 1046.00 | 1130.00 | 1240.00 |
|                               |                         | Girls | 859.50  | 950.00  | 1120.00 | 895.00  | 1000.00 | 1120.00 | 970.00  | 1060.00 | 1160.00 | 1010.00 | 1110.00 | 1240.00 |
|                               | Kurd                    | Boys  | 870.00  | 945.00  | 1014.25 | 952.75  | 1045.00 | 1145.00 | 920.00  | 995.00  | 1075.00 | 996.50  | 1100.00 | 1185.00 |
|                               |                         | Girls | 870.00  | 942.50  | 1045.00 | 905.00  | 990.00  | 1075.00 | 970.00  | 1045.00 | 1140.00 | 1020.00 | 1102.50 | 1200.50 |
|                               | Turk                    | Boys  | 921.75  | 1000.00 | 1070.00 | 1000.00 | 1090.00 | 1200.00 | 940.00  | 1040.00 | 1140.00 | 1060.00 | 1140.00 | 1240.00 |
|                               |                         | Girls | 875.00  | 955.00  | 1040.00 | 910.00  | 1000.00 | 1085.00 | 965.00  | 1060.00 | 1160.00 | 1020.00 | 1110.00 | 1205.00 |
|                               | Baluch                  | Boys  | 880.00  | 960.00  | 1070.00 | 960.00  | 1050.00 | 1210.00 | 920.00  | 1000.00 | 1150.00 | 1000.00 | 1100.00 | 1200.00 |
|                               |                         | Girls | 880.00  | 960.00  | 1083.50 | 915.30  | 1025.00 | 1150.00 | 670.00  | 1070.00 | 1210.00 | 1000.00 | 1120.00 | 1220.00 |
|                               | Arab                    | Boys  | 872.00  | 960.00  | 1050.00 | 990.00  | 1080.00 | 1204.50 | 870.00  | 1020.00 | 1137.00 | 1040.00 | 1130.00 | 1230.00 |
|                               |                         | Girls | 890.00  | 960.00  | 1060.00 | 940.80  | 1025.00 | 1114.60 | 995.00  | 1080.00 | 1186.50 | 1028.00 | 1135.00 | 1235.00 |

(continued)

Table 4. (Continued).

| Dimension                     | Percentile | Ethnicity | Sex   | Age    |        |        |        |        |        |        |        |        |        |        |        |
|-------------------------------|------------|-----------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                               |            |           |       | 7      |        |        | 8      |        |        | 9      |        |        | 10     |        |        |
|                               |            |           |       | 5      | 50     | 95     | 5      | 50     | 95     | 5      | 50     | 95     | 5      | 50     | 95     |
| Standing elbow height (mm)    | Fars       | Boys      | Girls | 650.75 | 710.00 | 790.00 | 690.00 | 750.00 | 830.00 | 716.50 | 790.00 | 885.00 | 740.00 | 810.00 | 900.00 |
|                               |            |           |       | 640.00 | 700.00 | 770.00 | 686.30 | 745.00 | 830.00 | 716.50 | 785.00 | 877.00 | 744.50 | 820.00 | 900.00 |
|                               | Lor        | Boys      | Girls | 634.50 | 720.00 | 800.00 | 750.00 | 810.00 | 890.00 | 690.00 | 760.00 | 830.00 | 796.00 | 860.00 | 934.00 |
|                               |            |           |       | 630.00 | 700.00 | 780.00 | 655.00 | 730.00 | 860.00 | 710.00 | 780.00 | 874.00 | 736.50 | 820.00 | 933.50 |
|                               | Kurd       | Boys      | Girls | 640.00 | 700.00 | 754.30 | 700.00 | 770.00 | 862.25 | 680.00 | 740.00 | 810.00 | 731.50 | 815.00 | 891.80 |
|                               |            |           |       | 650.00 | 710.00 | 795.30 | 675.00 | 742.50 | 810.00 | 720.00 | 785.00 | 865.00 | 755.00 | 827.50 | 915.00 |
|                               | Turk       | Boys      | Girls | 680.00 | 750.00 | 810.00 | 750.00 | 820.00 | 900.00 | 700.00 | 780.00 | 860.00 | 790.00 | 860.00 | 930.00 |
|                               |            |           |       | 647.70 | 720.00 | 785.00 | 687.00 | 755.00 | 828.00 | 720.00 | 800.00 | 880.00 | 757.80 | 835.00 | 910.00 |
|                               | Baluch     | Boys      | Girls | 680.00 | 750.00 | 810.00 | 740.00 | 810.00 | 930.00 | 710.00 | 770.00 | 860.00 | 770.00 | 850.00 | 930.00 |
|                               |            |           |       | 670.00 | 740.00 | 837.00 | 710.00 | 792.50 | 894.80 | 737.00 | 825.00 | 933.00 | 770.00 | 870.00 | 973.50 |
|                               | Arab       | Boys      | Girls | 670.00 | 730.00 | 820.00 | 750.00 | 840.00 | 950.00 | 660.00 | 780.00 | 887.00 | 790.00 | 880.00 | 989.50 |
|                               |            |           |       | 660.00 | 720.00 | 794.00 | 700.00 | 765.00 | 839.30 | 735.00 | 810.00 | 898.30 | 770.00 | 850.00 | 920.00 |
| Buttock-popliteal length (mm) | Fars       | Boys      | Girls | 236.00 | 276.00 | 313.90 | 250.00 | 296.00 | 333.60 | 273.00 | 312.00 | 370.00 | 279.80 | 328.50 | 373.30 |
|                               |            |           |       | 261.90 | 298.50 | 341.00 | 281.50 | 319.50 | 358.00 | 283.60 | 332.00 | 387.40 | 307.80 | 412.00 | 450.10 |
|                               | Lor        | Boys      | Girls | 230.00 | 280.00 | 345.50 | 290.00 | 330.00 | 390.00 | 255.50 | 310.00 | 350.00 | 300.00 | 350.00 | 430.00 |
|                               |            |           |       | 253.80 | 293.50 | 357.10 | 257.50 | 309.00 | 359.00 | 284.80 | 320.00 | 376.20 | 300.00 | 347.00 | 415.45 |
|                               | Kurd       | Boys      | Girls | 275.00 | 313.00 | 344.90 | 319.60 | 360.00 | 407.40 | 298.50 | 331.00 | 375.00 | 325.70 | 368.00 | 418.50 |
|                               |            |           |       | 271.90 | 310.00 | 348.10 | 276.00 | 320.00 | 369.00 | 304.00 | 339.00 | 387.00 | 323.00 | 363.00 | 415.00 |
|                               | Turk       | Boys      | Girls | 270.00 | 304.00 | 339.30 | 300.90 | 336.00 | 389.00 | 279.30 | 318.00 | 370.50 | 318.10 | 352.00 | 401.00 |
|                               |            |           |       | 275.60 | 312.00 | 346.50 | 289.80 | 327.00 | 359.00 | 305.70 | 347.00 | 386.40 | 327.00 | 365.00 | 402.90 |
|                               | Baluch     | Boys      | Girls | 259.30 | 299.50 | 351.80 | 295.20 | 332.00 | 391.60 | 275.20 | 314.00 | 373.90 | 290.00 | 345.00 | 403.00 |
|                               |            |           |       | 234.30 | 285.00 | 345.50 | 352.20 | 300.00 | 360.00 | 256.40 | 317.00 | 371.60 | 273.50 | 336.00 | 395.50 |
|                               | Arab       | Boys      | Girls | 246.80 | 289.00 | 334.50 | 286.00 | 336.00 | 388.90 | 251.20 | 310.00 | 358.00 | 307.10 | 352.00 | 403.70 |
|                               |            |           |       | 262.50 | 300.00 | 341.80 | 284.40 | 324.80 | 373.30 | 296.10 | 342.50 | 399.70 | 323.00 | 367.90 | 429.85 |

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Seven-, 10 - and 11-year-old Arab girls and 8- and 9-year-old Baluch girls were the tallest ones. Most sitting heights were higher among Baluch girls, although the difference with Arab girls was negligible. In most standing dimensions, Turk and Arab boys showed the highest measures in all age groups. In standing eye and shoulder height, Arab girls had the highest measures but in standing elbow height, Baluch girls showed the highest measure. Turk boys and Arab girls had the highest chest depth among all age groups.

Most anthropometric dimensions of the upper and lower extremities were highest among Turk boys and Arab girls. Generally, Turk boys and Arab girls were larger than their contemporaries, and Baluch boys and girls were thinner than their contemporaries in other ethnicities.

Most north-western and western provinces in Iran in which mostly Turk and Kurd ethnicities live, are rich areas with regard to climate and economy, but Sistan and Baluchistan in which Baluches live is a naturally deprived region. Therefore, in addition to ethnicity, these differences are probably due to geographic, climatic and economic differences in different parts of Iran.

In most age groups, boys had a higher weight than girls except for Arab ethnicity in which girls had a higher weight in all age groups. It is probably due to this factor that Arab girls who live in tropical regions reach their puberty sooner. In some ethnicities, weight of 11-year-old girls was higher than boys which may be due to earlier pubertal development in girls.

There are some studies in different populations for measurement of anthropometric dimensions. Rosnah *et al.* (2009) compared the anthropometric dimensions of adult Malaysians with regard to ethnicity. They evaluated 39 anthropometric dimensions and found a significant difference between Malays and non-Malays and between males and females as well which is in agreement with the results of the current study. Jahanshahi *et al.* (2008) found the effect of ethnicity on facial anthropometric dimensions in an Iranian population.

Diep (2003) measured eight anthropometric dimensions among Vietnamese children. All anthropometric dimensions were lower than the dimensions of the children in the current study.

Prado-Leon *et al.* (2001) measured 50 anthropometric dimensions among 4758 Mexican children and compared their results with other studies in other populations and found a significant difference among different populations. The anthropometric dimensions of Mexican children were significantly higher than Iranian children in the current study.

Lin *et al.* (2004) studied 33 anthropometric dimensions among four east-Asian adult populations and found a significant difference between the dimensions among four populations which was in agreement with the current study in finding difference between populations.

Anthropometric dimensions of the study children were different from other populations. Anthropometric dimensions of Greek, American and Mexican children were higher than Iranian children (Snyder *et al.* 1977, Prado-Leon *et al.* 2001, Panagiotopoulou *et al.* 2004) and these dimensions in Vietnamese children were less than Iranian children (Diep 2003).

One of the most important factors contributing to this difference is race or ethnicity, although we know that the climatic, nutritional and economic factors in Iran are different from other countries which can certainly affect the anthropometric dimensions.

The set of anthropometric dimensions we measured in this study are mostly used for school furniture design, so increasing the number of anthropometric dimensions produces databases which can be used to design clothing, shoes, etc. It is recommended to repeat these kinds of studies to understand the secular trends among Iranian children.

This study had some limitations. We tried to select native children in each ethnicity, but there may be some hybrid children which their parents did not inform us.

## 5. Conclusions

Children in different ethnicities had significantly different anthropometric dimensions; hence, considering these differences is important for designing such products as school furniture. According to the results of this study, school furniture should be designed and manufactured for each ethnicity, gender and age, separately. Manufacturing adjustable school furniture can be a practical method for solving the problem of various furniture designs and mismatch between furniture and anthropometric dimensions. We recommend furniture designers and manufacturers to use the data obtained in this study for making adjustable school furniture according to the anthropometric dimensions of Iranian children.

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