

Anthropometric measurements of Saudi boys aged 6-14 years

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Summary. Anthropometric measurements of 1169 Saudi school boys between the ages of 6 and 14 years are reported. The boys were randomly selected from primary schools in the city of Riyadh, Saudi Arabia. Measurements of height, weight, grip strength, chest, triceps and subscapular skinfold thicknesses as well as biacromial, chest, bi-iliac, knee, and elbow breadths were taken. Saudi boys have slightly lower values for body weight and height than American boys (NCHS standards). Values of skinfold measurements increased with age up to age 11 where they plateaued and took then a sharp increase by age 14. Means of triceps and subscapular skinfolds of the Saudi boys are also lower than some standards from U.S.A. throughout age 13. At age 14, however, the Saudi boys have higher means than the U.S.A. boys.

1. Introduction

Although there are considerable data on anthropometric measurements of Saudi infants and pre-school children (e.g. Al-Frayh, Jabar, Wong, Wong, and Bener 1987, Sebai, Hazmi, and Serenius 1981), only a few studies describe the pattern of growth of Saudi school children (Hammam, Kamel, and Hidayat 1980, Jan, Ghafouri, and Al-Fares 1983), and these few refer only to the western region. This study therefore, describes some anthropometric measurements of Saudi school boys aged 6-14 years living in the city of Riyadh in the central region of Saudi Arabia.

2. Materials and methods

Subjects

The sample comprised 1169 school boys drawn from the city of Riyadh primary schools. Riyadh is the capital and the largest city in Saudi Arabia. None of the subjects appeared to have any obvious medical problem or physical deformity. In selecting the sample the primary schools in Riyadh were divided into four geographical areas (north, south, east, west) and two schools were randomly chosen from each area. Later, one class from each grade (of six grades) was randomly selected. Thus the final selection was of 48 classes. The following measurements were then made on the whole class: standing height (cm), body weight (kg), grip strength (kg), chest, triceps, and subscapular skinfold measurements, as well as biacromial, chest, bi-iliac, knee and elbow diameters. Ages were obtained from the students' records and reported to the nearest whole year (6.50-7.49 reported as age 7, and so on).

Testing procedure

Students were tested bare-footed while wearing only shorts. Standing height was measured to the last complete 0.1 cm using a Martin-type anthropometer kit made by Takei and Co. Ltd. of Japan. Body weight was measured to the last complete 0.5 kg using a pre-calibrated portable scale. Maximum grip strength of the dominant hand was measured using a grip dynamometer which was calibrated before testing. Each subject was given two trials and the higher was recorded. Skinfold measurements were

taken on the right side of the body and recorded to the last complete 0.1 mm using a Harpenden caliper. For each site three measurements were taken and the mean value was recorded. All measurements of skinfold thickness were made by the author. The specific sites of measurements were chest, triceps and subscapular (Behnke and Wilmore 1974, Lohman, Roche, and Martorell 1988). In addition, body diameter measurements were made and recorded to the last complete 0.1 cm utilizing the Martin-type anthropometer kit according to standard procedures (Behnke and Wilmore 1974, Lohman, Roche and Martorell 1988). The specific sites of measurements were biacromial, chest, bi-iliac, knee, and elbow diameters.

Descriptive statistics (mean, standard deviation, etc.) were obtained utilizing the SAS program. In addition, the Pearson's correlation coefficient was used to test the relationships among the different variables under study.

3. Results

Height and weight

Means and standard deviations for the values of height and weight of Saudi boys are shown in table 1. Body mass index (BMI)—a measure of obesity—exhibited a continuous increase with age to reach 20.2 at age 14.

Table 1. Physical characteristics of the subjects (mean \pm SD).

Age (years)	Number	Weight (kg)	Height (cm)
6 \pm	40	20.3 \pm 3.1	114.0 \pm 5.2
7 \pm	180	21.4 \pm 3.2	117.4 \pm 4.6
8 \pm	166	23.9 \pm 4.8	122.6 \pm 5.1
9 \pm	177	26.8 \pm 4.9	127.6 \pm 5.6
10 \pm	179	29.3 \pm 6.1	132.5 \pm 5.6
11 \pm	171	33.7 \pm 7.5	138.0 \pm 5.3
12 \pm	151	35.3 \pm 8.4	140.9 \pm 6.7
13 \pm	74	39.7 \pm 7.6	147.5 \pm 6.9
14 \pm	37	47.8 \pm 12.9	153.0 \pm 9.0

Body diameter

Data on body diameters for biacromial, chest, bi-iliac, knee, and elbow are presented in table 2. The magnitude of increase in percentage from age 6 to 14 were similar for each of biacromial, chest, and bi-iliac widths, amounting from 34% to 37%. However, knee diameter increased only 28% by the age of 14 years.

Skinfold thickness

Values of skinfold measurements for Saudi boys are presented in table 2. Chest skinfold thickness increased with age up to age 11 where it plateaued and then took a sharp increase at age 14. Triceps skinfold measurements show yearly increases up to age 11, with no further increases until age 14 where a sharp increase occurred again. Subscapular skinfold measurements exhibited a similar trend to triceps thickness. However, lower values are reported for the subscapular as compared to triceps. All skinfold thicknesses were correlated highly with weight; chest and subscapular skinfold showed the highest skinfold-to-weight correlation ($r=0.77$).

Table 2. Means and standard deviations of selected anthropometric measurements of Saudi boys.

Variable	Age (years)								
	6±	7±	8±	9±	10±	11±	12±	13±	14±
Diameters (cm)	24.4	26.3	27.6	28.7	29.4	30.5	31.4	32.7	33.6
Biacromial	±1.7	±1.6	±1.7	±1.8	±2.0	±2.4	±2.4	±1.9	±2.4
Chest	17.4	18.1	18.8	19.5	20.0	20.9	21.3	21.9	23.4
	±1.1	±1.2	±1.8	±1.4	±1.9	±2.0	±1.8	±1.4	±2.4
Bi-iliac	17.3	17.8	18.7	19.6	19.9	20.8	21.5	22.0	23.5
	±1.2	±1.1	±1.5	±1.8	±1.6	±1.8	±2.0	±1.5	±2.1
Knee	7.1	7.3	7.5	7.9	8.0	8.4	8.4	8.6	9.0
	±0.5	±0.4	±0.5	±0.5	±0.7	±0.6	±0.6	±0.5	±0.7
Elbow	4.6	4.8	5.0	5.2	5.3	5.5	5.7	5.9	6.2
	±0.2	±0.3	±0.3	±0.5	±0.4	±0.4	±0.5	±0.5	±0.5
Skinfolds (mm)	4.5	4.8	5.6	6.0	6.7	8.6	8.6	8.7	12.7
Chest	±1.2	±2.2	±3.8	±3.9	±4.9	±6.3	±6.7	±6.6	±9.5
Triceps	7.4	7.3	7.7	8.2	8.7	10.1	9.9	9.7	12.5
	±1.4	±1.9	±3.0	±3.2	±3.6	±4.6	±4.9	±4.4	±7.3
Subscapular	4.3	4.6	5.2	5.6	5.9	7.3	7.4	7.1	11.1
	±0.9	±1.4	±2.5	±2.9	±3.1	±4.9	±5.3	±4.7	±8.3
Grip strength (kg)	5.5	6.2	8.3	9.5	10.9	13.6	15.0	17.7	20.2
	±2.2	±2.2	±2.8	±2.9	±3.3	±3.5	±4.4	±4.9	±6.3

Grip strength

Data on grip strength for the Saudi boys are presented in table 2. The absolute values for grip strength continuously increased with age to reach the highest value of 20.2 kg at age 14. When the increments in grip strength were considered relative to body weight, the same trend existed up to age 13, after which a slight drop occurred in strength gain. This might be explained partially by the large increase in body weight at age 14.

4. Discussion

Comparing these results with the limited number of published studies on Saudi school children reveals that Riyadh boys in this study are heavier than rural school boys (Hammam *et al.* 1980). However, data for body height, though there are variations, are generally comparable to those of rural school boys reported in previous studies. In addition, data obtained here for triceps skinfold thickness are very similar to those reported for urban school children from western Saudi Arabia (Jan *et al.* 1983) who were found to have mean values for triceps ranging from 7.4 to 10.9 mm for boys aged 6-16 years. With the exception of boys at age 14, values in this study were in that range. The higher values of skinfold thickness at age 14 compared to those of age 12 or 13 may have resulted from the observation that some of the subjects in that age were massively obese; since the number of subjects at that age was less than any of the other age groups the mean values were exorbitantly affected.

Comparison with data from world population

The Saudi boys' data were compared with the available growth data of various world populations, as described mostly by Eveleth and Tanner (1976). These data of world populations represent urbanized regions as in the case of the Saudi sample.

The Saudi data for body weight were found to be similar to those of France, Japan, Egypt (Eveleth and Tanner 1976) and Botswana (Corlet 1984). However, boys from West Germany are considerably heavier than the Saudi boys with the exception of boys at age 14 (Eveleth and Tanner 1976). When the Saudi boys' data for body weight were plotted and compared with some standards from the U.S.A. (Hamill, Drized, Johnson, Reed, Roche, and Moore 1979) and the U.K. (Tanner, Whitehouse and Takaishi 1966) as shown in figure 1, it is evident that the boys from the U.S.A. are markedly heavier than the Saudis at all ages reported. The U.K. boys, on the other hand, exhibit somewhat similar values to those of the Saudis up to age 11, but thereafter they show higher values than those of the Saudis, though the difference is not large at age 14.

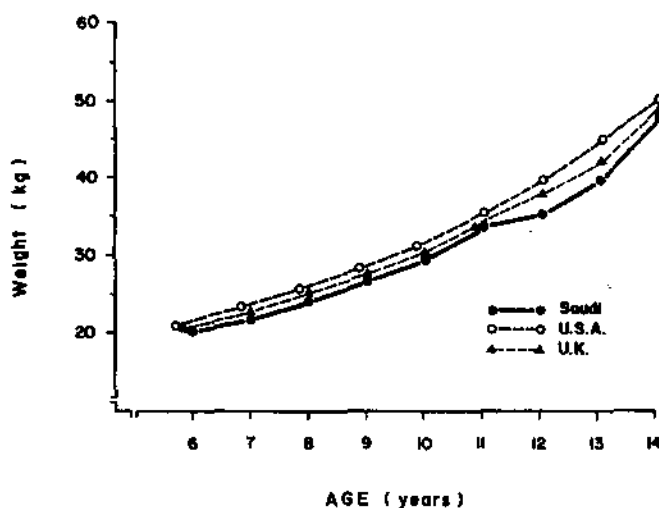


Figure 1. Means of weight for Saudi boys in comparison with data from U.S.A. (Hamill *et al.* 1979) and from U.K. (Tanner *et al.* 1966).

Data for body height of the Saudi boys were also compared. Saudi boys have lower height values than those of the French, German, or Italian. Saudi boys show, however, similar values to those of Japan and Egypt.

The data for Saudi boys for body height were also compared with data obtained from the U.S.A. (Hamill *et al.* 1979) and the U.K. (Tanner *et al.* 1966), as presented in figure 2. With the exception of those of six years old the Saudi boys have lower height values than the British or the American boys.

A comparison of the Saudi boys data for body diameters with those of the U.K., as described in Eveleth and Tanner (1969), is presented in figure 3. The comparison indicates that biacromial widths of the Saudi boys are found to be somewhat lower but not very different to those of the British boys. However, the Saudi boys appear to have considerably lower values for bi-iliac widths.

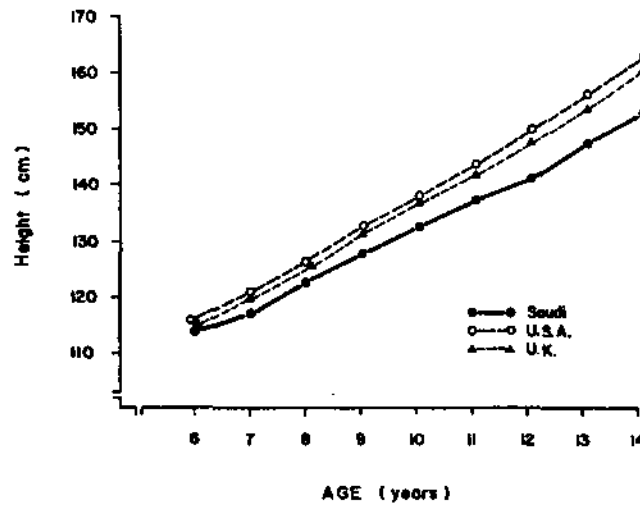


Figure 2. Means of height for Saudi boys in comparison with data from U.S.A. (Hamill *et al.* 1979) and from U.K. (Tanner *et al.* 1966).

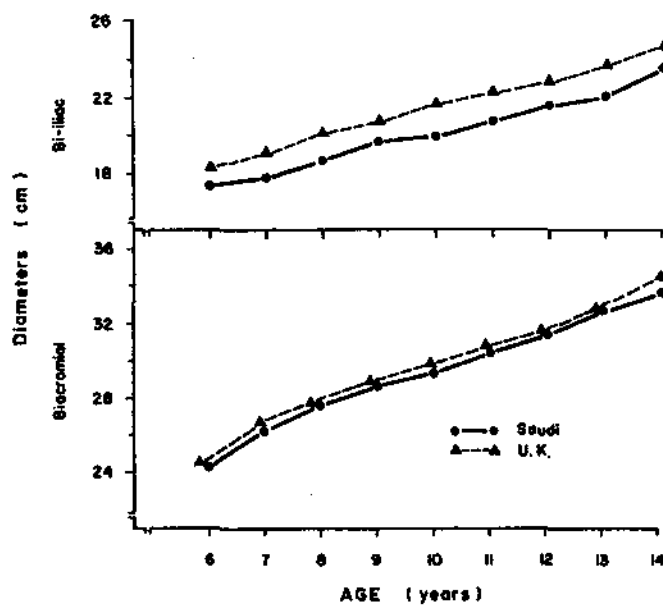


Figure 3. Means of biacromial and bi-iliac diameters for Saudi boys in comparison with data from U.K. (Eveleth and Tanner 1976).

Finally, triceps and subscapular skinfold thicknesses of Saudi boys were compared with those from U.S.A. (Johnson, Hamill and Lemeshow 1972, 1974) and U.K. (Tanner and Whitehouse 1975) as shown in figures 4 and 5 respectively. The comparison indicates that triceps skinfolds of Saudi boys are much lower than those of the Americans at ages 6-13 years. At age 14, however, the mean value for the Saudi boys is higher than that of the American boys. In addition, the Saudi boys have lower values at ages 6-8, similar values at ages 9 and 10, and higher values at ages 11-14 than those of the British boys.

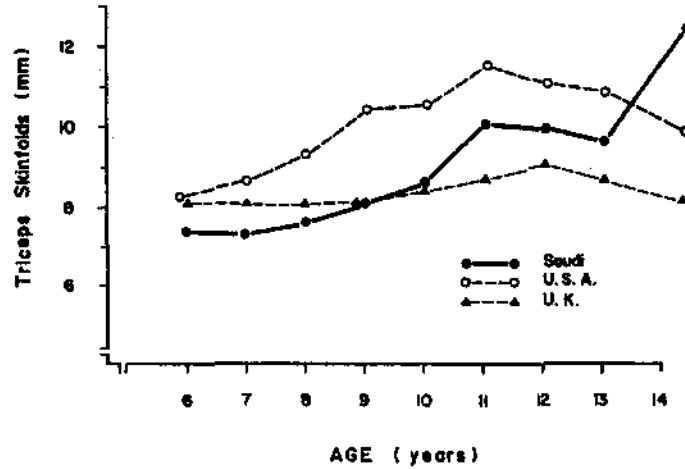


Figure 4. Means of triceps skinfolds for Saudi boys in comparison with data from U.S.A. (Johnson *et al.* 1972, 1974) and from U.K. (Tanner *et al.* 1975).

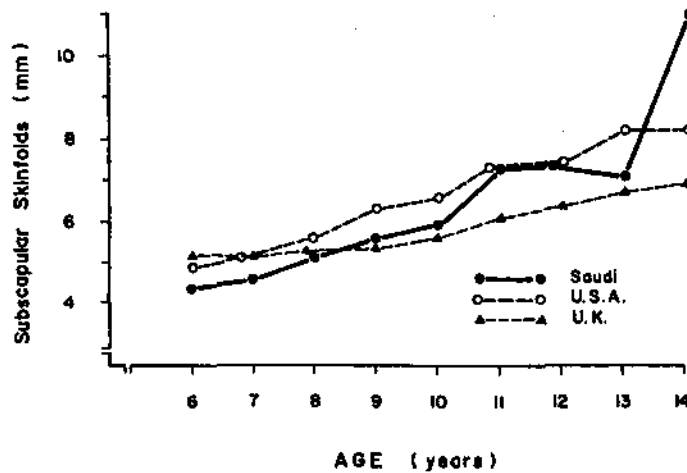


Figure 5. Means of subscapular skinfolds for Saudi boys in comparison with data from U.S.A. (Johnson *et al.* 1972, 1974) and from U.K. (Tanner *et al.* 1975).

Subscapular skinfolds indicate that the Saudi boys have lower values than those boys from U.S.A. or U.K. at ages 6–8. At ages 9–13 the Saudi data fall between those data from U.S.A. and U.K. At age 14, however, the Saudi boys exhibited values for greater than those of the U.S.A. and U.K. boys.

Furthermore, when the sums of triceps and subscapula skinfold thickness for Saudi boys were compared with those of the National Children and Youth Fitness Study from the U.S.A. (Ross and Gilbert 1985), the Saudis had lower values than the Americans at ages 6–10 and similar values at ages 11–13. At age 14, however, much higher values were found for the Saudis as compared to the Americans, but this point may be a poor reflection of the true Saudi mean.

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Zusammenfassung. Die anthropometrischen Maße von 1169 saudiarabischen Schulkindern zwischen 6 und 14 Jahren werden berichtet. Die Knaben waren zufallsmäßig in Grundschulen der Stadt Riad in Saudiarabien ausgesucht. Die Maße waren Körperhöhe, Gewicht, Griffstärke, Hautschichtdicken an Brust, Trizeps und subkapular, als auch Schulterbreite, Brustbreite, Beckenbreite und knie- und Ellbogenbreite. Saudiarabische Knaben haben etwas niedrigere Werte des Körpergewichts und der Körperhöhe als amerikanische Knaben (NCHS-Standard). Die Werte für Hautschichtdicken nahmen mit dem Alter zu, bis zum Alter von 11 Jahren, bis dem sie gleich blieben, und nahmen dann um das Alter 14 stark zu. Mittelwerte der Trizeps- und subkapularen Hautschichtdicken der Knaben von Saudiarabien sind auch niedriger als einige Standards aus den USA während des Alters 13. Im Alter von 14 Jahren haben die saudiarabischen Knaben jedoch höhere Mittelwerte als die USA-Knaben.