IJAE
Vol. 117, n. 1: 1-7, 2012
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Research Article: Basic and Applied Anatomy

Growth pattern in 7-12 years old Arak children (central Iran) in comparison with other ethnic subgroups of Iran

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Submitted December 28, 2010; accepted April 6, 2011

Summary

Background: growth is a remarkable index of health and can be influenced by genetic and environment conditions. The pattern of growth is unique for every nation and worldwide studies have demonstrated separate national standards. In the case of Iran, there is not enough information in this field.
Methods: This study was undertaken on 7-12 years old children from Arak. The data for each individual such as age, height, weight and body mass index (BMI) were recorded. Differences in the data between two sexes were tested by means of the paired sample t- test and the mean BMI was compared with sex- and age-specific reference values from the National Center for Health Statistics of the Centers for Disease Control (CDC) 2000 growth chart using independent sample t-tests. Levels of $P < 0.05$, $P < 0.01$ and $P < 0.001$ were recorded as significant.
Results: In this study, males were significantly taller and heavier than females at the same age ($P \leq 0.01$) except for length at age 10 and weight at age 12. The BMI curves were between 50th and 25th percentiles of CDC.
Conclusions**:** The present study shows the effect of socioeconomic background that had been also considered in other studies in Iran. There is a need for ethnic specific growth charts and BMI cut-off points for underweight, overweight and obesity in children of each ethnic subgroup of Iranian population.

Key words

Anthropometry; BMI; ethnic; Iran; CDC.

Introduction

Individual growth has been regarded as indicator of socio-economic and socio-hygienic conditions and of a population state of health. On the other hand, recent results of longitudinal analyses on twins have indeed demonstrated a major effect of a genetic component in growth, by showing that the surge of genetic variance in both stature and skeletal maturity coincides with the stage of rapid slowing down in growth rate. Moreover, nutritional levels and environmental conditions favor the full expression of the genetic potential for growth (Loesch et al., 2000).

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In children, growth is known to be population specific especially in their head dimensions (Little et al., 2006). This specificity is associated with industrialization, nutritional habits, social economic environment, living conditions etc. Thus it was observed that significant secular changes of body height and craniofacial proportion failed to take place in industrially underdeveloped rural regions (Prazuck et al., 1988). Body mass index (BMI) is an anthropometric parameter which is used to deduce the pattern of growth in children, its increase results from obesity which is a growing problem for developed social groups. Assessing pediatric obesity is not as straightforward as it may seem, but there is now a consensus that BMI should be used for clinical practice and epidemiology (Barlow & Dietz, 1998). However, BMI values in children are much lower than in adults and desirable BMI value changes with age. Thus, BMI cut-offs to define obesity in adults are not appropriate for children (Caballero, 2007) and instead age-related cut-offs should be applied. In children, the BMI cut-off values for overweight and obesity are strongly age dependent as weight and height increase at different pace during growth (Caballero, 2007). Because of differences in life and social standards, worldwide studies have demonstrated the need for separate standards for each nation (Malina 1979; Hauspie et al., 1997). Recent studies in Asian population groups have shown that body fat percentage is higher than in Caucasians of the same age and sex despite a lower BMI in Asians (Guricci et al., 1998; Deurenberg-Yap et al., 1999, Deurenberg et al., 2000; Ko et al., 2001; Deurenberg et al., 2002; Deurenberg et al., 2003). In the case of Iran, an Asian nation, there is limited information on growth patterns among native children. Previous studies have shown differences in anthropometric dimensions among Iranian ethnic racial subgroups (Golalipour & Heydari, 2004/2005; Golalipour et al., 2007; Bayat & Ghanbari, 2009, 2010; Ghanbari & Bayat, 2009), but few studies have compared the growth of natives of each part of Iran with the standards of the National Center for Health Statistics (Nasirian & Tarvij- Eslami, 2006; Razzaghy-Azar et al., 2006). The present study was aimed at assessing body mass index (BMI), as an indicator of the nutritional status, and the impact of body build on the relationship between body mass index and body height and weight of 7-12 years Arak children, as a sampled population of Iranian children, in comparison with CDC standards.

Materials and methods

Subjects

This cross sectional research was carried out in year 2008 on 1724 children 7-12 years old (819 males and 905 females), native of Arak which is a town located in central Iran. The children were selected by staged clustering from schools of Arak city, which had 45250 estimated inhabitants. The children come from families who had been living in the region for at least three generations. The research design followed the rules indicated by the ethic committee of Arak Medical Sciences University and was supported by a joint research thesis (no 88-72-7) from Arak and Kermanshah Medical Sciences Universities.

Anthropometric measurements

An anthropometric examination was conducted that included height and weight measured according to standard protocols as previously described (Lohman et al 1988). The age was calculated to the month, for the purpose of analysis, and exact age was recorded into categories. For example, the age category "10" included all youth ranging in age from 9 years to 9 years plus 11 month.

Standing height was measured using a wall-mounted tape meter without elasticity (sensitivity > 0.1 mm). The participants were asked to remove any hair ornaments, buns, braids, etc. Weight was measured with a physician's beam balance scale to the nearest value (sensitivity > 10 g) and then BMI [weight (kg)/ height $(m)^2$] was calculated for each individual. Measurements were performed by a team of two anthropometrists and taken in triplicate. The principal investigator conducted the measurement training. To minimize diurnal variation in height and weight, each adolescent was measured at approximately the same time of day (within 3 hr) and in standard, non-restrictive clothing.

Data Analysis

The data for each individual were recorded and processed using SPSS software of for Windows (version 15). Differences in height, weight and BMI between sexes were tested by means of *t*- test for paired values. Mean BMI was compared with sex-specific and age-specific reference values from two national probability samples, the CDC 2000 growth charts of the earliest nationally representative survey that examined children (Kuczmarski et al., 2002), using *t*-test for unpaired values. In all comparisons, $P < 0.05$, $P < 0.01$ and $P < 0.001$ were recorded and accepted as significant.

Results

The mean age of the sampled population was 9.34 years. Mean height, weight, and body mass index, by sex and age, are summarized in Table 1.

Height is plotted in figure 1A. Males appeared significantly taller than females ($P \leq 0.01$), except at 7 and 11 years of age, when they appeared significantly shorter. Weight is plotted in figure 1B. Males appeared significantly heavier than females except at age 12, when females appeared significantly heavier ($P \leq 0.001$). The mean BMI of males and females are shown in Fig. 1C. Mean of BMI was higher than female ($P < 0.001$) with two exceptions: those of females and males at age 11 were similar to each other and that of females at age 12 was significantly higher than that of males of the same age ($P \leq 0.001$).

Differences in age-specific mean BMI between sexes are shown in Fig. 2 The BMI had similar pattern of distribution at all ages in both sexes. The mean of BMI was lower than the 50^{th} CDC and the 25^{th} ercentile.

Discussion

The results of the present study show differences in growth pattern between girls and boys. These results should be considered in relation to the methods used and the

Table 1 – Mean and standard deviation of height, weight and BMI of 7-12 years old Arak children, by age and sex.

Age (years)	N	Height (cm)	Weight (kg)	BMI
Males				
7	88	123.00±6,00	22.75±3.34	15.07±2.00
8	168	125.12±5.37	24.51±3.31	15.69±2.09
9	173	130.59±5.29	27.54±4.50	16.16±2.63
10	192	137.15±4.91	31.02±6.00	16.49±3.00
11	116	142.19±8.15	33.87±6.00	16.86±3.50
12	82	13.07±7.38	34.47±6.70	16.96±4.00
Females				
7	90	119.87±6.67	21.16±4.80	14.88±4.00
8	259	123.42±5.00	23.06±2.00	15.16±2.80
9	164	129.10±4.90	26.14±5.00	15.17±2.70
10	157	136.88±4.00	29.59±4.80	15.79±3.00
11	160	139.05±5.11	33.19±5.53	17.52±3.00
12	75	143.07±7.38	36.10±5.89	15.73±3.00

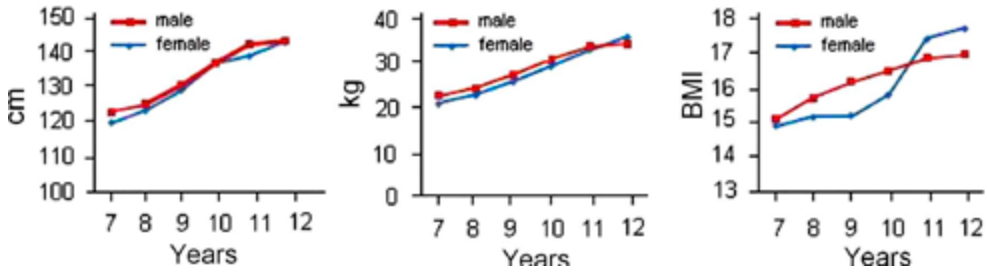

Figure 1 – A: mean height (cm); B: mean weight (kg), and C: mean BMI in 7-12 years old male (red lines) and female (green lines) Arak children; the age (years) is given in the X-axis.

results obtained from other studies on native Iranian children. Few studies of native Iranian children growth report sex- and age-specific sample sizes. Also, hardly any of these studies obtained a random sample. This was a reason for our ongoing project designed to develop growth percentiles of Iran pediatrics population. The children in this study are by no means representative of the general Iran pediatric population. The ethnic and geographical backgrounds of the children examined in this study and the U.S reference were vastly different. This is not a surprise as human stature varies among different populations that are at different stages of the secular trend.

The sample size was large enough to permit reliable comparison with the charts of the CDC, although several findings were striking when combined data were observed. Although our study population was made of healthy school children,

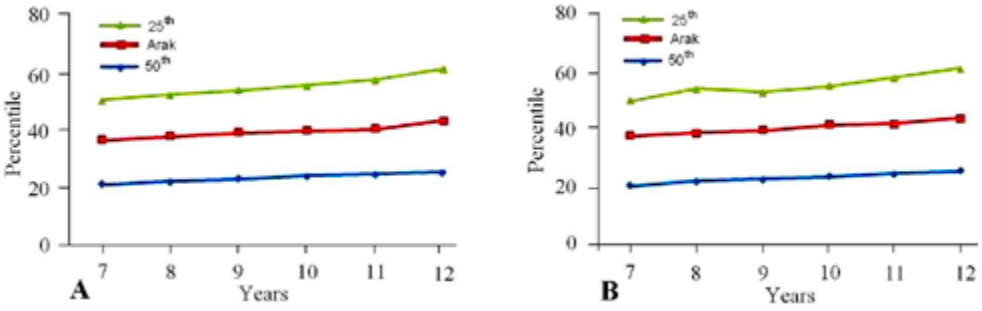

Figure 2 – BMI of 7-12 years old Arak children and corresponding North American CDC standards. A: males; B: females. red (upper) line = 25th percentile of CDC standard; blue (intermediate) line = percentile of Arak children (this study); green (bottom) line = 50th percentile of CDC standard.

The present findings on BMI may indicate that there is a need for ethnic specific growth charts and BMI cut-off points for underweight, overweight and obesity in children of Iran. Similar findings were observed where comparisons in the relationship between BMI and body fat were done for children aged 7-12 years from Singapore, Netherlands and Beijing (Deurenberg-Yap et al., 2000; Deurenberg et al., 2003).

A study compared the mean BMI-for-age of adolescent boys from Calcutta with French, Dutch, British and CDC standard and showed that children from Calcutta plotted well below the other groups including CDC standard, in line with the present study (de Onis et al., 2001). It is therefore important that the growth of children from different populations be rigorously assessed when developing the new international growth references (Deurenberg et al., 2002). Growth standards developed in industrialized countries may be appropriate in developing countries only for measuring child growth in the privileged groups (Wikland et al., 2002).

Updated growth reference charts are essential for every country (Kuczmarski et al., 2002); hence we embarked on this study as a first step, to be followed by the development of percentile charts for Iran pediatrics population. The arguments against using the international reference data for national purposes can be summarized as follows: evidence that the screening ability of the international reference may be poor; lack of evidence of biological validity and associated need for caution; practical problems with the adoption of the new reference; methodological problems inherent the international approach; and conceptual weaknesses inherent the international approach.

In conclusion the pattern of growth of boys and girls in Arak is similar to that in other parts of Iran. The percentiles of BMI of Arak children were lower than CDC standard. There is a need for ethnic specific growth charts and BMI cut-off points for underweight, overweight and obesity in children.

Acknowledgements

We acknowledge the Research Department of Arak University of Medical Sciences and the staff of Fertility and Infertility Research Center of Kermanshah University.

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