A Longitudinal Growth Study from Maturity for Weight, Height and Head Circumference of Normal Iranian Children Compared with Western Norms: A Standard for Growth of Iranian Children

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Abstract

Background: At the present there is no growth reference for Iranian children, and cross-sectional studies indicate that Iranian children grow at a lower percentile curve than Western children.
Aim: The present longitudinal study was undertaken: 1. To establish a growth standard for Iranian children and, 2. To compare their growth with Western norms.

Methods: Weight, length, height, and head circumference were measured from birth to maturity in 180 boys and 180 girls living in Shiraz in socioeconomic conditions similar to high income groups in Western Europe and USA. Raw data and smoothed distance curves are reported here.

Results: The 3rd, 10th, 25th, 50th, 75th, 90th, and 97th percentiles of the measurements were not significantly different from London and NCHS standards.

Conclusion: 1. These data can be used as standard for the growth of Iranian children. 2. The growth potential for Iranian children is similar to that of West European and US children. 3. Data from cross-sectional studies performed in developing countries should not ideally be used as standards.
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Keywords • Iran • child • body height • body weights and measures • growth

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Introduction

Authorities believe that each ethnic group should have its own growth standards with periodic reappraisal to evaluate the secular changes in growth of their population.[1] The difference noted in the growth of different ethnic and racial groups is rightly attributed to the environmental factors, such as nutrition and infections rather than racial background or ethnicity. Growth curves can be established based on longitudinal, cross-sectional, and mixed longitudinal and cross-sectional studies.

Longitudinal studies, being the most difficult and time-consuming of these studies, are less frequently performed, and actually only a few are reported in the literature.[2-5] On the other hand, cross-sectional studies are easier to perform, and in the developed countries where the influence of environmental factors are reduced to a minimum, could reliably be accepted as the standard, when performed on a large segment of population. On the contrary, this type of study, when performed in developing countries, where malnutrition and infection, the major determinants to preventing children to reach their growth potential, are still fairly common, should not be used as standard, although they constitute informative and valuable data for future comparisons.[6-9]

Long ago we reported a longitudinal study comparing the growth from birth to two years of children from the high urban socioeconomic class, poor urban group and rural group of children from South of Iran.[10] The comparison of growth of these children with each other and with those of Western norms brought us to the conclusion that: 1. The growth of children from the highest socioeconomic group from Shiraz, Iran was similar to standards given for Great Britain and USA. 2. The differences observed between high income, low income and rural children were likely due to ecological rather than genetic factors.

Despite some controversy regarding the use of growth charts, most authorities believe that the data from best-off children should always be used as standard. At the present time, there is no standard available for the growth of children from birth to maturity in Iran,[11] and the reported cross-sectional studies include different socioeconomic classes of families in which the environmental factors seem to have influenced the growth of their children.[8,12] The following longitudinal growth study was performed on a group of children from high socioeconomic class to establish a growth reference for Iranian children and to make a comparison between the growth of these children and Western norms.

Materials and Methods

All newborns who appeared for well baby check-ups in the author's clinic at the Nemazee Hospital, Shiraz, Iran from January 1978 were included in the study. Children seen in this clinic included private cases and children of the staff members of Shiraz University of Medical Sciences, and Shiraz University. There were 180 boys and 180 girls. The nature of the project was explained to the parents who then volunteered to participate in the study. A complete social and medical history was obtained for each case. They all had adequate prenatal and neonatal care, none of them had any major congenital anomaly or chronic diseases and there was no mortality during the period of the study. Twins, pre-term newborns (gestational age <37 weeks) and small for gestational age (SGA) babies were not included in the study. Children received their routine immunizations and were treated for minor illnesses as required. Appointments were made for children to be seen in the clinic in the afternoons once a month or at least every two months before the age of two years and once every three to six months thereafter. Efforts were made to see them on the exact date corresponding to the planned schedule each visit. Children were obviously brought to the clinic more frequently during the first few years of life for immunizations, feeding instructions and treatment of minor illnesses. All children entered the study before their 45th day of life and were followed up to the age of twenty years. At each clinic visit, following steps were carried-out: a complete history was taken, physical examination was done and the exact decimal age was recorded. Children were weighed with a minimum of clothing by an experienced nurse to the last completed 10 grams and subsequent adjustments were made to obtain the nude weight. Recumbent length was measured up to the age of five years and standing height was measured thereafter, using a Holtain limited, Crymmych, Pembs; U.K. infantometer and stadiometer respectively. Head circumference was measured by a metallic tape measure. Length, height and head circumference of all children were measured by the author. Measurements were made using the standard techniques.[13,14] Measurements at birth were done in the nurseries where children were born and only the available data were used. The study was completed in December 2001. Raw data for weight, height and head circumference are given and smoothed distance curves for the 3rd, 10th, 25th, 50th, 75th, 90th, 97th percentiles made on the basis of the above measurements are presented using the SPSS and AutoCAD software.[15,16]

Results

Figures 1-8 show the smoothed curves of these data and the comparison with British and NCHS standards. The 3rd, 10th, 25th, 50th, 75th, 90th and 97th percentiles of Shiraz group and the 3rd, 50th and 97th percentiles of British as well as US data are shown for comparison. The London[2] and the NCHS data[17,18] were used for comparison because they are well known and are commonly used in Iran at the present. The difference between weight, height and head circumference of Shiraz group and
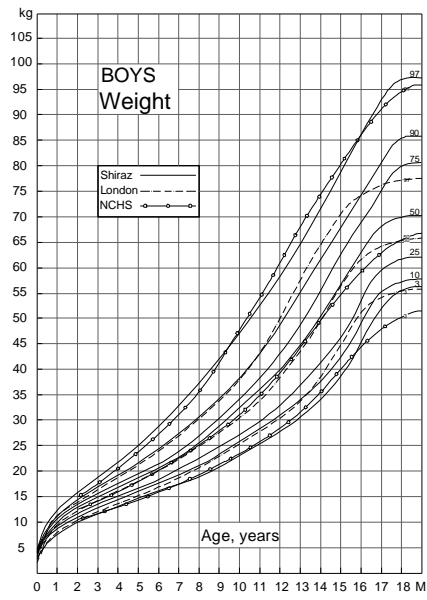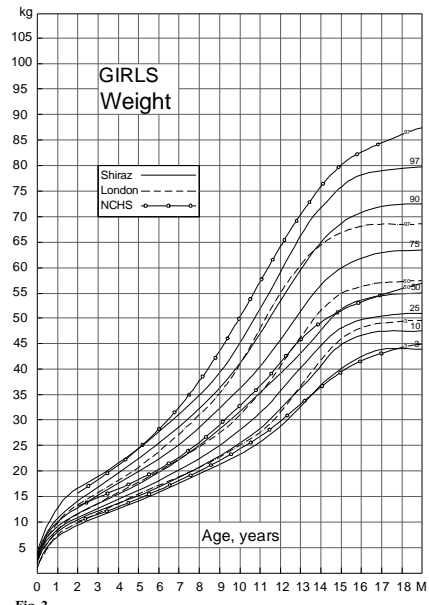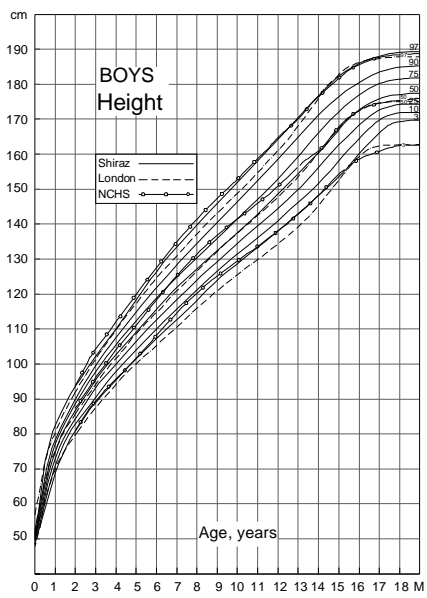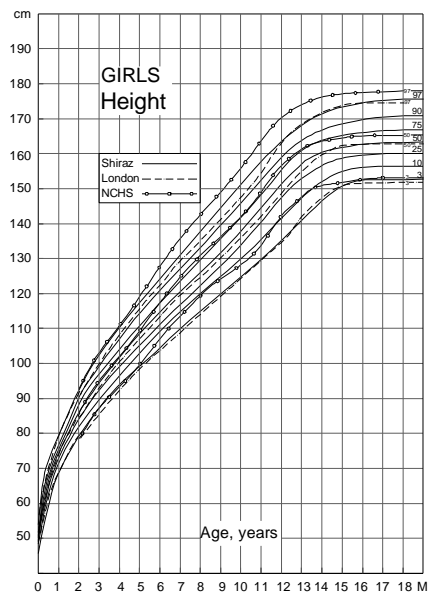
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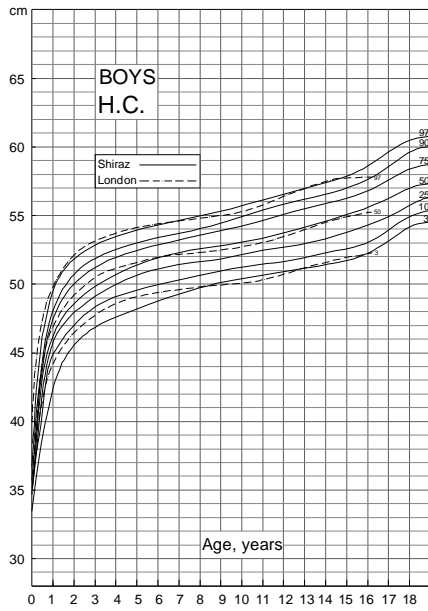
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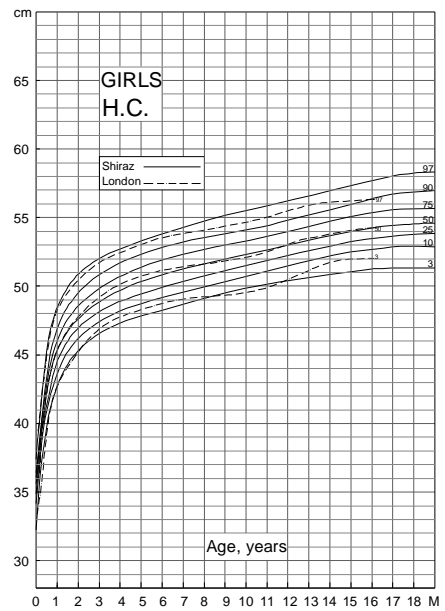
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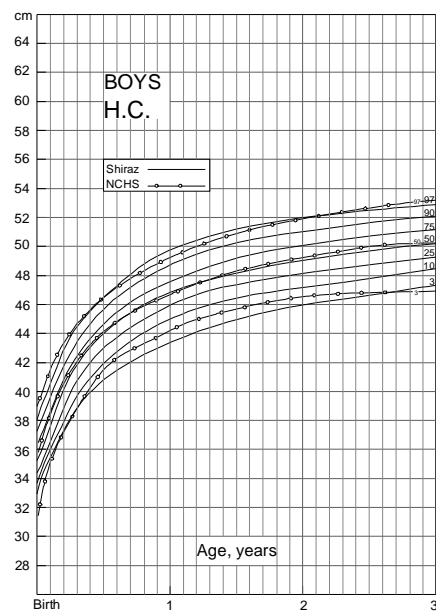
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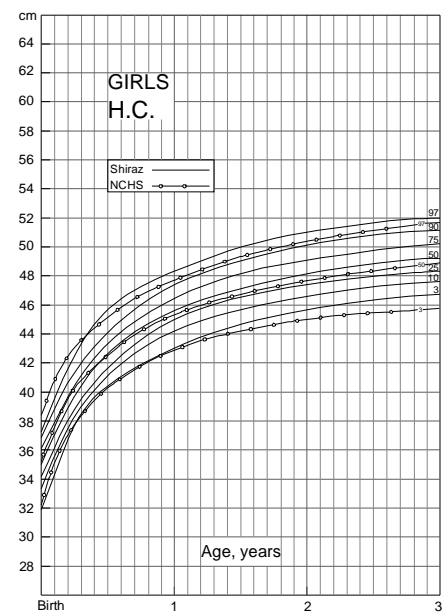
Fig. 8

those of the British and US standards are very small

Discussion

Shiraz, a city situated in the southern part of Iran, has a population of about 1.6 million at the present time. There has been a considerable increase in the size of the city within the past three decades due to migration of the people from rural areas and some migration from other cities during the Iran-Iraq war.

Severe malnutrition, kwashiorkor, marasmus, kwashiorkor-marasmus and other types of nutritional deficiencies used to be very common in Iran.[6,19,7] Recent studies indicate that the prevalence of malnutrition has decreased remarkably. Although not yet eradicated in hospital-referred cases, a decline from 27% to 11% has been observed over a period of about fifteen years. Protein-calorie deficiency and other nutritional deficiencies are still common clinical problems amongst urban and rural children in Iran.[9,8,20]

Infant mortality rate is rapidly declining in Iran; from 110/1000 in 1974 to 26/1000 in 1996. Mandatory routine immunization programs, availability and utilization of health care services, health insurance policies, urban and rural primary health centers, availability of clean drinking water; 98.4% in the cities and 82% in the villages in 1996, use of iodinated salt and free supply of iron for pregnant women and infants, and growth monitoring of children in urban and rural health centers are some of the factors contributing to these rapid changes[21] Consanguinity present in almost 35% of marriages in Iran, about 30 years ago, has plummeted to around 20-25% in large cities at present, although it has remained much higher in rural areas.[19,10]

Several years ago, comparing the height of young Iranian adults with the data from US National Health Survey,[22,10] it seemed showed that Iranian adults did not grow to their optimum potential, therefore, one would expect a considerable positive secular change in the growth of their children with the improvement of the environmental conditions. Our longitudinal growth study from birth to two years of life in children from high socioeconomic families carried out previously revealed that the growth of children from Shiraz was similar to Western norms, .[10]

The present study was performed to establish a growth reference for Iranian children and to compare their growth with that of Western norms. Considering family income, nutrition, parents' education and availability and utilization of health care facilities these children were growing up in an environment similar to those in Western Europe or US.

Therefore, one expects them to have a normal growth and development for their genotype.

There seemed little doubt that the children studied represented a reasonably homogeneous population. They were of the same religion, habitat and physical attributes. Family income and parents' education were used as indicators of socioeconomic status. None of the parents was illiterate and most of them had degrees in higher education. The family income in this group was more than ten times the average income of poor urban families.[10,21]. Average family size in high-income group was 4.0 without any significant change over the past three decades; this was in contrast to much larger families in the poor urban areas.[23]. Birth rate in Iran was 3.2% between 1976 and 1986 and gradually dropped to 1.41 in 1997. Breast-feeding was less common in these children at the beginning of the study and weaning was usually attempted around five or six months of age with proper supplementation from early life. This was remarkably different from the feeding pattern of children living in the less favorable environmental situations in Iran.[24,19]. However, breast-feeding is much favored recently and exclusive breast-feeding is practiced up to the age of six months and weaning is usually attempted around the age of 18-24 months by most families in Iran. In 1995, 79.1% of the infants in urban and 85.4% in rural areas have been on breast-feeding. Proper nutrition, good environmental sanitation, regular immunizations, early diagnosis and prompt treatment of minor illnesses are some of the factors responsible for lack of mortality in this group.

London data are based on measurement in a performed random sample of families living in Central London (about 80 of each sex) several years ago. The NCHS (The National Centre for Health Statistics) known as the Centers for Disease Control and Prevention (CDC) were Growth Charts: United States released in 2000. Figures 1-8 demonstrate the comparison of these standards with the data from Shiraz. Basically the difference between the three groups is very small. Weight of boys and girls from London are less than those of Shiraz and NCHS in the upper percentiles indicating the low prevalence of obesity at the time of London study, (figures 1 and 2). Length and height of the three groups are quite similar at different percentiles, (figures 3 and 4). Figures 5 and 6 show the comparison between the head circumference of Shiraz and London (up to the age of 16 years for London group) and figures 7 and 8 show the same comparison between Shiraz and NCHS (up to the age of 3 years for NCHS group). Measurements are essentially similar for the age groups studied. To summarize the findings it seems that the major difference among the three groups is the higher

prevalence of obesity in Shiraz and NCHC within the past few years.

According to the data from the Ministry of Education and Development, the city of Shiraz is divided into four educational districts. There is a significant difference in the socioeconomic class, family income and level of parents' education living in different districts. Most of the common childhood diseases, such as poliomyelitis, measles and tetanus are eradicated from the urban and rural areas and the prevalence of some of the other diseases such as tuberculosis and malaria is decreasing in Iran.[21]. Severe protein-calorie malnutrition is much less prevalent at the present, although borderline nutritional deficiencies do certainly exist .[20]Our previous studies, similar to several others' revealed that measurements in the low-income urban group were almost the same as those of high income group at birth but gradual deceleration of growth rate begins within the first few months although remained above those of rural children, .[19,10,11]

Many different cross-sectional studies performed on children in Iran and reported in local and international medical literature indicate that during the past 20-30 years, as expected, there has been some increase in the weight and height of children at different ages and in their ultimate adult size.[25] Children are also maturing earlier in Iran, the reported age at menarche, 12.55 ± 0.78 years [26] and 12.91 ± 1.23 [27] and the age of maturity in boys in the group under the study are similar to those reported from Western countries.[28,27]

However, most of the cross-sectional studies carried-out in Iran conclude that the growth of Iranian children is less than that of British or US children attributing to socioeconomic conditions, nutritional factors, diseases, the onset of adolescent growth spurt, or even racial differences.[9,25,12,8]

In a study carried-out on young children in agricultural area of Gilan, Iran[9] the authors conclude that family food availability and adult food intake were adequate, but food intake of young children were deficient in all socioeconomic groups, reflected in growth deficit. In their study, late introduction and small quantities of solid food, poor maternal knowledge of child feeding, low energy density due to rationing and the high price of animal proteins, contamination of water supply and use of sedative drugs were considered as some of the associated factors. In a study performed on children (aged 6-12) in Shiraz[25] it is reported that the median heights and weights of children in Shiraz lie approximately on the 25th percentiles of US children, but were above most groups of children from developing world. The spread of their data was similar to that observed in US and there was no evidence of widespread malnutrition.

Ayatollahi, and Carpenter in 1993, have shown that Iranian adults are taller and heavier than previously reported in the region but are smaller than European and US white adults. This observation, similar to ours, is certainly in favor of the effect of environmental rather than racial factors on the growth and suggesting that positive secular changes are also to be expected in the growth of children in this part of the world.

From a longitudinal growth study[11] performed on 317 infants (164 girls and 153 boys) born in Shiraz in 1996 and followed for two years, the authors conclude that all percentiles of length and weight charts are slightly above those of the NCHS under the age of six months, but fall substantially below those over the age of six months. However, the spread was similar, indicating that there was no suggestion that the difference could be due to prevalence of gross malnutrition. There are other studies[12] based on the data from a National Health Survey of Iran carried-out in 1990-1992. Differences between the growths of children in different provinces and between urban and rural areas were demonstrated. Savva and his coworkers in 2001 compared the growth of Cypriot children with the growth of Swedish and Iranian children.[29] They concluded that the 85th and 95th BMI percentile values were higher in Cypriot boys than in Swedish and Iranian boys through all ages 6 to 15 years, whereas after the age of 15 years, both Swedish and Iranian girls' percentiles were equalized with their Cypriot peers. In another report from Shiraz[30] the effect of socioeconomic/cultural factors on the growth of school children was examined. District of residence and father's education were identified as the factors influencing the growth of children after adjusting for the effect of family size and the parent sizes. Further longitudinal study was suggested in order to explore the complex inter-related pattern of other factors influencing the growth of infants and children in Iran.

The positive secular trend in growth is reported from different developing countries. A study from Brazil[31], on children of middle class urban families of European ancestry, comparing their growth in 1978 and 1997/98 shows the same trend.

Another study on the growth of children 6-12 years from two different geographic regions of Mexico also reveals that the gap between well-off and lower socioeconomic status children in different regions of Mexico has been reduced, while they report an increase in the prevalence of obesity.[32] It seems that with recent increases in weight and height of children, developing countries, similar to the developed world, are experiencing an increase in the prevalence of obesity; a fact which has also been observed by other investigators in Iran.[33,34]

Therefore, the data from cross-sectional growth studies performed on children from different districts of large cities in Iran, or other developing country for that matter, should not ideally be used as the standard; for the simple reason that most of these children have not grown to their optimum growth potential because of the adverse effects of environmental factors.

In conclusion: 1. The data presented here can be used as the standard for the growth of Iranian children. 2. There is no significant difference between the growth potential of Iranian children compared with children from Western Europe or USA. 3. Data obtained from cross-sectional studies in developing countries where severe or even milder degrees of malnutrition is still prevalent, although demonstrating the pattern of the growth of the majority of the children at the time of the study, should not ideally be used as standard. 4. The need for periodic reappraisal of growth parameters in developing countries is emphasized for evaluation of the effect of the positive secular trend in the growth of children.

Acknowledgements

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