

SECULAR TRENDS IN GROWTH AMONG SCHOOL CHILDREN OF SHIRAZ (SOUTHERN IRAN) BORN IN THE POST-WAR PERIOD

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ABSTRACT

Background: Secular trends in stature, weight and mid upper arm circumference (MUAC) of 2397 school children (1268 boys and 1129 girls) of the same age (6.5-11.5 years) and sex in representative samples from primary schools of Shiraz (southern Iran) at an interval of 15 years (1988 vs 2003) are reported.

Methods: Cross-sectional weight, height and mid upper arm circumference (MUAC) curves were created for both sexes. One sample t-tests were utilized to analyze differences between average height, weight and MUAC of the 1988 and 2003 samples (the values of the previous study treated as constant).

Results: Both samples included children of various socio-economic backgrounds for both males and females of each age-class. There are significant positive secular trends in stature, weight and MUAC of children born in the post-war period sampled in 2003. These children are generally taller, heavier, and larger than their peers of 15 years earlier born pre- and during the imposed war period of Iraq against Iran. The 2003 sample shows less growth deficits in relation to the CDC reference data.

Conclusion: The positive trend can be explained as the result of economic development and improvement of social and health indicators in Iran in the post-war period.

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Keywords: Secular Trend, Growth, Height, Weight, MUAC

INTRODUCTION

Secular changes in body dimensions have attracted the attention of anthropologists.¹ and in children of developed countries are well documented phenomena.²⁻¹⁸ However, it has still not been documented whether secular changes in body dimensions other than stature and weight have occurred in children.¹⁹

Although the mechanisms underlying secular trend in growth measures are not fully understood, environmental²⁰⁻²¹ as well as the interaction of genetic and environmental factors are believed to constitute a major cause of secular

increase.²² Secular increases in growth have been regarded as indicators of the improvement of socio-economic and socio-hygienic conditions and of a population's state of health.²³ Thus being a measure of social welfare, it is the keystone of the discipline of anthropometric history.²⁴

Studies of human growth throughout Iran dates back to 1966 and has been surveyed critically until 1993.²⁵ However at present no data is available on the secular trend of human growth in Iran. The aim of this paper is to evaluate age dependent secular changes in body height, weight and MUAC of a representative sample of 2397 school children of Shiraz (Iran) aged 6.5-11.5 years and born at least 2 years after the 8-year imposed war of Iraq against Iran (1980-1988) and carried out in 2003 with their peers in a representative sample of 1207 school children carried out in 1988 and fully described elsewhere.²⁶⁻²⁷ Both studies were cross-sectional and population based representative samples.

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Table I. Number (n), mean weight (kg), standard deviation (SD) and secular changes of the mean of boys and girls by age of Shiraz school children, Iran. (2003 growth study compared with 1988 growth study).

Age	Boys			Girls		
	n	Mean(SD) kg	Secular changes (kg)	n	Mean(SD) kg	Secular changes(kg)
7±	210	21.92 (3.14)	0.78	168	21.76 (3.42)	1.21
8±	206	24.41 (4.02)	0.67	197	24.24 (3.83)	1.24
9±	227	27.64 (5.15)	1.97	206	27.33(5.04)	1.20
10±	237	30.61 (6.02)	1.50	235	30.93 (6.50)	1.25
11±	262	33.15 (6.21)	2.02	258	34.90 (7.70)	3.23
Total	1161	27.55(4.54)	1.39(0.64) p=.008	1069	27.83(5.23)	1.63(0.9) p=.015

Table II. Number (n), mean height (cm), standard deviation (SD) and secular changes of the mean of boys and girls by age of Shiraz school children, Iran. (2003 growth study compared with 1988 growth study).

Age	Boys			Girls		
	n	Mean(SD) cm	Secular changes(cm)	n	Mean(SD) cm	Secular Changes(cm)
7±	211	119.55(5.06)	1.04	169	119.42(5.30)	2.01
8±	211	125.16(5.67)	1.61	199	124.63(5.34)	1.83
9±	231	130.54(6.19)	3.14	207	130.36(6.14)	2.26
10±	242	135.83(6.13)	2.76	234	136.07(6.28)	1.52
11±	266	139.92(6.45)	2.14	260	141.75(7.16)	1.74
Total	1141	130.2(8.14)	2.14(.85) p=.005	1064	130.5(8.87)	1.93(.38) p=.0003

MATERIAL AND METHODS

Subjects: A random sample of 2397 healthy school attenders (1268 boys, 1129 girls) aged 6.5-11.5 years was selected in a multistage method forming 2% of the school chil-

dren from the four educational districts of Shiraz, the capital of Fars province, with a population of 1.5 million of whom 87.2% are literate, in the academic year of 2002-2003.

Measurement: Height: The children presented for measurement of stature dressed in minimum clothing without

Table III. Number (n), mean MUAC (cm), standard deviation (SD) and secular changes of the mean of boys and girls by age of Shiraz school children, Iran. (2003 growth study compared with 1988 growth study).

Age	Boys			Girls		
	n	Mean(SD) cm	Secular changes(cm)	n	Mean(SD) cm	Secular Changes(cm)
7±	210	17.1(1.6)	1.26	172	17.4(1.9)	1.53
8±	210	17.8(2.2)	1.30	202	18.1(2.2)	1.52
9±	230	18.6(2.3)	1.60	205	18.7(2.2)	1.28
10±	237	19.2(2.3)	1.28	233	19.5(2.4)	1.45
11±	258	19.6(2.3)	1.28	250	19.9(2.4)	1.73
Total	1145	18.5(2.4)	1.4 p=.07	1062	18.8(2.4)	1.6 p=.045

Table IV. Average weight (kg) and height (cm) for boys and girls, Shiraz, Iran, and comparison with CDC values.

Age (year)	Boys			Girls		
	Shiraz Median (2003)	CDC Median (2000)	CDC percentile of Iranian mean	Shiraz Median (2003)	CDC Median (2000)	CDC percentile of Iranian mean
Weight (kg)						
7.0±	21.0	23.1	41.4	22.0	22.8	44.6
8.0±	24.0	25.6	40.0	24.5	25.6	43.6
9.0±	26.9	28.6	41.2	27.5	29.0	43.0
10.0±	29.7	31.9	40.3	30.9	32.9	42.3
11.0±	32.1	35.9	36.1	34.9	37.2	38.5
Height (cm)						
7.0±	119.2	121.8	39.4	119.8	121.5	43.1
8.0±	125.1	127.9	39.2	125.2	127.6	40.8
9.0±	130.6	133.5	39.4	130.6	132.9	41.6
10.0±	135.7	138.6	40.1	136.1	138.0	43.7
11.0±	140.5	143.1	40.9	141.6	144.0	42.7

Table V. Evaluation of some social indicators in Shiraz (Iran) from early 1988 to late 2003 (a 15 year period).

Indicator	1988	2003
Urban population (%)	63.6 %	78.6 %
Literacy rate (%)	76 %	88 %
% of health budget to GNP	2 %	3.1 %
Infant mortality rate per 1000 live births	29.9	27.7
Life expectancy at birth	64	69
Physicians per 10000 inhabitants	5.8	10.3
Students per 1000 inhabitants	194	296
Population growth rate (%)	3.8 %	1.24 %

shoes. The subjects were instructed to stand upright against the stadiometer such that their heels, buttocks and scapulae were in contact with the backboard, and the heels were together. As positioning was of the greatest importance the observers (auxologists) always checked that the subjects were in the correct position by starting with the feet and checking each point of contact with the backboard as he moved up the body. Height was recorded to the nearest mm.

Weight: The observer ensured the subjects were dressed in minimum clothing without shoes. The subjects stand straight, but not rigid or in a 'military position' and are instructed to 'stand still' using a digital stadiometer (Model Seca 707, Germany). Weight was measured to the nearest 100 grams.

Mid Upper Arm Circumference (MUAC): The mid upper arm landmark was taken as the point on the lateral border of the acromion and the olecranon when the arm was flexed at 90 degrees. This may be easily determined by

marking the lateral border of the acromion and applying a tape measure to this point. The tape was allowed to lie over the surface of the arm, and MUAC was recorded to the nearest mm.

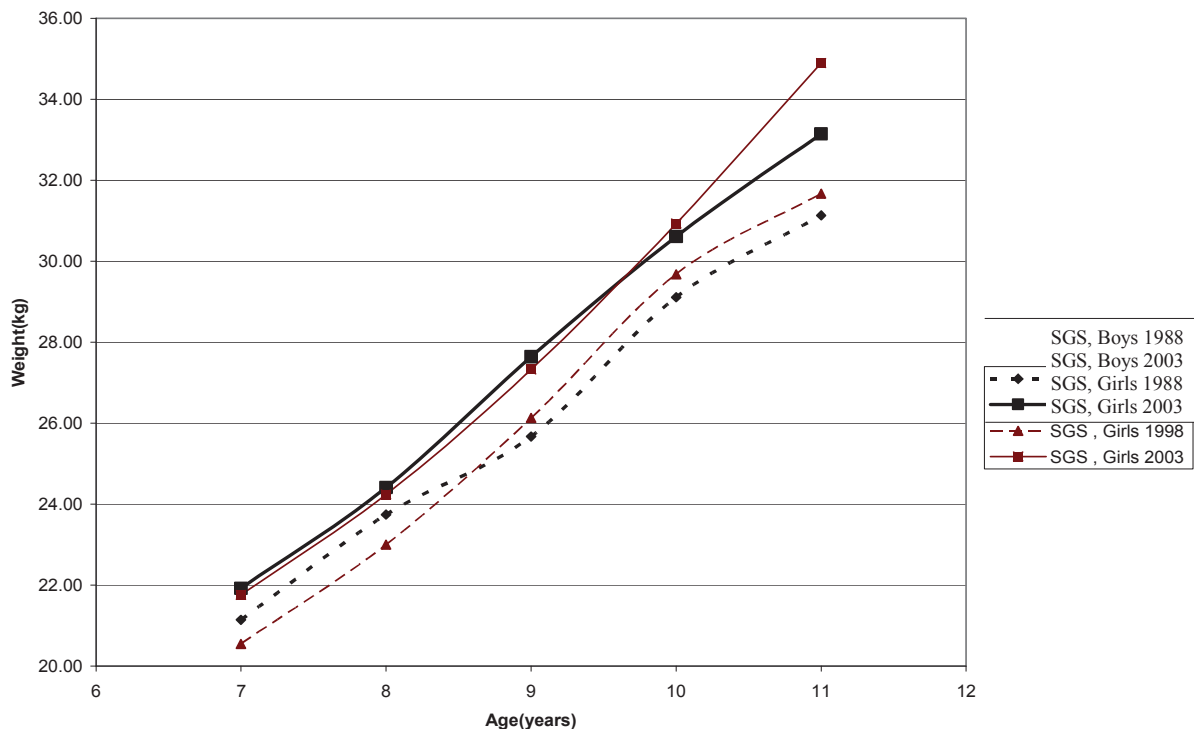
Twenty school children were not available for measurements (0.9%). Valid measurements were available for 1161 boys (91.6%) and 1069 girls (94.7%) heights, 1141 boys (90%) and 1064 girls (94.2%) weights and 1145 boys (90.3%) and 1062 girls (94.1%) MUAC. Ages were calculated exactly as the difference between the date of measurement and the date of birth as recorded in their birth certificate, which is accurate.

Methods: The data were compared to the cross-sectional study of 1207 school children of the same age carried out 15 years earlier (1988) who experienced at least 6 years of the imposed war of Iraq against Iran (started in 1980 and ended in 1988).

Cross-sectional weight, height and MUAC curves were created for both sexes. One-sample t-tests were utilized to analyze differences between average height, weight and MUAC of the 1988 and 2003 samples (the 1988 averages treated as constant). Statistical tests and curves were performed using statistical package SPSS²⁸ and Excel graphics. Comparison with the center for disease control and prevention (CDC) reference values²⁹ were performed using SPSS software.²⁸

RESULTS

Summary statistics of weights, height and MUAC of

**Fig. 1.** Curve of average weight (kg) by sex, Shiraz, Iran, 1988-2003.

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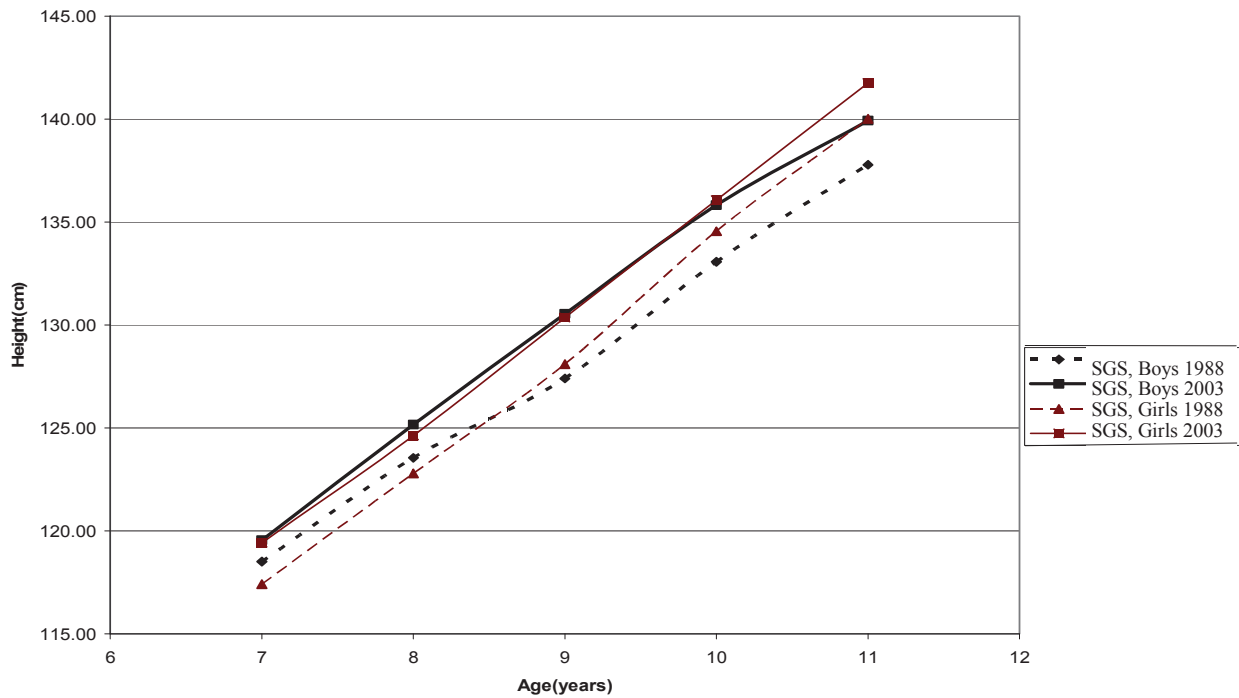


Fig. 2. Curve of average height (cm) by sex, Shiraz, Iran, 1988-2003.

school children of Shiraz in 2003 are compared with the findings of the 1988 study presented in Tables I to III. Children are now, 1.4 kg for boys ($p=0.008$) and 1.6 kg

for girls ($p=0.015$), heavier than their peers of 15 years earlier on the average. An average secular change of 2.1 cm for boys ($p=0.005$) and 1.9 cm for girls ($p=0.0003$) is

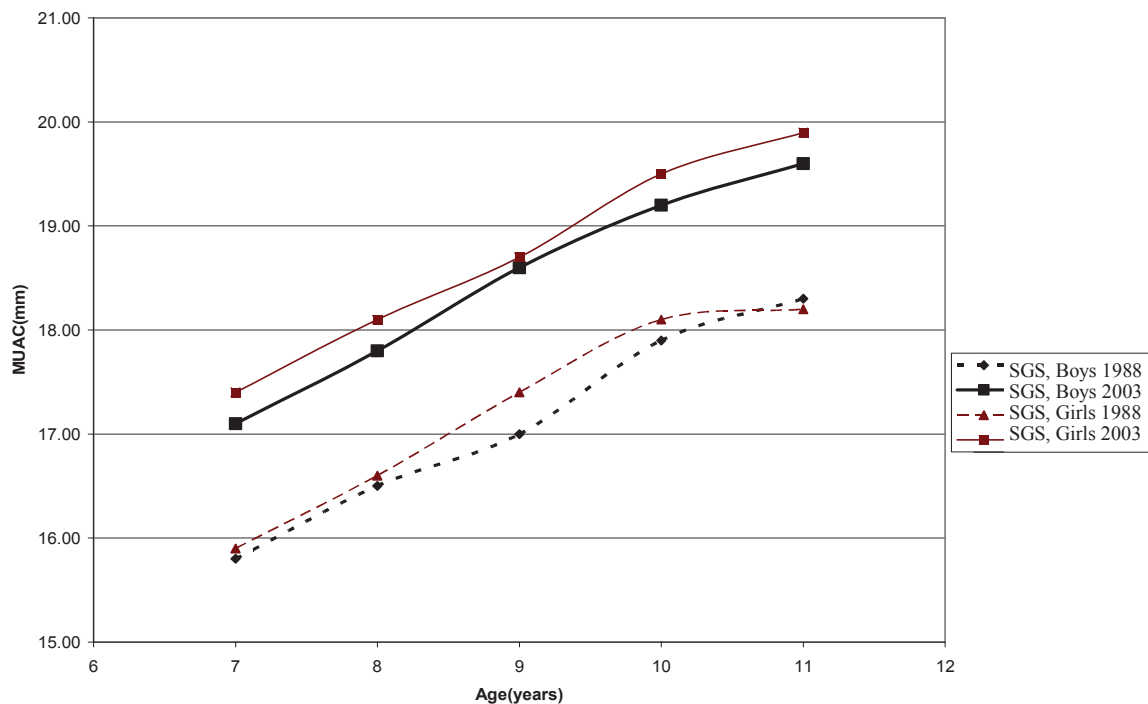


Fig. 3. Curve of average MUAC (mm) by sex, Shiraz, Iran, 1988-2003.

seen in height measurement of post-war period subjects. On the average a positive secular change of 1.4 cm for boys ($p=.07$) and of 1.6 cm for girls ($p=.045$) is observed during a 15 year postwar period in MUAC measurements. (However, the change is not significant for boys; but we can see its trend is positive)

Curves of average weight of boys and girls of Shiraz in the two studies carried out in 1988 and 2003 show that our children are now heavier than their peers of 1988 at all ages (Figure 1). A positive secular change is apparent for all ages in height (cm) showing that the children are now taller than their counterparts of the previous study (Figure 2). Curve of average MUAC of boys and girls of Shiraz in the two mentioned studies indicates that Shiraz children now have larger arm circumferences (Figure 3).

Table IV presents average weight (kg) and height (cm) of boys and girls of Shiraz school children at 7 and 11 years of age and comparison with the CDC values is provided.

Mean values of weight and height for age of our subjects expressed as centiles of the CDC standard are displayed in Figure 4.

Table V shows some social indicators of Shiraz (Iran) from early 1988s to late 2003 (a 15 year period) which might have positively influenced the growth of our children born during the Iran reconstruction period. This couples with economic improvement as well as educational promotion explaining the growth secular trend in our children.

DISCUSSION

Compared with the results of Ayatollahi et al.,²⁶⁻²⁷ this study shows significant secular changes in height, weight and MUAC in boys and girls. Better post-war environmental situations might have favored earlier growth.

Sex difference for means of weight (0.28 kg.), height

(0.3cm) and MUAC (0.3 cm) was not statistically significant ($p>.05$). However, around age 10 and onwards girls grow faster than boys, indicating their approach to the pubescent ages which affect their growth indices positively.

A major methodological issue in population based growth studies is whether the procedure sufficiently ensures a representative sample adequately stratified to affect growth. In the two consecutive growth studies in Shiraz, all possible precautions were taken to arrive at a representative study sample, and the methodology has been essentially equal. In both studies, the small number of nonresponders ensures the representative sample.

Environmental improvements play an important role in the positive secular trends in growth in post-war Iran and the significant improvement in mean level of parental and maternal schooling.

The present study reveals a sharp positive trend in growth of school children. For example, we can see at the age of 11 years, rates at which the process is occurring, especially for male weight (1.35 kg. per decade) and female height (1.2 cm per decade), are among the highest reported so far. Positive trends in male heights (1.43 cm per decade) and female weights (1.1 kg. per decade) are also high (Table I&II).

It must be noted that high rates of increase in weight and height shown with other developing economics like Hong Kong, Taiwan, Brazil and China,⁴ can be interpreted as resulting from the fact that the sample is healthy and no pronounced malnutrition is seen.

However this study reveals some differences between Shiraz children and CDC curves. Growth of our children has been improved to much less deficits in relation to the CDC than their peers of 15 years earlier. The analyses reinforce an almost general perception that growth deficits

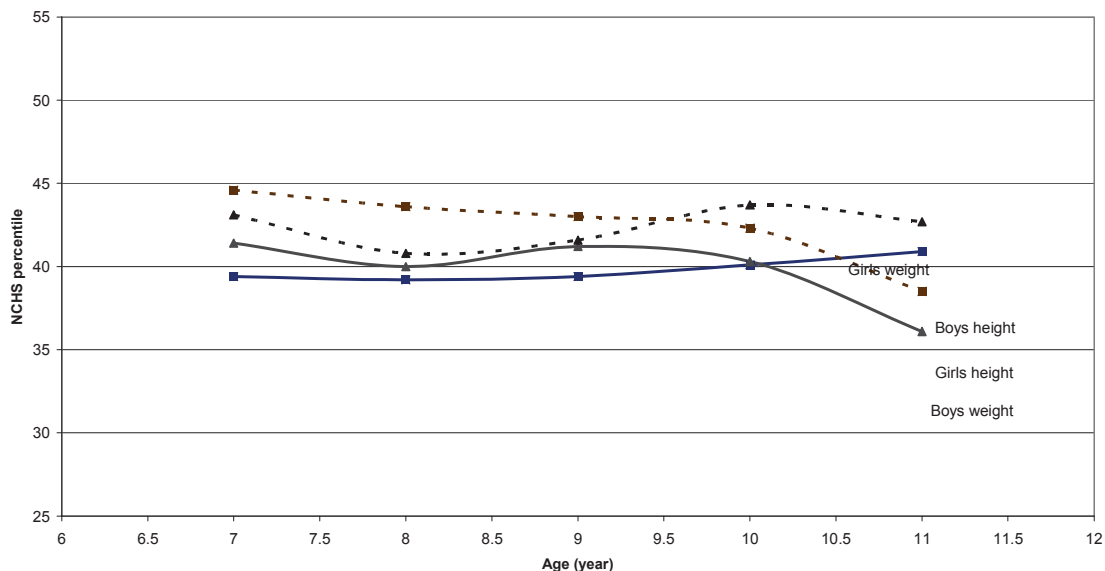


Fig. 4. Median values of weight and height for age expressed as percentiles of the NCHS for the recent Shiraz growth study.

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in relation to the CDC should not always be interpreted as the outcome of nutritional deficits. Rather, this suggests using local growth standards in evaluating children in Iran.

After a decade of relative economic stagnation and sanctions due to the revolution that happened in 1979 and the imposed war in 1980, Iran might have returned to the path of improvement of public services and living conditions in the reconstruction decade, evidenced by a positive variation in social indicators in the period from early 1988 to 2003 (Table V). Industrialization, urbanization and increase in per capita are producing beneficial effects on growth.

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