HEIGHT AND WEIGHT PATTERNS AS INDICATORS OF GROWTH AMONG SCHOOL CHILDREN IN AN AIR FORCE STATION : A CROSS-SECTIONAL STUDY

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ABSTRACT

A cross sectional study of school children between 6-17 years of age was carried out in an Air Force Station to determine their growth patterns as indicated by weight and height with a view to detect gender bias, if any, and compare the findings with those of affluent Indian children and National Centre for Health Statistics (NCHS), USA, standards. A total of 763 boys and 605 girls were examined. There was no gender bias in growth. Though the children compared almost favourably, with affluent Indian children, particularly in respect to stature, they were lagging far behind the NCHS standard. Goal for achieving the NCHS standards in the long run has been discussed.

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KEY WORDS : Adolescents; Anthropometry; Growth; School children; Under-nutrition.

Introduction

Measurement of growth has always been an important tool for assessing the nutritional status of children. Anthropometry has enjoyed an important place among procedures for nutrition in individuals and communities. Unfortunately, there has not been much work in this area in South East Asia Region (SEAR) [1]. Most growth studies in the SEAR countries have concentrated on the pre-school child (under-five). It is now important to collect data on patterns of growth amongst school going and adolescent children across different socioeconomic groups in the region. Such data collected and published, will not only help in comparing different populations, but also provide direction to national planners and policy-makers.

The present study was carried out amongst school children between 6-17 years of age and of both sexes, in an air force station. The aim was to detect firstly, whether there was any gender bias in growth of school children, and secondly, to compare the growth of the school children, with national and international standards.

Material and Methods

All school children between the ages 6-17 years of both sexes studying in Kendriya Vidyalaya of an Air Force Station comprised the study population. They were mostly wards of Air Force personnel, and other central government employees. They could be taken as prototype of the educated, salaried, Indian middle to lower middle class.

Height and weight measurements of all school children of both sexes (n=1368, male=763, female=605) were recorded, besides routine health examination, standing height for each child was measured by making the child stand barefoot with heels, buttocks and shoulders touching the vertical surface and head in the Frank-furt plane (line passing through the outer canthus and external auditory meatus which is parallel to the ground). Weight was measured with help of recently calibrated spring balance, barefooted and in summer clothing. Age was recorded from school records.

The findings were compared with height and weight percentiles sex-wise and age wise of affluent Indian children [2], and National Centre for Health Statistics (NCHS) standards [3]. The NCHS standards recognized by WHO for international comparisons have been obtained from a sample of more than 20,000 American children selected to represent the non institutionalized US population from birth to 18 years. Underweight and short stature was taken as below the 3rd percentile (of weight or height for that particular age and sex), as compared either to the chart for affluent Indian Children or the NCHS standards. Similarly overweight/abnormally tall stature was taken as reading above the 97th percentile. The 50th percentile of both height and weight age wise of both sexes in the present study was worked out and compared with the 50th percentiles of both affluent Indian children and NCHS measurement. Only apparently healthy children without any chronic debilitating conditions were included in the study.

Results

Underweight: Tables 1 & 2. A total of 1368 school children, 763 boys and 605 girls between the age of 6-17 years, were examined. Compared to affluent Indian children (Table-1), 112 (8.19%) of the total 1368 children examined were underweight (3rd percentile of weight of affluent Indian children). Out of these, 72(9.44%) of the boys and 40(6.61%) of the girls were underweight. There was no correlation between sex and underweight (Chi Sq=3.22, p=0.0729090, OR=1.47, Cornfield 95% CI=0.97, < OR < 2.24). However, compared to NCHS standards

(Table 2), 434(31.73%) of the total children were underweight, out of which 252 (33.03%) of the boys, and 182(30.08%) of the girls were underweight. Again, there was no difference among the boys and girls in the rates for underweight (Chi sq=1.22, $p=0.2696571$, OR=1.15, Cornfield 95% CI=0.90<OR<1.45).

TABLE 1

Percentage of underweight children as compared to affluent Indian children

Sex	Underweight (< 3rd percentile)	> 3rd percentile	Total
Male	72 (9.44%)	691 (90.56%)	763 (100%)
Female	40 (6.61%)	565 (93.39%)	605 (100%)
Total	12 (8.19%)	1256 (91.81%)	1368 (100%)

Chi Sq = 3.22; df = 1; $p = 0.0729090$; OR = 1.47; Cornfield 95% CI = 0.97<OR<2.24

TABLE 2

Percentage of underweight children as compared to NCHS (USA) standards

Sex	Underweight	> 5th percentile	Total
Male	252 (33.03%)	511 (66.97%)	763 (100%)
Female	182 (30.08%)	423 (69.92%)	605 (100%)
Total	434 (31.73%)	934 (68.27%)	1368 (100%)

Chi sq = 1.22; df = 1; $p = 0.2696571$; OR = 1.15, Cornfield 95% CI = 0.90<OR<1.45

Overweight : Only 8 boys (1.05%, and 6 girls (0.99%) were overweight (i.e.97 percentile), when compared with standard for affluent Indian children. None of the boys and only 2(0.33%), of the girls were overweight when compared with NCHS criteria.

Short stature Tables 3 and 4. Compared with affluent Indian children (Table 3), 96 (7.02%), of the 1368 children were of short stature. Of these 55(7.21%) of the boys and 41(6.77%) of the girls were of short stature. There was no sex differential (Chi Sq=0.04, $p=0.8385364$, OR=1.07, Cornfield 95% CI=0.69<OR<1.66). Compared to the NCHS criteria (Table-4), 275(20.10%), of the 1368 school children were of short stature, 150(19.66%) of the boys, and 125(20.65%) of the girls, with no gender difference in short stature (Chi Sq=0.15, $p=0.69556$, OR=0.94, Cornfield 95% CI=0.71<OR<1.24).

TABLE 3

Percentage of short stature children as compared to affluent Indian children

Sex	Short stature (<3rd percentile)	> 3rd percentile	Total
Male	55 (7.21%)	708 (92.79%)	763 (100%)
Female	41 (6.77%)	564 (93.23%)	605 (100%)
Total	96 (7.02%)	1272 (92.98%)	1368 (100%)

Chi sq = 0.04; df = 1; $p = 0.8385364$; OR = 1.07; Cornfield 95% CI = 0.69<OR<1.66

Abnormally tall stature : Out of the total 1368 children, 45(3.29%), were more than the 97th percentile when compared with affluent Indian children, comprising 30(3.93%)of the boys

and 15(2.48%) of the girls. Compared with NCHS percentiles, 24(1.75%) of the total children examined were of abnormally tall stature, 17(2.23%)of the boys and 7(1.16%) of the girls.

TABLE 4

Percentage of short stature as compared to NCHS standards

Sex	Short stature	>5th percentile	Total
Male	150 (19.66%)	613 (80.34%)	763 (100%)
Female	125 (20.66%)	480 (79.34%)	605 (100%)
Total	275 (20.10%)	1093 (79.90%)	1368 (100%)

Chi sq = 0.15; df = 1, $p = 0.69556$; OR = 0.94; Cornfield 95% CI = 0.71<OR<1.24

Median Weight boys : Table 5 shows the median weight of the boys age-wise (50th percentile), compared with both the median of affluent Indian children, and NCHS. The median weights were significantly lower ($p=0.002692$ and $p=0.000117$ respectively).

TABLE 5

Median weight (50th percentile) of boys of present study compared with affluent Indian children and NCHS medians

Age (yrs.)	Median wt. (kg) (present study)	Median wt. (kg) (affluent Indians)	Median wt. (kg) (NCHS)
6	18 (n = 79)	19	20.69
7	20 (n = 61)	21	22.85
8	21 (n = 79)	22.6	25.35
9	25 (n = 87)	24.4	28.13
10	26 (n = 70)	27	31.44
11	28 (n = 91)	30.6	35.30
12	31 (n = 66)	34.8	39.78
13	37 (n = 79)	39.4	44.95
14	44 (n = 44)	44.1	50.77
15	46 (n = 43)	48.5	56.71
16	48.5 (n = 34)	52.4	62.10
17	49.0 (n = 30)	55.5	66.31

P value* a) compared with affluent Indian boys; $p = 0.002692$ (significant)

b) compared with NCHS; $p = 0.000117$ (significant)

*Paired t-test

Median weight girls : This is shown in Table 6. Median weight of the girls did not differ significantly from those of affluent Indian girls ($p=0.092426703$), but were lower than NCHS medians ($p=0.000832$).

Median height boys : Table 7 shows the median weight of boys. Compared with affluent Indian boys the median heights in the present study did not vary significantly ($p=0.24880594$). However they were lower than NCHS ($p=0.0000209174$).

Median height girls : Table 8. In girls also, the difference in median heights when compared to affluent Indian girls just missed statistical significance ($p=0.061999014$), and varied significantly compared to NCHS ($p=0.0000204297$).

Discussion

The overall male : female ratio of 763 : 605 in the present study shows an unfavourable gender bias against school attendance of the girl child. However,

TABLE 6

Median weight of the girls compared with affluent Indian girls and NCHS

Age (yrs.)	Median wt. (present study)	Median wt. (affluent Indian girls)	Median wt. (NCHS)
6	18 (n = 57)	17.8	19.52
7	20 (n = 43)	19.0	21.84
8	22 (n = 68)	20.8	24.84
9	23 (n = 53)	23.5	28.46
10	25 (n = 91)	26.9	32.55
11	30 (n = 67)	30.9	36.95
12	35 (n = 70)	35	41.53
13	39 (n = 54)	39.1	46.10
14	42 (n = 25)	42.7	50.28
15	44.5 (n = 28)	45.7	53.68
16	43 (n = 33)	47.7	55.89
17	45 (n = 16)	48.4	56.69

p value*

a) compared to affluent Indians girls; $p = 0.092426703$ (not significant)

b) compared to NCHS standards; $p = 0.000832$ (significant)

*Paired t-test

TABLE 7

Median height (50th percentile) of boys compared with Indian affluent boys and NCHS

Age (yrs.)	Median ht (cm) (Present study)	Median ht (cm) (Affluent Indian)	Median ht (cm) (NCHS)
6	113	114.2	116.10
7	119	119.7	121.70
8	124	123.6	127.00
9	131	128.2	132.00
10	134	133.6	137.50
11	135	139.6	143.33
12	144	145.8	149.70
13	151	152.0	156.50
14	157	157.6	163.10
15	164	162.5	169.00
16	165	166.3	173.50
17	167	168.7	176.20

p value*

a) when compared with affluent Indian boy; $p = 0.24880594$ (not significant)

b) when compared with NCHS standards; $p = 0.0000209174$ (significant)

*Paired t-test

unlike in a previous study [4], of nutritional status limited to pre-school under-five children of service personnel, there was no gender bias in growth as indicated by weight and stature of the girl child both when compared with affluent Indian children, and NCHS. Perhaps school attendance per se may remove the gender-divide in overall well being of the girl child vis-a-vis the boy child. Whatever the association, it is an encouraging finding.

What is not very encouraging is the very significant

TABLE 8

Median height of girls compared with median of affluent Indian girls and NCHS

Age (yrs.)	Median ht (cm) (Present study)	Median ht (cm) (Affluent Indians)	Median ht (cm) (NCHS)
6	112.00	112.50	114.60
7	119.00	117.40	120.60
8	125.50	123.20	126.40
9	128.00	129.20	132.20
10	132.00	135.20	138.30
11	139.00	140.90	144.80
12	144.00	146.00	151.50
13	148.00	150.40	157.10
14	152.00	153.80	160.40
15	155.00	156.00	161.80
16	154.00	156.80	162.40
17	157.50	157.00	163.10

p value*

a) when compared with affluent Indian girls; $p = 0.061999$ (not significant)

b) when compared with NCHS standards; $p = 0.0000204$ (significant)

*Paired t-test

deficit in weights and statures of our schoolchildren when compared to NCHS growth charts. This deficit is more evident teen years onwards. There have been suggestions that the NCHS growth charts, accepted by WHO, may not be applicable to children of South East Asia Region (SEAR) and that these countries should settle for separate growth standards reflecting a lower order of growth suited to their current status of socio-economic underdevelopment [5]. More misleading is the view that "smallness" reflecting retarded growth need not be harmful [6] and can be viewed as a form of "cultural adaptation". There is basis for this view, which can only perpetuate under nutrition. Such views need to be firmly rejected by policy makers in developing countries.

Separate growth standards would be justified only if it is clear that the present lower anthropometric measurements of children are truly of genetic origin [1]. This has not been demonstrated. On the contrary, studies show that genetic differences with respect to growth are negligible. For eg. the Nutrition Foundation of India undertook a multi-centric study on the pattern of growth of adolescent girls drawn from the most affluent sections of the Indian population [7]. The study showed that the growth performance of these Indian girls conformed to the 50th percentile of the NCHS standards till the 12th year, thereafter (between 12-18 years), increments in heights of Indian girls were significantly less than those of American girls, as represented by NCHS standards. Similar phenomenon has been noted in Japan [8]. It has been postulated that calcium deficiency could underline the

differences with respect to adolescent growth of Indian and American girls. In order to test this hypothesis, the Nutrition Foundation of India is undertaking a study on the effect of calcium supplementation in adolescence growth performance [1]. It is possible that calcium available in pre-dominant cereal diets of Asians is not adequate to sustain peak bone growth during adolescence.

The progressive increase in anthropometric measurements in successive generations, brought about by the removal of dietary and environmental constraints on growth, constitutes the "secular trend" in growth. In countries of North America and Europe, "secular trends" were evident for nearly four to five decades before a "plateau phase", representing the maximum attainable height, was reached. Japan is reaching this phase now, after more than 40 years of successful development [1].

Countries of SEAR are now in varying stages of developmental transition. Assessment of growth of children-cross sectional and longitudinal-will become more important than ever before in nutritional investigations. It is recommended that anthropometrical data be maintained from all schools as an important tool for nutritional surveillance on a national level. The objective of any meaningful national nutritional policy must be the liberation of children from prevailing dietary and environmental constraints, which are currently inhibiting their physical growth. It may take decades of

development, as has been the experience of Europe, USA and Japan.

Until our adolescents achieve the NCHS growth pattern, Olympic Gold will remain a distant dream.

References

1. Gopalan C. Growth and development In : Nutrition Research in South East Asia; the emerging agenda of the future. Regional Publication, SEARO, No 23, New Delhi, World Health Organization, South East Asia Region, 1996;32-40.
2. Agarwal DK, Agarwal KN, Upadhyay SK. Physical and sexual growth of affluent Indian children from 5 to 18 years of age. *Indian Paediatrics*, 1992;29:1203-84.
3. Needlman RD. Growth and Development. In : Nelson WE, Behrman RE, Kleigman RM, Arwin AM, editors. *Nelson Text-book of Paediatrics Book 1*, 15th ed. Bangalore:Prism Books Pvt Ltd and WB Saunders, 1996;30-72.
4. Banerjee A. Epidemiology of under-five malnutrition :sex differential in health care and nutritional status. *MJAFI*.Vol54:No2:1998;119-20.
5. Waterlow JC. The presentation and use of height and weight data for comparing the nutritional status of groups of children. *Bulletin of WHO*, 1977;55:489-98.
6. Secklar O. In Sukhatme PV, ed. *New concepts in nutrition and their implications for policy*. Maharashtra Association for Cultivation of Science 1982;127-31.
7. Nutrition Foundation of India. *Growth of affluent Indian girls during adolescence*, 1989, Scientific Report No 10.
8. Tanner JM. Increase in length of leg relative to trunk in Japanese children and adults from 1957 to 1977 : Comparison with British and with Japanese Americans *Annals of Human Biology*, 1982;9:411-23.