Growth Pattern and Prevalence of Underweight and Stunting Among Rural Adolescents

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Abstract

Introduction: A cross-sectional study of 1094 (boys = 665; girls = 429) rural school children aged 11-18 years of Midnapore Sadar North subdivision, Paschim Medinipur District, West Bengal, India, was undertaken to evaluate their growth pattern and nutritional status. **Methodology:** Anthropometric measurements including weight and height were measured following standard techniques. Underweight and stunting were used as indicators of nutritional status. Underweight and stunting were defined as weight-for-age (WAZ) and height-for-age (HAZ) <-2 z-scores, respectively, of the National Centre for Health Statistics (NCHS) guidelines. **Results:** Results revealed that boys were significantly heavier than girls from age 16 onwards; they were also significantly taller from age 14 years. The mean WAZ for boys and girls were -1.488 and -1.417, respectively. The corresponding mean values for HAZ were -1.317 and -1.486. The overall rates of underweight and stunting were 28.3% and 27.8%, respectively. The prevalence of underweight was significantly higher among boys (31.0%) than girls (24.2%). These rates for stunting were 27.4% and 28.4%, for the boys and girls. The rate of underweight and stunting was more in late adolescents (15-18 years) than early adolescents (11-14 years). In boys, the prevalence of stunting was significantly (1.5 times) more in late adolescents than early adolescents. According to the WHO classification for assessing severity of malnutrition, the rates of stunting were medium in both sexes. The rates of underweight were high and very high for girls and boys, respectively. **Conclusion:** In conclusion, present study provided evidence that the nutritional status of these adolescents were not satisfactory especially among late adolescents.

Key Words: Adolescent, Rural, Nutritional Status, Underweight, Stunting

Introduction

Adolescence is a significant transitional phase between childhood and adulthood of human growth and maturation after infancy. About 21% of the population of India, consists of adolescents (10-19 years), comprising one fifth of the total population of the country[1]. During this period, individuals gain about fifty percent of adult body weight and height growth with a unique pattern of sexual dimorphism. The nutritional status during this period is an important determinant of health outcomes. It was well documented that short stature in adolescents indicating prolonged undernutrition is associated with lower lean body mass, deficiencies in muscular strength and productivity[2]. In adolescent girls, short stature that carries on into adulthood is associated with many concurrent and future adverse health and pregnancy outcomes[3,4,5]. During childhood health and nutritional status is an important indicator of the national public health importance in the development of its future manpower[6]. Therefore formulation of exclusive health care of this section will cater to the health needs of one-fifth population of the country[7].

Two most commonly used internationally recommended indicators used to evaluate nutritional status of adolescents are underweight (low weight-for-

age) and stunting (low height-for-age). While underweight reveals low body mass relative to chronological age, which is influenced by both, a child's height and weight; stunting reflects a failure to reach linear growth potential due to sub optimal health and/or nutritional conditions[2,8].

Many recent studies from India[9,10,11,12] including West Bengal[13,14,15,16] have used anthropometry to evaluate nutritional status of adolescents. However, there is a dearth of data on the prevalence of underweight and stunting among adolescents from rural West Bengal. Therefore, we conducted a study to evaluate growth pattern and levels of underweight and stunting, based on National Centre for Health Statistics (NCHS) z-scores, among rural adolescents of Paschim Medinipur District, West Bengal.

Materials and Methods

Study area and subjects

Data for the present study were collected from higher secondary schools, situated in a rural area within the Paschim Medinipur Sadar north subdivision about 29 Km from Midnapore town. Formal approval was obtained from Vidyasagar University and school authorities prior to the study. Subjects were randomly selected from these schools. The sample size consisted of 1094 (boys = 665; girls = 429) children aged 11-18 years. Verification of age was done from the school records, as well from the answers to specific questions in the pre-tested questionnaire, which was completed by every subject.

Anthropometric measurements and evaluation of nutritional status

Height and weight measurements were taken on each subject following the standard techniques[17] using weighing scale and anthropometer rod to the nearest 0.5 Kg, 0.1cm, respectively. Technical errors of measurements (TEM) were found to be within reference values[18]. Thus, TEM was not incorporated in statistical analyses.

Two commonly used undernutrition indicators, i.e., underweight and stunting were used to evaluate the nutritional status of the subjects. The NCHS[19] age and sex specific <– 2 z-scores were followed to define underweight and stunting. The following scheme was utilized:

Stunting: height-for-age z-score (HAZ) < -2.0 sd

Underweight: weight-for-age z-score (WAZ) <-2.0 sd

We followed the WHO[2] classification for assessing severity of malnutrition by percentage prevalence ranges of these two indicators among children. The classification is:

Indicators	Low (%)	Medium (%)	High (%)	Very High (%)
Underweight	< 10	10 –19	20 – 29	≥ 30
Stunting	< 20	20 – 29	30 – 39	≥ 40

Statistical Analyses

The distributions of height and weight were not significantly skewed therefore not necessitating their normalization. Between sexes differences in means of height and weight were tested by student's t-test. One-way and two-way ANOVA were employed to test age, sex and interaction on dependent variables. Odds ratio (OR) and 95% confidence interval (CI) were calculated using standard formulae. Proportion test was employed to test the sex difference of underweight and stunting.

Results

The age and sex specific means±SD of weight and height are presented in figure 1 (weight) and figure 2 (height). Results revealed that boys were significantly heavier than girls from age 16 onwards; they were also significantly taller from age 14 years. Results of one-way ANOVA showed that weight and height increased significantly with advancement of age in both sexes. Further, two-way ANOVA tests were employed to determine the effect of age, sex and interaction on dependent variables (Table 1). Except for the weight-for-age and height-for-age z-scores, all anthropometric indicators of nutritional status showed significant effect of age and sex. Except for weight-for-age z-scores, all three dependent variables were significantly influenced by age-sex interaction.

The distributions of weight-for-age and height-for-age z-scores are presented in figure 3 and figure 4 in comparison to NCHS standards. Figure 5 and figure 6 presents the age and sex specific mean±SD weight-for-age and height-for-age z-scores among the subjects. The means in all cases had negative values. Overall, the mean weight-for-age z-scores for boys and girls were -1.488 and -1.417, respectively. The corresponding mean values for height-for-age z-scores were -1.317 and -1.486, respectively.

The age and sex specific prevalence of underweight and stunting are presented in Table 2. Based on the z-scores, the rates (age and sex combined) of underweight and stunting were 28.3% (95% CI: 25.7 – 31.1) and 27.8% (95% CI: 25.2 – 30.5), respectively. The prevalence of underweight was significantly higher

among boys (31.0 %, 95%CI: 27.6-34.6) than the girls (24.2 %, 95%CI: 20.4-28.5). These rates for stunting were 27.4 % (95%CI: 24.1 – 30.9) and 28.4 %, (95%CI: 24.4 – 32.9) for the boys and girls. The rate of underweight and stunting was more among late adolescents (15-18 years) than early adolescents (11-14 years). In boys, the prevalence of stunting was 1.5 times (OR= 1.47; 95%CI: 1.03 –2.09) more in late adolescents than early adolescents. According to the WHO classification for assessing severity of malnutrition, the rates (age combined) of stunting were, medium in both sexes. The rates of underweight were high and very high for girls and boys, respectively.

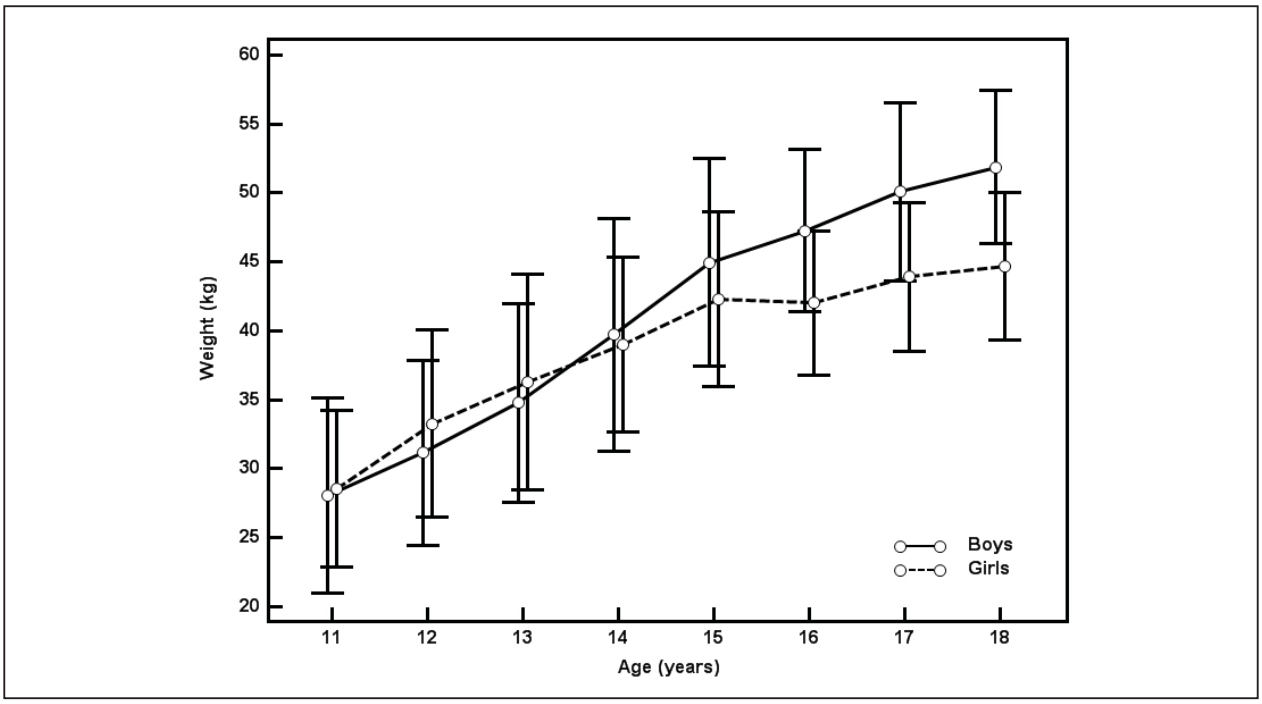

Fig 1: Mean±SD of weight (kg) by age and sex.

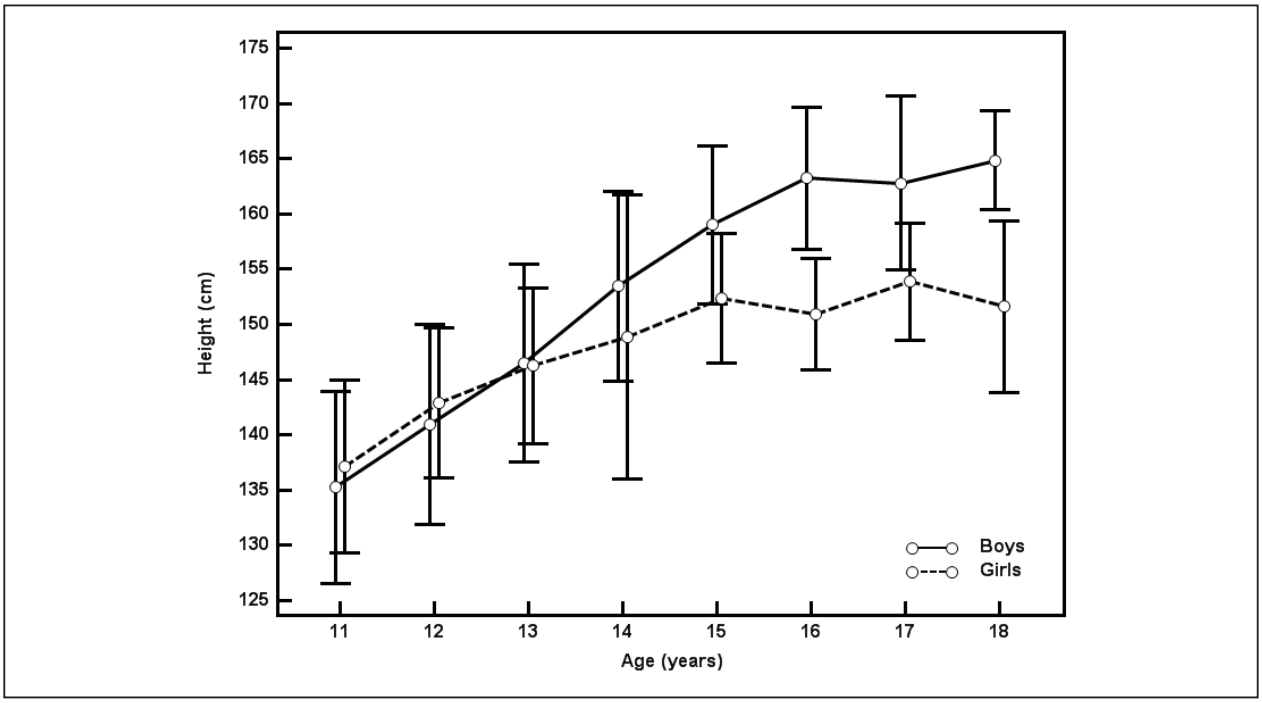

Fig 2: Mean±SD of height (cm) by age and sex.

Table 1: Result of univariate two-way analyses of variances (2-way ANOVA)

Dependent Variable	Age (F value)	Sex (F value)	Interaction (F value)
Weight	131.294**	24.250**	7.622**
Height	124.631**	91.898**	15.603**
HAZ	6.542**	2.857	2.352*
WAZ	5.264**	1.789	0.340

** p < 0.01, ** p < 0.001. (Age and sex were independent factors)*

Table 2: Prevalence (%) of underweight and stunting by age and sex.

Age (Years)	Sample (n)		Underweight (WAZ < - 2)		Stunting (HAZ < - 2)	
	Boys	Girls	Boys	Girls	Boys	Girls
Overall	**665**	**429**	**206 (31.0)***	**104 (24.2)**	**182 (27.4)**	**122 (28.4)**
Early adolescents:						
11	96	66	26 (27.1)	20 (30.3)	27 (28.1)	15 (22.7)
12	117	59	33 (28.2)	15 (25.4)	28 (23.9)	14 (23.7)
13	121	82	36 (29.8)	17 (20.7)	33 (27.3)	27 (32.9)
14	100	84	31 (31.0)	15 (19.9)	19 (19.0)	23 (27.4)
Total	434	291	126 (29.0)	67 (23.0)	107 (24.7)	79 (27.1)
Late adolescents:						
15	70	40	18 (25.7)	8 (20.0)	13 (18.6)	9 (22.5)
16	56	43	16 (28.6)	11 (25.6)	15 (26.8)	14 (32.6)
17	47	24	21 (44.7)	7 (29.2)	22 (46.8)	5 (20.8)
18	58	31	25 (43.1)	11 (35.5)	25 (43.1)	15 (48.4)
Total	**231**	**138**	**80 (34.6)**	**37 (26.8)**	**75 (32.5)****	**43 (31.2)**

** Significant sex difference; p < 0.05.*

*** Significant age group (late vs early adolescent) difference: p < 0.05.*

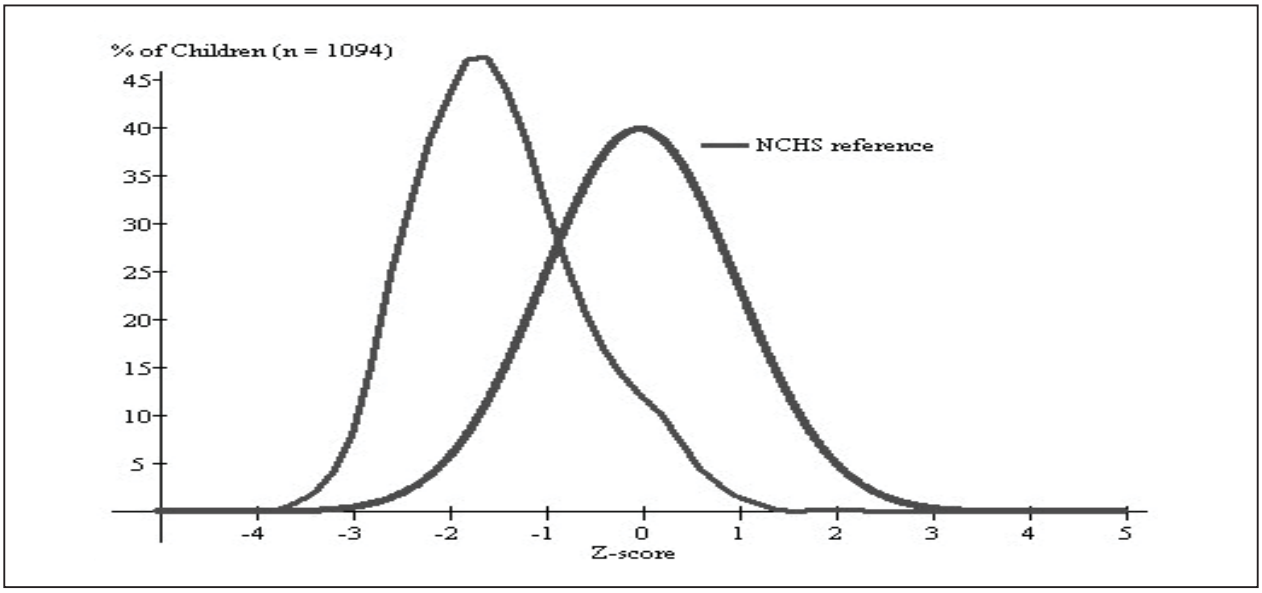

Fig 3: Distribution of weight-for-age z-scores of the rural adolescents

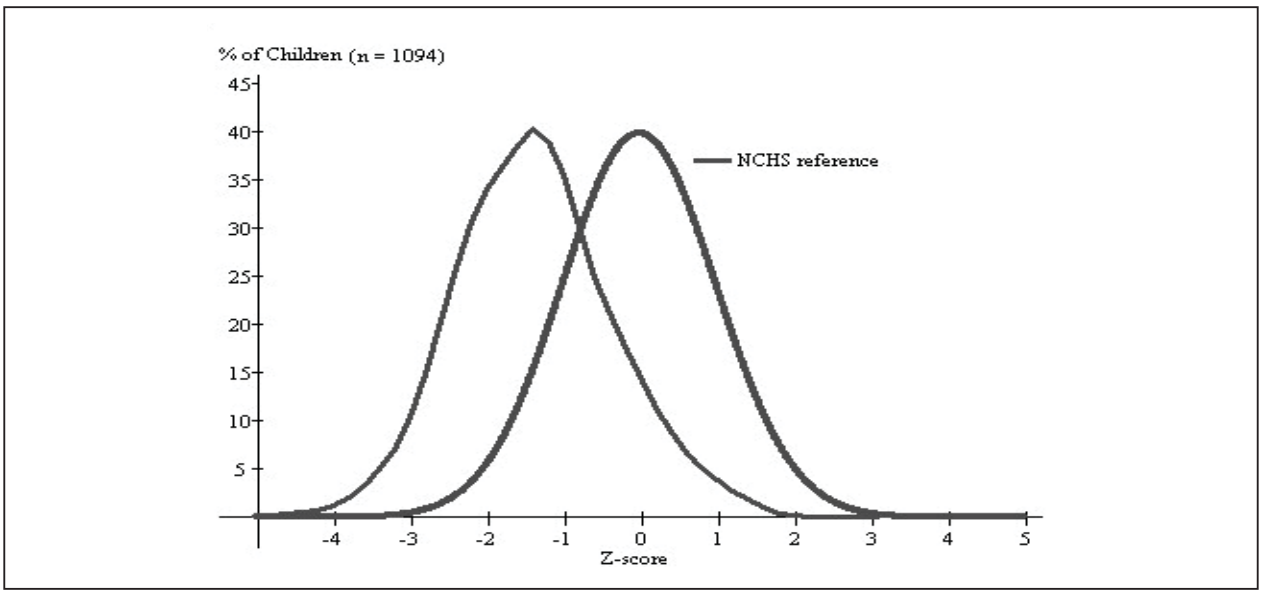

Fig 4: Distribution of height-for-age z-scores of the rural adolescents

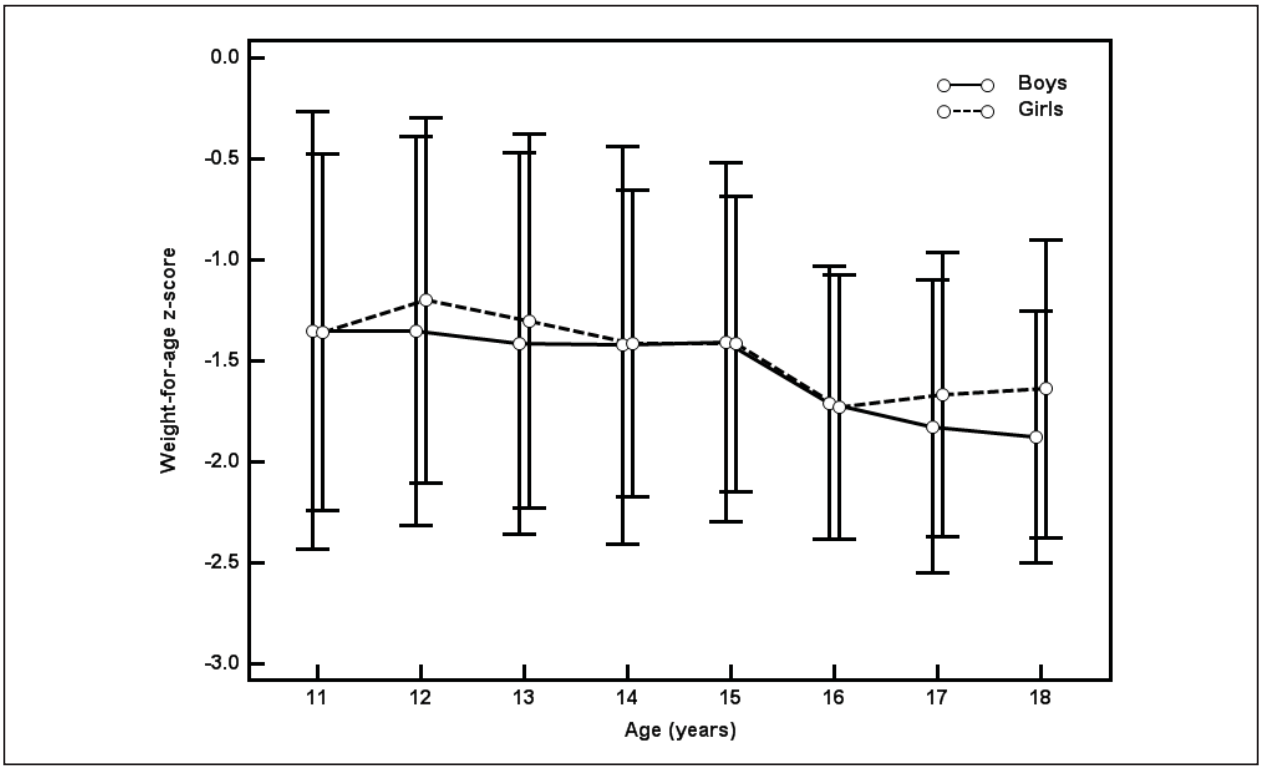

Fig 5: Mean±SD weight-for-age z-scores by age and sex

Discussion

Anthropometric indicators have been widely used in population-based studies directed to nutritional evaluation. Although they are proxy indicators, that is, they represent indirect measures of undernutrition that do not take into account nutrient intake or biochemical examination, their wide use is justified due to the ease of the method and its high sensitivity to nutritional alterations in a population[20]. Cohort studies, ideal for nutritional conditioning monitoring, suffer, in developing countries like India, from the logistic difficulties usually associated with population studies of large magnitude. In such cases, cross-sectional studies can provide relevant information for understanding the connection between health status and physical conditions of life. These studies have the advantage of relatively low costs and they can also provide fundamental information for

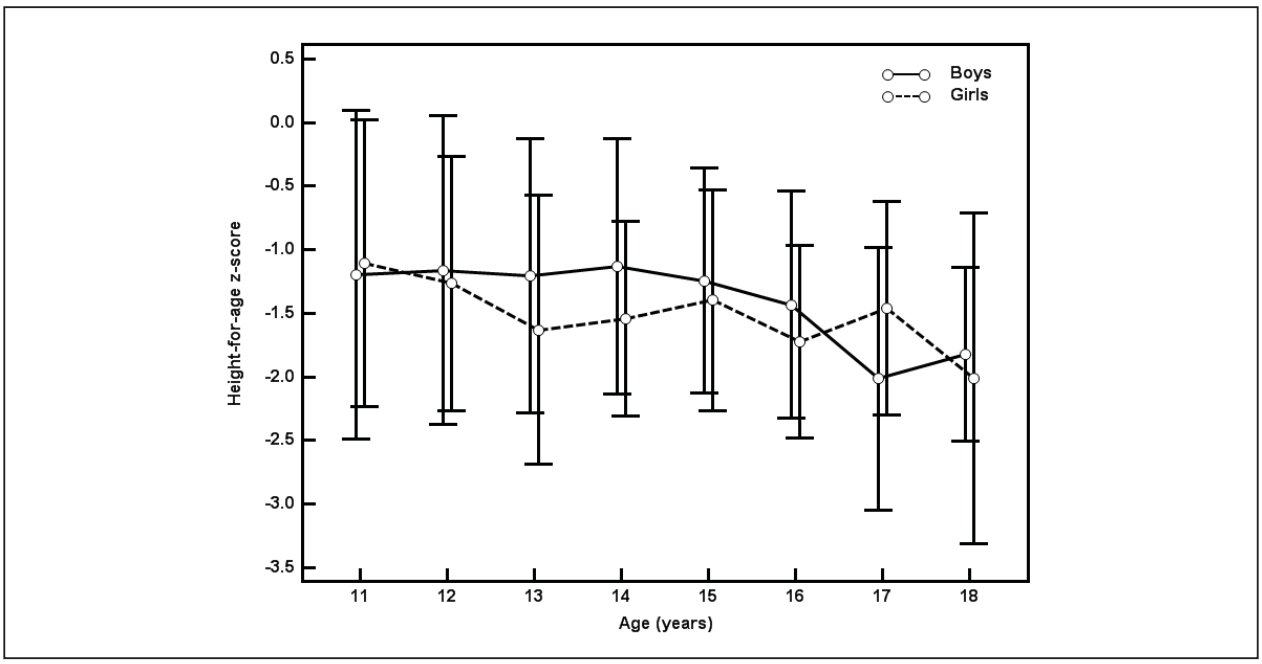

Fig 6: Mean±SD height-for-age z-scores by age and sex.

the implementation of health surveillance systems and the definition of long-term health intervention strategies[21,22,23].

Undernutrition continues to be a cause of ill-health and premature mortality among children and adolescents in developing countries like India[24,25]. The two most commonly used indicators of undernutrition among adolescents are underweight (low weight for age) and stunting (low height for age). Stunting is an indicator of chronic undernutrition, the result of prolonged food deprivation and/or disease or illness whereas underweight is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them[2].

These indices are compared against an international reference population developed from anthropometric data collected in the US by the NCHS[19]. Children whose measurements fall below –2 z-scores of the reference population median are considered undernourished, i.e. to be underweight or stunted. These indices reflect distinct biological processes, and their use is necessary for determining appropriate interventions[2].

The results of the present study clearly indicated that, based on WHO classification of severity malnutrition, the (age combined) prevalence of underweight was high (20-29%), while those of stunting were medium (20 – 29%), in both sexes. The rates of underweight, which is used as a composite indicator to reflect both acute and chronic undernutrition, demonstrated that the level was high. In case of stunting among these subjects, there existed medium level of chronic undernutrition due to prolonged food deprivation. Overall, these findings suggested widespread adverse nutritional experience of the subjects.

It has been suggested that since undernutrition is a function of both food deprivation and disease, which are in turn the consequences of poverty, anthropometric indices can serve only as proxies for evaluating the prevalence of undernutrition among children[25]. Efforts to reduce undernutrition, morbidity and mortality depend on reducing poverty and raising people's living standards by improving the quality of homes and by increasing access to clean drinking water and adequate sanitation. Such interventions have positive impacts on health, and implementing these also goes some way towards fulfilling people's basic human rights[25]. Since the nutritional status of the subjects of the present study is not satisfactory, it seems that there is scope for much improvement in the factors associated with their nutritional status. The school health services might provide an ideal platform to detect the health problems early and treat them. Early detection of the morbidities through regular survey helps in prompt treatment and prevention of serious health complications[7,26]. Therefore, such kind of studies may help to formulation of appropriate strategies to combat health complication of adolescents that already an important global public health burden in the last two decades.

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Conflict of Interest: None
Permission from IRB: Not Required

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