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Original Research Article

Assessment of nutritional status of adolescent school going boys of Himachal Pradesh

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ABSTRACT

Background: Given the paucity of data on the nutritional standard of the Himachali children, the present study was conducted to assess the physical growth and malnutrition of adolescent school-going boys of Himachal Pradesh within the age group of 15-17 years.
Methods: Boys were selected from both government and private schools of the non- hilly regions of Mandi district of Himachal Pradesh. Height, weight, and BMI were determined. Stunting was evaluated from height-for-age Z-score, and thinness, overweight, and obesity were estimated from BMI-for-age Z-score using the WHO recommended cut-off values.
Results: Mean height varied between 167.2 to 168.7 cm. Weight varied between 52.4 to 56.1 kg with a corresponding BMI between 18.7 to 19.7 kg/m^2.The overall prevalence of stunting and wasting were 5.7% and 15.8% respectively. The coexistence of stunting and wasting was not found in any of the age groups. The overall prevalence of overweight and obesity was 5.4% and 1.7% respectively.
Conclusions: Himachali boys appeared to be taller than most of the Indian population of boys of similar age groups. Prevalence of the different categories of over nutrition and undernutrition were also lower as compared to that obtained for other Indian studies on adolescent boys. The existence of overweight and obese individuals points towards the double burden of malnutrition.

Keywords: Physical growth, Malnutrition, Stunting, Thinness, Adolescent, India

INTRODUCTION

Growth is the most fundamental survival mechanism. Physical growth is a complex and continuous process of physical development by which an infant develops into an adult. It involves a progressive development in terms of physical size and morphology which commences through different phases and can be described as growth during infancy, childhood, and adolescence. Height and weight are considered the two most fundamental and sensitive anthropometric indicators of physical growth. In each phase of development the height and weight increase at a particular pace. Therefore, growth monitoring for infants, children, and adolescents, is fundamentally based on the measurement of these two parameters. Growth monitoring can assess the physical growth profile for a group of population in terms of presence and extent of growth problem and thereby reveals conditions of malnutrition. Subsequently, this provides an opportunity to take preventive and supportive actions to promote proper nutrition for the betterment of health and well-being.

However, to detect various clinical and sub-clinical forms of growth deficiencies and malnutrition, only height and

weight values do not help. Therefore the height and weight data need transformation to suitable indices. Growth indices are constructed by combining height and weight with age and sex.[1] Three sex and age-specific indices are most commonly used for the evaluation of growth and nutritional status in children and adolescents up to 19 years of age. They are height-for-age (HAZ), BMI-for-age (BMIAZ) and weight-for-age (WAZ).[2]

The Height-for-age (HAZ) is a height-based indicator and indicates linear growth. It compares whether a child or adolescent has achieved the expected level of height as compared to a child from a healthy well-nourished reference population of the same age. A low HAZ indicates a short stature condition as compared to age which is called stunting or linear growth retardation and reflects a state of chronic malnutrition. Body mass index (BMI) is used to identify if an individual has an abnormal weight in proportion to their height. BMI-for-age (BMIAZ) is a weight-based index that assesses both over and undernutrition.

The BMIAZ compares the BMI of a child, at a particular age with the BMI of a child representing the reference population of a similar age group. Given that the BMI reflects relative fatness of the body, BMIAZ identifies conditions of overnutrition that include overweight and obesity. Both overweight conditions and obesity are considered as chronic states of malnutrition.Furthermore, low BMIAZ scores indicate a condition of undernutrition termed as "thinness" or "wasting". BMIAZ has been recognized as the best direct indicator of thinness during adolescence.[3] Thinness directly indicates an acute state of malnutrition.[4] Several studies have estimated the height and weight trends and the prevalence of different categories of malnutrition among Indian adolescents across diverse socio-demographic and economic conditions.[5-13] The reports of these From these studies, it appeared that there is a significant prevalence of malnutrition among the adolescent population of different Indian states.

Himachal Pradesh is the most progressive hilly state of India. It has its own geographically unique, isolated lifestyle and culture that differs considerably from the majority of Indian states. Furthermore, the state has undergone a socio-economic transformation during the last two decades. It is a well-established fact that the economic status is a major determinant of nutritional status of the community and socio-cultural and economic transition can affect the nutritional standard of particularly the children and the adolescent.[14] To date, there is a paucity of data regarding the physical growth standard and malnutrition of the Himachali adolescent population. Only a few studies have reported on the anthropometric profile of Himachali children and adolescents.[15-18] These studies were conducted on children below 15 years of age.

Against this backdrop, the present study was conducted among the adolescent school-going boys of Himachal Pradesh aged 15-17 years. This age group represents the late adolescent period and to date, very few studies have reported the nutritional standard of boys belonging to this age group. The present study is aimed to evaluate the physical growth standard of 15-17 years boys in terms of height and weight. The study also intends to report the prevalence of different categories of malnutrition among these boys.

METHODS

Study design and location

A cross-sectional survey design was adopted in the present study which was conducted in the Mandi district of Himachal Pradesh. To avail the logistic advantage, a wider range of geographical locations including hilly regions of the districts were excluded and only the non-hilly zones and valley regions of the districts were selected. This includes three subdivisions of Mandi district; Mandi Sadar, Balh, and Sundernagar. These zones cover urban, peri-urban, and as well as rural areas.

Subjects

A total number of 298 boys were selected from both the government and private schools. The children suffering from any type of chronic disease or those who reported any illness during the last one month before the survey date were excluded from the study. Before the study, all the students were explained about the purpose of the study and the extent of their involvement in presence of the respective class teachers. The same was also conveyed to their parents through the class teachers.

Physical measurement

Determination of age: the date of birth (DOB) was obtained from the school register which is based on the birth certificate presented at the time of admission. From this DOB, the exact age at the time of admission was obtained and expressed as year and month. Determination of height: height was measured with an anthropometric rod with shoes removed and head aligning in the Frankfurt plane. Readings were taken to the nearest 1 cm. Determination of weight: weight was measured in kg by using a bathroom scale with minimum clothing and shoes removed to the nearest 500 grams. Determination of BMI: BMI was obtained as the square of height in meter divided by body weight in kg according to the formula: BMI-height (m^2)/weight (kg) and expressed kg/m^2. Anthropometric assessment of nutritional status: classification of nutritional status was made according to public health criteria recommended by the World Health Organization expert committee.[19] To evaluate the conditions of undernutrition and overnutrition, five outcome variables were considered; stunted, thin or wasted, coexistence of both, or thin and stunted,

overweight, and obese. These conditions were assessed from the WHO recommended z scores of two nutritional indices. The z scores of the Height-for-age index were used to assess stunting while the z scores of the BMI-for-Age index were used to assess the other three categories, i.e., thinness, overweight, and obesity.

Calculation of Z scores

The HAZ z score for an individual subject of the study population belonging to a particular age was calculated as: (measured height-median height of the reference population of the same age)/SD of the ref population. For calculating the z- scores of BMIAZ, the body mass index values of the study population were converted to exact z scores from the L, M, and S values of the reference charts of the corresponding age groups, using the following formula:

$$Z\ score = ([BMI\ score\ of\ study\ population\ /M]^{L} - 1) / LS$$

Where L, M and S are Box-Cox power, median, and coefficient of variation of the corresponding age of the reference population respectively.[20] Cut off values of Z scores for defining malnutrition: **c**ategories of malnutrition were defined according to the cut-off values of z scores presented in the WHO growth reference data for 5-19 years old adolescents.[2] The following cut-offs for the Z-score of HAZ was used to define different categories of undernutrition as per HAZ: stunted= z score <-2SD to ≤-3SD, severely stunted= z score <-3SD**.** The following z scores cut-off values of BMIAZ were used to define the different conditions of under and overnutrition: wasted =z score is <-2SD to ≤-3SD, severely wasted=z score = <-3SD, overweight = z score >1SD, obese= z score is >2SD**.** A subject was considered normal if the z scores for both HAZ and BMIAZ were found to be >-2SD.

RESULTS

The mean height at 15, 16, and 17 years was 167.2±7.01 cm, 168.3±6.13, and 168.7±5.84 cm respectively which shows an increasing trend with age. At 15 and 16 years age group government boys were slightly taller than the private boys, however, the mean differences in the height were not found to be statistically significant. However at 17 years of age, the private boys appeared to be statistically significantly taller (mean height 170.8±5.24 cm) as compared to the government boys (mean height 166.4±5.69 cm, t=3.30, p=0.002) (Table 1). The mean weight showed an increasing trend with age. The mean height at 15, 16, and 17 years was 52.4±1.0 kg, 53.6±8.8 kg, and 56.1±7.0 kg respectively. At 15 and 16 years, the boys from government school were heavier than the private school boys and the mean difference appeared to be statistically significant. At 17 years of age, the private boys appeared to be slightly heavier than the government boys, but this difference was not statistically significant (Table 2). The mean BMI at 15, 16, and 17 years was 18.7±3.21, 18.9±2.69, and 19.7±1.95 respectively which also showed an increasing pattern with age. At all age groups, there was no statistically significant effect for school category despite the government schoolboys have higher BMI as compared to the private boys (Table 3).

Table 1: Descriptive summary of height.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	167.8	6.69	168.0	1.20	0.973	0.33
	Pvt. (71)	166.6	7.27	167.0			
	Total (131)	167.2	7.01	168.0			
16	Govt. (43)	168.8	6.69	169.0	0.90	0.725	0.470
	Pvt. (57)	167.9	5.70	168.0			
	Total (100)	168.3	6.13	168.7			
17	Govt. (32)	166.4	5.69	165.0	-4.40	3.30	0.002
	Pvt. (35)	170.8	5.24	170.0			
	Total (67)	168.7	5.84	167.0			
Total	Govt. (136)	167.8	6.48	168.0	-0.20	0.265	0.791
	Pvt. (163)	168.0	6.51	169.0			
	Total (298)	167.9	6.49	168.0			

The overall prevalence of stunting was found to be 5.7%. In different age groups, the percentage of stunted boys varied between 5% in 16 years, to 6.1% in 15 years. At 17 years the stunting rate was 6%. The Pearson's chi-square test showed that and there was no significant level of association between the prevalence of stunting with the age group's age (χ^2 square=0.140(2), p= 0.932). None of the boys were found to be severely stunted (Table 4). The overall prevalence of thinness was found to be 15.8%. The highest prevalence of thinness (19.8%) was found among the 15 years old boys followed prevalence of (16%) at the age of 16 years and 7.5% at 17 years of age.

In different age groups, none of the boys were severely wasted. The overall prevalence of overweight and obesity was 5.4% and 1.7% respectively. The percentage of overweight boys varied between 3% at 17 years to 6.9% at 15 years of age.

Table 2: Descriptive summary of weight among boys of Government and private schools.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	53.7	1.0	51.5	2.30	13.12	0.000
	Pvt. (71)	51.4	1.0	50.0			
	Total (131)	52.4	1.0	51.0			
16	Govt. (43)	55.1	1.02	53.0	2.60	2.25	0.03
	Pvt. (57)	52.5	7.5	51.0			
	Total (100)	53.6	8.8	52.0			
17	Govt. (32)	55.2	8.29	52.0	-1.70	0.99	0.33
	Pvt. (35)	56.9	5.63	55.5			
	Total (67)	56.1	7.0	55.0			
Total	Govt. (136)	54.5	9.71	52.0	1.60	1.51	0.133
	Pvt. (163)	52.9	8.65	52.0			
	Total (298)	53.6	9.2	52.0			

Table 3: Descriptive summary of BMI among boys of government and private schools.

Age (years)	School (N)	Mean	SD	Median	Mean difference	t	P value
15	Govt. (60)	19.0	3.36	18.3	0.60	1.06	0.29
	Pvt. (71)	18.4	3.07	18.0			
	Total (131)	18.7	3.21	18.1			
16	Govt. (43)	19.3	3.11	18.1	0.70	0.02	0.98
	Pvt. (57)	18.6	2.32	18.1			
	Total (100)	18.9	2.69	18.1			
17	Govt. (32)	19.9	2.21	19.2	0.40	0.84	0.41
	Pvt. (35)	19.5	1.68	19.3			
	Total (67)	19.7	1.95	19.3			
Total	Govt. (136)	19.3	3.04	18.6	0.60	1.85	0.07
	Pvt. (163)	18.7	2.58	18.5			
	Total (298)	19.0	2.81	18.5			

Table 4: Prevalence of stunting among Himachali boys; N (%).

Age group (years) (N)	Normal	Stunting (<-2SD)	Severe. stunting (<-3SD)	X^2 (P value)
15 (131)	123 (93.9)	8 (6.1)	0 (0)	0.140 (0.932)
16 (100)	95 (95)	5 (5)	0 (0)	
17 (67)	63 (94)	4 (6)	0 (0)	
Total	281 (94.3)	17 (5.7)	0 (0)	

The prevalence of obesity was 3.1% at 15 years and 1% at 16 years. None of the boys at the age of 17 years were found to be obese. The Pearson's Chi-Square test showed that there was no significant level of association between the prevalence of different categories of malnutrition with the age groups (Chi-Square=10.633(6), p=0.100) (Table 5). Five different categories of malnutrition were identified. Wasting or thinness was much higher as compared to other categories of malnutrition. The coexistence of both stunted and wasted children was found only at the age group of 15 years (Figure 1).

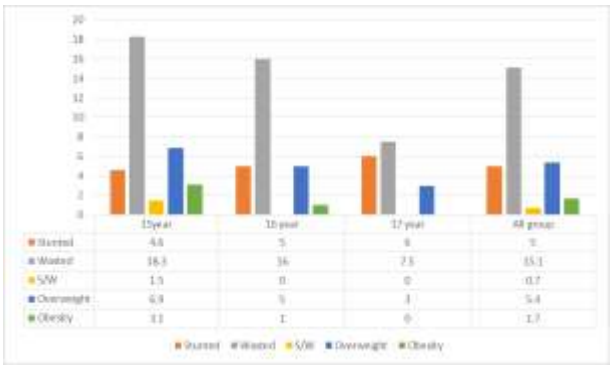

Figure 1: Representation of different categories of malnutrition.

Table 5: Prevalence of thinness among Himachali boys; N (%).

Age group (years) (N)	Normal	Thinness (<-2SD)	Severe thinness (<-3SD)	Overweight	Obesity	X^2 (P value)
15 (131)	92 (70.2)	26 (19.8)	0	9 (6.9)	4 (3.1)	10.633 (0.100)
16 (100)	78 (78)	16 (16)	0	5 (5)	1 (1)	
17 (67)	60 (89.6)	5 (7.5)	0	2 (3)	0 (0)	
Total	230 (77.2)	47 (15.8)	0	16 (5.4)	5 (1.7)	

DISCUSSION

Assessment of height and weight and converting them into nutritional indices is a standard procedure worldwide for the assessment of the nutritional profile of a population. The present study reported the nutritional profile of the Himachali adolescent boys within the age group of 15-17 years of age.

Height of the Himachali boys

The height of the Himachali boys examined in the present study varied between 167.2 cm at 15 years to 168.8 cm at 17 years. These boys were found to be taller than the Shabar tribal adolescents of Orissa; mean height 155.9 cm at 15 years, 156.5cm at 16 years, and 157.7 cm at 17 years of age, but comparable with the heights reported for the north Indian school children; mean height 165.9, 169.3, and 172 cm at 15, 16, and 17 years of age respectively.[21,22] On a comparative account, it appeared that the 15 years old Himachali boys were slightly taller as compared to the north Indian boys reported in this study. However, the 16 and 17 years old north Indian boys appeared to be taller than the Himachali boys by 1 cm and 3.2 cm respectively.

In a more recent study, much lower heights (155.5 cm at 15 years, 157.5 cm at 16 years, and 158.6 cm at 17 years) were reported for rural adolescent children from West Bengal[8] as compared to Himachali boys. For the age group of 15 years, the mean reported heights available in different studies varied from 153.6 cm for urban adolescent boys of south Gujarat and 161.2 cm for urban children of Nagaland Himachali boys were taller as compared to these populations. However, the mean height (168.4 cm) of 15 years old children from Kharad, Maharastra, was higher than the present 15 years old Himachali boys.[6,23,24]

Weight of Himachali boys

Like the height, the mean weight of the present Himachali boys was higher than the weights reported for the Shabar tribal adolescents of Orissa, for all the age groups considered; 42.5 kg at 15 years, 44.2 kg at 16 years, and 45.7 kg at 17 years. Himachali boys were also found to be heavier than the rural adolescent boys from West Bengal with a mean weight of 42.8 kg at 15 years, 44.2 kg at 16 years, and 47.2 kg at 17 years.[8,21] In comparison to the North Indian school children, the mean weights of Himachali boys were found to be lower at all age groups.[21,22] The mean weight of Himachali boys at 15 years was 52.4 kg. Almost similar weight (52.2 kg) was obtained for 15-year-old urban boys from Karad Maharastra.[24] Two other studies reported a mean weight of 36.2 kg for the urban adolescents of South Gujrat and 48.7 kg for the Naga children which were much lower as compared to the present Himachali boys.[6,23]

Comparison of stunting

The prevalence of stunting of the Himachali boys in three different age groups was almost similar and varied between 5-6%. This is much lower as compared to the stunting reported among the rural adolescents from nine different Indian states.[25] In this study, the stunting rates were 48.9%, 51.8%, and 59.7% in the age groups of 15, 16, and 17 years respectively. Higher rates of stunting were also reported among the rural adolescent boys of U.P (27.4%) rural adolescent boys of West Bengal (59.5%)[8] and adolescent boys of UP and Bihar (27.3%) of similar age group.[10,13]

Comparison of thinness

The rate of thinness in the present Himachali boys showed a decreasing trend from 15 to 17 years. Varying from 19.8% to 7.5% respectively, with an overall prevalence rate of 15.8%. Some studies also reported a similar decreasing trend in the age group of 15-17 years.[8,21] The rate of thinness among the present Himachali boys (15.8%) was lower as compared to the urban Bengali adolescent boys, from urban and rural areas with a prevalence rate of 20.6%, and 38% respectively.[5,8] Chakraborty and Bharti reported a prevalence of thinness that varied between 33.3%-25% between 16-17 years with the lowest prevalence of 25% observed in 17 years of age. These values were also higher as compared to the present study.[6,21]

An overall prevalence rate of 25.7% was reported among the Naga children, [6] which was also higher than the rate obtained in the present study. In contrast to the above mentioned higher prevalence rates of thinness reported from different Indian states, the rate of the thinness of the boys from Mandi district of Himachal Pradesh, almost matches with previous findings that reported 18.2% thinness among the 15 years old boys from Naggar area of Kullu district of Himachal Pradesh.[16]

Comparison of overweight and obesity

In the present study obesity and overweight, both categories of over nutrition were found among the Himachali boys. The overall prevalence of overweight and obesity was found to be 5.4% and 1.7% respectively. The findings on the overweight were lower in all the age groups in comparison to the rate of overweight reported among Bengali urban adolescents.[5] The prevalence of overweight and obesity among present Himachali boys was 3% -6.9% which was lower as compared to the overweight and obesity rate among urban Bengali boys.[5] However, the prevalence of overweight was almost similar to that of the rural Bengali boys.[8] The present rate of overweight among the 15 years old boys was higher as compared to the two previous reports of overweight among Naga children and Himachali boys from Naggar district of Kullu.[6,16]

CONCLUSION

Himachali boys appeared to be taller than most of the Indian population of boys of similar age groups. Prevalence of the different categories of overnutrition and undernutrition were also lower as compared to that obtained for other Indian studies on adolescent boys. The existence of overweight and obese individuals points towards the double burden of malnutrition.

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