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Mr. Arun B. Godam**

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Present Preface Message

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Here's a great pleasure to hand over this + research Journal title '**Current Global Reviewer**' At Present different papers are published through various branches of knowledge. But they are concerned to specific subject or thought. We are very glad in publishing this paper to get the more information about research to new learner about research in all the spheres. This is the age of supersonic. That is why we must concentrate at present at a large scale in higher education. It's very important in this modern phase for researchers and to encourage for the effort put by us. In the long run it will very useful for us as guide lines and directions.

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Survey on prevalence of undernutrition in adolescent children in Chikhaldara town of Maharashtra state

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Abstract

In rural parts and semi urban areas of developing nations like India, undernutrition and underweight among adolescent children are a significant public health issue. The objective of the current study was to assess the prevalence of underweight and overweight incidence among boys and girls of two schools- Shivaji school and Girijan school of Melghat area in Chikhaldara town of Maharashtra state. A total of 200 students aged 13- 16 years old were included in the study. Height and weight parameters were measured and Body Mass Index (BMI) was calculated accordingly. The overall prevalence of underweight in boys and girls was 58.1 % and 34.4 % respectively. The prevalence of underweight with BMI less than 18.5 kg/m^2 was observed more in boys than in girls. The normal BMI between 18.5 to 24.9 kg/m^2 was observed more in girls (65.5 %) than in boys (40.9 %). While the height in boys was observed to be significant (143.74 cm) compared to girls (141.57 cm), the weight of girls was more (39.17 kg) compared to boys (37.41 kg). The study provided evidence that underweight in adolescent boys from semi-urban areas is prevalent because of their increasing body metabolism together with high energy demands and low nutritional uptake probably due to the socioeconomic background or lifestyle. This nutritional stress among the young generation indicates requirement of immediate and appropriate public nutritional reforms and programs.

Keywords: Adolescent, Body Mass Index, semi-urban area, underweight, undernutrition.

Introduction

Nutritional intake is unquestionably a significant factor that affects both male and females' physical performance (Begam, 2020). However, in India, poor nutrition has always been a serious source of health problems. The burden of disease on the planet is significantly increased by underweight, and it is linked to death (Caulfield et al., 2004). Evidence suggests a range of risk linked with underweight, with no obvious threshold impact, and most fatalities brought on by underweight are ascribed to intermediate levels of underweight (Pelletier et al., 1993). Additionally, a lot of health policy makers have tried to address the issue by considering underweight as an additive health issue rather than as having a synergistic link with morbidity, meaning that underweight has a potentiating rather than additive influence on mortality (Pelletier et al., 1993). Additionally, there is a relationship between preschool underweight and reduced cognitive performance (Armstrong et al., 2003).

In the course of human development, adolescence is a time of fast growth and maturation (Venkaiah et al., 2002). According to UNICEF, 250 million adolescents lived

in India in 2016; in Maharashtra, the proportion was 19% in 2011 (Lok & No, 2019). Between the ages of 10 and 19, adolescence is split into early (10–14 years) and late (15–19 years) adolescence (Organization, 2014; Patton et al., 2016). Micronutrient deficiencies, stunting, being underweight or overweight, and other public health issues affect teenagers in India (Christian & Smith, 2018). In terms of the risk of non-communicable diseases, being born into an environment low in energy content and nutrients and then subsequently being exposed to high-energy surroundings might be the least advantageous combination (Bavdekar et al., 1999). Adolescence could be a crucial time for subsequent health and disease, and better nutrition may boost human capital and lower the risk of non-communicable diseases over the course of a person's life (Hanson & Gluckman, 2011; Viner et al., 2015).

It is crucial for public health policy to comprehend the incidence and patterns of undernutrition, particularly stunting, the formation of underweight and overweight in children and adolescents, and the related risk for metabolic illness (Kimani-Murage et al., 2010). Because the quantity of habitual physical activity increases dramatically throughout this stage of life, the transition from childhood to adolescent appears to be particularly crucial in terms of physical activity (Telama & Yang, 2000). This is also accompanied by nutrition transition that occurs in low and middle income countries such as diet and food insufficiency (Organization, 2006; Organization, 2002). Recent research have shown that eating disorders are strongly correlated with racial and ethnic groups (Furnham & Adam-Saib, 2001; Furnham & Husain, 1999; Sjostedt et al., 1998); gender (Nelson & Hughes, 1999; Stephens et al., 1999); age (Jaeger et al., 2002; Szabo & Hollands, 1997); and socioeconomic background (Dunkley et al., 2001; Mujtaba & Furnham, 2001).

We postulate that the undernutrition in adolescent period in a semi urban area remains a concern and the effort taken by the society and the government to better the nutrition in these children continues to be an important step. The aim of the current investigation was to conduct a survey of BMI profiles of school children of adolescent age and to observe the prevalence of underweight through age and sex in a semi-urban area of Maharashtra state.

Material and Methods

In the study, 200 children were included between the age group of 13–16-year-old. Out of these, 110 (55 %) were boys and 90 (45 %) were girls. The subjects were selected from two different schools for the study i.e., Shivaji school and Girijan school from Melghat area in Chikhaldhara town of Amravati district. During the study of 13-year-old students, 28 (57.14 %) were boys and 21 (42.85 %) were girls. The 14-year-old group comprised of 27 (52.94 %) boys and 24 (47.05 %) girls. In 15-year-old batch, 26 (53.06 %) were boys and 23 (46.93 %) were girls. Out of 51 students in the 16-year-old group, 29 (56.86 %) students were boys and 22 (43.13 %) students were girls. The children were selected from two schools to get an equal distribution for the gender. School officials were informed to generate a list of students enrolled in grades seven through ten as well as assist in the anthropometric measurements. The height (cm) and weight (kg) required for calculating Body Mass Index (BMI) was measured according to the standard protocol (Ramachandran et al., 1997). The BMI was calculated through

the formula kg/m^2 (Prentice, 1998). The measurements were carried out through the help of two trained technicians. The BMI of each student was calculated and grouped accordingly. The students whose BMI was less than 18.5 kg/m^2 were tagged as underweight. Likewise, the students whose BMI scored between 18.5 - 24.9 kg/m^2 were categorized as normal and students above 25 kg/m^2 were termed as overweight.

Statistical Analysis

The standard deviation and standard error of the means were calculated. Analysis of Variance ANOVA or t-test was done to compare the means and significant difference in the means were calculated using post hoc LSD analysis.

Results

The height in boys was observed to be lesser compared to girls in ages 13 and 14-year-old. The mean was calculated to be $134.1 \pm 0.02 \text{ cm}$ and $135.5 \pm 0.01 \text{ cm}$ in boys and girls of 13-year-old while the total mean of height calculated in boys and girls of 14-year-old was $139.4 \pm 0.01 \text{ cm}$ and $140.0 \pm 0.01 \text{ cm}$ respectively. However, there was an increasing trend observed in the height of boys compared to girls in 15-year-old and 16-year-old. The mean height of boys and girls in their 15th year age was recorded to be $148.0 \pm 0.02 \text{ cm}$ and $142.8 \pm 0.01 \text{ cm}$ while in 16th year it was recorded as $153.3 \pm 0.01 \text{ cm}$ and $147.8 \pm 0.01 \text{ cm}$ respectively. Hence, total mean height of all ages in boys was found to be higher than girls and calculated as 143.7 cm in boys and 141.5 cm in girls. The details of standard error of mean and standard deviation are given in Table 1.

In every age group, girls were found to weigh more than boys. The mean weight for boys and girls among 13-year-old students was $31.5 \pm 1.11 \text{ kg}$ and $33.6 \pm 1.28 \text{ kg}$, respectively, while the mean weight for boys and girls among 14-year-old students was $35.8 \pm 1.06 \text{ kg}$ and $39.2 \pm 1.72 \text{ kg}$, respectively. 14% of 13-year-old male pupils were over 40 kg in weight, whereas 53.5% were in the 30- to 40-kg range. The remaining boys (32%) weighed more than 25 kg but under 30 kg. Boys' weight ranged from 25 kg to 45 kg, the highest and lowest weights ever measured. In the 13-year-old female pupils, 23% of the females were above 40 kg, 33% were between 30 and 40 kg, and the equal number of girls were under 30 kg but over 25 kg. Out of 27 male students of 14-year-old age, 47 % boys weighed above 40 kg while 48 % boys had weight in the range of 30- 40 kg. A very few boys- 7 % had weight of 29 kg. The girls in 14-year-old age group exhibited higher weights compared to their male counterpart. More than half of the girls (58 %) experienced weight above 40 kg with some weighing as much as 50 kg, a quarter of the girls had weight in the range of 30- 40 kg. A very few girls (16 %) experienced weight below 30 kg. It was observed that with increasing age, the upward trend in weight was observed in both the genders. In 15-year-old students, the prevalence of weight was found to be more varied regarding the range of weights in both the genders however, the calculation of mean exhibited similarity in the final weight. The mean value observed in boys and girls was $40.0 \pm 1.32 \text{ kg}$ and $40.2 \pm 1.40 \text{ kg}$ respectively. The varied weight range among girls and boys of 15-year-old was between 29- 55 kg. Out of all 26 boys, 53 % exhibited weight above 40 kg reaching to a maximum of 55 kg. 46 % boys were in the category of 30- 40 kg weight. None of the boys from this group experienced weight below 30 kg. similar pattern of weight was observed in the girls of the same age group. Many girls exhibited above 40 kg weight

going up to 55 kg and their percent was 65 %. The girls weighing between 30- 40 kg were 30 % while just 1 girl out of the whole group recorded 29 kg weight. In the 16th age group, the trend of weight was similar to that of 15-year-old group. The mean weight increased from that of 15-year-old group and went up to 42.2 ± 1.01 kg and 43.6 ± 0.67 kg for boys and girls. 69 % of boys exhibited weight above 40 kg and reaching up to 52 kg for some. 31 % boys had weight in the range of 30- 40 kg. None of the boys showed weight below 30 kg. 90% of the girls in this age group weighed more than 40 kg, the maximum percent of all the age groups. And the remaining 10 % girls had weight in the range of 30- 40 kg, while no student exhibited weight below 30 kg in this group. The details of the mean, standard deviation and standard error are given in Table 1.

The Body Mass Index (BMI) profiles of these teenagers revealed significant sex differences regarding under nutrition. The boys were found to have higher prevalence of under nutrition compared to girls. The mean BMI of boys in all age groups was 18.02 kg/m^2 that falls under the category of under nutrition while girls had the BMI was 19.39 kg/m^2 that comes under the normal category. An increasing trend of BMI was observed among the girls with increasing age. The mean BMI of girls in 13-year-old was $18.1 \pm 0.47 \text{ kg/m}^2$, in 14-year-old it was $19.7 \pm 0.60 \text{ kg/m}^2$ and $19.6 \pm 0.55 \text{ kg/m}^2$ in 15-year-old age group while the last age group exhibited $20.01 \pm 0.36 \text{ kg/m}^2$ BMI. Contrary to these values, the boys BMI indices generally showed under nutrition trend in all the age groups. The 13-year-old boys had BMI mean value of $17.4 \pm 0.47 \text{ kg/m}^2$, while 14-year-old and 15-year-old boys showed similar BMI of $18.3 \pm 0.39 \text{ kg/m}^2$ and the last 16-year-old boys had BMI of $17.9 \pm 0.39 \text{ kg/m}^2$. The highest percentage of under nutrition students were observed in 13-year-old male students with 71 % while the lowest percent BMI was calculated from the girls' group of 16-year-old with 13 % (Table 2). The students who came under the category of normal BMI were highest in 16-year-old girls with 86 % while the lowest normal BMI was recorded from the male category of 13-year-old students and it was 28 %. The 13-year-old age group of boys were 71.4 % underweight whose BMI was less than 18.5 kg/m^2 while 28.5 % boys of this age group were normal with BMI in the range of 18.5 to 24.9 kg/m^2 (Figure 1). The girls' group of this age exhibited 47.6 % underweight and 52.3 % normal. The 14-year-old age group had BMI percent of 51.8 % underweight and 48.1 % normal in boys while 41.6 % girls were underweight and 58.3 % were normal. The 15-year-old male students exhibited 57.6 % underweight percent, 38.4 % were normal and 3.8 % were found to be overweight. The girls group witnessed 34.7 % underweight and 65.2 % normal BMI. In the last group i.e., 16-year-old group of students, 51.7 % boys were underweight and 48.2 % boys were normal. The girls posed with 13.6 % underweight and 86.3 % girls were normal (Figure 2)

Table 1 Descriptive Statistics of height, weight and BMI of boys and girls in all age groups.

		N	Mean	Std. Deviation	Std. Error
Height (cm)	Male13	28	134	0.08	0.02
	Male14	27	139	0.06	0.01
	Male 15	26	148	0.08	0.02
	Male16	29	153	0.05	0.01
	Female13	21	136	0.05	0.01
	Female14	24	140	0.06	0.01
	Female15	23	143	0.05	0.01
	Female16	22	148	0.03	0.01
	Total	200	143	0.09	0.01
Weight (kg)	Male13	28	31.50	5.87	1.11
	Male14	27	35.85	5.50	1.06
	Male 15	26	40.04	6.75	1.32
	Male16	29	42.21	5.42	1.01
	Female13	21	33.62	5.87	1.28
	Female14	24	39.21	8.42	1.72
	Female15	23	40.22	6.69	1.40
	Female16	22	43.68	3.15	0.67
	Total	200	38.25	7.21	0.51
BMI (kg/m ²)	Male13	28	17.49	2.49	0.47
	Male14	27	18.36	2.03	0.39
	Male 15	26	18.36	3.02	0.59
	Male16	29	17.94	2.10	0.39
	Female13	21	18.16	2.18	0.47
	Female14	24	19.75	2.93	0.60
	Female15	23	19.64	2.64	0.55
	Female16	22	20.02	1.68	0.36
	Total	200	18.65	2.54	0.18

13, 14, 15, and 16 denote the age of the students

Table 2 BMI index of boys and girls of all age groups

Gender	Boys				Girls				
	13	14	15	16	13	14	15	16	
Age (years)	28	27	26	29	21	24	23	22	
Number	20	14	15	15	10	10	8	3	
BMI GROUP	<18.5 Underweight	(71.4)	(51.8)	(57.6)	(51.7)	(47.6)	(41.6)	(34.7)	(13.6)

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18.5-24.9 Normal	8 (28.5)	13 (48.1)	10 (38.4)	14 (48.2)	11 (52.3)	14 (58.3)	15 (65.2)	19 (86.3)
25-29.9 Overweight	0	0	1 (3.8)	0	0	0	0	0

The numbers in brackets denote the respective percent

Table 3 Post HOC LSD analysis of height of students of different ages.

	M13	M14	M15	M16	F13	F14	F15	F16
M13	-				*			
M14		-				*	*	
M15			-					*
M16				-				
F13	*				-			
F14		*				-	*	
F15		*				*	-	
F16			*					-

Where M is male and F is female and numbers following M or F are the ages of the students in years. * denotes that the means are similar. blank cells denotes that the means are significantly different at 0.05 level of significance.

Table 4 Post HOC LSD analysis of weight of students of different ages.

	M13	M14	M15	M16	F13	F14	F15	F16
M13	-				*			
M14		-			*	*		
M15			-	*		*	*	
M16				-		*	*	*
F13	*	*			-		*	
F14		*	*	*		*	-	*
F15			*	*			*	-
F16				*				-

Where M is male and F is female and numbers following M or F are the ages of the students in years. * denotes that the means are similar. blank cells denotes that the means are significantly different at 0.05 level of significance.

Table 5 Post HOC LSD analysis of BMI of students of different ages.

	M13	M14	M15	M16	F13	F14	F15	F16
M13	-	*	*	*	*		*	
M14	*	-	*	*	*		*	
M15	*	*	-	*	*			
M16	*	*	*	-	*			
F13	*	*	*	*	-			

F14						-	*	*
F15		*	*			*	-	*
F16						*	*	-

Where M is male and F is female and numbers following M or F are the ages of the students in years. * denotes that the means are similar, blank cells denotes that the means are significantly different at 0.05 level of significance.

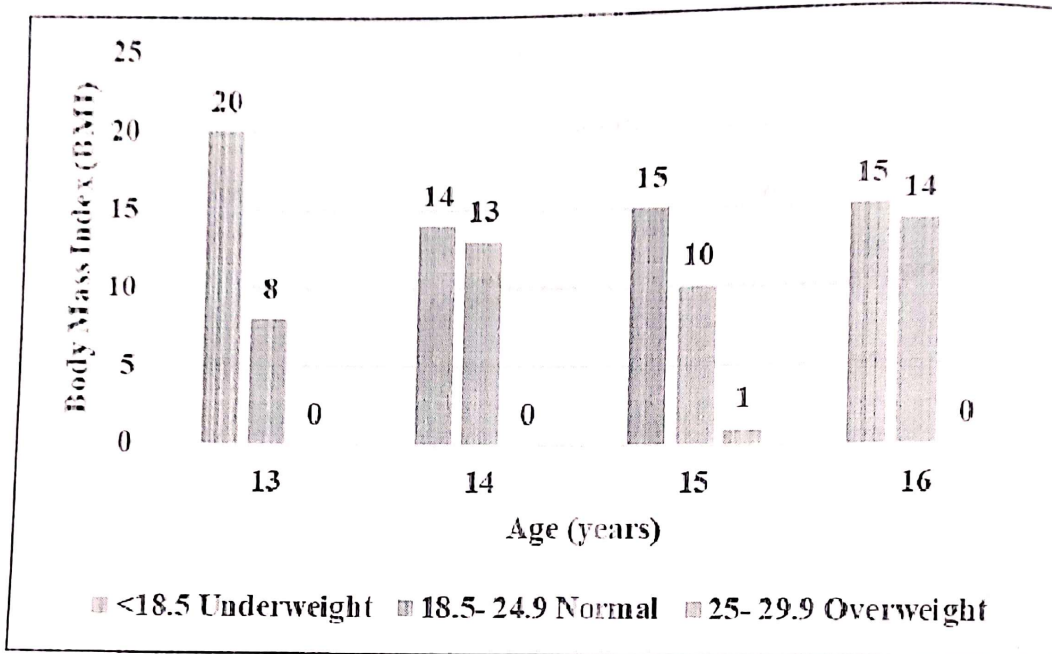


Figure 1 BMI profile of Boys of all age groups

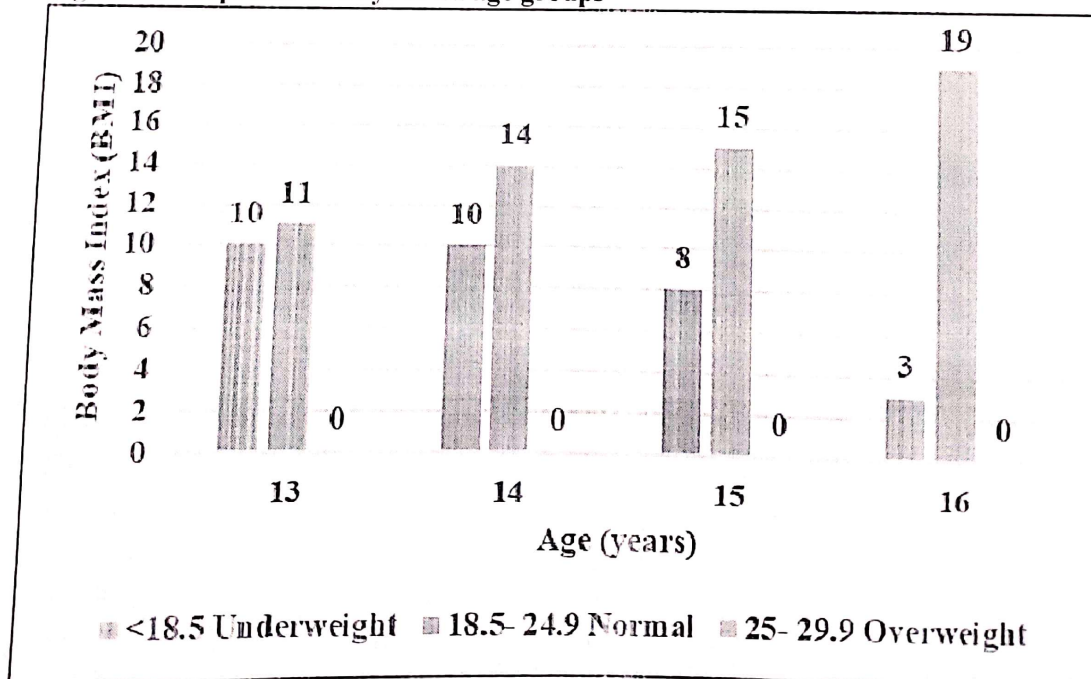


Figure 2 BMI profile of girls in all age groups

Discussion

The nutritional deficiency, leading to reduced weight seems to be common among semi urban cities in India, irrespective of the states (Jeemon et al., 2009). The BMI comparison among students of their respective age showed that males were underweight in general as compared to females. This study correlates with the findings of the Demographic and Health Survey of Africa, where it was observed that prevalence of underweight was higher among the African males compared to the African females (Reddy et al., 2003). The similar findings from other underdeveloped countries show similar growth pattern among males and females post 12 years of growth (Venkaiah et al., 2002).

The height to weight ratios showed that males looked a lot thinner than females. The post hoc analysis revealed that the boys had a fastidious growth, since the height of boys of particular age group didn't correlate with that of boys of other age group. Though, it did show significant similarity with their elder counterpart females. Females on other hand at the age group of 14 and 15 years did show similarity with boys of 14 years. The males of 16 years didn't show any significant similarity with any students of other age group in study. This study showed that females had a significant stagnancy in growth of height from the age of 14 to 16. The boys though had a steady increase in the height.

A normal growth corresponds to increase in weight along with the height. From this perspective, the females, despite having a relatively lower height had a normal body weight. This was true for girls of all age groups. The same was not true with boys, since they didn't display increase in weight with regards to their increasing height. The disparity can be linked to the fact that females engage in less physical activity than boys do. Even the body metabolism of boys is higher than that of girls in growing age that explains the weight difference among them. Teenage male students were more likely to be underweight as they got older, whereas female individuals were less likely to be underweight with increasing age (Darling et al., 2020). In the current study, the post hoc analysis of weight of both girls and boys revealed that the weight of girls was more compared to boys (Table 4). Additionally, it increased even further in the 15 and 16-year-old without the further increase in height. In contrast, boys' weight was also increased but the height increased even further compared to girls. This can be because of the low engagement of girls in physical activity and body metabolism which contributes to weight gain. Trost et al. (2008) suggested that females may be major mediators of this gender difference in weight and Body Mass Index (BMI) due to lower levels of perceived competence, low levels of physical activity, and perceived value of sports.

The area under study was from a semi-urban region where students are actively engaged in vigorous physical activities, lesser sedentary lifestyle where schools promote physical activities like games and physical trainings. Though, there was a plausible deficit of proper nutritional input among the students. The survey showed that girls had a proper nutritional input corresponding to their physical activities, unlike boys. Senbanjo and Oshikoya (2010) reported that underweight is more common in physically active kids. This may suggest that there is an unfavorable ratio between the

energy consumed and the energy expended during exercise. This needs to be taken into account in a society where protein energy deficiency is prevalent due to unfavorable socioeconomic conditions, widespread ignorance, and infectious illnesses.

The BMI is a general index of relative body size and not the health of the person. The boys and girls were both found to be quite sturdy, with lower fat ratio. The post hoc analysis showed that height of girls at age of 14 and 15 didn't vary much, but despite the fact, they had a trend of normal BMI, with relative weight (Table 3). The post hoc analysis of BMI also demonstrated that the BMI profile of boys was of the underweight category (Table 5). The boys didn't show awareness of a controlled body growth. With increasing age and height, their body metabolism might be high. These physical attributes are relative to socio-economic and everyday lifestyle and there is a need of balanced diet correlating to the physical needs of the students.

Conclusion

Males in particular from semi-urban areas are more likely than girls to be underweight in the older adolescent age. The determinants for this difference include gender, age, and socioeconomic status of the area. A correlation exists between underweight and high physical activity. Therefore, food nutrition awareness programmes in these under developed areas must be incorporated. The awareness shall be provided for the energy balance in light of the significant incidence of undernutrition in these children.

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energy consumed and the energy expended during exercise. This needs to be taken into account in a society where protein energy deficiency is prevalent due to unfavorable socioeconomic conditions, widespread ignorance, and infectious illnesses.

The BMI is a general index of relative body size and not the health of the person. The boys and girls were both found to be quite sturdy, with lower fat ratio. The post hoc analysis showed that height of girls at age of 14 and 15 didn't vary much, but despite the fact, they had a trend of normal BMI, with relative weight (Table 3). The post hoc analysis of BMI also demonstrated that the BMI profile of boys was of the underweight category (Table 5). The boys didn't show awareness of a controlled body growth. With increasing age and height, their body metabolism might be high. These physical attributes are relative to socio-economic and everyday lifestyle and there is a need of balanced diet correlating to the physical needs of the students.

Conclusion

Males in particular from semi-urban areas are more likely than girls to be underweight in the older adolescent age. The determinants for this difference include gender, age, and socioeconomic status of the area. A correlation exists between underweight and high physical activity. Therefore, food nutrition awareness programmes in these under developed areas must be incorporated. The awareness shall be provided for the energy balance in light of the significant incidence of undernutrition in these children.

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