

# A Study on Body Mass Index and Nutrient Intake of Adolescent Girls

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## ABSTRACT

Recognizing the importance of anthropometric measurements among adolescent girls, this study was undertaken to view the anthropometric measurements and to explore the nutrient intake of the selected adolescent girls. A cross – sectional study was carried out targeting 215 school going post- pubescent girls. Using the body mass index as an index of adiposity, 36.3 and 4.8 % of government and matriculation school girls respectively were found to be severely undernourished. Further, 16.5 and 29.8 % were found to be normal and 19 and 48 % of them were obese. Anthropometric measurements of the selected girls were lower when compared with National Centre for Health Statistics as a reference population. A significant difference was observed between selected girls and Indian adolescent girls with respect to weight, except girls in the age group between 13 and 14 years from matriculation school. Mean nutrient intake of the selected government school girls were significantly lower when compared with Recommended Dietary Allowance of Indians. Nutritional inadequacy is one of the main causes of prevalence of malnutrition that can lead to higher incidence of diseases among adolescents.

**KEYWORDS:** Adolescent Girls. Anthropometric Measurements. Body Mass Index. Recommended Dietary Allowance. Nutrient Intake

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## INTRODUCTION

The word Adolescent is derived from Latin word “Adolesere” means to grow to maturity. This Adolescent period accelerated physical, biochemical and emotional development. There are nearly one billion adolescents in the world accounting for 20-25% of the total population in the developing countries. In India, the adolescent population constitutes more than one fifth (23%) of the total population (Roy et al 2000). Adolescence period is characterized by rapid increase in height, weight and hormonal changes resulting in sexual maturation (Gupta 1990). Most girls begin a rapid growth spurt between the ages of 13 and 19 years. Nearly every organ in the body grows faster during this period which lasts about 3 years. Owing to sudden and special growth taking place in this phase, the nutritional requirement also increase tremendously compared to preceding years of growth. Adolescence, one of the nutritional stress periods of life with profound growth, comes with increased demands for energy, protein, minerals and vitamins (Gopalan et al.2001). In India, poor nutrition, early bearing and reproductive health complications compound the difficulties of physical development in adolescent girls (Manford and Picciano 2000).

In a country like India with varying social customs and common beliefs against females there is a high prevalence of malnutrition amongst girls. Increased physical activity combined with poor eating habits and the onset of menstruation contribute to accentuating the potential risk for adolescent's poor nutrition (Bhaskaran 2001). High severe malnutrition amongst girls has been reported from West Bengal (Sen & Sengupta 1983) and Punjab (Bhatia & Chandra 1993). Dietary habits of adolescent girls in slum areas are very poor (Parimalavalli et al. 2007).

Anthropometric measurements help in the assessment of nutritional status and monitor changes in growth of adolescents. Research on anthropometric measurements of adolescents is an important determinant of a nation's health. Measurements of height, weight and nutrient intake are the reliable means to evaluate the nutritional status and it is very much in need. Hence the present study was undertaken to conduct the anthropometric measurements and to know the nutrient intake among adolescent girls.

## **METHODS AND MATERIALS**

The present study was conducted during the period Dec 2010- Jan 2011. The area selected for the study was Viluppuram districts of Tamil Nadu in India. The sample size was 215 post-pubescent girls (Government=91, Matriculation = 124) aged 13-18, randomly selected, who had menstruation for more than two years.

Data was collected by personal interview and a pre-planned questionnaire. The questionnaire consisted regarding general information, anthropometric measurements included height and body weight and specific information as age, type of house, family size, and age at menarche and monthly income of their family from the respondents. The anthropometric measurements Height was measured while the subject was standing without foot wear, to the nearest 0.1 cm, using a portable Anthropometry rod. Weight was measured with the subject standing and wearing light clothes to the nearest 0.1kg using a portable electronic weight machine. Body Mass Index (BMI) is a widely used parameter and it is moderately associated with height among adolescents. The formula  $\text{weight (Kg)} / \text{height (m}^2\text{)}$  was used to calculate Body Mass Index (BMI). The results were compared with NCHS standards (Jelliffe 1966).

The nutritional status of the adolescent girls was assessed in the present study. Different parameters used for assessing their nutritional status were 24 hour dietary recall survey and anthropometric measurements. Intake of nutrient was computed using the values given in the nutritive value of Indian foods (Gopalan et al. 2001). The collected data were processed and statistically analyzed. Student 't' test was used for analyzing the data. A P value <0.01 was fixed as the cut off level of significance.

## RESULTS AND DISCUSSION

Table 1: Socio-economic distribution of adolescent girls (N=215)

Particulars	Government school	Matriculation school
<i>Age (Years)</i>	No. (%)	No. (%)
13-15	20 (22)	36 (29%)
16-18	71 (78)	88 (71%)
<b><i>Types of Houses</i></b>		
Kuchha	29 (31.8)	0 (0)
Semi Pukka	48 (52.8)	53 (42.7)
Pukka	14 (15.4)	71 (57.3)
<b><i>Family Size</i></b>		
Small (1-4)	22 (24.2)	77 (62.1)
Medium (5-6)	50 (54.9)	39 (31.5)
Large (above 7)	19 (20.9)	8 (6.4)
<b><i>Age at Menarche</i></b>		
10-12 yrs	3 (3.3)	19 (15.3)
13-15 yrs	71 (78.0)	82 (66.2)
16-18 yrs	17 (18.6)	23 (18.5)
<b><i>Monthly Income in Rs</i></b>		
Below 4500	54 (59.3)	6 (4.8)
4500- 7500	22 (24.2)	48 (38.7)
Above 7500	15 (16.5)	70 (56.5)

Table 1 showed that the socio-economic background of the two hundred and fifteen girls revealed that nearly 71 to 78 percent of them were in the age group of 16 - 18 years. Nearly 50 percent of the respondents resided in semi pucca house.

In government school, 24.2, 54.9 and 20.9 percent of them had small, medium and large size family respectively. In matriculation school, 62.1, 31.5 and 6.4 percent of them lived in small, medium and large size family respectively. About 78 and 66.2 per cent of the selected girls in the government and the matriculation school respectively attained menarche in the age group of 13 - 15 years. Fifty- nine per cent of the girls in government school belonged to low income group whereas fifty six percent of the girls in the matriculation school belonged to high income group. A recent study on adolescent girls in urban slum area of Andhra Pradesh stated that 67.7 percent of girls belonged to large family size i.e. family size more than 5 members (Prashant and Chandan 2009). Educational status and socio-cultural level of parents strongly influence the

nutritional status of adolescent girls (Singh and Mishra 2001).

Table 2: Age wise height of the selected subjects (N = 215)

Age (yrs)	NCHS* height (cm)	Mean $\pm$ Standard deviation					
		No. of Sample	Government school	t' value	No. of Sample	Matriculation school	t' value
13	155	-	-	-	5	145.29 $\pm$ 8.2	2.6 <sup>NS</sup>
14	159	4	146.21 $\pm$ 6.9	3.1 <sup>S</sup>	12	150.9 $\pm$ 7.5	2.9 <sup>NS</sup>
15	161	14	147.7 $\pm$ 5.2	8.6 <sup>S</sup>	17	152.29 $\pm$ 7.9	4.5 <sup>S</sup>
16	162	19	150.34 $\pm$ 8.4	5.8 <sup>S</sup>	25	155.10 $\pm$ 9.7	4.6 <sup>S</sup>
17	163	46	153.09 $\pm$ 8.1	8.2 <sup>S</sup>	54	157.32 $\pm$ 7.5	5.4 <sup>S</sup>
18	164	8	156.12 $\pm$ 7.6	3.9 <sup>S</sup>	11	159.21 $\pm$ 8.8	1.7 <sup>NS</sup>

**NCHS\*** - National Centre for Health Statistics, **N**-Number of samples, **NS**- No Significant, **S**-Significant at 1% level

Table 2 shows that the mean weight of the post pubescent girls of the government school was significantly ( $p < 0.01$ ) lower than NCHS reference value. In matriculation school, no significant difference was found between standard height and mean height of the girls of 13, 14 and 18 year ages only, whereas significant difference was found among the age of 15, 16 and 17 years. Anand et al. (1999) reported that the study in rural north India among adolescent school children recorded a prevalence of stunting (height for age) as 41 and 19.9 percent as per NCHS and Indian standards respectively.

Table 3: Age wise weight of the selected subjects (N = 215)

Age (yrs)	NCHS* height (Kg)	Mean $\pm$ Standard deviation					
		No. of Sample	Government school	t' value	No. of Sample	Matriculation school	t' value
13	-	44	-	-	5	38.64 $\pm$ 5.9	1.9 <sup>S</sup>
14	3	41	39.64 $\pm$ 5.9	2.4 <sup>NS</sup>	12	41.71 $\pm$ 6.4	3.3 <sup>S</sup>
15	12	51.4	42.47 $\pm$ 5.4	5.6 <sup>S</sup>	17	52.72 $\pm$ 8.3	0.6 <sup>NS</sup>
16	18	53	44.26 $\pm$ 6.2	6.0 <sup>S</sup>	25	53.89 $\pm$ 8.2	0.5 <sup>NS</sup>
17	45	54	45.81 $\pm$ 5.9	9.1 <sup>S</sup>	52	52.60 $\pm$ 9.6	1.3 <sup>NS</sup>
18	8	54.4	46.90 $\pm$ 6.1	3.5 <sup>S</sup>	11	53.10 $\pm$ 9.1	0.6 <sup>NS</sup>

\* NCHS - National Centre for Health Statistics, **NS**- No Significant, **S**-Significant at 1% level

Table 3 shows that the majority of the girls from the government school were underweight showing the highest in the age group of 15-18 years and were statistically significant. In matriculation school, no significant difference was noticed between standard weight and mean weight of the samples at the age between 15 to 17 years, whereas significant difference was observed at the age of 13 and 14 years. The anthropometric measurements of adolescent girls were not satisfactory. Weights of the adolescent girls were somewhat similar to those of height which fell below the NCHS standard values (Kumar et al.2006).

Table 4: Mean body mass index of the selected subjects (N = 215)

<i>Body Mass Index*</i>	<i>Government school</i>		<i>Matriculation school</i>		<i>Total</i>	
	No.	%	No.	%	No.	%
Severe under nutrition	33	36.3	6	4.8	39	18.1
Moderate under nutrition	12	13.2	8	6.5	20	9.3
Mild under nutrition	14	15.4	13	10.5	27	12.6
Normal	15	16.5	37	29.8	52	24.2
Obese I	13	14.3	54	43.6	67	31.2
Obese II	4	4.3	6	4.8	10	4.6
Total	91	100	124	100	215	100

\* WHO 2000

It is evident from the Table 4 that the Body Mass Index of the selected adolescent girls revealed that 36.3 and 4.8 per cent of the girls from government and matriculation school respectively were severely undernourished, 16.5 and 29.8 per cent of them were noted to be normal and 19 and 48 percent of them were identified as obese. Comparing the anthropometric measurements of the selected girls with National Centre for Health Statistics as a reference population, there was a significant ( $P<0.01$ ) difference observed with respect to weight except in girls at the age of 13 and 14 years from matriculation school. BMI reflects the positive association between height and weight (Khan et al. 2004). A similar study conducted in an urban slum of Varanasi depicted that 70 percent of the adolescent girls had BMI < 20; 51.43 percent of the study subjects were suffering from chronic energy deficiency while stunting was present in 10 percent of the adolescent girls (Singh & Mishra 2001). In the third National Health and Nutrition Examination survey (NHANES III), over 50 percent of girls and 25 percent of boys reported themselves as overweight while they had an age and height adjusted body mass index of <85th percentile (Carmona et al. 2002). Ferro-Luzzi and Sharma (2005) concluded that

there is a relationship between BMI and an independently assessed measure of socio-economic status was also seen in communities in India.

Table 5: Mean nutrient intake of the adolescents

<i>Nutrient</i>	<i>RDA*</i>	<i>Government school</i>			<i>Matriculation school</i>		
		<i>Mean Nutrient</i>	<i>Percent excess/deficient</i>	<i>t' value</i>	<i>Mean Nutrient</i>	<i>Percent excess/deficient</i>	<i>t' value</i>
EnergyK.Cal	2060	1905	-7.5	3.8S	2034	-1.3	0.5 <sup>NS</sup>
Protein (g)	63	48.9	-22.4	3.2S	56.4	-10.5	2.9 <sup>S</sup>
Fat (g)	22	19.3	-12.2	7.16S	21.8	-0.9	1.12 <sup>NS</sup>
Calcium (mg)	500	400.7	-19.9	7.9 S	439.3	-12.1	1.48 <sup>NS</sup>
Iron (mg)	30	17.8	-40.6	11.4 S	19	-36.7	12.9 <sup>S</sup>
Vit.c (mg)	40	29.1	-27.3	4.3 S	33.6	-16	2.0 <sup>NS</sup>

\*ICMR (1998),

RDA- Recommended Dietary Allowance, S - Significant at 1% level, NS - No Significant

Table 5 shows that the mean nutrient intake of the selected adolescent girls was less when compared with RDA. The mean energy intake of the government (1905 k.cal.) school girls were significantly lower than RDA. Intake of nutrients such as proteins (48.9g), fat (19.3g), calcium (400.7 mg), iron (17.8mg) and vitamin C (29.1mg) were found to be significantly far below the RDA. Diet survey analysis of the matriculation school girls indicated that the nutrient intake such as protein (56.4 g) and iron (19 mg) were significantly lower than the RDA whereas fat (21.8g), calcium (439.3g) and vitamin C (33.6g) was not significantly less than the RDA. Varsha et al. (2008) stated that the rural adolescent girls of Marathwada region were consuming all nutrients below the recommended, revealed gross deficiency of nutrients. Compared to other nutrients, fat intake was found to be slightly satisfactory as the intake was almost one-third of the requirement. The anthropometric measurements were not satisfactory in the selected girls and these were the reflection of less nutrient intake of the adolescent girls were reasons. Similar findings were obtained by Srijaya and Jhansirani (2003) and Tatia and Taneja (2003). Low intake of different food items was related to poor economic status (Venkateswaralu 2003). Brache et al. (2003) stated that reasons for malnutrition of adolescent girls such as misinformation about food values, eating in fast food restaurants, skipping meals, consuming snacks, and foods high in sugar and going on fad dieting.

## **CONCLUSION**

Poor nutritional status during adolescence is an important determinant of health outcomes. Previous studies, among adolescent girls, have observed that the height, weight, MUAC, TSF and chest circumference values were significantly lower in those from the poor socioeconomic strata than the well-to-do group (Aggarwal et al 1992 & Tripathi et al 1985). National Nutrition Monitoring Bureau (NNMB 1981), also showed that the height, weight and growth rates of adolescents of low income group, were about 70-80% of those of well-to-do adolescents.

The result shows that majority of the samples were in the age range of 13-18 years with small and medium size family and most of them had attained their menarche in the age range of 13-15 years. Regarding the anthropometric measurements, height and weight of the selected individuals were found to be significantly different when compared with the standard which would be due to faulty dietary habits. During the period of puberty, the body requires high calories and nutrients like protein, calcium, iron, foliate and zinc. Iron and calcium are particularly important nutrients during adolescence. Earlier diet surveys in adolescent population have also shown that the diets are inadequate in all nutrients including iron, proteins, calcium and calories (Pushpamma et al 1982, Thimmayamma et al 1982 & Kapil et al 1993). Similar findings were also reported by Reddy et al 1993 and Vasanthi et al 1994. Nutritional status of adolescent girls contributes to the nutritional status of the community. There is a need to initiate intervention measures to improve the nutritional status of adolescent girls who are the future 'mothers-to-be'. Hence, there is a need to create an awareness among adolescents about nutrition and health.

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