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Research Paper

Anthropometric status of school going adolescent girls of Kanpur (U.P.)

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■ **ABSTRACT :** Adolescence is a time when physiological need for consumption of a diet with good nutritional quality is particularly important. During this period, adolescents achieve the final 15-20 per cent of adult height, gain 50 per cent of adult weight and accumulate upto 45 per cent of their skeletal mass. The present study was conducted to assess the anthropometric status of 400 school going adolescent girls (13-19 years) of Kanpur. The girls in the age group of 13 – 16 years have mean weight and S.D, 42.8±7.5kg, height, 153.6±6.6cm, BMI, 18.1±2.8kg/m^2, MUAC, 22.1±2.5cm, WC, 64.2±6.8cm, HC, 84.0±6.7cm and TSF, 2.4±0.5. The age group of 16 – 19 years of girls have mean weight and S.D 46.2±8.7kg, height, 154±6.5cm, BMI, 19.4±3.5kg/m^2, MUAC, 23.4±3.0cm, WC, 67.0±8.8cm, HC, 86.3±7.8cm and TSF, 2.5±0.6cm. The weight of the adolescent girls increased with age and correlation co-efficient (0.2223*) was significant at 5 per cent level of significance. Height of the adolescent girls in both the age groups was found to increase slightly and correlation co-efficient was non-significant. BMI of the adolescent girls increased positively with respect to age. Similarly, correlation co-efficient of MUAC (0.2486*), WC (0.1999*) and HC (0.1998*) were found to be significant at 5 per cent level of significance with positive response according to the age. The study also showed that 26.25 per cent of respondents were found to be underweight and 38.75 per cent of them were in the risk category of overweight.

■ **KEY WORDS:** Adolescence, Malnutrition, BMI, Growth monitoring

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Adolescents are those between the ages of 10 and 19 years old (WHO, 1995). Adolescence is a transitional phase between childhood and adulthood characterized by marked acceleration in growth (Anand *et al*., 1999 and WHO, 2005a). During this period there is 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. 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).

A myriad of biological changes occur during puberty including sexual maturation, increase in height and weight,

completion of skeletal growth and changes in body composition (Kalamka, 2001). This has direct relevance for the nutritional requirements of adolescents. During adolescent growth spurt, some dietary requirements are higher in adolescents than in other age groups (WHO, 2005b). Several studies have demonstrated the effect of nutrition on growth and development of adolescents (Mitra *et al*., 2004). The nutritional status of adolescents, contributes significantly to the nutritional status of the community. In addition, this age group accounts for more than one-fifth of world's population. The prevalence of malnutrition, particularly, among adolescents is an alarming global problem affecting about one third of the world population and the immediate future having no solution. In the long duration, this may affect both physical growth and mental development (Bagchi, 1986).

Under-nutrition among adolescent girls is a major public health problem leading to impaired growth (Kalhan *et al*., 2010). The two most commonly used indicators of under nutrition among adolescents are underweight (low weight for age) and stunting (low height for age). Stunting is an indicator of chronic under nutrition, 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 under nutrition, although it cannot distinguish between them (WHO, 1995).

Previous study showed that girls from disadvantaged backgrounds have poor nutritional status (Ghosh and Paul, 1991 and Choudhary *et al*., 2009). Their weights and heights are lower than the well-to-do Indian counterparts (Goyle, 2009). Anthropometrics can be sensitive indicator of health, growth and development in infants and children. In particular, anthropometry has been used during adolescence in many context related to nutritional status (WHO, 1995 and Gaiki and Wagh, 2014).

Growth monitoring by anthropometric measurement during this period, is not only an important health indicator but also a predictor of various morbidity in the community, though the anthropometry is universally applicable, simple, inexpensive and non-invasive technique, it is still an underused tool for guiding public health policy as well as individual clinical decision (WHO, 1995).

Research on anthropometric measurements of adolescents is an important determinant of a nation's health. Measurements of height, weight, BMI are the reliable means to evaluate the nutritional status and it is very much in need. Therefore, the purpose of this study was to assess the nutritional status of school going adolescent girls of Kanpur through anthropometric measurements.

■ RESEARCH METHODS

The study was carried out as a part of an ongoing research work leading to Ph.D. degree under C.S.J.M. University of Kanpur by the first author. The study area comprised of 10 schools selected randomly from Kanpur Nagar. Between 13-19 years of age, 40 adolescent girls were selected from each school to make a total sample size of 400 girls for the study purpose.

After taking permission from the school authority, the class teachers of class were explained the purpose of the study and rapport was built up with the girl students and verbal consent was obtained from them. Briefing was done to the students regarding the questionnaire provided to them. Data on anthropometric and socio-demographic variables (*i.e.* occupation, income, literacy, family type, diet habit) were collected using a pre-designed questionnaire. The students who were physically challenged were excluded from the study. Data were entered and analyzed by using SPSS 15.0.

General profile:

It consists of particulars related to the respondent's name, age, class, religion and food habits.

Demographic profile:

Data on socio-demographic variables (occupation, income and family type) were collected using a pre-designed questionnaire.

Anthropometric parameters:

Nutritional status was assessed using WHO recommended anthropometric indicators. The measurements were performed by following the standard techniques (Lourie and Wiener, 1981). Height, weight, body mass index (BMI), mid-upper arm circumference (MUAC), waist circumference (WC), hip circumference (HC) and skin fold thickness was taken into consideration.

Height :

Height in centimetre was taken with the help of a measuring tape. All children were measured against the wall. The children were asked to remove the foot wear,

and stand with heels together and positioned so that the line of vision was perpendicular to the body. A glass scale was brought down to the top most point on the head. Height was recorded to the nearest1 centimetre (Anand *et al*., 1999).

Weight

Body weight was measured with light clothing and shoes off, using digital weighing scale to the nearest 100g.

BMI:

Body mass index (BMI) is a widely used parameter and it is moderately associated with height among adolescents. BMI reflects the positive association between height and weight (Khan *et al*., 2004). BMI-for-age is the method recommended for screening overweight and underweight in children and adolescents from 2 to 20 years of age. BMI-for-age is a screening tool that may lead to further assessment to diagnose a specific health condition. The formula weight (kg)/ height (m^2) was used to calculate body mass index (BMI). The results were compared with NCHS standards (Jelliffe, 1966).

The collected data were processed and statistically analysed. Nutritional status was evaluated using the WHO (1995) recommended age and sex-specific cut-off points of anthropometric indicators based on the NHANES-I percentile values (WHO, 1985).Under nutrition was defined as 5^{th} percentile values of NHANES-I. This cut-off point has been utilized by several studies worldwide on under nutrition among adolescents (Venkaiah *et al*., 2002 and Woodruff and Duffield, 2002). Under nutrition in respect of BMI was defined as <18.5.

MUAC:

Mid-upper-arm circumference (MUAC) measures the arm muscle and fat area. As MUAC is a simple, non- invasive, and inexpensive method, there is a need for studying its use as a screening indicator for under-nutrition among different age groups and ethnicities. Adolescents in developing countries are at a greater risk of the undesirable consequences of under-nutrition. Therefore, there is a need to identify simpler techniques to assess under-nutrition among this age group. Mid-upper-arm-circumference (MUAC) was measured in at the level of the midpoint of the upper arm (left arm), hanging relaxed with the help of a measuring tape to the nearest 0.1 cm range **(**Gopaldas and Seshadri, 1987). Participants having BMI and MUAC less than the fifth percentile as per WHO were categorized as under-nourished (Dasgupta *et al*., 2010).

Waist and hip circumference:

Waist and hip circumference was measured with the help of a non-stretchable measuring tape in centimetres.

Total skin fold thickness:

Total skin-fold thickness is accepted as a predictor of fatness because 40-60 per cent of total fat is in the subcutaneous region of the body and skin fold was directly measured by using a well calibrated calliper.

■ RESEARCH FINDINGS AND DISCUSSION

The socio- economic background of 400 school going adolescent girls of Kanpur Nagar has been presented in Table 1. It reveals that 68.7 per cent of them were in the age group of 13-16 years and 31.3 per cent of them were in the age group of 16-19 year. The family size of the school going adolescent girls were

Table 1: Socio- demographic profile of school going adolescent girls (n=400)

Particulars	Percentage
Age in years	
13 - 16	68.7
16 - 19	31.3
Family size	
Small (1 - 4 members)	45.7
Medium (5 - 8 members)	47.5
Large (9 and above)	6.80
Income	
Upto Rs. 50,000/-	11.0
Rs. 50,000/- to 1,00,000/-	19.0
Rs. 1,00,000/- and above	70.0
Religion	
Hindu	86.75
Muslim	7.5
Christian	3.0
Sikh	2.75
Food habits	
Vegetarian	77.5
Non-vegetarian	22.5

divided into 3 categories in which 45.7 per cent of them lived in small sized families, 47.5 per cent lived in medium sized families and 6.8 per cent of adolescent girls lived in large sized families. While 11 per cent of school going adolescent belonged to the low income group, while 70 per cent belonged to the high income group.

When classified on the basis of religion, a major part of the respondents, *i.e.* 86.75 per cent of the adolescent girls belonged to the Hindu religion, 7.5 per cent were muslims, 3.0 per cent to christianity and 2.75 per cent to sikhism. More than 3/4th (77.5%) of the girls were found to be vegetarian and the remaining 22.5 per cent of them were non-vegetarian.

Anthropometric measurement:

Data were processed using the statistical software package SPSS. The mean and the standard deviation of the mean (S.D.) values of weight, height, BMI, mid-upper-arm circumference (MUAC), waist circumference (WC), hip circumference (HC) and total skin fold thickness (TSF) were measured. The anthropometric parameters of school going adolescent girls have been presented in Table 2. The girls in the age group of 13-16 years have mean weight and S.D. 42.8±7.5kg, height, 153.6±6.6cm, BMI, 18.1±2.8kg/m^2, MUAC, 22.1±2.5cm, WC, 64.2±6.8cm, HC, 84.0±6.7cm and TSF, 2.4±0.5.

Similarly the girls in the age group of 16-19 year have mean weight and S.D, 46.2±8.7kg, height, 154±6.5cm, BMI, 19.4±3.5kg/m^2, MUAC, 23.4±3.0 cm, WC, 67.0±8.8cm, HC, 86.3±7.8cm and TSF, 2.5±0.6 cm, respectively.

Latesh and Garg (2015) conducted a study on 100 adolescent girls in Sonepat district of Haryana. Their study revealed that mean height, weight and BMI of adolescent girls was 159.45cm, 50.3 kg and 19.77 kg/m^2, respectively. BMI of the present study (19.40kg/m^2) is similar to the BMI (19.77kg/m^2) reported in their study.

A community based cross sectional study was carried out by De (2017) among adolescent girls in the age group of 10-19. Her study reported that the overall means, standard deviations of height and weight of the adolescent girls were 150.01 cm (4.81) and 44.06 kg (5.70), respectively. Among all circumferential measurements, mean hip circumference was highest (84.85) cm (6.57) and among skin folds triceps skin fold was 8.98 mm (2.03). Mean height increased 7.54 cm progressively from 10 to 19 years, 8.76 kg weight increases from 10 to 19 years. The results of the present study are quite similar to the inferences reported by De (2017).

The increase in the weight, height, BMI, MUAC, WC and HC of 16-19 years adolescent girls from 13-16 years were found to be 3.4kg, 0.4cm, 1.3kg/m^2, 1.3cm, 2.8 cm and 2.3 cm, respectively. This shows that with the increase in age range, the anthropometric parameters of weight, waist circumference and hip circumference increases markedly. These results focus the risk of overweight and stunting in the future. The percentage of adolescents who were malnourished according to Jeyakumar *et al*. (2013) was 4.8 per cent according to BMI and 5.0 per cent for MUAC. BMI highly correlated with MUAC (r = 0.593) and MUAC as a screening tool showed 28.57 per cent sensitivity and 96.46 per cent specificity.

According to the age group, weight of the adolescent girls increases with age and correlation co-efficient (0.2223*) was significant at 5 per cent level of significance. Height of the adolescent girls in both the age groups were found to increase slightly and correlation co-efficient was non-significant at 5 per cent. In case of

Table 2 : Anthropometric parameters of school going adolescent girls **(n=400)**

Parameters	Mean + S.D. (n=275) (13-16years)	Mean +S.D. (n=125) (16-19years)	Overall mean +S.D. (n= 400) (13-19years)	Correlation co-efficient (r)	Per-cent adequacy
Weight (kg)	42.8 ± 7.5	46.2 ± 8.7	43.9 ± 8.1	0.2223*	p<0.05
Height (cm)	153.6 ± 6.6	154 ± 6.5	153.8 ± 6.6	0.0289	p<0.05
BMI *(Kg/m2)	18.1 ± 2.8	19.4 ± 3.5	18.5 ± 3.1	0.2346*	p<0.05
MUAC *(cm)	22.1 ± 2.5	23.4 ± 3.0	22.5 ± 2.7	0.2486*	p<0.05
W C* (cm)	64.2 ± 6.8	67.0 ± 8.8	65.1 ± 7.6	0.1999*	p<0.05
H C *(cm)	84.0 ± 6.7	86.3 ± 7.8	84.7 ± 7.1	0.1998*	p<0.05
TSF*(cm)	2.4 ± 0.5	2.5 ± 0.6	2.4 ± 0.6	0.0076	p<0.05

* indicate significance of value at P=0.05

BMI, co-efficient of correlation (0.2346*) was found to be significant at 5 per cent probability level. Hence, BMI of the adolescent girls increased positively with respect to age. Similarly correlation co-efficient of MUAC (0.2486*), WC (0.1999*) and HC (0.1998*) were found to be significant at 5 per cent level of significance with positive response according to the age (Table 2).

The adolescent growth spurt may differ in timing, intensity and duration in individual children, but usually coincides with the onset of puberty. As a result there can be large variations in anthropometric dimensions. BMI-for-age (determined from CDC percentiles: Addendum 4) is recommended to be used above weight-for-height for interpretation of nutritional status in adolescents. A BMI-for-age of <5th percentile indicates wasting or is cut off for underweight based on recommendations by the World Health Organisation Expert Committee on Physical Status (WHO, 1995). Between 85th and 95th percentile, BMI-for-age shows the risk of overweight (Himes and Deitz, 1994).

Table 3, shows that 26.25 per cent of respondents in the study were found to be underweight and on the other hand 38.75 per cent of them were in the risk category of overweight. Sachan *et al*. (2012) in their study reported that overall prevalence of thinness was found to be 17.0 per cent and 11.4 per cent (BMI <5th percentile according to NCHS-CDC reference) among urban and rural school going adolescent girls, respectively. Overall prevalence of overweight was found to be 5.4 per cent and 3.9 per cent (BMI >85th percentile according to NCHS- CDC reference) among urban and rural school going adolescent girls, respectively. A cross-sectional study conducted by Sarkar *et al*. (2015) among 150 adolescent girls of Champadanga Bijoy Krishna Balika Vidyalaya, Tarakeswar block, Hooghly district, West Bengal revealed that prevalence of thinness, overweight or obesity and stunting were 16 per cent, 11.4 per cent and 20.7 per cent, respectively.

Przyslawski *et al*. (2011) from their study revealed that mean values of body height and mass were approximately in the 50th percentile. However, 13.7 per cent of females were underweight, 7.7 per cent were overweight and 1.2 per cent were obese. Omobuwa *et al*. (2014) reported that around 1/3rd of respondents were detected to be underweight. Under nutrition is a common problem amongst the adolescents and can be rectified only through continual nutritional education imparted to adolescents.

Bhattacharya *et al*. (2015) in their study carried out in Burdwan district of West Bengal among 424 school going adolescent girls in the age group of 10-19 years found that the prevalence of underweight and stunting were 53.31 per cent and 47.41 per cent, respectively, which was significantly higher in early adolescence than in late adolescence. Roba *et al*. (2016) conducted the study on 726 adolescent girls in Adama city, Ethiopia and reported that 21.3 per cent of adolescent girls were underweighted, 3.3 per cent were overweight, 1.0 per cent was obese and 15.6 per cent were stunted. Patil *et al*. (2015) in their cross-sectional, school based study of 321 adolescents (10-15 years) from rural Maharashtra found that the prevalence of stunting in girls of 10-15 years age was 6.3 per cent and the prevalence of thinness was 28.1 per cent which is similar to the underweight result (26.25%) of the present study. There was statistically highly significant association between socio-economic status and prevalence of stunting and thinness.

Conclusion:

Nutritional deficiencies have far reaching consequences, especially in adolescent girls. If their nutritional needs are not met, they are likely to give birth to undernourished children, thus, transmitting under nutrition to future generations. From the findings of the present study, it can be concluded that there is prevalence of stunting, underweight and overweight among school going adolescent girls of Kanpur. This age group needs special attention because of the turmoil of adolescence which they face due to the different stages of development that they undergo, different circumstances that they come across, their different needs and diverse problems. Therefore, nutrition education of adolescents is very important and various educational programmes should be adopted to convey relevant messages.

Table 3: BMI classification of school going adolescent girls on percentile basis

Basis of percentile	Category	No. of girls	Percentage
< 5th percentile	Underweight	105	26.25
85th to < 95th percentile	Risk of over weight	155	38.75

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