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EFFICACY OF DIETARY ASSESSMENT AND ANTHROPOMETRY PARAMETERS TO EVALUATE NUTRITIONAL STATUS OF SCHOOL GOING ADOLESCENTS IN LUCKNOW, UTTAR PRADESH, INDIA.

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ABSTRACT

Adolescence is an important phase in the life of human being with rapid changes in their physical, cognitive and psychological areas. Nutrition status of adolescent is a significant factor to determine the health of a country. Nutrition plays an important role in the growth and development in adolescent girls and boys both. According to National Family Health Survey-5 the prevalence of anemia among adolescent girls was 57% and boys about 33.8%. Various assessment techniques have been used to assess malnutrition by adopting anthropometric measurements in terms of overweight and underweight such as BMI, MUAC and 24-hour dietary recall method. In present study, diet consumption pattern significantly reflected on the population anthropometric indices such as BMI and MUAC. In this study adoption of two assessment tools like anthropometric measurements and Dietary recall method were found to be effective in indicating malnutrition prevalence. For instance, weight was found to be increased in late adolescents as compared to early adolescents similarly their dietary pattern also indicated that late adolescent group consumed high carbohydrate -loaded diet and with high fat consumption pattern. The present research has tried to make nutritional assessment better by adopting anthropometric and dietary assessment parameters in compounded form rather than using them separately.

Keywords: adolescent; anthropometry measurements; dietary intake; nutritional status

INTRODUCTION

Nutrition status of adolescent is a significant factor to determine the health of a country. Adolescence is an important phase in the life of human being with rapid changes in their physical, cognitive and psychological areas. Person's age falling between 10 to 19 years is studied for adolescents (1). 16% of the total global population comprises of adolescents which equals to 1.2 billion across the countries, streaming it down in India, the prevalence rates for underweight of adolescent girls was 33.40% and the prevalence rate amongst adolescent boys was 32.50% (2). Nutrition plays an important role in the growth and development of adolescents (3). The National Family Health Survey-5 showed that the prevalence of anemia among adolescent girls was 57% and boys about 33.8% (4). The report of Recommended Dietary Allowances- Indian Council of Medical Research (RDA-ICMR) 2024, stated that the average weight of adolescent girls in the age group 13 to 15 years should be 49.6 kg (on average) and for 16 to 18 years should be 55.7 kg, (on average) similarly, as per the report adolescent boys of age group between 13 to 15 years should weigh 50.5kg (on an average) and boys between 16 to 18 years should weigh around 64.4 kg (5). In order to indicate the prevalence of malnutrition, various assessment techniques have been adopted and practiced worldwide. Amongst the most commonly used under

the category of anthropometric measurements are measurements of height (in cm), weight (in kg), Mid Upper Arm Circumference (MUAC) (cm), Body Mass Index (BMI). Ranges of BMI as defined by ICMR, Indian Academy of Pediatrics (IAP) and World Health organization (WHO) are widely used measurements to assess malnutrition in terms of overweight and underweight. MUAC helps to assess muscle mass wasting and is used very frequently to assess protein energy malnutrition during community's surveys. Shakir's tape is commonly used in Indian population by community health workers (6). Apart from anthropometric assessment dietary consumption pattern is also important tool to assess the adequacy of nutritionally balanced food intake across the population. Dietary consumption pattern can be observed through various assessment tools such as 24-hours dietary recall method, food diary method, food weighment method etc. For gross and large sample size 24 hours dietary recall method is a quick and easily adopted method. This method helps interviewer to record the responses of even illiterate population (7). During the entire human life cycle growth spurts occur at infancy and adolescent's period which should be carefully monitored and taken care of. Failing to which deficit of nourishment occurs, this also adversely affect the achievement of milestones of various age groups (8). Therefore, during these two phases food choices, frequency of meals, eating pattern, socio-economic factors should all be considered if malnutrition is a rampant problem across the population (9). Recent studies highlighted the fact that adolescents are getting more inclined towards carbohydrate loaded foods, processed foods and excess consumption of fast food not only this, they are also in the practice of erratic food habits such as skipping of meals, irregular eating times, less consumption of water and seasonal foods and vegetables (10). Thus, adolescent population is becoming more vulnerable towards developing macronutrient deficiencies such as adolescent obesity, anorexia nervosa as well as micronutrient deficiencies such as iron deficiency Anaemia, Calcium and Vitamin D deficiency etc. (11). Therefore, present study aims to assess the prevalence of malnutrition by adopting anthropometric measurement such BMI and MUAC and also 24-hours dietary recall method amongst school going adolescents in Lucknow city, India. This study also tries to establish relationship between anthropometric as well as dietary assessment in order to assess prevalence of malnutrition if present.

MATERIALS AND METHODS

Census data from 2011 show that the total population of children, below the age of eighteen years is 472 million. India has the largest adolescent population in the world, which is 253 million, and one fifth of the subjects are between 10 to 19 years (12). The total adolescent population of Lucknow city, in Uttar Pradesh, India is approximately 4.38 million. The total number of government schools in Lucknow (Nagar Skshetra) are 41 which are educating approximately 75,463 children. We selected 5 schools randomly one from each region (North, South, East, West and

Central region of Lucknow City), for selection of the sample for this study. We randomly selected 122 adolescents between 13-19 years of age from each school, by using computer generated random numbers, which came out to be approximately 17 students from each class, based on numbering given to students, in the various classes of the government schools. If a student refused to participate in the study, the student of the next number was included in the study to complete the sample size.

$$n = \hat{p} \times (1 - \hat{p}) \times z^2 / \text{MOE}^2$$

Where, n: Sample size, $\hat{p}$: sample proportion (50% in case of unknown prevalence)

z= 95% confidence interval (1.96), MOE: margin of error (to be divided to get a decimal)

$n = 384.16 = 385$ With a margin of error of $\pm 0.05\%$ and an expected sample proportion of 0.5, the sample size would need to be 385. If consider the design effect is 1.5, then the total sample size will be $n = 385 \times 1.5 = 578$. Further, we consider 5% sample will be washed out. Therefore, total sample size should be, above 607. Adolescents between 13-19 years of age of both genders, ($n = 649$) without any chronic illness were selected, from various government schools from urban areas of Lucknow city. Adolescents suffering from diseases like celiac disease ($n = 4$), lactose intolerance ($n = 3$), type 1 diabetes ($n = 6$), thalassemia ($n = 1$), chronic diarrhoea and dysentery ($n = 9$) or on any medications ($n = 2$), and those who refused to be part of the study ($n = 17$) were excluded. Thus, after excluding all these adolescents (total number $n = 42$), 607 subjects formed the material for this study. Data were collected using a case record form by the registered dietitians via interviews and a using a validated pretested structured questionnaire among subjects. The questionnaire was prepared in both English and Hindi Language which is also the regional language. The questionnaire gathered all the information about socio-demographic profile, anthropometric measures, dietary pattern (24-hour dietary recall) (13). Nutrient intakes were calculated based on Indian food composition tables (14). Anthropometric measurements; such as height, weight and MUAC were recorded through standard procedures. The height was measured to the closest 0.1 cm, after removing shoes, by a certified and reliable Stadiometer B0849JRVRN /Thermocare height measurement scale/ /Thermo Plast Industries/India (15). The weight was recorded in light underclothes, using a calibrated electronic weighing scale Omron HN 300T Digital Weighing Machine/ Omron Healthcare/ China .Two readings of weight were recorded simultaneously and then the average weight was recorded to the nearest 0.1kg. Body mass index (BMI) was calculated after obtaining the values of height in meters and weight in Kg, by dividing weight in Kg with height in meter square (Kg/m^2) (16). We used Shakir's tape B01650G458/ Ibis Medical/ India to measure the MUAC (17). The median MUAC was computed after readings for the upper arms of the left and right were obtained. The dependent variable was over-nutrition, which is a composite indicator calculated from WHO-BMI ranges based upon weight and height measurements at appropriate cut off points. Therefore, the major independent

variables of this research were anthropometric assessment (height, weight, median of MUAC and diet consumption pattern (24-hours dietary recall method) so as to establish association between consumption pattern and risk of overweight among school-going adolescents. The study has been approved by Institutional Ethical committee of Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow.

RESULTS

To assess the physical health parameters in presence study BMI, an average MUAC methods were used. (Table 1)

Table 1. Description of Anthropometric measurements in Early and Late Adolescents groups boys and Girls.

Anthropometry Measures	Early Adolescent (Mean $\pm$ SD)	Early Adolescent		Late Adolescent (Mean $\pm$ SD)	Late Adolescent	
		Boys (44)	Girls (69)		Boys (301)	Girls (193)
Age	13.69 $\pm$ 0.46	13.66 $\pm$ 0.48	13.71 $\pm$ 0.46	16.37 $\pm$ 1.24	16.47 $\pm$ 1.24	16.21 $\pm$ 1.24
Height (CM)	155.63 $\pm$ 8.76	160.99 $\pm$ 9.61	152.21 $\pm$ 6.12	162.17 $\pm$ 9.44	166.93 $\pm$ 7.77	154.75 $\pm$ 6.62
Weight (Kg)	41.74 $\pm$ 7.62	43.89 $\pm$ 8.56	40.37 $\pm$ 6.67	48.96 $\pm$ 9.57	51.83 $\pm$ 9.77	44.50 $\pm$ 7.28
BMI	17.20 $\pm$ 2.59	16.92 $\pm$ 2.89	17.38 $\pm$ 2.39	18.64 $\pm$ 3.14	18.67 $\pm$ 3.75	18.58 $\pm$ 2.81
Left MUAC	21.97 $\pm$ 2.40	21.81 $\pm$ 2.91	22.08 $\pm$ 2.02	23.81 $\pm$ 2.87	24.07 $\pm$ 3.08	23.40 $\pm$ 2.45
Right MUAC	22.07 $\pm$ 2.33	21.91 $\pm$ 2.92	22.17 $\pm$ 1.89	23.89 $\pm$ 2.87	24.16 $\pm$ 3.08	23.47 $\pm$ 2.47
Average MUAC	22.02 $\pm$ 2.34	21.86 $\pm$ 2.90	22.12 $\pm$ 1.92	23.85 $\pm$ 2.85	24.11 $\pm$ 3.06	23.43 $\pm$ 2.44

In Table 1. As expected, sudden spurt in height and weight was found in late adolescence. Average MUAC also increased from 6% to 10% in adolescents. An increment of 7% in the BMI of girls and 10% in boys was observed. The body weight of boys was higher than girls in both categories of Adolescent. The difference in the body weight between boys and girls was greater for late adolescents than early adolescents ($p < 0.01$). Average gain in body weight for girls was 4.13 kg. The average increase of weight of boys was about 1.9 fold higher than girls. 10% higher BMI in boys was observed in late adolescents as compare to boys of early adolescence. Similarly, 7% higher BMI in late adolescence girls was observed as compare to early adolescence girls. Change of average MUAC of boys belonging to early adolescents as compare to late adolescents boys was 10.3% higher while change of average MUAC in late adolescents girls was 7% higher as compare to early adolescents girls. To assess the impact of adequate food consumption on physical growth of both adolescents group, 24-hours dietary recall method was used in present study.

Table 2. Description of Macro and Micro Nutrients consumption in Late and Early Adolescent Boys and Girls.

Nutritional Parameters ↓	Early Adolescent (Mean±SD)	Early Adolescents		Late Adolescent (Mean±SD)	Late Adolescent	
		Boys (44)	Girls (69)		Boys (301)	Girls (193)
Protein [g]	39.64±13.58	44.07±13.43	36.82±13.0	43.14±14.59	44.97±15.59	40.28±12.36
Fat [g]	28.71±12.33	31.47±13.06	26.95±11.59	26.79±10.92	26.77±10.90	26.82±10.99
Carbohydrate [g]	203.40±71.59	224.72±78.19	189.80±63.78	222.75±73.44	230.25±74.94	204.04±69.62
Energy in Kcal	1445.69±393.58	1473.50±372.01	1427.96±408.42	1502.49±398.63	1534.33±406.78	1452.84±381.83
Calcium (Ca) [mg]	182.14±135.86	206.99±129.85	166.29±138.14	168.16±2.34	240.50±181.42	192.51±140.62
Iron (FE) [mg]	10.03±4.32	76.20±33.47	55.97±26.39	4.34± 1.95	75.03±29.56	58.65±29.33
Magnesium (Mg) [mg]	256.04±64.30	266.45±65.04	249.40±63.41	63.54±1.83	272.11±63.91	262.16±62.66

Phosphorous (P) [mg]	675.24±103.21	686.47±103.46	668.08±103.17	104.07±1.00	689.48±105.71	680.73±101.49
Potassium (K) [mg]	2408.38±513.24	2489.62±436.56	2356.58±553.49	497.05±0.18	2408.94±500.55	2383.74±492.46
Sodium (Na) [mg]	2379.64±431.28	2379.34±367.46	2379.83±470.09	414.16±0.10	2377.53±406.10	2371.82±427.48

(Table 2) Through 24-hours dietary recall method, nutritional intake in terms of macro as well as micronutrients was assessed on daily basis. it was observed that intake of macronutrients such as Carbohydrate, Fat, Energy and of micronutrients such as Iron, Magnesium, Phosphorus, Potassium and Sodium were low in both early and late adolescent when compared to recommended dietary allowances as suggested by ICMR-RDA-2024. The difference in macronutrients such as Protein, Carbohydrate, Energy and micronutrients such as Calcium, Iron, Magnesium, and Phosphorus was higher for late adolescents compared to early adolescents. The average gain in macronutrients for late adolescents was about 0.2, 2.57, 2.4, 7.29, 2.2, 2.25 and 12.65 fold greater than early adolescents. While the average of macronutrient Fat content for boys and girls of late adolescent was lower than early adolescents by 1.02 fold lower than girls of early adolescents. In micronutrients, average of Potassium and Sodium for boys and girls of late adolescents was decreased to 0.33 and 3.10 fold as compared to early adolescents of boys and girls respectively.

DISCUSSION

Prevalence of malnutrition in adolescent age group is not only limited to individual concern but also calls for amendments in National Health Policies and other regulatory policies. As undernourished adolescents cannot secure a healthy future for the nation (18). Adolescents group constitutes major part of Indian population. Therefore, their overall health is of significant importance for country's growth. Various indices have been worldwide used to assess the health of adolescents. Assessment tools such as Anthropometric, Biochemical, Clinical and Dietary are important yardsticks to find out rate of prevalence of malnutrition in said population. Nutritional and physical health are the fore frontiers. In order to evaluate nutritional and physical health as per the guidelines given by international regulatory bodies like WHO, IAP and national bodies like ICMR RDA-2024, NIN, etc., anthropometric and dietary assessment tools are frequently used. In our study, inadequate nutritional intake increases the dual burden of malnutrition that is overnutrition in terms of fat, energy, protein and carbohydrate and undernutrition in terms of protein and various

vital micronutrients. In the major findings of the study, girls belonging to adolescent age group either early or late are nutritionally deprived as compared with the boys. Therefore, findings of this study are analogous to the findings in studies done by (19). Their studies also revealed that inadequate dietary intake was significant indicator of stunting and anemia amongst adolescent in India. Inadequate nutrition intake was observed when compared with recommended dietary allowances as given by national body ICMR RDA-2024, this also reflects on anthropometric measurements in directly proportional manner. An anthropometric measurement helps to reinforced the findings of nutritional assessment (20). In present study, strong correlation between both the assessment techniques was established.

CONCLUSIONS

Therefore, conclusion may be drawn that present study highlighted that in order to determine the prevalence of malnutrition amongst the adolescent age group adoption of one or two assessment techniques helps to derived more accurate findings. In present study, diet consumption pattern significantly reflected on the population anthropometric indices such as BMI and MUAC. In this study adoption of two assessment tools like anthropometric measurements and Dietary recall method were found to be effective in indicating malnutrition prevalence. For instance, weight was found to be increased in late adolescents as compared to early adolescents similarly their dietary pattern also indicated that late adolescent group consumed high carbohydrate -loaded diet and with high fat consumption pattern.

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CONFLICT OF INTEREST

The authors have no conflicts of interest relevant to this article.

AUTHORS' CONTRIBUTION

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