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Anthropometric Assessment of Nutritional Status of Adolescents in Rural School of Unokoti District of Tripura, North-East India

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ABSTRACT A cross-sectional survey was conducted among 300 boys and girls (1:1) of 10-15 years, randomly selected, from three Govt. Secondary School of Unokoti District of Tripura State, to assess their nutritional status. The weight, height, head circumference (HC) and mid-upper-arm circumference (MUAC), body mass index (BMI) and chest circumference (CC) were taken as nutritional status indices. Nutritional status was evaluated using the age and sex-specific cut-off points of anthropometric indicators of the NHANES-I percentile values. The percent of malnourished children was found varying from 53% to 76% on the basis of different nutritional status indices, socio-economic status, and sex. There is a decreasing trend in the proportion of undernourished child with increasing socio-economic status (SES). The low values of anthropometric indices and high rate of malnourished child obtained from this study suggest that there is need for improvement in the nutritional status of adolescents.

INTRODUCTION

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; Bose and Mukhopadhyay et al. 2005; Gupta et al. 2011; Gaiki and Wagh 2014). 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). Many developing countries face an increasing burden of under nutrition (Mukhopadhyay et al. 2005; Dey et al. 2011; Kumar 2012). It is also a culminating of constraints in India (Popkin et al. 2001). Tripura, a north-eastern state is not an exception in this sphere (Uddin and Nag 2012). Adolescent, a period of transition between childhood and adulthood occupies a crucial position in life of human beings because in this period rapid growth and maturation in human development occur, because of rapid growth in stature, muscle mass and fat mass during the peak of the adolescent growth spurt, the requirements for some nutrients is as high or higher in adolescent than in any other age group (WHO 2000; Dey et al. 2011). The nutritional status of adolescents, the future parents, contributes significantly to the nutritional status of the community. In addition, this age group accounts for more than one-fifth of world's population. In India, this age group forms 21.4% of the total population (Choudhuri et al. 2003). The foundation of good health and sound mind is laid during this period. Besides, it is basic milestone in the life of an individual and responsible for many changes that takes place during later life. This age is considered as dynamic period of growth and development because children undergo physical, mental, emotional and social changes. The United Nations Sub-Committee on Nutrition meeting held in Oslo in 1998 concluded that more data on health and nutrition of school age children are needed to assess their scale of problem. The school children are easily accessible, capacitive and responsive group (ACC/SCN 1998; Chugh and Puri 2001; Suvarna and Itagi 2009). Adolescents have been considered to have the lowest mortality among different age group and have therefore received low priority in terms of nutritional status assessment (Chaturvedi et al. 1996). Though, the health issues of adolescents like sexually transmitted diseases and reproductive health have been given

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due importance, limited research works has been done on their nutritional status, particularly from rural India (Gaiki and Wagh 2014). In addition, to date, there are no studies (de Onis et al. 2001; Bhadra et al. 2004), which have dealt with socio-economic and sex differences in the level of under nutrition among adolescent Bengalis, especially in the context of Tripura, a north-eastern state. Hence, the present study was undertaken to evaluate socio-economic and sex trends in the level of under nutrition among 10-15 year old Bengalei adolescents of rural Unokoti District of Tripura.

MATERIAL AND METHODS

Study Area and Samples

The study was carried out as part of an ongoing research work leading to Ph. D. degree under Tripura University by the first author. The study area comprised of three Government Secondary Schools out of eleven in Tilagaon, Ragnauti and Irany Gram Panchayet of Unokoti Tripura District. The present study was carried out during the period 2010-2011. The schools are located approximately 4-6 kms from Kailashahar, the then District town of Unakoti Tripura. According to the census report of 2011 the population of Tripura is about 36.71 lakhs with about 1.87 lakhs males and 1.79 lakhs females. The sex ratio of the state is 961 females per thousand males. The density of the population is 350 persons per square kilometer. Tripura constitutes 0.3% of India's total population. They are scattered over 8 districts, 40 blocks and 870 villages. 82.94 percent people of this state live in rural areas. The district of Unokoti has an area of 592.93 square kilometer and a population of about 27.7 lakhs with a density 157 persons per square kilometers. The literacy rate of the district is 91.61% in male, 83.40% in female and 87.58% in total (Bhargav et al. 2006; Das 2008; Uddin and Nag 2012). The schools were selected by simple random sampling technique taking the distance from the Head Quarter, availability of drinking water, electricity, homogeneity in the Bengalese students of different SES (Socio-economic Status) status etc. into consideration. 300 (150 males 150 females) pupils in the age group of 10-15 years with equal sex distribution in each age group (N=25×6+25×6) were selected from the sampled schools by simple random sampling technique. The subjects consisted mostly from families of lower socio-economic class of Muslim and some were from Hindu Community and are considered to be typical of average Indian children.

Data Collection

Ethical approval and prior permission was obtained from Tripura University Ethics Committee, Local community leaders and Heads of all the schools surveyed, respectively before commencement of the study. Self administered questionnaires were used to collect in formations on socio-economic characteristics of the subjects' parents. The socio-economic characteristics of the households from where the adolescents studied was investigated following Kuppuswamy's socio-economic status scale upgrading for 2007 (Kumar et al. 2007) with suitable modification as per the availed data (Uddin and Nag 2012). The questionnaires were given to the children to take home for their parents to fill and these were collected in the following days. Each gender group was divided into 3 groups according to modified Merging Kuppaswamy's socio-economic classification (Kuppaswamy's upper lower and lower were considered as lower, Kuppaswamy's upper middle and lower middle were considered as middle). As the individual subjects were from rural area, the upper group was not available in this study. All anthropometric measurements were made by the corresponding author himself and a trained lady investigator had been engaged to collect the data from girls. The measurements were performed by following the standard techniques (Lourie and Wiener 1981). Height, weight, body mass index (BMI), mid-upper arm circumference (MUAC), head circumference (HC), chest circumference (CC) was taken into consideration. All measurements were performed between 2.00 and 4.00 hr. Height in centimeter was marked on a wall in the school 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 nearest 1 centimeter (Anand et al. 1999). Body weight was measured with light clothing and shoes off, using Seca digital scale (German) to the nearest 100g. The BMI was calculated from the body

weight and body height using the following equation as suggested by Bray 1978: BMI=Weight (kg)/Height (m^2). HC was measured in cm nearest to 0.1 cm around the head with the tape passing over the supracilliary ridges in front and occipital protuberance (ICMR 1972).

Chest circumference (cm) was measured on the chest at the level of Xiphisternum and in a plain at the right angle to the Vertebral Column below the inferior of the Scapulae to nearest to 0.1 cm at the mid time of a normal expiration and inspiration (ICMR 1972). Mid-upper-arm-circumference (MUAC) was measured in at the level of the midpoint of the upper arm (left arm), between the acromin process and the tip of the olecranon, with the arm hanging relaxed by an accurate soft metallic tape (Stanley, made in England) to the nearest 0.1 cm range (Gopaldas et al. 1987). 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 recent studies worldwide on under nutrition among adolescents (Venkaiah et al. 2002; Woodruff and Duffield 2002). Under nutrition in respect of BMI was defined as <18.5.

Data Analysis

Data was processed using the statistical software package SPSS for Windows 12 (SPSS, Chicago, III, USA). The mean and standard deviation of the mean (SD) values of age, height, weight, BMI, height-for-age z-score, head circumference, mid-upper-arm circumference and chest circumference were determined. The classifications of nutritional status of the subjects were expressed in percentages. Fischer's LSD test was performed between all the physical parameters of boys and girls. Statistical significance was set at $p<0.05$.

RESULTS

Most of the subjects (almost 67%) were found to belong to the families of lower socio-economic class. The boys and girls have a mean Age, 13.04±1.78 and 12.76±1.66 years; Weight, 35.13±9.7and 34.73±7.46 kg; Height, 145.58±12.84 and 142.96±8.83cm; BMI, 16.3±2.54 and 16.80±2.36 kg/m^2; Head Circumference, 51.29±1.54 and 50.55±3.15 cm; MUAC, 19.06±2.47 and 19.45±3.22 cm and CC of 66.90±7.89 and 68.95±7.53cm respectively (Table1).

There were significant ($p<0.001$) differences in all the parameters of boys and girls except BMI and CC (Table 1).

The socio-economic attributes of the parents of the children showed that majority of them (33.5%) were government employees followed by farmers (16.17%), businessmen (14.97%), day-laborers (14.37%), skilled workers (carpenters, mason, electrician, tailors etc.) (7.78%), motor shramik (3.59%), contractors (2.8%), religious activities (1.2%). The remaining 3.65% had no specific socio-economic activities. The educational background of the parents showed that 10.79% had no formal education; 38.1% had primary school leaving certificate, 29.76% senior basic school education, 12.5% had Madhyamik, 11.9% higher secondary, 7.74% attended tertiary and Higher Education Level respectively. The monthly income of the parent showed that 23.76% earn Rs 980-2935; 35.6% earned Rs 2936-4893; 25.74% earned Rs. 4894-7322; 10.4% earned Rs 7323-9787 and 4.46% earned between 9788-19,574 respectively.

Table 1: Nutritional status indicators of the Bengali adolescents by sex

Parameters	*Boys (N=150) (Mean± SD)*	*Girls (N=150) (Mean± SD)*	*Overall(N=300) (Mean± SD)*	*P values (<)*
Age(Years)	13.04± 1.78	12.76±1.66	12.9± 1.72	0.001**
Weight(kg)	35.13± 9.7	34.73±7.46	34.93± 8.66	0.001**
Height(cm)	145.58±12.84	142.96±8.83	144.27±11.08	0.001**
BMI(kg/m^2)	16.3± 2.54	16.80±2.36	16.55± 2.46	0.268
Head circumference(HC)	51.29± 1.54	50.55±3.15	50.92± 2.50	0.001**
Mid-upper arm circumference (MUAC)	19.06± 2.47	19.45±3.22	19.27± 2.87	0.001**
Chest circumference(CC)	66.90± 7.89	68.95±7.53	67.93± 7.77	0.127

P values were determined using Fischer's LSD test, **Significant at 1% level

As per BMI-for-age of the adolescents, 76.2% had found to below normal nutritional status out of which 42% % had severe thinness, 13.6 % had moderate thinness, 20.6% had mild thinness and only 23.8% had normal BMI (Table 2).

According to the present nutritional status (weight-for-age z-score) criteria of the children, 57.66% of the adolescents were malnourished. Height-for-age Z score (an index of stunting) showed that 54% of the adolescents fell under malnourished category (Table 3).

Results also reflected that 58.66% studied adolescents had suffered from malnutrition (Table 3). There was a recognizable decreasing trend in the proportion of malnourished children with increasing socio-economic status (SES). Children of lower SES revealed higher prevalence of malnutrition assessed on the basis of weight-for-age (boys -60% and girls 64%) compared to the children of middle SES (boys -52.7% and girls 58.7%). Similar trends were also observed when assessed through height-for-age and MUAC.

When SES was taken into account to find out its role in malnutrition, it was found that according to weight-for-age, height-for-age, and MUAC-for-age criteria percentage of adolescents suffered from under nutrition was relatively higher in low SES group (57% to 63.8% than the adolescents of middle SES group (48.5% to 55.54%).

To see the impact of sex on under nutrition, it was found that 57% to 64% of girl adolescent were undernourished according to weight-for-age, height-for-age, and MUAC-for-age criteria. While in boys, it was 50% to 56% which was relatively lower than in girls. It was further observed that the girl adolescents of low SES were more vulnerable than the girl adolescents middle SES.

DISCUSSION

Adolescence is an important stage of growth and development that requires specific health and nutrition needs and adolescent anthropometry varied significantly worldwide (WHO 1995; Mukhopadhya et al. 2005; Maiti et al. 2011; Kumar 2012; Gaiki and Wagh 2014). The basic objective of anthropometric assessment is to provide an estimate of the prevalence severity of malnutrition. The information collected can then be used for the formulation of health and developmental policies. Information regarding the nutritional status of adolescents in Tripura is scarce (Woodruff and Duffield 2002). The use of anthropometry is more difficult in adolescents than in any other age groups because adolescent anthropometric indices in normally nourished adolescents change with age and sexual

Table 2: BMI Classification of adolescents (boys and girls)

BMI class (kg/m²)	*Boys*		*Girls*		*Overall*		*Grade*
	No.	*%*	*No.*	*%*	*No.*	*%*	
<16	60	40	66	44	12	42	Severa Thinness (III)
16.00-16.99	15	10	21	14	41	13.6	Moderate Thinness (II)
17.00-18.49	29	19.3	32	21.4	62	20.6	Mild Thinness (I)
18.50-24.99	22	30.7	31	20.6	71	23.8	Normal
Total	150	100	150	100	300	100	

Table 3: Prevalence of under nutrition in adolescents (age group 10-15 years) by socio-economic status

Nutritional status indicator→			*Weight-for-age No. (%)*	*Height-for-age No. (%)*	*MUAC-for-age No. (%)*
SES class	*Sex*	*No.*			
Lower (N=199)	Boys	(N=95)	57 (60)	49 (51.57)	56 (58.94)
	Girls	(N=104)	67 (64.7)	65 (62.50)	71 (68.27)
	BS	(N=199)	124 (62.3)	114 (57.3)	127 (63.8)
Middle (N=101)	Boys	(N=55)	29 (52.7)	25 (45.45)	30 (54.55)
	Girls	(N=46)	27 (58.7)	24 (52.17)	26 (56.52)
	BS	(N=101)	56 (55.4)	49 (48.5)	56 (55.4)
Overall (N=300)	Boys	(N=150)	84 (56)	76 (50.60)	80 (53.33)
	Girls	(N=150)	89 (59.33)	86 (57.33)	96 (64)
	BS	(N=300)	173 (57.7)	162 (54)	174 (54)

development. Various studies carried out by different workers and research groups in different parts of the country have shown variation in degree of under nutrition (Dey et al. 2011).

It was observed in the present study that a large proportion (54% to 58%) of adolescents under study was malnourished. This may be due to the low socio-economic status of their parents (Pena and Bacallao 2002). In another study with 16-18 years adolescents of North Tripura District, Uddin and Nag in 2012 have reported that the high prevalence of malnourished adolescents is due the low SES of their parents. In a study by Banerjee et al. in 2009 with adolescent girls of 10 to 18 years from peri-urban area (Duttapukur) of North 24 Parganas district of West Bengal, India had reported that their study subjects were suffering from mild and moderate malnutrition due to low per capita income of their parents. In a study, Kumar in 2012 found that there is prevalence of under nutrition among the girls in the late adolescent group, Hindus, those who lived in joint family, low monthly income and with family size more than 7.

The mean values of the anthropometric indices of 10 to 15 years' adolescents studied were found more or less similar with those reported among rural adolescents in recent studies in India (Venkaiah et al. 2002; Suvarna and Itagi 2009). The higher values of most of the anthropometric indices found in boys in the present study are supported by the fact that at this age (that is, 10 to 15 years), boys usually have a larger body build, grow to a larger structure and also continue to grow farther than the girls even after adolescence (Barbara 1984; Goran 1998). Similar trend were also observed by several authors from their studies in other states of India and abroad (Chugh et al. 2001; Onis et al. 2001; Ogechi et al. 2007; Suvarna and Itagi 2009).

In the present study, majority (42%) of the adolescents had grade 3 thinness, 13.6% had grade 2 thinness, and 20.6% were grade 1 while only 23.8% were normal. Kumar TA (2012), in his study also explored that majority rural adolescent girls of Tamil Nadu were malnourished. Choudhary et al. (2003) reported 68.52% of adolescents had BMI less than 18.5kg/square meter in rural area of Varanasi. In another study, Uddin and Nag (2012) had reported 33.3% boys and 40.2% girls of 16-18 years age group had BMI less than 18.5kg/square meter in rural area of Tripura. Shahabuddin et al. (2000) reported 67.0% prevalence of thinness in Bangladesh**.** The situation is serious and may prove an obstacle in achieving RCH (Reproductive and Child Health) program targets, like reduction in proportion of low birth weight babies and in improving other reproductive out comes (Kirchengast and Winkler 1996). Over the years, the programs directed towards this have failed to achieve targets, and one of the major reasons may be poor nutritional status of adolescents.

In the present study, thinness was significantly more in girls (58%) than boys (50%). These findings are in concurrence with the study of Maiti et al. (2011) on adolescent rural school girls of 10 to 14 years from Midnapur District, West Bengal. Shahabuddin et al. (2000) reported that boys were affected more (75%) than the girls (59%). Chaturvedi et al. (1996) reported prevalence of chronic energy deficiency to be 93.5% among adolescent girls of rural Rajasthan. Onis et al. (2001) reported prevalence of thinness to be 50.5% among Indian adolescent boys. NNMB (2002) reported no sex difference in under nutritional status in the age group 10-13 years.

Weight-for-age, z-score (an index of present nutritional status) has shown that 56% of studied adolescent boys, 59% girls and an overall 57% had low weight for their ages. A research group of Community Medicine, NRS Medical College and Hospital, Kolkata, West Bengal, India had reported that 33% boys and 19% girls of school going adolescents in a rural Block of Darjeeling were suffering from under weight (Dey et al. 2011). In another study with 15-19 years' adolescent girls of rural Tamil Nadu, Kumar in 2012 had found a maximum of 58.3% underweight in illiterate family. Maiti et al. (2011) determined the lowest percentage (18.5%) of 10 to 14 years' rural adolescent school girls of Dantan-II Block, Paschim Medinipur District, West Bengal had normal weight-for-age.

The prevalence of stunting (low height-for-age, z-score) in the adolescents was 57% among girls, 50% among boys and 54% in the both sex. Anand et al. (1999) reported a 25% stunting among boys and 27.3% among girls. However, the report of WHO consultation on nutritional status of adolescents noted a 45% stunting among girls and 20% among boys with an average 32% in both sexes (WHO 1998). Venkaiah et al. (2002) reported stunting of 39.5% from NNMB data; Yadav and Singh (1999) reported it to be 60%. Kumar (2012) found a 23% stunting in 15

years rural adolescent girls of Tamilnadu. Gaiki and Wagh (2014) have found a 23.96% stunting in the 15 years' adolescents from selected rural area of a district from Central India. Shahabuddin et al. (2000) also reported stunting to be as 48% in Bangladesh.

Arm circumference is generally associated with a specific and relative risk of malnutrition, sexual development and is widely used as an indicator of thinness (Waterlow 1992). MUAC changes with onset of puberty (Gasser et al. 1993; Samsuddin 1990). In the present study, the prevalence of low arm circumference (53% in boys and 64% in girls) was found to be similar for both sexes (Table 3). The prevalence of low arm circumference showed that together with been underweight and stunted, the adolescents also showed low fat and muscle reserve. This finding is concurrent with the other findings of several authors in their previous studies with adolescent population of different parts of India and abroad (Chaturvedi et al. 1996; Alam et al. 2010; Dasgupta et al. 2010; Iyer et al. 2011).

The impact of socio-economic status and food habit of adolescents on their growth was studied by several workers (Bogin and Macvean 1981; Aneena and Usha 2007; Uddin and Nag 2012). They showed that high household socio-economic status (SES) was associated with the increased number of meals and the increased intakes of many nutritious foods such as: animal food items, fruits and vegetables and dairy foods. Adolescent population of Tripura are mostly non- vegetarians (Dapi et al. 2005). The foods they consume include rice, *dal*, seasonal vegetables and fruits and occasionally fish/egg/meat. The food habit in rural adolescents were characterised by traditional food, and despite a lower frequency of meat/fish/eggs, vegetables, cereals and milk products. Thus, their calorie intake seemed to be adequate but dietary supplies of protein is insufficient.

Most of the study population belong to low socio-economic strata as their parents were mostly daily labourers (Uddin and Nag 2012).

CONCLUSION

1. Rural adolescents of Unokoti District of Tripura had moderate rates of under nutrition (53% for boys and 64% for girls).
2. There were straightforward socio-economic and sex variations in the rates of under nutrition prevalent among the study samples.
3. These rates of under nutrition of the present study were more than some other developing countries, and specifically higher than earlier Indian findings.
4. It is essential to implement adolescents' friendly health services as recommended by World Health Organization (WHO) to improve the nutritional status.

RECOMMENDATIONS

The low values of anthropometry obtained from this study suggested that there is need for improvement in the nutritional status of these adolescents. Besides, more attention needs to be done to address the issue of adolescent's malnutrition.

LIMITATIONS

1. The present work is exclusively on 10 to 15 years' adolescents population of Unokoti Tripura District,
2. The authors are not confirm whether the findings of the present study are applicable to the other parts of Tripura,
3. The sample size is reasonable but not sufficient to draw any robust conclusion.

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