Assessment of Nutritional Status: A Case of Tribal Children in Assam, Northeast India

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Abstract

Introduction: Thinness is a major underlying problem among children and adolescents in the developing countries including India. The present study was carried out to determine the prevalence of nutritional status among the Sonowal Kachari children aged 6-18 years of Dibrugarh district of Assam, Northeast India. **Materials and Methods:** The cross-sectional data on height and weight measurements were collected among 1343 (670 boys, 673 girls) children belonging to Sonowal Kachari tribal ethnic group using multi-stage stratified sampling procedure. The Body Mass Index {BMI=weight (kg)/height^2 (m^2)} was calculated. The new international cut-off points of Cole et al. were used to classify the magnitude of thinness. **Results:** The overall mean BMI was found to be significantly higher among girls than the boys ($p<0.01$). The overall prevalence of thinness was observed to be 25.99% (28.08% boys, 23.92% girls) ($p>0.05$). The prevalence of thinness was generally higher in the early age (6-11 years), but thereafter decreased with age in both sexes. **Conclusion:** The results of the present study clearly indicate that the nutritional status of these children is unsatisfactory. Nutritional intervention in terms of a comprehensive supplementary balanced diet and micronutrient rich or protective foods should be introduced to ameliorate the nutritional status.

Key words: Thinness; BMI; Sonowal Kachari; Northeast India; undernutrition

Introduction

Undernutrition is a serious public health problem among children in the developing countries[1]. Child undernutrition is one of the measures of health status that the World Health Organization (WHO) recommends for equity in health[2]. Conversely, undernutrition has been estimated to be an underlying cause for around half of all child deaths worldwide[3]. Recent comparative risk assessment study on undernutrition is estimated to be the largest contributor to the global burden of disease[3,4]. It has been estimated this approximately 70.00% of the world's undernourished children live in Asia, giving that region the highest concentration of worldwide childhood undernutrition[5]. Moreover, India shows the highest occurrence of childhood undernutrition in the world[6] and it has been estimated that more than half of Indian children are undernourished[7]. A recent large scale survey in India reported that 42.30% and 58.80% of the preschool (less than 5 years) children were found to be underweight and stunted respectively[8]. Given recent statistics, undernutrition continues to be the major cause of ill-health and premature mortality and morbidity of the children in developing countries including India[1,3,7,9]. Recent studies in India have primarily focused on the problem of undernutrition, particularly among women and children[10].

The prevalence of child undernutrition is generally assessed by conventional anthropometric indices of stunting (height-for-age), underweight (weight-for-age) and wasting (weight-for-height) following recommended international standards[1,11,12], although conventional anthropometric indices are unable to provide the actual magnitude of undernutrition due to overlapping in nature[1,13]. The body mass index (BMI) as measured by weight in kilogram (kg) divided by height in meter (m) squared, is an inexpensive and non-invasive anthropometric measure that has been extensively utilized to assess the chronic energy deficiency (CED; BMI<18.50 kg/m2) and thinness (low BMI-for-age) among adults and adolescents respectively[11]. Very recently, international age and sex specific reference

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and cut-offs have been proposed to evaluate the prevalence of overweight and obesity[14] and thinness[15] among children in the age range of 2 years to 18 years. The information on the thinness prevalence in children of developing countries like India is needed to be generated from national as well as international comparisons. In India, given its large population size and widespread poverty, a majority of individuals are undernourished and underprivileged[1,6,7,12,13]. Moreover, the recent study has already advocated that undernutrition is better assessed as thinness rather than wasting among the children[15]. Therefore, the present study has been undertaken to assess the prevalence of low BMI-for-age among children aged 6-18 years residing in an economically and socially backward tribal blocks of the state of Assam, Northeast India by using these newly proposed age and sex specific cut-offs[15].

Materials and Methods

The present community based, cross sectional study was carried out among 1343 (670 boys, 673 girls) tribal Sonowal Kachari children aged 6-18 years of Dibrugarh district (Latitude 27^{0}42'30''N, Longitude 95^{0}29'8''E) of Assam, Northeast India, situated 426 km from Dispur, the state capital of Assam. The community area has an area of 3381 km^2 having a total population of 11,85,072 (6,13,555 males; 5,71,517 females) individuals with total literacy rate of 87.30%[16]. Currently, the Sonowal Kachari's are mainly engaged as an agriculturist and concentrated mostly in the upper districts of Dibrugarh, Tinsukia, Sibsagar, Jorhat, Golaghat, Sonitpur, Lakhimpur and Dhemaji of Assam[17,18]. The Sonowal Kachari is enlisted as a scheduled tribe in the plains of Assam. Ethnically, they belong to Mongoloid tribal ethnic population and showing affinity with Boro Kachari, Dimasa Kachari and Thengal Kachari. According to the Census 2001, the total population of Sonowal Kachari is 2,35,881 and constitutes 7.10% of total scheduled tribe's population of Assam[16]. The collection of data was done from July 2006 to January 2008. A total of 20 lower primary and 16 higher secondary schools from 26 villages of Dibrugarh district of Assam were covered using multistage stratified random sampling method. A total of 1485 (743 boys; 642 girls) children belonging to a Sonowal Kachari ethnic group of aged 6 years to 18 were identified and approached. Of these 1485 children, a total of 142 (77 boys; 65 girls) children whose dates of birth were either not available or inappropriate in the school records or were not in the age group of 6–18 years were excluded. The anthropometric measurements were collected in the respective schools. Special care was taken so that each category (age/sex) had a minimum of 50 children. The school records were utilized to ascertain their age which was subsequently verified from their birth and official records. All the children were free from any physical deformity and not suffering from any disease at the time of examination. Any previous histories related to medical and surgical episodes were also taken into consideration during the time of examination. All necessary approvals and consents were obtained from the village level local authorities and school authorities prior to conducting the study. Parents of the children were informed about the objectives of our study before obtaining of the measurements. All the necessary approvals, consents and permissions of the study protocols were taken from the Dibrugarh University. The study was conducted in accordance with the ethical guidelines for human experiments as laid down in the Helsinki Declaration of 2000[19].

Collection of Anthropometric measurement and Assessment of Nutritional status

The anthropometric measurements of height and weight were recorded from selected children using standard procedures[20]. Height of the children was recorded to the nearest 0.1 cm with the help of an anthropometric rod with the head held in the Frankfort horizontal plane. The weight of the children wearing minimum clothing and with bare feet was taken using a portable weighing scale to the nearest 100 gm. The intra-observer and inter- observer differences were calculated for testing the co-efficient of reliability (R) of the collected anthropometric measurements using the technical error measurement {TEM= $\sqrt{(\sum D2/2N)}$, D=difference between the measurements, N= number of individuals measured} following the method of Ulijaszek and Kerr[21]. Very high values of R (>0.98) were obtained for height and weight for both inter- and intra-observer TEM analysis and these values were found within the cut-off values of 0.95 as suggested by Ulijaszek and Kerr[21]. Hence, the measurements obtained in the present study were considered to be reliable and reproducible. The TEM values were not incorporated for further statistical consideration.

The BMI was calculated following the internationally accepted standard equation[11]: BMI=Weight (kg) /Height^2 (m^2). The prevalence thinness was assessed following the international BMI cut-off points proposed by Cole et al.[15]. The BMI values were used to determine the definite grades of thinness (Grade-III: severe, Grade-II: moderate, Grade-I: mild), these above classifications are similar to the different grades of adult chronic energy deficiency (CED)[11]. The CED is the chronic undernutrition is classified as BMI found below 18.50 kg/m^2 among adults[11]. In the present study, a child found below of any thinness grades I, II and III of the age and sex specific cut-off values of the international reference population is classified as mild, moderate and severely thin respectively[15].

Statistical Analysis

The data were statistically analysed using the Statistical Package for Social Science (SPSS, Inc., Chicago, IL; version 15.0). A p-value of less than 0.05 was considered to be statistically significant. The descriptive statistical analysis of the data obtained was depicted in terms of mean and standard deviation (SD). One way analysis of variance (ANOVA) using the Scheffe procedure was done to assess age and sex differences in overall and age-specific weight, height and BMI. The Chi-square analysis was used to assess the sex differences in the prevalence of different grades of thinness. The Least Mean Square (L, M and S) model approach was utilized to convert the measurements for a child of known age- and sex- to evaluate the centile and standard deviation score or z-score, as proposed by Cole and Green[22] and Cole et al.[23]. The L, M and S model approach take into the account the degree of skewness (L), central tendency (M; Median) and dispersion or the generalized coefficient of variation (S) for the conversion. This method was used to derive the age- and sex-specific percentile reference curves of BMI. The method summarizes percentiles at each age based on the power of age-specific Box-Cox power transformations used to normalize data. The centile curves (3rd, 10th, 25th, 50th, 75th, 90th and 97th) were derived as reference data for further evaluation of body composition. The LMS Chart Maker software program (The Institute of Child Health, London) was used to obtain the smooth centile curves that fitted smooth centile curves to the reference data.

Results

The age and sex specific subject distribution, mean ±SD of weight, height and BMI and prevalence of different grades of thinness among the studied Sonowal Kachari children are depicted in Table 1. The boys are found to be taller (p<0.01) and heavier (p>0.05) than girls in all age groups. The age specific mean values of weight, height and BMI values were observed to be progressively increased with age among both boys and girls. The overall mean BMI among girls (17.22 ± 2.93 kg/m^2) was found significantly higher than the boys (16.62 ± 2.34 kg/m^2) (p<0.01). The age and sex specific mean BMI values were found to be higher among girls when compared to boys in most ages, with exception observed in 6 years, 8 years, 9 years and 10 years. The age specific mean BMI was ranged from 14.21±0.99 kg/m^2 to 19.71±1.21 kg/m^2 (in boys) and 13.79±0.96 kg/m^2 to 20.69 ±1. 04 kg/m^2 (in girls) among children aged 6 years to 18 years respectively. Using ANOVA, there were statistically significant sex differences observed in height (F value=8. 25; d.f. 1, 1342; p<0.01) and BMI (F value=17. 47; d.f. 1, 1342; p<0.01) except in height (F value=0. 42; d.f. 1, 1342; p>0.05) between the sexes (p< 0.05). Using ANOVA, the differences in anthropometric measurements were also found to be statistically significant (p<0.01) with respect to age and weight (F value =433. 99, d.f. 12, 669, p<0.01), height (F value =572. 15, d.f. 12, 669, p<0.01) and BMI (F value =125. 96, d.f. 12, 669, p<0.01) among boys and also age and weight (F value =460. 65, d.f. 12, 672, p<0.01), height (F value =547. 92, d.f. 12, 672, p<0.01) and BMI (F value =140. 53, d.f. 12, 672, p<0.01) among girls. The age and sex specific smooth percentile curves (3rd, 10th, 25th, 50th, 75th, 90th and 97th) for BMI were derived for the further evaluation of nutritional status using L, M and S parameter in the model approach statistical procedures among the Sonowal Kachari boys and girls are depicted separately in Figure 1.

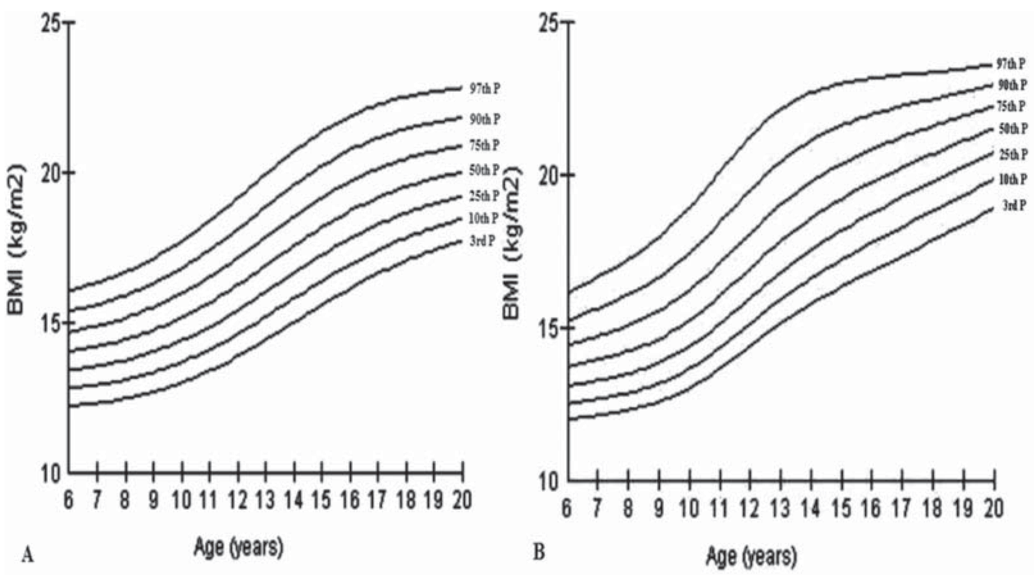

Fig 1: Age and sex specific smooth percentile curves of BMI using L, M and S model approach among the Sonowal Kachari Boys (A) and Girls (B)

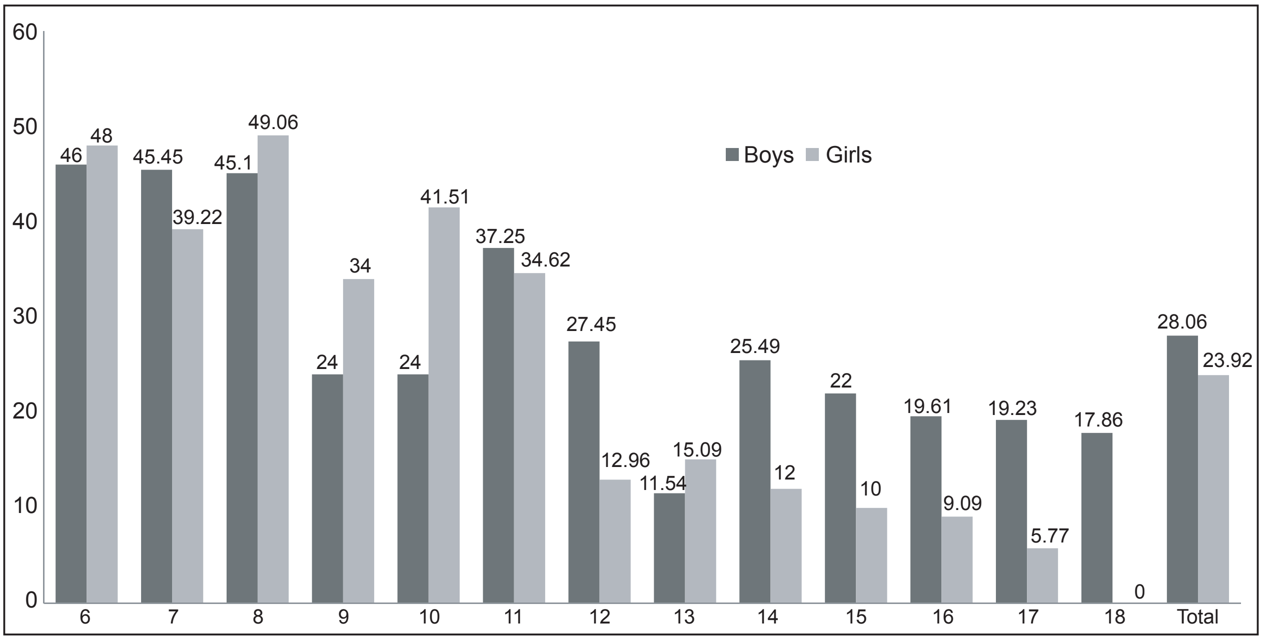

Fig 2: Age and sex specific prevalence of overall thinness (Grade I, II and III) among the Sonowal Kachari of Assam

Table 1: Age and Sex specific subject distribution, descriptive statistics (mean ±SD) of weight, height, BMI and prevalence of thinness among Sonowal Kacharis of Assam, North-east India

Age (years)	No of Subjects		Weight (kg)		Height (cm)		BMI (kg/m²)		Prevalence of Thinness: Grade III		Grade II		Grade I		Sex difference between thinness grades		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	χ^2 value	d.f.	p
6	50	50	16.17 ±1.46	15.51 ±1.70	106.66 ±3.87	105.96 ±5.01	14.21 ±0.99	13.79 ±0.96	2 (4.00)	2 (4.00)	4 (8.00)	8 (16.00)	17 (34.00)	14 (28.00)	1.61	3	0.65
7	55	51	18.71 ±1.97	18.73 ±2.08	114.58 ±4.74	113.78 ±4.48	14.23 ±0.98	14.44 ±1.08	2 (3.63)	0 (0.00)	4 (7.27)	4 (7.84)	19 (34.54)	16 (31.37)	1.88	3	0.60
8	51	53	20.67 ±2.61	20.19 ±2.65	119.93 ±5.47	119.86 ±5.88	14.32 ±0.97	14.01 ±0.97	0 (0.00)	1 (1.89)	5 (9.80)	10 (18.86)	18 (35.29)	15 (28.30)	2.82	3	0.42
9	50	50	23.90 ±3.04	23.73 ±3.68	126.12 ±6.26	126.03 ±6.63	14.97 ±0.97	14.85 ±1.08	0 (0.00)	0 (0.00)	2 (4.00)	0 (0.00)	10 (20.00)	17 (34.00)	3.63	2	0.16
10	50	53	26.23 ±3.32	26.25 ±3.14	131.32 ±4.78	132.67 ±5.28	15.16 ±1.17	14.88 ±1.19	1 (2.00)	1 (1.88)	3 (6.00)	5 (9.43)	8 (16.00)	16 (30.18)	2.04	3	0.56
11	51	52	29.94 ±4.72	31.74 ±5.40	137.76 ±8.17	139.83 ±6.86	15.70 ±1.35	16.15 ±1.86	1 (1.96)	0 (0.00)	1 (1.96)	2 (3.84)	17 (33.33)	16 (30.76)	2.03	3	0.57
12	51	54	33.44 ±5.54	38.29 ±5.77	143.28 ±7.39	146.81 ±6.22	16.18 ±1.39	17.71 ±2.00	0 (0.00)	0 (0.00)	1 (1.96)	0 (0.00)	13 (25.49)	7 (12.96)	2.76	2	0.25
13	52	53	38.89 ±5.35	42.42 ±5.98	150.49 ±7.13	149.79 ±5.35	17.10 ±1.23	18.93 ±2.71	0 (0.00)	0 (0.00)	1 (1.92)	1 (1.88)	5 (9.61)	7 (13.2)	0.27	2	0.87
14	51	50	45.83 ±7.93	44.23 ±4.62	160.20 ±8.69	152.94 ±4.56	17.74 ±1.86	18.90 ±1.69	0 (0.00)	0 (0.00)	5 (9.80)	3 (6.00)	8 (15.68)	3 (6.00)	2.26	2	0.32
15	50	50	48.53 ±6.76	45.40 ±4.31	162.23 ±7.37	153.12 ±3.58	18.37 ±1.69	19.36 ±1.65	0 (0.00)	0 (0.00)	3 (6.00)	0 (0.00)	8 (16.00)	5 (10.00)	3.39	2	0.18
16	51	55	50.35 ±5.14	46.88 ±3.71	162.94 ±5.38	153.74 ±5.09	18.95 ±1.50	19.84 ±1.43	0 (0.00)	1 (1.81)	1 (1.96)	0 (0.00)	9 (17.64)	4 (7.27)	3.71	3	0.29
17	52	52	51.17 ±3.62	48.34 ±4.45	163.41 ±3.81	154.39 ±3.83	19.16 ±1.20	20.27 ±1.64	0 (0.00)	0 (0.00)	1 (1.92)	0 (0.00)	9 (17.3)	3 (5.76)	3.59	2	0.17
18	56	50	53.13 ±4.81	49.82 ±3.95	164.06 ±4.96	155.12 ±4.61	19.71 ±1.21	20.69 ±1.04	0 (0.00)	0 (0.00)	1 (1.78)	0 (0.00)	9 (16.07)	0 (0.00)	8.29	2	0.01
Total	670	673	35.26 ±13.86	34.78 ±12.66	138.88 ±17.33	141.88 ±20.74	16.62 ±2.34	17.22 ±2.93	6 (0.89)	5 (0.74)	32 (4.77)	33 (4.90)	150 (22.38)	123 (18.27)	2.44	3	0.49

Values in parenthesis indicate the percentages

A high level of prevalence was observed in overall thinness is 25.99% (28.08% boys, 23.92% girls) Figure 2. The sex difference was found to be statistically insignificant using chi-square analysis (χ^2 value = 1.76; d.f. 1; p>0.05). The overall prevalence in different thinness grades of mild (grade I; 22.38% vs. 18.27%) and severe (grade III; 0.89% vs. 0.74%) were found higher among boys than girls, with the exception in the moderate thinness category (grade II; 4.77% vs. 4.90%) respectively. The prevalence of moderate (grade II) and severe (grade III) decreased with the advancement of age in both sexes, while no such trends observed in mild thinness (grade I) but the prevalence was found to be higher in early age groups. Age-specific overall thinness was found to be higher in 6 years (46.00%) and 8 years (49.06%), while lower incidences were observed in 13 years (11.54%) and 17 years (5.77%) among boys and girls respectively (Figure 2). The prevalence of thinness ranged from 1.96% (in 11 years) to 35.29% (in 8 years) and from 1.81% (in 16 years) to 34.00% (in 9 years) among the boys and girls, respectively. Using chi-square analysis, sex differences were found statistically insignificant (p>0.05) in overall and respective ages specific prevalence of different grades of thinness, but only exception was found in 18 years (χ^2 value =8. 29; d.f. 2; p<0.05) Table I.

Discussion

The prevalence of undernutrition among children and adolescent are considered as a serious public health problem in developing countries such as India where the vast majority of the populations are undernourished and underprivileged[1,12]. It is well known that contemporary India consists of a sizable number of ethnic and indigenous elements having enormous amounts of ethnic and genetic diversity[24]. Such assessments are important for the improvement of their nutrition and health status, thereby overall development of the community concerned, where use of anthropometric measurements plays a pivotal role in the assessment of nutritional status[11,12]. In the present study the assessment of thinness among the children aged 6 years to 18 years belonging to the Sonowal Kachari tribal ethnic population of Assam, Northeast India was undertaken using newly proposed cut-off[15]. These new cut-off points were suggested to encourage direct comparison of trends in child and adolescent thinness worldwide and also provide a classification of thinness for public health purposes. Several studies have already reported the magnitude of thinness among Indian children and adolescents [12, 15-31] using these newly proposed international cut-off points[15]. Therefore, these cut-off values are valid for use among Indian children including these Sonowal Kachari children of Assam, Northeast India.

It is apparent from this study, that there is a high prevalence of overall thinness (25.99%) observed among the Sonowal Kachari. The sex specific prevalence was found significantly higher among boys (28.06%) than girls (23.92%) (p>0.05) Table I. The prevalence of thinness was significantly higher in the early age groups (e.g., 6-11 years), but decreased with the advancement of ages in both sexes. A similar trend has been reported by Mondal and Sen[12] that the prevalence of thinness decreased with age among rural children of West Bengal, India. It has also been observed that several studies have reported that boys were more affected than girls in thinness among children and adolescents[12,25,27,29,30]. Several studies have reported very high prevalence of thinness of 62.26% in Bengalee[25], 63.40% of rural children[12], 67.23% in Korea-Modi[30], 56.40% in Santal Tribe[29], 45.15% of Nepali children[31] than the present Sonowal Kachari (Table I). It is however now generally accepted that there is a high prevalence of thinness among Indian communities with more than 50.00% of children is being affected in higher aged groups[32,33]. It is evident from the above discussion, that the problem of thinness is persistent transversely among different Indian ethnic populations especially among the children and adolescents including these Sonowal Kachari with variable proportions residing in rural and tribal regions of India. The children suffering from thinness are more likely to develop into a thin adult individual with a low BMI (e.g., CED) that would have an impact on their work productivity as well as lead to greater prevalence of morbidity and mortality[11,34]. It can be summarized that the rural Sonowal Kachari under the present study is facing a greater risk in terms of undernourishment (e.g., thinness) which is even more pronounced among children of early ages. The poor nutritional status of the children, particularly girls in the higher ages, has important implications in terms of physical work capacity and adverse reproductive outcomes[11,35] and nutritional deficiencies, menstrual irregularity and eating disorders[36, 37].

Conclusion

Further studies should be conducted using the newly proposed thinness cut-offs for assessment of nutritional status of the different Indian population especially rural and tribal population for the nation and international comparison and development of new reference population for future comparison. The results of the present investigation will be useful for policy makers in their endeavour to formulate various developmental and health care programs. Nutritional intervention in terms of a comprehensive free supplements balanced diet and micronutrient rich or protective foods needs to be introduced to ameliorate the overall nutritional status and health condition. An effort should be made to disseminate the knowledge related to age specific nutritional requirements at the community level to warrant better quality of life among the children and adolescents.

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Conflict of Interest: Nil.

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