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Nutritional Status Based On Anthropometry Of Tribal Preschool Children In Paschim Medinipur District Of West Bengal, India

Samiran Bisai
Society for Applied Studies, Kolkata, West Bengal, India.
Department of Anthropology, Vidyasagar University, Midnapore , West Bengal. India.

Kaushik Bose
Department of Anthropology, Vidyasagar University, Midnapore , West Bengal. India.

Tarapada Ghosh
Department of Pediatrics, Midnapore Medical College, Midnapore, West Bengal, India.

Goutam Kumar De
Department of Pediatrics, Midnapore Medical College, Midnapore, West Bengal, India.

R. Khongsdier
Department of Anthropology, North Eastern Hill University, Shillong, Meghalaya, India.

Slawomir Koziel
Institute of Anthropology, Polish Academy of Sciences, Wroclaw, Poland

Dilip Mahalanabis
Society for Applied Studies, Kolkata, West Bengal, India.

Panchali Mallick
Department of Anthropology, Vidyasagar University, Midnapore , West Bengal. India

Running title: Nutrition status of tribal preschool children, India

Abstract:

Objectives

There is a paucity of data on nutritional status among tribal preschool children. Therefore a study was conducted to determine the nutritional status based on anthropometry among rural preschool children.

Methods

A community based cross sectional study was conducted during July-August 2009 in a village of Paschim Medinipur district, West Bengal, India. Nutritional status was determined based on weight-for-age, height-for-age and weight-for-height and mid upper arm circumference-for-age z-scores method. Prevalence of undernutrition was defined as Z-score <-2.0 SD from the new WHO reference standards.

Results

A total of 65 Munda and Oraon children aged 13-60 months were included in the present study. Overall, the prevalence of underweight, stunting and wasting was 61.5 %, 38.5% and 55.4%, respectively. The prevalence of undernutrition was 56.9% based on MUAC, of whom, 44.6% and 12.3% children was moderately and severely undernourished, respectively. It was observed that the MUAC had good agreement (Kappa=0.84) with underweight, followed by moderate agreement with wasting (Kappa=0.53). While poor agreement was found with stunting (Kappa=0.28).

Conclusion

According to WHO criteria for severity of malnutrition, the overall prevalence of stunting was high while underweight and wasting were very high, indicating a critical situation.

Key words: Malnutrition, Stunting, Tribal, Underweight, Wasting. MUAC

Introduction:

In recent times, anthropometric measurements have become a popular measure to assess childhood health and nutritional status (Bisai et al. 2009). Anthropometry is widely acceptable low-cost, easy and non-invasive technique for defining the nutritional status of children (WHO 1995). However, the standard against which nutritional status of the sample population should be determined has been controversial (Kumar et al. 1996). Recently the WHO (WHO 2006) developed a childhood growth database for international reference or standard incorporating the data from developing countries including India for assessment of nutritional status and the results can be presented as nutritional indices in the form of z-scores, percentiles, or percentage of median.

It is well established that good nutrition is a determinant of healthy growth of mind and body. Inversely, malnutrition is progressively more recognized as a prevalent and important health problem in many countries. This problem has serious long-term consequences for the child and adversely influences development of a nation. Most common nutritional problems are protein energy under-nutrition. Undernutrition continues to be a primary cause of ill-health and premature death among children in developing country. Moreover, the people living in rural areas of India proportionately suffer from higher rate of undernutrition compare with their urban counterparts.

It was documented that, India probably has the largest number of tribal communities in the world (Topal and Samal 2001). The vast majority of the tribal populations reside in rural areas of the country; most of them were illiterate and very low-wage unskilled labor. The tribal populations of India are recognized as socially and economically vulnerable (Bisai and Mallick 2011). Munda and Oraon are such two agricultural tribes resident in Paschim Medinipur district, West Bengal, India. According to latest census, the total population of the Oraons in West Bengal was 617,138. Oraons are the second largest tribal community, which constitute 14.0% of total tribal population of the state. The Oraons speak Kurukh, which belongs to the sub group of the Dravidian language group. They are distributed in the districts of Paschim Medinipur, Jalpaiguri, Nadia, Barddhaman, etc. They are also found in Bihar, Jharkhand and adjoining areas of Madhya Pradesh, Orissa and also in Tripura and Assam. On the other hand, the Mundas are the third largest tribal group in the state with a total population of 341,542, which constitute 7.8% of the total tribal population. Mundas speak Mundari, one of the major Austro Asiatic languages in India. They are concentrated in Jalpaiguri, 24 Parganas and

Paschim Medinipur districts. They are also found in Jharkhand and Bihar states. More importantly both these tribal group used Devnagari script (Mandal et al. 2002).

There is a paucity of community-based data on nutritional status of tribal preschool children by using WHO recommended z-scores method based on three commonly used indices as weight-for-age, height-for-age and weight-for-height. Therefore, the present study was undertaken to determine the prevalence of underweight, stunting and wasting among tribal preschool children of Paschim Medinipur district, West Bengal.

Materials and methods:

We carried out a cross sectional study during six days during July and August 2009 in a village of Paschim Medinipur district habited by people of the Munda and Oraon. The village is situated approximately 4 km from east side of the Midnapore town and 130 km from Kolkata city, the provincial capital of West Bengal. A total of 114 families live in this village. Out of 47 families found to be illegible for the study children. The average family members of the studied household were 5.9 ± 2.3 people and average child of each family was 2.62 ±1.5.

Following house-to-house visit, it was ascertained that there were 71 children aged 13-60 months in this village. In total, 65 children were measured, out of, 30 boys and 35 girls to determine the nutritional status. Six children were excluded due to illness during study period. This is a pilot data of proposed project on maternal and child health (MCH) survey. Data on age, sex, height and weight was collected on a pre-tested questionnaire by one of the author (PM). Children's age were recorded as reported by mothers and verified further with other senior members of the household. The institutional ethical committee approved the study protocol. Parents were informed about the objectives of the study and their consent was obtained.

The anthropometric measurements i.e. height, weight and mid upper arm circumference (MUAC) of each subject were taken according to the standard procedures (Lohman et al. 1988). The weight, height and MUAC were measured using digital (CAS, Korea) weighing scale, anthropometer rod and fibre tape to the nearest 0.1 kg and 0.1cm, respectively. The scale was standardized using known weight every day before data collections. A seven days training was given to the investigator (PM) and quality control was performed on 10 subjects by supervisor (SB) and field investigator. There was strong correlation was found between supervisor and field investigator. Prevalence of

underweight, stunting, wasting and undernutrition was define as weight-for-age, height-for-age, Weight-for-height and MUAC-for-age z-score < -2.0 SD of the WHO (2006) reference standards. Prevalence of severe and moderate undernutrition was defined as Z-score <-3.0, and ≥3.0 - < -2.0, respectively. Further the nutritional status was assessed based on cutoff points for MUAC (Shakir and Morley 1974) as documented by earlier studies (Achraya et al. 1994, Mishra and Mishra 2007, Senbanjo et al. 2007). The cut-off points for MUAC of 13.5 cm was used for identifying children undernutrition, a MUAC of between 12,5 cm and 13,5 cm denoting moderate undernutrition and less than 12,5 cm severe undernutrition (Shakir and Morley 1974). Thus, MUAC has been considered a valid and simple screening measure for protein-energy malnutrition in preschool children (Jelliffe 1969). We followed the WHO (1995) criteria for assessing severity of malnutrition by percentage prevalence ranges of these three indicators among children.

Student's t-test was used to test for sex differences in height, weight and MUAC. Proportion test were performed to test for differences in prevalence of underweight, stunting and wasting between sexes. Odds ratio (OR) and correlation coefficient (r) was also calculated. Statistical analyses were performed using the EPI6 statistical package. A p value less than 0.05 is considered to be statistically significant.

Results:

The mean age of the studied sample was 45.0±13.3 months. Anthropometric characteristics and z-scores for all and by age groups are presented in **table 1**.

Anthropometric Characteristics	Age in year/ months										Age Combined (n=65) Mean =45.6 SD = 13.8 Min = 13 Max = 60	
	1year (n=5) Mean =15.4 SD = 2.5 Min = 13 Max = 18		2 year (n=5) Mean = 26.8 SD = 3.9 Min = 24 Max = 32		3 year (n=17) Mean = 38.2 SD = 2.8 Min = 36 Max = 42		4 year (n=17) Mean = 49.5 SD = 2.6 Min = 48 Max = 54		5 year (n=21) Mean = 60 SD= 0			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Height (cm)	72.6	4.6	81.8	6.8	92.4	3.8	96.8	5.5	102.2	6.7	94.4	10.1
Weight (kg)	7.9	1.3	8.9	1.5	11.3	1.5	12.7	1.6	13.6	2.4	11.9	2.5
MUAC (cm)	13.3	1.1	13.0	0.6	14.0	1.5	14.1	1.3	14.1	1.6	13.9	1.4
Z-scores												
Weight-for-Age	-2.0	1.1	-2.8	0.9	-2.2	1.1	-2.1	0.9	-2.2	1.2	-2.2	1.1
Height-for-Age	-2.1	1.1	-2.1	1.4	-1.2	1.1	-1.7	1.2	-1.6	1.4	-1.6	1.2
Weight-for-Height	-1.4	1.0	-2.5	0.8	-2.2	1.2	-1.7	1.2	-2.0	1.3	-1.9	1.3
MUAC-for-Age	-1.1	1.0	-2.0	0.6	-1.5	1.3	-1.6	1.0	-1.9	1.2	-1.7	1.2

Table 1. Mean (SD) of anthropometric characteristics and z-scores of the studied children

It was observed that mean height (boys = 93.79±9.23 Vs girls = 94.85±10.84, t=0.424, p>0.05), weight (11.85 ±2.24 Vs 12.03 ±2.80, t=0.286, p>0.05), MUAC (13.93 ± 1.41

Vs 13.99 ± 1.47, t=0.189, p>0.05) and z-scores values, i.e. WAZ (-2.17 ±1.03 vs -2.18 ±1.12, p>0.05), HAZ (-1.47 ±1.35 vs -1.59 ±1.19, p>0.05), WHZ (-2.07 ±1.26 vs -1.85 ±1.29, p>0.05) and MUACZ (-1.76± 1.21 vs -1.72± 1.16, p>0.05) were similar in both sexes. Table 2 presents, the prevalence of underweight, stunting and wasting of the studied subjects for the total and by sex of the subjects. It was observed that the overall, 61.5 % tribal children were underweight. Of these, 33.8% and 27.7% children were found to be moderately and severely underweight. Moreover, among boys 60.0% were underweight; out of whom, 33.3% and 26.7% was moderately and severely underweight. Similarly, 62.9 % girls were found to be underweight, of these, 34.3% and 28.6 % girls were moderately and severely underweight.

The result revealed that the overall, 38.5 % tribal children were stunted. Of these, 24.6% and 13.8% children were found to be moderately and severely stunting, respectively. It was observed that girls (40.0 %) were found to be more stunted than boys (36.7%). Similarly, higher prevalence of moderate and severe stunting was observed among girls.

Moreover, overall prevalence of wasting was 55.4 %. Of these, 32.3% and 13.1% children were found to be moderately and severely wasted, respectively. The boys were (60.0%) more wasted than the girls (51.4%), they had 42% (OR=1.42, 95% CI: 0.47-4.28) more risk of being wasted. Similarly moderate and severe wasting was slightly higher among boys (**table 2**).

Underweight (Low weight for age)	**All n = 65**	**Boys n = 30**	**Girls n = 35**	**Chi-square (p-value)**
Prevalence of underweight (<-2 z-score)	61.5 (49.4 - 72.4)	60.0 (42.3 - 75.4)	62.9 (46.3 - 76.8)	0.06 (0.813)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	33.8 (23.5 - 46.0)	33.3 (19.2 - 51.2)	34.3 (20.8 - 50.8)	0.01 (0.936)
Prevalence of severe underweight (<-3 z-score)	27.7 (18.3 - 39.6)	26.7 (14.2 - 44.4)	28.6 (16.3 – 45.1)	0.03 (0.864)
Stunting (Low height for age)				
Prevalence of stunting (<-2 z-score)	38.5 (27.6 - 50.6)	36.7 (21.9 - 54.5)	40.0 (25.6 – 56.4)	0.08 (0.783)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	24.6 (15.8 - 36.3)	23.3 (11.8 - 40.9)	25.7 (14.2 – 42.1)	0.05 (0.824)
Prevalence of severe stunting (<-3 z-score)	13.8 (7.5 - 24.3)	13.3 (5.3 - 29.7)	14.3 (6.3 – 29.4)	0.06 (0.803)
Wasting (Low weight for height)				
Prevalence of global malnutrition (<-2 z-score)	55.4 (43.3 - 66.8)	60.0 (42.3 - 75.4)	51.4 (35.6 – 67.0)	0.48 (0.488)
Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score)	32.3 (22.2 - 44.4)	36.7 (21.9 - 54.5)	28.6 (16.3 – 45.1)	0.48 (0.487)
Prevalence of severe malnutrition (<-3 z-score)	23.1 (14.5 - 34.6)	23.3 (11.8 - 40.9)	22.9 (12.1 – 39.0)	0.01 (0.963)

Table 2. Prevalence of underweight, stunting and wasting of the studied children

*Values are percentage (%) and 95% Confidence Interval (CI)

The results showed that there were no significant sex differences of underweight, stunting and wasting, respectively.

Nutritional status of children based on mid upper arm circumference are presented in **table 3.**

Mid upper arm circumference (MUAC)	Total (n=65)	Boys (n=30)	Girls (n=35)	Chi-square p-value
Severe (<12.5 cm)	16.9 (8.45-30.28)	16.7 (5.41-38.89)	17.1 (6.29-37.31)	0.01 (0.959)
Moderate (12.5 – 13.4 cm)	35.4 (22.43-53.09)	33.3 (15.98-61.30)	37.1 (19.78-63.52)	0.10 (0.749)
Undernutrition (<13.5cm)	52.3 (36.22-73.09)	50.0 (27.98-82.47)	54.2 (32.68-84.77)	0.12 (0.730)

Table 3. Nutritional status of children based on mid upper arm circumference (MUAC)

* Values are percentage (%) and 95% Confidence Interval (CI)

The prevalence of undernutrition using the Shakir's cut-off point for MUAC measurement was 52.3%, out of whom 35.4% and 16.9% children were found to moderately and severely undernourished, respectively. More importantly girls (54.2%) were more undernourished than the boys (49.6%), they had 16% (OR=0.84, 95% CI: 0.28-2.51) more risk of being undernourished, but results showed no statistical significance.

Moreover, the prevalence of malnutrition based on MUAC-for-age z-score was 56.9%, out of whom, 44.6% and 12.3% children were found to moderately and severely malnourished, respectively (**Table 4**).

Mid upper arm circumference (MUAC)	Total (n=65)	Boys (n=30)	Girls (n=35)	Chi-square p-value
Severe (<-3sd)	12.3 (5.31-24.25)	10.0 (2.06-29.22)	14.3 (4.64-33.34)	0.02 (0.884)
Moderate (-3sd - <-2 sd)	44.6 (29.88-64.08)	53.3 (30.48-86.61)	37.1 (19.78-63.52)	1.71 (0.191)
Undernutrition (<-2 sd)	56.9 (40.08-78.46)	63.3 (38.13-98.90)	51.4 (30.48-81.28)	0.93 (0.334)

Table 4. Nutritional status of children based on MUAC-for-Age z-score

* Values are percentage (%) and 95% Confidence Interval (CI)

The overall prevalence of malnutrition was more among boys than girls (63.3 vs 51.4; p>0.05). More importantly the MUAC-for-age z-score had good significant

positive correlation with WAZ (r=0.81, p<0.001) followed by HAZ (r=0.58, p<0.001) and WHZ (r=0.53, p<0.001), respectively (**table 5**).

Z-scores	Boys	Girls	Total
Weight-for-Age	0.88***	0.75***	0.81***
Height-for-Age	0.53*	0.64***	0.58***
Weight-for-Height	0.63**	0.44*	0.53***

Table 5. Correlation coefficient (r) between MUAC-for-Age with Weight-for-Age, height-for-Age and Weight-for-Height.

*p<0.01, **p<0.001, ***P<0.0001,

The **table 6**

Nutritional status	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Kappa
Underweight	90.0	96.0	97.3	85.7	0.84
Wasting	80.6	72.4	78.4	75.0	0.53
Stunting	76.0	55.0	51.4	78.6	0.28

Table 6. Screening test of undernutrition based on MUAC and underweight, stunting and wasting.

represents the result of screening test. It was observed that the MUAC had good agreement (Kappa=0.84) with underweight, followed by moderate agreement with wasting (Kappa=0.53). While poor agreement was found with stunting (Kappa=0.28). Moreover, for the diagnosis of malnourished children, the MUAC had high sensitivity, specificity, negative predictive and positive predictive power to detect underweight children than wasting and stunting.

Discussion:

In many developing countries, including India, undernutrition among preschool children is an important public health problem. It has been well documented that the prevalence of undernutrition was higher among economically and socially under privileged communities than others (IIPS 2007). In India, tribal populations are considered as both economically and socially under privileged communities. The overall age and sex combined prevalence of underweight, stunting and wasting were 61.5%, 38.5 % and 55.4%, respectively. Based on the WHO (1995) classification of severity of malnutrition, the overall prevalence of stunting (30 – 39%) was in high category. However, underweight and wasting were in very high (≥30% and ≥ 15%), category, indicating critical situation.

In general, when compared to age-specific mean weight and height with Indian affluent children, the Munda and Oraon children were lighter and shorter at all age group (Agarwal and Agarwal, 1994). Similarly, previous Indian studies (Currimbhoy 1963, Swaminathan et al. 1964, Banik et al. 1972, Gupta et al. 1973, Dhamija et al. 1976, Vijayaraghavan 1976) have been reported that higher mean anthropometric values among the children of higher socio-economic groups. More importantly, the present study found no significant sex difference in mean anthropometric and z-score values as reported recent study (Bisai and Mallick, 2011). The study rejects the sex biasness of food allocation and care. However, since, the prevalence of malnutrition in socio – economically weaker group is still higher (IIPS 2007). **Table 7**

Tribe	State	Age group	Sample size	Underweight (%)	Stunting (%)	Wasting (%)	Reference
Kawar	Chattisgarh	1-5	199	48.2	47.7	48.2	Mitra et al. 2007.
Gond	Madhya Pradesh	0-5	1022	61.6	51.6	32.9	Mitra et al. 2007.
Kodaku	Madhya Pradesh	1-5	182	59.8	43.0	35.0	Dolla et al. 2005.
Tribal children	Maharastra	0-6	40	68.7	60.4	30.2	Khandare et al. 2008.
Saharia	Rajasthan	1-5	193	72.1	67.8	13.4	Rao et al. 2006.
Kora-Mudi	West Bengal	2-5	47	61.7	51.1	27.7	Bisai and Mallick 2011.
Lodha	West Bengal	1-5	74	47.0	35.0	20.0	Bisai et al. 2008.
Munda & Oraon	West Bengal	1-5	65	61.5	38.5	55.4	Present study

Table 7. Prevalence (%) of undernutrition among various tribal children in India: comparison with present study.

compares the prevalence of underweight, stunting, wasting of tribal children in different parts of India along with present study. It is observed that the prevalence of underweight is similar to the rates of underweight of Gond (Rao et al. 2005), Kodaku (Dolla et al. 2005), Koramudi (Bisai and Mallick 2010) tribal preschool children. However, the prevalence was higher than the Lodha (Bisai et al. 2008) and Kawar (Mitra et al. 2007) tribal children. The rates of underweight were lower than the Saharia (Rao et al. 2006) and tribal children from Maharastra (Khandare et al. 2008). When compared to the prevalence of stunting with other tribal children in India, it was observed that prevalence of stunting is similar to Lodha children (Bisai et al. 2008), lower than Gond

(Rao et al. 2005), Kodaku (Dolla et al. 2005), Kawar (Mitra et al. 2007), Koramudi (Bisai and Mallick 2011) and Saharia (Rao et al. 2006) tribal children studied in different parts of India. Moreover, the prevalence of wasting was higher than all those studies conducted among different tribal communities (Dolla et al. 2005, Rao et al. 2005, Rao et al. 2006, Mitra et al. 2007, Bisai et al. 2008, Khandare et al. 2008, Bisai and Mallick 2011). Since, wasting is a composite indicator of immediate and chronic or long term nutritional deficiency, the children in the present study have been experiencing both instant and prolonged nutritional stress.

An earlier study reported the rates of underweight, stunted and wasted among Bauri children to be 51.2%, 39.2% and 26.6%, respectively (Das and Bose 2009). When compared to the prevalence of undernutrition with scheduled caste (Bauri) children in Purulia District of West Bengal, results indicated that prevalence of stunting was similar in both tribe and caste (Bauri) children. However, the rates of underweight and wasting were higher in tribal children than the caste (Bauri) children. Similarly, higher rate of undernutrition among tribal children than caste and other groups have also been reported in a recent Indian national survey (IIPS 2007). It is well documented that the dietary insufficiencies are mainly reflected through high prevalence of malnutrition in the form of underweight, stunting and wasting in Indian preschool children. In general, tribal communities in India are a neglected lot, discriminated in terms of income distribution and social status, which tend to have higher rates of undernutrition. Moreover, high rates of low birth weight along with inadequate care and restricted access to health services translates into high rates of child undernutrition and threatens the process of healthy development, lead to high rates of morbidity and mortality. Therefore, tribal communities need much greater access to health care information, opportunities and resources to improve their children's nutritional status.

In the present study, the prevalence of undernutrition using the Shakir's cut-off point for MUAC measurement was 52.3%, out of whom 35.4% and 16.9% children were found to moderately and severely undernourished, respectively. A study from Nigeria, reported that the prevalence of malnutrition using Shakir's cut-off point for MUAC measurement was 31.9%. In total, 26.7% and 5.2% children were moderately and severely malnourished (Senbanjo et al. 2007). When the MUAC measurement was related to the age of the children, there was a slight drop in the prevalence of malnutrition using the Z-scores of MUAC-for-age to 28.8%. Out of whom, 24.8% and 4% children were moderately and severely malnourished (Senbanjo et al. 2007). In

contrast, this study found higher rate (56.9%) of undernutrition when MUAC-for-age z-scores were used for the assessment of nutritional status. These rates were higher than those reported among preschool children from Punjab (Kaur et al. 2005), Orissa (Chakrabarty et al. 2006), Kolkata, West Bengal (Chatterjee and Saha 2008) and Nadia, West Bengal (Biswas et al. 2010). The rates were 38.5%, 35.6%, 35.1% and 28.6%, respectively (**table 8**).

Studied children	Prevalence (%)	References
Children from Punjab	38.5	Kaur et al. 2005.
Savar tribal children from Orissa	35.6	Chakrabarty et al. 2006.
Children from N. R. S. Medical College, Kolkata, West Bengal	28.6	Chatterjee and Saha 2008.
ICDS children from Arambag, Hooghly, West Bengal	64.5	Mandal and Bose 2009.
Bengalee Children of Chapra, Nadia, West Bengal	35.1	Biswas et al. 2010.
Urban poor preschool children, North 24 Parganas, West Bengal	69.8	Bisai 2010
Oraon and Munda tribal preschool children from Paschim Medinipur, West Bengal	56.9	Present study

Table 8. Comparison of the overall prevalence (%) of undernutrition based on MUAC.

A study from Tanzania, reported lower rate of undernourishment using MUAC-for-age z-scores (Nyaruhucha et al. 2006). However, earlier studies from West Bengal had reported comparatively higher prevalence undernutrition based on MUAC (Mandal and Bose 2009, Bisai 2010).

Our study clearly indicated that the nutritional status of these pre-school children was serious with very high rates of undernutrition using both methods, z-scores (Weight –for-age, height-for-age and weight-for-height) and MUAC (MUAC-for-age and fixed cutoffs), respectively. However, it must be mentioned here that some limitations of the present study were the small sample size and the nonavailability of data on dietary

intake. Due to this lack of information it is not possible to draw any conclusion regarding the quantity and quality of food given to the subjects at their homes.

Moreover the present study observed that the MUAC had good significant positive correlation with WAZ, HAZ and WHZ. Since, MUAC is much easier to measure than WAZ, HAZ and WHZ indices, the use of MUAC should be preferred in large-scale studies. Therefore, with limited resources and in the absence of skilled manpower, it may be more appropriate to use MUAC for human population surveys, especially among rural populations of developing countries (Bisai and Bose 2009). Thus, although WAZ, HAZ, WHZ and MUAC could be used to evaluate nutritional status, the latter may be preferred for its simplicity. It requires no scale, anthropometric rod and calculator, application of MUAC is inexpensive to detect child malnutrition and is easy to learn and perform. Therefore, MUAC is increasingly used in developing countries for rapid and extensive nutrition surveillance and screening programmes (Velzeboer et al. 1983).

Conclusion:

The nutritional status of the Munda and Oraon preschool children of this region is critical. Since undernutrition is intricately linked with morbidity and mortality, improvement of nutritional status is of paramount importance to ensure the well-being of the child. In this regard, it is mandatory for relevant authorities to enhance the nutritional status of these children so as to improve their health status. One of the limitations of the present study was the non-availability of data on illness. Future studies on nutritional status of tribal children should incorporate various measures of morbidity. Such investigations will provide us with valuable information on the relationship between undernutrition and illness.

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