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Assessment of undernutrition among male Bhumijs of West Bengal, India: A comparison of body mass index and mid-upper arm circumference

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ABSTRACT

Background. Undernutrition among rural population, especially the underprivileged tribal people is a major health problem in India.

Objectives. To assess nutritional status and to compare the utility of two different anthropometric indicators of chronic energy deficiency (CED) among adult Bhumij males.

Methods. A cross-sectional study of 195 male adult individuals was conducted. The body mass index (BMI) and mid-upper-arm circumference (MUAC) were used to evaluate CED (BMI < 18.5 kg/m^2).

Results: the prevalence of CED was 52.3% and of undernutrition based on MUAC < 23.0 cm was 48.2%, respectively. Both of these prevalence comes under the very high-prevalence category (≥ 40%) indicating a critical situation according to World Health Organization recommendations. Among the low MUAC (<23.0 cm) individuals, the rate of CED was significantly ($p<0.001$, $x^2=57.93$) higher (79.79%) than among the normal MUAC (≥ 23.0 cm) individuals (20.21%).

Conclusion: This tribal population was facing severe nutritional stress. With limited resources and in the absence of skilled manpower, it may be more appropriate to use MUAC for human population surveys, particularly among tribal population of developing countries.

Keywords: West Bengal; Tribal; Bhumij; Anthropometry; Undernutrition

INTRODUCTION:

Notwithstanding some inherent limitations, anthropometry remains the most practical tool for a rapid assessment of nutritional status at individual as well as community level, particularly in resource constrained circumstances in developing countries such as India. Body mass index (BMI) is widely accepted as one of the best indicators of nutritional status in adults (WHO, 1995). Many studies have shown that BMI is a reasonable anthropometric measure of total body fat or storage of energy in the body (Deurenberg et al., 1991; Bose, 1996). Although adult nutritional status can be evaluated in several ways, the BMI is the most widely used because it is simple, inexpensive, safe and suitable for large scale surveys (Lohman et al, 1988; Ferro-Luzzi et al., 1992; James et al., 1994; Lee & Nieman, 2003). BMI reflects not only the nutritional status but also the socio-economic condition of a population, especially, the adult population in developing countries (Ferro-Luzzi et al., 1992; Shetty & James, 1994; Nube et al., 1998; Khongsdier, 2002; Mosha, 2003). A BMI<18.5 kg/m^2 is widely used as a practical measure of chronic energy deficiency (CED) i.e a 'steady' state of underweight in which an individual is in an energy balance irrespective of a loss in body weight or body energy stores (Khongsdier, 2005). Such a 'steady' underweight is likely to be associated with morbidity or other physiological and functional impairments (James et al, 1988; Shetty & James, 1994; WHO, 1995). CED is caused by inadequate intake of energy accompanied by high level of physical activities and infections for a considerably long period of life (Shetty & James, 1994; Shetty et al., 1994). It is associated with reduced work capacity (Pryer, 1993; Durnin, 1994), poor work performance and productivity (Kennedy & Garcia, 1994), increased morbidity due to suppressed immune function (Garcia & Kennedy, 1994; Shetty & James, 1994; Strickland & Ulijiastek, 1994) and behavioral changes (Kusin et al., 1994).

On the other hand, mid-upper arm circumference (MUAC) is another anthropometric measure used to evaluate adult nutritional status (James et al., 1994). It is simpler measure than BMI, requires minimum equipment and may predict morbidity and mortality as accurately as underweight (Briend et al., 1989). An extensive study using data from 8 countries (Mali, India, Senegal, Zimbabwe, Somalia, Ethiopia, Papua New Guinea and China) suggested that MUAC could be used as a simple screening tool for assessment of nutritional status. MUAC has been suggested as a substitute for BMI when the rapid screening of an adult population is required as a prelude to targeting the provision of assistance to those who are undernourished (James et al., 1994).

Until recently, there has been little attempt to assess the prevalence of under-nutrition among adults living in developing countries despite the widespread concern about world hunger and food insecurity (Griffiths et al., 2001). In spite of the economic development in the region, undernutrition

remains an important public problem in many Asian countries (Wickramasinghe et al., 2004). India being one of the poorest countries in the world and adopting several recent community level measures to lift up the nutritional status of its people, improvements during the last two to decades have not been impressive (Griffiths et al., 2001). More than half of the world's undernourished people lived at the end of 20th century in India (Krishnaswami, 2000). Moreover, the tribal populations are among the most underprivileged people in India.

The 2001 census of India recorded more than 84 million tribal populations who constitute 8.2% of total population (Census of India, 2001). India probably has the largest number of tribal communities in the world (Topal & Samal, 2001). The vast majority of the tribal populations resides in rural areas of the country and is socially and economically underprivileged (Mittal & Srivastava, 2006; Ghosh & Bharati, 2006). The Bhumij is one such tribe being the fourth largest (7.5% in 2001 census) tribal group in West Bengal state. The term 'Bhumij' means owner of the soil. They inhabit rugged forested terrains, speak an Austro-Asiatic language and are divided into several exogamous clans. Settled agriculture is the predominant occupation supplemented with occasional hunting and trapping of birds and small wild animals. Many work as labourers in agriculture and other sectors. More than 95% of the Bhumij follow some traits of Hinduism along with their traditional religious practices (Mandal et al. 2002).

Information on nutritional status of Bhumij, nevertheless, is extremely scanty (Bose et al., 2008) and there is no study concerning BMI and MUAC together to assess undernutrition among the adult population of the tribe. In view of this context, the present study was conducted to report the prevalence of CED as well as undernutrition based on MUAC cut of value among the adult male Bhumij villagers of the Paschim Medinipur District in West Bengal, India.

MATERIALS AND METHODS:

Data for this cross sectional study were collected from four villages in the West Midnapore district of West Bengal, namely, Bhimchawk, Bhatapukur, Sajowal and Tetuldanga. These were located within 5 km radius from Kharagpur, which is an important Railway Station under South-Eastern Railways, located approximately 115 km from Kolkata, the state capital of West Bengal. The villagers were communicated about the study and a total 195 adult male Bhumij residents aged above 18 years in those villages were included in the study. The response rate was little below 82%. The vast majority of the subjects were illiterate and very low-waged manual laborers belonging to low socio-economic status.

Ethical considerations were guided by the Helsinki Declaration (Goodyear et al., 2007). The district level and local administrative relevant authorities and the community leaders were informed about

the objective of the field work. Verbal informed consent was obtained from each participant in their own language prior to each interview and measurement procedure. The first Author (MG) took anthropometric measurements following the standard techniques of Lohman et al (1988). Both height and mid-upper arm circumference were recorded to the nearest 1 mm and weight to nearest 500 g. BMI was computed as weight (kg)/ Height (m^2).

Nutritional status was evaluated using internationally accepted BMI guidelines (WHO 1995) as follow:

1) CED : BMI<18.5 kg/m^2
2) Normal : BMI=18.5-24.99 kg/m^2
3) Overweight : BMI≥25.0 kg/m^2

We followed the World Health Organization's classification (1995) of the public health problem of low BMI, based on adult populations worldwide. This classification categorizes prevalence according to percentage of a population with BMI< 18.5 kg/m^2.

1) Low (5-9%): warning sign, monitoring required.
2) Medium (10-19%): poor situation.
3) High (20-39%): serious situation.
4) Very high (≥40%): critical situation.

Mid-upper arm circumference (MUAC) can be used for evaluating nutritional status studies among third world adults.

The following cut-off points were used:

Nutritional Status	Among Men
Under-nutrition	MUAC < 23.0 cm
Normal	MUAC ≥ 23.0 cm

Mean and Standard Deviation were calculated to describe the age and anthropometric parameters. Percentage was used to calculate the prevalence rates. Chi square statistics was used to assess the significance of differences in prevalence rates between groups. Odds ratio (OR) with its 95% confidence interval (95% CI) was also calculated to estimate the likelihood of occurrence of certain condition, e.g., undernutrition). All statistical analyses were undertaken using the SPSS statistical package, statistical significance was set at $p < 0.05$.

RESULTS

Table 1 shows the anthropometric characteristics of the studied subjects. The mean and standard deviation of MUAC and BMI were 23.0 ± 2.1 cm and 18.6 ± 2.4 kg/m^2, respectively. **Table 2** presents the nutritional status of the subjects based on BMI. Overall the extent of malnutrition was 53.8%; among them 52.3% were undernourished. The rates of CED-Grades III, II and I were 13.3%, 6.7% and 32.3%, respectively. **Table 3** presents the nutritional status of the subjects based on MUAC. The rates of under-nutrition are 48.2% and normal is 51.8%. It is nearest to the rates of low BMI (52.3%). **Table 4** showed the relationship between prevalence of CED and under nutrition assessed by BMI and MUAC, respectively. Overall 48.2% under-nutrition based on MUAC and 52.3% under-nutrition based on BMI. Among the low MUAC (<23 cm) individual, the rates of under-nutrition is greater than that of normal MUAC (79.8% vs. 20.2%) based on BMI. This low MUAC was statistically highly significant (x^2=57.93, p<0.01,) with low BMI. The result reveals that low MUAC had 10.82 fold greater risks for chronic energy deficiency.

Table 1. Age and anthropometric characteristics of the studied sample

Variable	**Mean ±SD**
Age (years)	36.6 ±15.9
Weight (kg)	47.5 ± 7.2
Height (cm)	159.8 ± 6.7
MUAC (cm)	23.0 ± 2.1
BMI (kg/m^2)	18.6 ± 2.4

Table 2. Nutritional status of the subjects based on body mass index (BMI).

BMI(kg/ m^2)	Category	Frequency	Percentage (%)
< 16.0	CED Grade-III	26	13.3
16 - 16.99	CED Grade-II	13	6.7
17 - 18.49	CED Grade-I	63	32.3
18.5 - 24.99	Normal	90	46.2
≥25.0	Overweight	03	1.5
≥ 30.0	Obese	00	00
Total		195	100

Table 3. Nutritional status of the subjects based on Mid-upper arm circumference (MUAC).

MUAC (cm)	Category	Frequency	Percentage (%)
<23.0	Under-nutrition	94	48.2
≥23.0	Normal	101	51.8
Total		195	100

Table 4. Relationship between body mass index (BMI) and mid-upper arm circumference (MUAC).

Nutritional Status by BMI (row) and MUAC (column)	**Under-nutrition BMI < 18.5 kg/m^2 (n, %)**	**Normal BMI ≥ 18.5 kg/m^2 (n, %)**	**Total (n, %)**
Under-nutrition (MUAC <23 cm)	75 (79.8)	19 (20.2)	94 (48.2)
Normal (MUAC≥23 cm)	27 (26.7)	74 (73.3)	101 (51.8)
Total	102 (52.3)	93 (47.7)	195 (100)

Chi-square =57.93, p <0.001. OR=10.82 (95%CI: 5.24-22.59).

DISCUSSION:

Several recent studies from India (Yadav et al., 1999; Gogoi & Sengupta, 2002; Sahani, 2003; Bose & Chakrabarty, 2005; Bose et al., 2006a) have utilized BMI to study under-nutritional status of tribal populations. Therefore, the use of BMI and its cut-off points recommended by WHO for the evaluation of CED are valid for use among tribal populations of India.

The economic and health burden of high frequencies of adult CED has been well documented (Ferro-Luzzi et al., 1992; Cambell et al., 1994; James et al., 1994; Naidu & Rao, 1994; Khongsdier, 2005). The functional and economic significance of a high prevalence of CED has already been established (Ferro-Luzzi et al. 1992). Therefore, efforts must be made to investigate the consequences of the functional impairments commonly associated with low BMI in various ethnic groups. It is also essential to ascertain the relationship of the high prevalence of under-nutrition with morbidity and mortality among adults.

The outcome of the present study clearly indicated that the prevalence of CED among adult Bhumij male was very high on the basis of either BMI (52.3%) or MUAC (48.2%). Both of these percentages are greater than 40% placing the populations in the critical situation according to WHO recommendation. High rates of CED have also been reported from other tribal populations of West

Bengal **(table 5). Table 5** presents the mean BMI and the prevalence of the CED among adult male tribal populations of Eastern India. The mean BMI ranged from 18.4 to 19.54 and the rates of CED ranged from 30.6% to 55%; these values are classified as high (20% - 39%) to very high (≥40%) rates according to WHO (1995). These results clearly indicated that adult males of these tribes were under serious or critical nutritional stress.

Table 5. Mean BMI and prevalence of CED (based on BMI) among various tribes of Eastern India.

Tribe	Sample Size	Mean BMI (kg/m^2)	CED (%)	Study Area	Reference
Santal	196	19.54	30.6	Purulia	Das (2010)
Oraon	290	18.48	53.1	Ranchi	Dutta Banik (2009)
Kora-mudi	250	18.7	48.0	Bankura	Bose et al (2006)
Juang	414	19.4	51.9	Keonjhar	Goswami (2013)
Lodha	202	19.48	416	Paschim Medinipur	Mondal (2007)
Oraon	200	18.8	47.0%	Jalpaiguri	Mittal & Srivastava (2006)
Santal	400	18.5	55.0	Bankura	Ghosh & Malik (2007)
Bathudis	183	18.4	52.7	Keonjhar	Bose et al (2005)
Savars	300	19.3	38.0	Keonjhar	Bose ey al (2006)
Bhumij	**195**	**18.58**	**52.3**	**Paschim Medinipur**	**Present Study**

In the present study, the prevalence of undernourished individuals (MUAC < 23 cm) was significantly higher among the CED individuals (Chi-square=57.93, $p<0.001$), which indicated that these measures were well correlated. This implies that both these measures could be used to evaluate nutritional status among adult male Bhumij. However, the difference in the prevalence of CED according to the two measures may have public health implications, especially in large population surveys. Moreover, as MUAC is much easier to measure than BMI (WHO, 1995; Ulijaszek et al., 1999), 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 appropriate to the use of MUAC for human population's survey, especially among rural population of developing countries. Thus, although both BMI and MUAC could be used to evaluate nutritional status, MUAC may be preferred for its simplicity.

However, it must be mentioned here that some limitations of the present study were the small sample size and the non-available of data on dietary intake. From the public health perspectives of paramount importance is the immediate initiation of appropriate nutritional intervention programmers among this ethnic group. Future investigations should emphasize on determining different methods for the estimation of under nutrition. Appropriate proposals should also be given to tackle the problem of under nutrition in India, especially among tribal populations.

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