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Age Trends in Under-nutrition among Sabar Males of Purulia, West Bengal, India

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ABSTRACT The present cross-sectional study was conducted among adult Sabar males of Purulia district of West Bengal, India, to determine the prevalence of under-nutrition based on Body Mass Index (BMI) <18.5 kg/m^2 and mid upper arm circumference (MUAC) <24.0 cm. Data was collected from 13 villages of Purulia District. A total of 307 healthy adult Sabar men aged 18-60 years were measured. Anthropometric variables of height (cm), weight (kg) and MUAC (cm) were measured using standard protocol. Based on BMI (kg/m^2), Chronic Energy Deficiency (CED) was used as a measure for under-nutrition. The overall presence of under-nutrition based on BMI (kg/m^2) and MUAC (cm) were 47.2 percent and 54.4 percent, respectively. The rate of under-nutrition increased with age. There was a highly significant difference between MUAC (cm) and BMI (kg/m^2) ($p<0.001$) among studied participants. Therefore, the present study proposes the use of MUAC global cut off of <24.0 cm may be combined with BMI for more accurate screening of under-nutrition with better precision among different ethnic communities.

INTRODUCTION

Under-nutrition describes a condition whereby normal nutritional guidelines and recommendations are not met (Marcus 2013). It can result from lacking food consumption, poor retention of nutrients or excessive loss of nutrients (de Onís et al. 1993; Maleta 2006). Few terms such as protein energy deficiency, specific micronutrient deficiencies have been used for defining under-nutrition. It not only affects the physical condition but the social and economic development of an individual, which finally leads to negative growth of a country's economy (Global Nutrition Report 2018). For the last two decades, under-nutrition continues to be the major health burden for South Asian countries (Nubé and Van den Boom 2003; Müller and Krawinkel 2005). In India, the condition is worrying as the latest National and Family Health Survey (NFHS-4) data revealed that 35.7 percent of children below 5 years of age, 22.9 percent women and 20.2 percent men of 15-49 years were undernourished (IIPS 2016). Deaton and Dreze (2009) in their study showed that out of 23 sub-Saharan countries of Africa, except Eritrea, all other countries have lower incidence of Chronic Energy Deficiency (CED) than India. The states remaining at the top of the under-nutrition pyramid in India are Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh and Orissa (Himanshu 2010). Moreover, the prevalence of under-nutrition is highest among the marginalised populations like the tribal (Kshatriya and Acharya 2016), despite the fact that they constitute 8.6 percent of the total population of India (Census of India 2011). Traditionally, Indian tribes are mostly living in rural and forest areas but last few decades' rapid growth in urbanisation pushed them from their traditional habitat and make them socio-economically trivial. Hitherto, there is absence of information on the nutritional status of various Indian tribes, which necessitates such as this study (Khongsdier 2001; Bose et al. 2006; Chakrabarty and Bharati 2010; Das et al. 2013; Das et al. 2019a; Kshatriya and Acharya 2016).

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Due to the advantage of application in remote areas, anthropometry can be used as a screening aid to identify individuals at risk of under-nutrition followed by elaborated biochemical and clinical techniques (Gorstein and Akre 1988). Body Mass Index (BMI) has been accepted as the most valid scientific method by majority of the researchers from all over the globe to access under-nutrition, especially in developing countries (Lohman et al. 1988; Ferro-Luzzi et al. 1992; James et al. 1994; Shetty and James 1994; Khongsdier 2001). However, there is still search for alternative measures of BMI that can be simpler and would require minimal technique and nominal specialisation to be applied in remote areas and be used by unskilled health personnel. Mid upper arm circumference (MUAC) has been proven as one of the proxies of BMI, which is easy to use and require only a single anthropometric tape to measure under-nutrition (Briend et al. 1987; James et al. 1994). Firstly, James et al. (1994) had proposed a global cut off for adults-which was used for a long period of time until 2017, when the Food and Nutrition Technical Assistance III project (FANTA) funded by the U.S Agency proposed a global cut off of <24.0 cm as a screening tool to identify under-nutrition among the adults using data of 17 studies (on adults) from Africa, India, Vietnam, USA and Argentina (FANTA 2017). Thus, the use of MUAC along with BMI for more accurate screening of severe under-nutrition gains maximum interest among researchers of health studies.

Objectives

There is paucity of data on nutritional status of tribal population especially tribal males of India. In this context, the main objective of the present study is to evaluate age trends in under-nutrition using two simple anthropometric measures as BMI and MUAC among adult Sabar males of Purulia, West Bengal, India.

METHODOLOGY

This community based cross-sectional study was conducted among 307 apparently healthy adult Sabar men aged 18-60 years. Participants were selected on the basis of the availability during data collection at random. Data was collected in two phases from September to November 2018, and then from October to December 2019. The study area comprised of 13 different villages under 3 blocks namely, Purulia-I, Puncha and Manbazar-I of Purulia district of West Bengal. As a part of the Chotanagpur plateau, Purulia is the westernmost district of West Bengal and around 300 km away from Kolkata, the state's capital. According to 2001 census, Purulia has a sizable tribal population (18.27%) and is the land for several major tribes like Santals, Bhumij, Mundas, etc. Sabar is one of them comprising seven percent of the total tribal population of the district (Census of India 2001). Sabars are one of the "Denotified Tribes" (DNTs) in India. Like other DNTs they also suffer from social and economic inequalities and carried the label of a criminal tribe, which they got during the British period under Criminal Tribe Act 1871. Traditionally they are foragers, but after the implementation of national forest policies, they were separated from their natural habitat (Das et al. 2019a). Lack of modern skill made them more marginalised and shrunk their employment opportunities. Nowadays, most of them earn their livelihood by working as wage labourer in the fields of agriculture, tea plantation, mine, road construction, etc. with very low wage (Das et al. 2019a, 2019b). Data was collected after necessary permissions were obtained from local authorities and community leaders. Participants were explained about the objective of the study and verbal consent has been acquired before commencement of the study.

Anthropometric variables like height (cm), weight (kg) and MUAC (cm) were measured by KD and KM following standard techniques (Lohman et al. 1988). Martin's Anthropometer, digital weighing machine (Omron HN 289) and calibrated non-elastic measuring tape (Gulick Anthropometric Tape) were used to measure height, weight and MUAC, respectively. Height and MUAC were recorded to the nearest 0.1 cm and weight to the nearest 0.5 kg. Technical error of measurements (TEM) were calculated and found within acceptable limits (Ulijaszek and Kerr 1999). BMI was calculated following the formula: BMI = Weight (kg)/Height (m^2). WHO Asia Pacific cut-off (WHO 2000) was used to evaluate CED. In this study, participants were divided into two groups:

(a) CED (BMI <18.5 kg/m^2)
(b) Non-CED (BMI ≥18.5 kg/m^2)

Recently proposed MUAC value <24.0 cm (FANTA 2017) was used to determine under-nutrition (BMI <18.5 kg/m^2).

All statistical analyses were done by using the Statistical Package for Social Science (SPSS Version 16) program. Total population was divided into four groups: group-I (≤27 years), group-II (28-39 years), group-III (40-49 years), and group-IV (≥50 years) based on 25th, 50th and 75th percentile values of age. The Chi-square test was used to access the association between BMI and MUAC in prevalence of under-nutrition among different age groups. A p-value of 0.05 was considered as statistically significant.

RESULTS

Table 1 presents descriptive statistics of age and anthropometric variables. The mean and standard deviation of age, height, weight, BMI and MUAC were 38.7±12.9 years, 162.2±5.3 cm, 49.9±6.8 kg, 18.9±2.3 kg/m^2 and 24.0±2.3 cm, respectively. It has also been observed that the BMI and MUAC of studied population range from 13.2 to 30.6 kg/m^2 and 17.5 to 31.5 cm.

Nutritional status based on BMI among men is shown in Table 2. Overall presence of CED was found to be very high (47.2%) and the highest prevalence of CED was observed among group-IV (62.3%) followed by group-II (48.1%), group-III (47.1%) and group-I (31.6%). The frequency of non-CED was 52.8 percent. The Chi-square test has revealed significant age group difference between CED and non-CED (χ^2=14.90; p < 0.01).

Table 3 displays the nutritional status based on MUAC. The frequency of under-nutrition based on MUAC was higher (54.4%) than the prevalence of CED assessed by BMI (47.2%). Interestingly, the results show that the frequency of under-nutrition gradually increased with

Table 1: Descriptive statistics of age and anthropometric variables of the participants

Variables	*Mean*	*SD*	*Minimum*	*Maximum*	*Percentile*		
					25th	*50th*	*75th*
N= 307							
Age (yrs)	38.77	12.95	18.00	60.00	27.00	39.00	49.00
Height (cm)	162.24	5.32	140.50	176.00	159.20	162.00	165.50
Weight (kg)	49.97	6.81	35.00	77.10	45.80	49.30	53.10
BMI (kg/m^2)	18.97	2.38	13.26	30.69	17.48	18.65	20.13
MUAC (cm)	24.06	2.32	17.50	31.50	22.50	24.00	25.30

Table 2: Nutritional status based on BMI (WHO 2000)

BMI category	*Age group (yrs)*					χ^2
	≤27 (N= 79)	*28-39 (N= 79)*	*40-49 (N= 74)*	*≥50 (N= 75)*	*Total (N= 307)*	
CED	25(31.6)	38(48.1)	35(47.3)	47(62.7)	145(47.2)	14.90**
NON-CED	54(68.4)	41(51.9)	39(52.7)	28(37.3)	162(52.8)	

Percentages are presented in parentheses; **- p < 0.01

Table 3: Nutritional status based on MUAC (FANTA 2017)

MUAC category	*Age group (yrs)*					χ^2
	≤27 (N= 79)	*28-39 (N= 79)*	*40-49 (N= 74)*	*≥50 (N= 75)*	*Total (N= 307)*	
Undernutrition (<24 cm)	30(38.0)	39(49.4)	45(60.8)	53(70.7)	167(54.4)	18.63***
Normal (≥24 cm)	49(62.0)	40(50.6)	29(39.2)	22(29.3)	140(45.6)	

Percentages are presented in parentheses; ***- p < 0.001

age. Highly significant age group difference was observed in under-nutrition and normal categories based on MUAC (χ^2=18.63; p < 0.001).

Table 4 represents the comparison between frequency of prevalence of CED and under-nutrition assessed by BMI and MUAC. Overall prevalence of under-nutrition based on MUAC and BMI were 54.4 percent and 47.2 percent, respectively. Significantly positive correlation was observed between MUAC and BMI (χ^2=102.57, p<0.001).

DISCUSSION

The study has been conducted among 307 adult males of Sabar community from Purulia district of West Bengal. Results suggest that MUAC identified more individuals as belonging to CED category. Based on BMI, 145 (47.2%) men were classified as CED whereas using MUAC it was 167 (54.4%). This difference was statistically significant (χ^2=102.57, p<0.001).

Various studies have been undertaken among Indian tribal populations across age groups where BMI varied significantly among different age groups (Chakrabarty and Bharti 2010; Mungreiphy et al. 2011; Kshatriya and Acharya 2016). It has been observed that individuals belonging to age group IV (≥50 years) had the highest prevalence of under-nutrition based on BMI (62.7%) as well as MUAC (FANTA) (70.7%). The age trends in under-nutrition among Sabar males in the present study corroborates with earlier research findings worldwide (Volkert et al. 1991; Poulsen et al. 2006; Chakrabarty and Bharti 2010; Das and Bose 2010; Das et al. 2013; Mukherjee et al. 2015; Ghosh et al. 2018; Das et al. 2019a).

Anthropometric techniques are readily portable, inexpensive and non-invasive (Alemi et al. 2017; Bhattacharya et al. 2019). The use of extremity circumference measurements to estimate regional and whole body muscle mass is well established in the recent past (Lukaski 1997; Heymsfield et al. 1998). In contrast, BMI tends to overestimate body fat and is not sensitive for detecting small change in body composition (Pupim 2013). Numerous studies worldwide have been conducted in different decades, which have demonstrated that BMI is a good marker of malnutrition (de Onís et al. 1993; Shetty and James 1994; Che 2002; Nubé and Van den Boom 2003; Müller and Krawinkel 2005; Letamo and Navaneetham 2014; Kshatriya and Acharya 2016). The prevalence of CED based on BMI among various tribal male populations of eastern India is presented in Table 5. This table revealed the high-

Table 4: Frequency of undernutrition: A comparison of two criteria

MUAC category	*BMI category*		*Total*	χ^2
	CED	*NON-CED*		
Undernutrition (<24 cm)	123 (84.8)	44 (27.2)	167 (54.4)	102.57***
Normal (≥24 cm)	22 (15.2)	118 (72.8)	140 (45.6)	
Total	145 (47.2)	162 (52.8)	307 (100)	

Percentages are presented in parentheses; ***- p < 0.001

Table 5: Comparison of prevalence of CED based on BMI (<18.5 kg/m^2) among various tribal populations (males) in eastern India with present study

S. No.	*Community*	*Studied area*	*Samples size*	*Mean BMI (kg/m^2)*	*Prevalence of CED (%)*	*Reference*
1	Lodha	Paschim Medinipur, West Bengal	157	19.5	45.2	Bose et al. 2008
2	Santal	Purulia, West Bengal	196	19.5	30.6	Das and Bose 2010
3	Oraon	Paschim Medinipur, West Bengal	104	18.6	46.2	Das et al. 2013
4	Munda	Paschim Medinipur, West Bengal	106	18.4	50.0	Das et al. 2013
5	Birhor	Purulia, West Bengal	72	20.5	19.4	Das et al. 2013
6	Bhumij	Paschim Medinipur, West Bangal	195	18.6	52.3	Ghosh and Bose 2015
7	Savar	Keonjhar, Orissa	300	19.3	38.0	Bose et al. 2006
8	Shabar	Cuttack and Khurda, Orissa	134	19.1	40.3	Chakrabarty and Bharati 2010
9	Sabar	Bankura,West Bengal	111	19.8	46.8	Ghosh et al. 2018
10	Sabar	Purulia, West Bengal	307	18.9	47.2	Present study

Table 6: Comparison of prevalence of CED based on MUAC (cut off <24.0 cm) among various tribal populations (males) in eastern India with present study

S. No.	*Community*	*Studied area*	*Samples size*	*Mean MUAC (cm)*	*Prevalence of CED (%)*	*Reference*
1	Oraon	Gumla, Jharkhand	205	23.5	56.6	Chakraborty et al. 2011
2	Mahali	Bankura, West Bengal	102	24.16	38.2	Bose et al. 2019
3	Sabar	Purulia, West Bengal	307	24.06	54.4	Present study

est prevalence of CED among Bhumij (52.3%) of Paschim Medinipur (Ghosh and Bose 2015) followed by Munda (50.0%) of Paschim Medinipur (Das et al. 2013) and Sabars (47.2%) of Purulia (present study). It can be noticed that the Sabars of this study showed higher frequency of CED than Savars (38.0%) of Keonjhor, Orissa (Bose et al. 2006), Shabars (40.3%) of Cuttack and Khurda, Orissa (Chakrabarty and Bharati 2010) and Bankura of West Bengal (46.8%) (Ghosh et al. 2018).

On the other hand, MUAC is a simple measurement in nutrition evaluation being an indicator of protein energy reserves of an individual (Lusting and Strauss 2003). Sometimes in rigorous fieldwork in remote areas researchers encounter problems to measure height and weight of the participants. For this reason, MUAC is another anthropometric measurement, which is preferred, especially in rural settings (Chakraborty et al. 2009; Sultana et al. 2015; Benítez Brito et al. 2016).

The diagnostic value of MUAC in determining malnutrition especially under-nutrition among children is globally accepted by many researchers (Briend et al. 1987, 2012; Vella et al. 1993; Fiorentino et al. 2016). The global MUAC cut off proposed by James et al. (1994) for adult malnutrition classification have been used widely. WHO also proposed global MUAC cut off of 11.0 cm (WHO 2007) and modified to 11.5 cm (WHO 2009) for 6-59-month-old children to screen severe acute malnutrition and these cut offs have been used by many contemporary researchers as a diagnostic tool for assessing nutritional status (Fernández et al. 2010; Dasgupta et al. 2013; Roberfroid et al. 2013; Grijalva-Eternod et al. 2015; Sougaijam et al. 2019). In the year 2017 another standardised MUAC cut off for and adults has been proposed as <24.0 cm, which meets the criteria for optimal sensitivity and specificity across various sub population when assessed against low BMI (FANTA 2017). A few recent studies on various communities from different countries have been conducted to access nutritional status based on this MUAC cut off (<24.0 cm) (Charlton et al. 2005; Jacobson et al. 2006; Bose et al. 2007; Chakraborty et al. 2009, 2011; Sheehan et al. 2011; Tang et al. 2011). However, very few studies have been reported from Indian tribal populations using this cut off (Table 6). Prevalence of under-nutrition among Oraon males (56.6%) of Jharkhand (Chakraborty et al. 2011) was found to be the highest followed by the present study population (54.4%) and Mahalis (38.2%) of Bankura (Bose et al. 2019).

CONCLUSION

Findings of the present study clearly demonstrated that the Sabar males of Purulia is experiencing serious nutritional stress and needs immediate nutritional intervention. It has also been understood that use of MUAC cut off (<24.0 cm) along with BMI (<18.5 kg/m^2) will provide more precision to screen undernourished people. As well as this study also suggested that in remote places MUAC could be used as a single measuring tool as a proxy for BMI.

RECOMMENDATIONS

Considering different ethnic communities living in the country, there is a need for conducting multi-ethnic studies by using MUAC (cut off <24.0 cm) for evaluating nutritional status among different parts of rural India. The present investigation clearly demonstrated that significant association existed between BMI and MUAC but the nature and magnitude of this relationship may vary across various ethnic groups, not only of India but also elsewhere. Therefore, the present study proposed the use

of MUAC measurement as a tool for nutritional study in combination with BMI, where many more undernourished individuals can be screened, detected and referred to medical practitioners for further assessment and nutritional intervention. Lastly, as nutritional status is influenced by several factors like dietary habits, physical activities, socio-economic condition, and ecological setting, so further research should be undertaken including these factors with larger sample size.

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