Use of anthropometric measures for nutritional status assessment among the Santal adult population of Singhbhum district in Jharkhand state in India

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ABSTRACT:

Tribes, who still could not drift with the mainstream population of the country, are one of the major concerns of our country since they largely contribute in the demography of India. They prefer to restrict themselves into a traditional boundary; therefore, they could not access most of the resources of the nation. Improper accession of several socio-economic as well as dietary resources can lead the tribal communities towards occurrence of malnutrition. The Santal is one of them and the present study mainly concerns about the nutritional status of the Santal adult population of Jharkhand state of India. This cross-sectional study included 80 adult Santal individuals (42 males and 38 females) from Kalimati mouza under Ghatshila block of Singhbhum district of Jharkhand, India. BMI and MUAC were the major indicators used here for assessing the nutritional status of the participants. Outcome of this study stated that the reference population mostly comprised of young adults (18-40 years of age). They contributed to 60% of the study population which was noticeable. Mean age of the participants of both the sexes showed 38.24±14.36 years and 37.11±16.64 years respectively for males and females. In the average of all the anthropometric measurements gender asymmetry was clearly noticed. Study further revealed that 16.67% of males, 42.11% of females and 28.75% of total population were suffering from Chronic Energy Deficiency and 16.67% of males, 13.16% of females and 15.00% of total population became overweight. Nutritional status assessment through MUAC also revealed more or less similar result. It also suggested that nearly three fourth of the population (72.50%) was nutritionally normal whereas rest (27.50%) was found to be underweight. The study concluded that the high prevalence of undernutrition prevailed in the studied population and females were in more concerning situation for undernutrition than males.

Keywords: Santal, undernutrition, anthropometric indicators, BMI, MUAC

INTRODUCTION:

According to 2001 census conducted by government of India, tribes of India possess almost 8% of the total Indian population; more than 84 million peoples are tribal. Most probably India has the largest number of Tribal communities in the whole world. In India, tribals are the most unprivileged and undernourished people since they have poor scope of earning, education and other facilities (Topal and Samal, 2001). Among all the Indian tribal communities the Santal is the largest one which is mostly found in the states of West Bengal, Bihar, Orissa, Jharkhand and Assam. In number this community reaches upto two millions (Mukhopadhyay, 2010). Santals are also found in Bangladesh and Nepal. The Santal has a traditional language named as *Santali* which is from Austro-Asiatic language group. The Santals has basically a patriarchal society. However, data on malnutrition as well as nutritional status of this tribal community across the India is still very limited to understand the nutritional aspect of this particular community.

The condition of the body influenced by those micro and macro nutrients that can maintain the normal metabolic integrity is called nutritional status. To maintain the required levels of those essential nutrients for the body, one must need to have adequate diet full of balanced micro and macro nutritional elements. Inadequate and excessive nutrients can cause imbalance in normal metabolism in the body. Consequently one can suffer from malnutrition (undernutrition for lack of balanced nutrients and overnutrition for excessive nutrients than the requirements of the body).

Inadequacy and excessiveness in required balanced nutrients for the body can arise directly for lack of adequate proper diet, inappropriate and unhealthy food habit and lifestyle and indirectly for economic condition, social beliefs and practices and for lack of education also.

Malnutrition belongs to different populations of the different parts of the world in different form and rate. Since it is mostly regulated by socio-economic condition of a state as well as a population, it is mostly seen in the form of overnutrition in some countries, especially in developed countries, and in some under developed countries it mostly arrives in the form of undernutrition causes Chronic Energy Deficiency (CED). But in India, both the forms, overnutrition and undernutrition, are running parallel at almost similar rate. Obesity caused by overnutrition has been an epidemic in the strong economical section of India whereas undernutrition, mostly affecting the people of low income section, has become a burden of public health in India (Adhikari et al., 2018). From this perspective it is important to assess the nutritional status of India to find out the way of reducing the burden of public health as well as to reach the people of India in a safe zone of nutritional condition by identifying the most probable causes of malnutrition.

Since nutritional status is that kind of criteria which is not only dependent on biological profile of an individual as well as population but also is driven by socio-economic condition, environment and food habit of the population. Therefore nutritional status is a population-based measurement and that is why it needs to be assessed on different population of the world. It is established that using of anthropometry is such an important indicator of assessment of nutritional status of a population. among them BMI and circumferences of different body parts are very good and useful indicator of obesity and CED as they can not only portrait the nutritional status but also socio-economic condition of a population. Moreover these indicators are inexpensive, noninvasive and suitable for large scale population (Bose et al., 2006).

Most of the studies conducted on Santal population of different states of India show similar trend in case of nutritional aspect of adult Santals. Dash and Adhikari (2018) in their study, conducted on 173 Santal women of Purba Medinipur, Purulia, and Bakura districts, stated that the studied women Santal population was suffering from malnutrition; 89 % of them were in underweight category, whereas only 11% were in normal weight category. The studied women group with an average age of 27.5 ± 1.8 yrs was observed with mean height of 155.6 ± 3.01cm and mean weight of 43.0 ± 2.3 kg. Their mean BMI was 17.8 ± 0.72 kg/mt^2 with a range of 15.2 kg/mt^2 to 19.5 kg/mt^2. This study suggested that inadequate food and nutritional elements are responsible for this situation. This study also supports the study of Mukhopadhyay (2010), undertaken among 400 adult (age range 19–75 years) subjects (200 males and 200 females) of two villages under Bolpur Sriniketan block of Birbhum district. In this study it was evident that the studied population was under critical situation for high prevalence of low BMI as well as undernutrition. It was exhibited that 34.5% of the studied population was found to have poor nutritional condition (BMI<18.5) among them 38.5% of females and 30.5% of males were found to be under low BMI category although this notable disparity was not statistically significant (chi square = 2.832, P = 0.092). Another study of Bose and Bisai (2007), undertaken among 332 male Santal individuals from Orissa and 197 male Santals from West Bengal, exhibited that though these they had significant differences in terms of several anthropometric characteristics, both the population was in serious situation having high prevalence of CED (Orissa=26.2%, West Bengal=31.5%). Mean BMI was found to be 19.6 ± 1.8 kg/mt^2 in Santals of Orissa and in case of West Bengal Santals, it was found to be 20.0 ± 2.6 kg/mt^2. But in case of mean MUAC, no such difference was found between these two populations (23.7 ± 2.1 cm and 23.8 ± 2.3 cm respectively for Orissa and West Bengal). In another cross-sectional study conducted by Bose et al. (2006) on 332 male Santal villagers of Keonjhar district of Orissa, India, a high prevalence of undernutrition was found among them. All the adult males were included in the study from five villages (Kashibera, Gourshinga, Majhisahi, Sonatangri and Kumunia) of Anandapur Region of Keonjhar district. This study revealed that the prevalence percentage of undernutrition among the sample population, in respect of BMI, was found to be 26.2%; grade III CED, grade II CED and grade I CED show 3.3%, 3.9% and 19.0% respectively. As per

MUAC, it was seen that 33.7% of the sample population came under the category of undernutrition. Das and Bose (2012a) conducted another study only based on MUAC among Santal adult population of Purulia district of West Bengal. This study was to find out the prevalence percentage of undernutrition among them. A total of 520 participants of both sexes were included in this study. It revealed that based on both MUAC and BMI more females were undernourished than males. As per MUAC 64.7% of females and 54.4% of males were undernourished whereas according to BMI 59.4% of females and 34.6% of males were undernourished. In both the cases significant sex differences were noticed; MUAC (t=2.378, p<0.05) and BMI (t=4.971, p<0.001).This study concluded that both the sexes of the studied population was nutritionally under critical situation. Mahajan et al. (2019) in their study revealed that the males and the females of the Santal population (n=101) of Jharkhand had mean BMI of 20.40±2.75 and 19.85±3.08 respectively. Numerically, females (35.7%) of the study population were observed to be more undernourished than their male counterparts (17.8%) as per BMI. Also according to MUAC, 17.8% males were observed to be undernourished whereas unlike BMI, 42.9% females were found to be highly undernourished. The findings of the study observed higher prevalence of undernourishment in adult males and females of the Santal population with a great gender disparity in respect of mean MUAC (t-value=2.88, p<0.05).

Objectives:

All the mentioned previous studies tried to depict the nutritional status of Santals of different regions of India from different perspectives and the present study is also a little effort to explore the nutritional background of the Santal population of Jharkhand of India. The primary objective of the study is to determine the nutritional status using internationally accepted anthropometric indicators like BMI and MUAC and to find out the prevalence of undernutrition within the study population.

MATERIALS AND METHODS:

The present study was conducted in November, 2019 and followed cross-sectional study design to enumerate the nutritional status of the reference population. The data were collected from some of the tribal hamlets of Kalimati mouza of East-Singhbhum district predominantly inhabited by Santals of Jharkhand of India. A total of 80 adult Santal individuals of this area were randomly selected to collect qualitative as well as quantitative measurements to assess the nutritional condition of the village. They contributed to 60% of the study population which was noticeable. Among them 42 individuals were male and 38 females were involved. The individuals with the age of below 18 years were excluded from the study and the selected participants were apparently free

from any skeletal and other deformities also. All the measurements and data were collected during day light between 8 am and 4 pm. Necessary official approval from the local government authority as well as ethical consent from the individual participants were taken well before the study.

Anthropometric measurements such as height (vertex to standing platform), MUAC, Medial Calf Circumference, foot lengths (linear distance between the most prominent projected point of the heel and the most distal point of the longest toe) and foot breadths (linear distance from the most prominent point on the medial aspect of the head of the first metatarsal to the most prominent point on the lateral aspect of the head of the fifth metatarsal), hand lengths, hand breadths, Morphological facial height were recorded to the nearest 0.1 centimetre. Body mass of each individual was also recorded to the nearest 0.5 kg. All the measurements were taken following standard procedures recommended by Lohman et al. (1988).

Among all the collected anthropometric variables, some specific variables such as height, weight, MUAC were used here to compute the nutritional condition of the population which could better assess the same.

Data was complied on excel sheet and then transferred to SPSS (16.0) for doing statistical analysis. To establish nutritional condition of the population two standard methods were used here; one is Body Mass Index (BMI) and another is Mid Upper Arm Circumference (MUAC).

BMI was calculated using the Worldwide accepted standard formula and evaluated using internationally accepted BMI guidelines (WHO, 1995:854) that fixed the cut off value for every category of nutritional state of an individual (table 1).

Table 1: BMI category and cut off values according to WHO, 1995

BMI category	Cut off value
CED or Underweight	<18.5
Normal	18.5-24.9
Overweight	≥25.0

The classification of the problem of public health of low BMI provided by World Health Organization (WHO, 1995: 854) was followed here to understand the prevalence of undernutrition of the studied population (table 2). The classification of WHO categorized the prevalence of undernutrition based on the percentage of a population with BMI less than 18.5 (Das and Bose, 2012b).

Table 2: Low BMI classification of WHO, 1995

Prevalence category	Cut off percentage	Remarks
Low prevalence	5-9 %	Warning and monitoring required

Medium prevalence	10-19 %	Poor situation
High prevalence	20-39%	Serious situation
Very high prevalence	≥40 %	Critical situation

MUAC is another reliable method of evaluating nutritional status of a population and it is worldwide accepted now. The standard cut off value of MUAC for CED category of nutritional condition is established as <23 cm for males and <22 cm for females. Individuals with MUAC ≥23 and ≥22for males and females respectively come under the NORMAL category of nutritional condition (Das and Bose, 2012a).

RESULTS:

Table 3: Descriptive statistics of all the quantitative and anthropometric variables

Variables	Male						Female					
	n	Min	Max	Mean	S.E.	S.D.	n	Min	Max	Mean	S.E.	S.D.
Age (years)	42	19.00	70.00	38.24	2.22	14.36	38	18.00	81.00	37.11	2.70	16.64
Height (cm)	42	144.00	174.50	161.13	1.11	7.17	38	136.50	174.00	150.83	1.26	7.76
Weight (kg)	42	40.00	96.00	55.26	1.71	11.11	38	32.00	72.00	44.90	1.67	10.29
BMI(kg/m^2)	42	14.50	32.79	21.29	0.61	3.97	38	12.49	32.74	19.76	0.71	4.39
MUAC (cm)	42	18.00	40.00	25.27	0.57	3.70	38	19.50	32.20	23.34	0.47	2.91

For getting the results of the present study, first of all descriptive statistical analysis of all the studied anthropometric variables with age and BMI has been exhibited in the table 3. Age of both the sexes show equal mean values (male- 38.24 yrs and female- 37.11 yrs) but standard deviation shows more dispersion in case of females (±16.64 yrs) than that of males (±14.36 yrs). Here it has been seen that the studied population has average height of 161.13±7.17 cm ranging from 144.00 cm to 174.50 cm in case of males and 150.83±7.76 cm ranging from 136.50 cm to 174.00 cm in case of females which suggest that it is a medium statured population. But weight shows lower values for both the sexes. Males have mean weight of 55.26±11.11 kg and females have mean weight of 44.90±10.29 kg. It indicates that the population may have a chance of CED. In case of BMI, males show a mean value of 21.29±3.97 kg/m^2 ranging from 14.50 kg/m^2 to 32.79 kg/m^2 whereas females have mean BMI of 19.76±4.39kg/m^2 ranging from 12.49 kg/m^2 to 32.74 kg/m^2.MUAC of males is ranging from 18.00 cm to 40.00 cm with a mean value of 25.27±3.70 cm, whereas mean MUAC of females shows little lesser

value (23.34±2.91) than that of males. A little gender asymmetry has been seen here for all the anthropometric variables.

Table 4: Nutritional status analysis of adult Santal population of Kalimati mouza under Ghatshila block of East-Singhbhum district of Jharkhand based on BMI

Sex	BMI Category	Age Group						
		18-30	31-40	41-50	51-60	>60	Total	% within sex
Male (42)	Underweight	4	1	2	0	0	7	16.67
	Normal	8	8	6	4	2	28	66.66
	Overweight	2	2	2	0	1	7	16.67
Female (38)	Underweight	8	3	0	3	2	16	42.11
	Normal	9	3	3	1	1	17	44.73
	Overweight	1	0	2	2	0	5	13.16
Total (80)	Underweight	12	4	2	3	2	23	28.75
	Normal	17	11	9	5	3	45	56.25
	Overweight	3	2	4	2	1	12	15.00

Through statistical analysis of BMI of every individual, the nutritional status of the studied population has been exhibited in the table 4. All the individuals have been put under three broad categories of nutritional classification based on their BMI values following the standard classification of BMI provided by WHO, 1990. The aforesaid table portraits that a great percentage of individuals in case of both the sexes (16.67 % of males, 42.11 % of females and 28.75 % of total population) come under the category of underweight or CED though females have much greater frequency under this category. Further classification of CED has not been performed here because of small sample size. According to low BMI classification of public health problem provided by WHO, males of the population are in poor situation (10-19 %) for the prevalence of undernutrition whereas females are in critical situation of undernutrition as per the cutoff point (≥40%). Most of the males are nutritionally normal (66.66 % of males) whereas less than half of the female individuals (44.73 % of females) occupies normal nutritional status. On the other hand overweight individuals also prevail in this population but relatively in low frequency. Only 16.67 % of males are overweight where 13.16 % of females come under this group. For both the sexes a particular age group 18-30 shows maximum contribution to all the nutritional categories. Most of the CED and normal individuals are from this group; it also has some overweight

individuals, therefore, this age group of this population is more significant for understanding the nutritional condition of this population. Figure no. 1 also presented the above mentioned scenario in the graphical form.
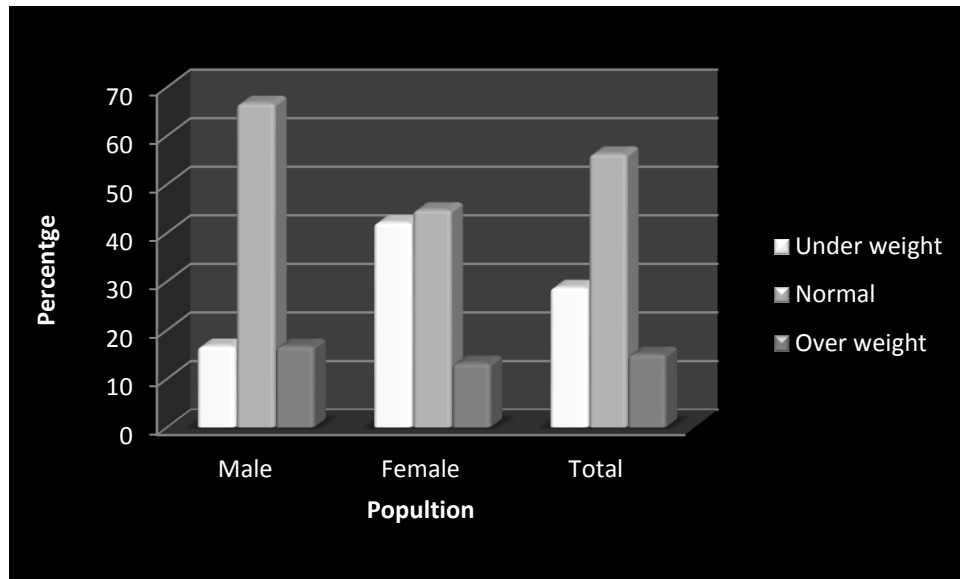

Figure 1: Nutritional status based on BMI

Table 5: Nutritional status analysis of adult Santal population of Kalimati mouza under Ghatshila block of East-Singhbhum district of Jharkhand based on MUAC

Sex	MUAC category	Age group						
		18-30	31-40	41-50	51-60	>60	Total	% Within sex
Male (42)	Underweight	3	2	2	1	1	9	21.43
	Normal	11	9	8	3	2	33	78.57
Female (38)	Underweight	5	2	1	3	2	13	34.21
	Normal	13	4	4	3	1	25	65.79
Total (80)	Underweight	8	4	3	4	3	22	27.50
	Normal	24	13	12	6	3	58	72.50

Nutritional status of the population though MUAC has been depicted in the table 5 and graphically represented through figure no. 2. It also shows more or less similar trend like BMI analysis. MUAC of the individuals suggests that 21.43 % of males are under CED whereas CED females have 34.21 % of all the female population; both male and female prevalence percentages fall under the higher range of prevalence (20-39%) provided by WHO indicating a serious situation for the individuals of both the sexes of the study population.

Moreover, it exhibits that 27.50% of total sample population are undernourished which also indicates that the total population is under serious situation for undernourishment.
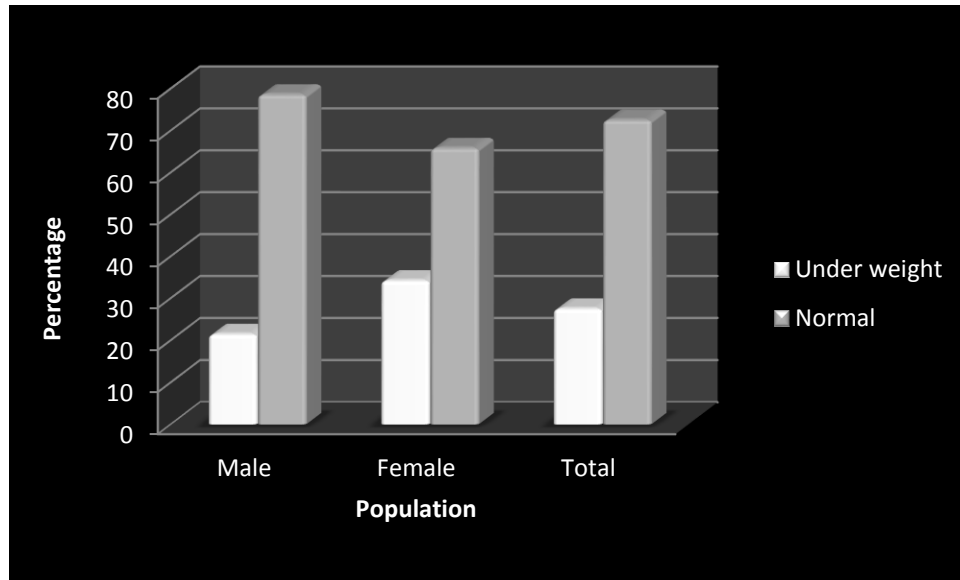

Figure 2: Nutritional status based on MUAC

DISCUSSION:

Nowadays malnutrition has been a global burden in public health which causes CED and adiposity across the world. Adiposity is mostly found in high economic group of people whereas undernutrition as well as CED is widely evident in tribals who are low earning people. A wide number of tribes of different parts of the world was studied to understand their nutritional status and it's trend in tribals. In India, also a good number of studies was reported on the nutritional status of the people of different Indian tribes ((Dutta Banik S, 2009; Goswami M, 2014;Yadav et al., 1999;Khongsdier, 2001;Gogoi and Sengupta, 2002;Sahani, 2003).Many similar studies on Santal tribal population of different regions of India were done by Mukhopadhyay (2010), Adhikari et al. (2018), Bose et al. (2006c), Ghosh & Mallik, 2007, Chakraborty et al., 2008, Bose et al., 2006e , Das and Bose (2012a) and many more. A comparison of the present study with other similar studies on different tribal populations of Eastern India has been drawn in the table 6 in terms of their mean BMI. The Santal population of the present study exhibits highest mean BMI value for both the sexes in comparison with all the tribal populations considered from the different states of the eastern India, though almost all of them belong to the normal nutritional category. Males of the present Santal population also show higher BMI value than that of the Santal females likely other Santal population mentioned in the above table.

Table 6: Comparison of present study with different tribal populations from different state of Eastern India in terms of mean BMI

State	Tribe	Male BMI(kg/m^2) Mean	Female BMI(kg/m^2) Mean	Reference
West Bengal	Oraon	18.8	19.7	Mittal & Srivastava, 2006
	Santal	20.0	19.3	Bose et al., 2006c
	Santal	18.5	18.7	Ghosh & Mallik, 2007
	Lodha	19.5	19.3	Mondal, 2007
	Santal	20.5	19.5	Mukhopadhyay, 2010
	Santal	19.5	18.1	Das & Bose, 2010
	Oraon	19.46	--	Bose et al., 2011
Orissa	Santal	19.6	--	Bose et al., 2006e
	Oraon	18.8	19.7	Mittal & Srivastava, 2006
	Munda	19.1	--	Chakraborty et al., 2008
	Santal	18.3	--	Chakraborty et al., 2008
Jharkhand	Oraon	18.5	--	Datta Banik, 2008
	Oraon	18.0	--	Chakraborty & Bose, 2008
	Santal (Present)	21.29	19.8	Mukhopadhyay & Paul, 2022

All these studies used BMI and MUAC as a primary indicator to assess nutritional status and found that a high rate of undernutrition belonged to their studied tribal population. The present study has shown more or less similar trend. Although it has found higher mean BMI value in case of both the sexes than any other previous studies mentioned, it has exhibited that almost one third of the population is underweight (28.75%) and half a little more is of normal weight (56.25%). Overweight people also present in this population but in low frequency (15.00%). It is also evident that females (42.11%) of the studied population are much ahead of males (16.67%) in terms of undernourishment and males have shown greater percentage than females in terms of normal weight category. In case of overweight category, both the sexes have shown more or less equal contribution. MUAC has also shown more or less similar trend. According to MUAC, 27.50 % of the population is under CED category which is little lesser than the output of BMI.

By summing up all those studies it can be said that Santal population of different regions of India are nutritionally in poor condition; they have mostly been found to have undernutritional condition which can lead the population towards sever CED.

Conclusion:

According to the present study it is concluded that the studied Santal population found to have a serious situation of prevalence of undernutrition. Females of this population were in more vulnerable condition than males and it was justified by both the anthropometric indicators (BMI and MUAC). Adiposity was also found in both the sexes but in low frequency. Obesity was present in males more than females. So it was recommended that immediate nutritional intervention programs were needed in this population. Further study was required to find out the root cause behind the situation of the population. It should be needed to understand the probable consequences of the situation and to take immediate effective action to make the population come out from it.

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