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Research Article

Adiposity and Health Status among Adult Male Mundas and Oraons of Paschim Medinipur, West Bengal, India

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The present cross-sectional study was conducted among two male tribal groups Munda ($n = 106$) and Oraon ($n = 104$) aged 18–73 years of Paschim Medinipur, West Bengal. Objective was to evaluate the health status based on body mass index (BMI) and percent body fat (PBF). Measurements of weight, height, circumferences, and skinfolds were recorded. Results revealed that mean age of Mundas (36.2 ± 13.3) and Oraons (35.1 ± 15.3) in years were similar. Significant ($P < 0.05$) ethnic differences in mean chest circumference and anterior thigh skinfold were observed. Both Munda (50.0%) and Oraon (46.2%) males suffered from very high degree of chronic energy deficiency (CED) based on BMI. Similarly, for percent body fat (PBF), Mundas (29.3%) and Oraons (35.4%) had unhealthy (too low) PBF (i.e., ≤5%) levels. Significantly negative correlations were observed between age and BMI and positive correlations between age, waist-hip ratio (WHR), and conicity index (CI) (only Mundas) among Mundas and Oraons. In Linear regression, age had a significant impact on all derived central and overall adiposity measures. Prospective studies are required to determine the associations between health status and PBF as well as nutrition status and BMI in different indigenous ethnic groups of India and elsewhere.

1. Introduction

The poor nutritional condition of young children in India has received much attention recently, but Indian adults are also experiencing a variety of nutritional problems [1]. The developing world faces the growing problem of obesity. About one-third of the world's population today is overweight, and almost one in ten is obese [2]. Fat is one of the basic components that make up the structure of our body. The other components include muscle, water, bone, and your organs—the brain, liver, kidneys, spleen, stomach, pancreas, intestines, and so forth. All are necessary for normal, healthy functioning. Body fat can be divided into two categories: essential fat and storage fat. In men, essential fat is approximately 3% of body weight. Men and women have similar amounts of storage fat [3].

BMI measures both lean body mass and body fat. The correlation between body fatness and BMI ranges from 0.6 to 0.8, depending on the methods for determining body fat and populations. The relation between BMI and percentage of body fat also differs between men and women, across age groups, and in some studies across racial groups [4–6]. BMI, because of its simplicity and hence general applicability, is a widely used substitute measure of obesity. While BMI and percentage of body fat (BF) are generally well correlated, there is increasing evidence of wide ethnic variation in the relationship between these two variables [7]. The WHO has recognized the deficiencies of a universal cut-off for obesity [8], and a WHO [9] report suggested that further body composition studies of Asian and Pacific Island populations are needed to determine equivalent fatness levels and the relationship of BMI with body size. Ethnicity-specific recommendations for BMI-based thresholds for obesity may have significant implications for public health policies in many countries.

Inadequate nutrition in adolescents and young adults can put them at a high risk of chronic diseases, particularly if

Table 1: Descriptive statistics with t-test of the anthropometric variables.

Variables	Ethnicity	N	Mean	Std. deviation	t	Sig.
Weight (kg)	Munda	106	50.50	6.83	1.464	0.825
	Oraon	104	49.10	7.00		
Height (cm)	Munda	106	159.91	6.40	0.058	0.823
	Oraon	104	159.85	8.15		
Mid-upper arm circumference (cm)	Munda	106	23.39	1.97	0.411	0.424
	Oraon	104	23.27	2.23		
Chest circumference (cm)	Munda	106	79.32	3.86	1.428	0.004
	Oraon	104	78.42	5.21		
Waist circumference (cm)	Munda	106	72.35	5.62	1.705	0.067
	Oraon	104	70.89	6.76		
Hip circumference (cm)	Munda	106	79.74	5.13	0.950	0.869
	Oraon	104	79.08	4.95		
Biceps skinfold (mm)	Munda	106	2.33	0.83	−0.311	0.725
	Oraon	104	2.37	0.86		
Triceps skinfold (mm)	Munda	106	3.94	1.44	−0.485	0.559
	Oraon	104	4.04	1.55		
Subscapular skinfold (mm)	Munda	106	7.37	2.19	−0.659	0.709
	Oraon	104	7.57	2.21		
Suprailiac skinfold (mm)	Munda	106	5.06	1.90	−1.019	0.060
	Oraon	104	5.35	2.23		
Anterior thigh skinfold (mm)	Munda	106	6.40	2.09	0.461	0.047
	Oraon	104	6.24	2.90		
Medial calf skinfold (mm)	Munda	106	4.95	2.20	−0.486	0.512
	Oraon	104	5.10	2.22		

combined with other adverse lifestyle behavior [10]. Malnutrition received recognition of planners and policy makers right from the beginning of five-year planning. Although a large number of national nutritional programmes have been executed to battle the threat of malnutrition, it still persists.

In view of the above background, the present study provides a comprehensive comparative analysis of the body composition of Munda and Oraon tribal male adults centering on the prevalence of health and nutritional status of both these communities using BMI (k/m^2) and PBF (%).

2. Materials and Methods

The present study was a community based cross-sectional comparative study carried out during the month of June to August, 2008 (period of data collection). All available males during data collection in two villages Muradanga and Taldanga were included in the study. A total of 210 males (106 Mundas and 104 Oraons) aged 18–73 years were anthropometrically measured. Data were collected after obtaining necessary approval from the university ethical committee and villagers. Villagers were informed about the objectives of present study prior to taking measurement. Data on age and anthropometry were collected on a pretested questionnaire by house-to-house visit. The total population of West Bengal at 2001 Census has been 80,176,197 of which 4,406,794 persons are Scheduled Tribes (STs) constituting 5.5 percent of the total population of the state. Out of the total tribal population of West Bengal, Oraon (14.0%) and Munda (7.8%) comprised second and third highest tribal population after Santal of West Bengal, India [13]. All the measurements were taken by one of the author (BD) following standard techniques [12]. Technical errors of measurement were found to be within reference values and thus not incorporated in statistical analyses [14].

Oraons speak a Dravidian language known as Kurukh. Oraons are closely related to the neighboring Munda tribe, and the headman of an Oraon village is called *munda*. Although there are no subcastes among the Oraons, the Kudas ("navvies") and Kisans ("cultivators"), having their distinct occupations, tend to marry among themselves [11].

Mundas are also known as Horo-hon or Mura, which means headman of a village. They believe that they are the descendants of Sing Bonga, the supreme God. They are one of the well studied tribal communities, and probably the only one with an encyclopedia of their own, the Encyclopedia Mundarica. This Munda, an ancient people, also lent its name to the language, called Austro-Asiatic Mundari, or Kolarian, which is one of the four language families of India. The Mundas live in the states of Bihar, West Bengal, Assam, Tripura, Madhya Pradesh, and Orissa [15].

As far as the occupation of these Munda tribes is concerned, in earlier times the Munda tribes were wandering huntsmen and collectors. Very recently, these Munda tribes too took up the profession of shifting cultivation, thereby

Table 2: Descriptive statistics with t-test of overall and central adiposity variables.

Variables	Ethnicity	N	Mean	Std. deviation	t	Sig.
Measures of overall adiposity						
BMI (kg/m^2)	Munda	106	18.46	2.41	−0.456	0.649
	Oraon	104	18.62	2.75		
FM (kg)	Munda	106	3.71	2.21	−0.417	0.392
	Oraon	104	3.84	2.40		
FMI (kg/m^2)	Munda	106	1.44	0.83	−0.518	0.188
	Oraon	104	1.51	0.92		
PBF (%)	Munda	106	7.08	3.57	−0.789	0.486
	Oraon	104	7.48	3.75		
BAI	Munda	106	21.49	2.71	0.371	0.303
	Oraon	104	21.31	4.20		
Measures of central adiposity						
CI	Munda	106	1.18	0.07	0.785	0.062
	Oraon	104	1.18	0.09		
WC (cm)	Munda	106	72.35	5.62	1.705	0.067
	Oraon	104	70.89	6.76		
WHR	Munda	106	0.91	0.05	1.698	0.324
	Oraon	104	0.90	0.05		
WHTR	Munda	106	0.45	0.04	1.472	0.142
	Oraon	104	0.44	0.05		

Table 3: Prevalence of health and nutritional status based on PBF (%) [11] and BMI (kg/m^2) [12] among the subjects.

Variable	Cut of point	Classification	Munda	Oraon
BMI (kg/m^2)*	<18.5	Undernutrition	50.0	46.2
	18.5–24.9	Normal	48.1	51.0
	≥25.0	Overweight	1.9	2.9
PBF (%)#	≤5%	Unhealthy (too low)	29.3	35.4
	6–15%	Acceptable (lower end)	68.5	61.0
	16–24%	Acceptable (upper end)	2.2	3.7
	≥25%	Unhealthy (too high)	—	—

*Chi-square = 0.467, df = 2, and sig = 0.792.
#Chi-square = 1.196, df = 2, and sig = 0.550.

following the practice of most of the tribes of Indian subcontinent. They built up the Parha system of Government, which is fundamentally a "confederacy of village governments." The village markets play very vital role in their economic lives where they exchange their products required for their basic sustenance. Both studied communities are now engaged in industrial labour (in spinning mills, rice mills), rickshaw pullers, and brick factory workers as most of them do not have enough land to cultivate.

There were various direct and indirect methods for assessing body composition and health status of adults. Anthropometry provides portability in large scale community study. Body mass index (BMI) and percent body fat (PBF) provide the overall adiposity of an individual and has been calculated by the following formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2\ (\text{m}^2)}, \quad (1)$$

see [16].

The individuals were categorized for their BMI status as per WHO [16] standard. We followed the World Health Organization's classification [16] of the public health problem of low BMI, based on adult populations worldwide.

Consider the following:

$$\text{PBF} = \left(\frac{4.95}{\text{density}} - 4.50\right) \times 100, \quad (2)$$

see [17].

Percent body fat in the adult male tribals has been categorized with reference to the body fat ranges for persons 18 years of age and older [18].

Density was derived following the standard equation [19]:

$$D = 1.1631 - 0.0632\,(\log X), \quad (3)$$

where D = estimated body density; X = the sum of the biceps, triceps, subscapular, and suprailiac skinfolds.

Table 4: Correlation matrix showing association between age with overall adiposity and central adiposity measures.

Community	Variables	AGEY	WSTCIR	BMI	WHR	WHTR	CI	PBF	FM	FMI	BAI
Munda	AGEY	1.000	0.062	−0.202*	0.265**	0.137	0.265**	−0.046	−0.065	−0.051	−0.024
	WSTCIR		1.000	0.580**	0.566**	0.875**	0.654**	0.545**	0.596**	0.583**	0.462**
	BMI			1.000	0.003	0.306**	−0.193*	0.542**	0.675**	0.621**	0.188
	WHR				1.000	0.596**	0.652**	0.076	0.054	0.078	−0.082
	WHTR					1.000	0.638**	0.497**	0.494**	0.545**	0.718**
	CI						1.000	0.103	0.066	0.066	0.189
	PBF							1.000	0.973**	0.981**	0.464**
	FM								1.000	0.989**	0.448**
	FMI									1.000	0.523**
	BAI										1
Oraon	AGEY	1	−0.041	−0.348**	0.225*	0.007	0.256**	−0.100	−0.143	−0.136	−0.115
	WSTCIR		1	0.668**	0.760**	0.803**	0.737**	0.613**	0.644**	0.604**	0.297**
	BMI			1	0.185	0.419**	0.056	0.645**	0.774**	0.707**	0.215*
	WHR				1	0.715**	0.802**	0.276**	0.240*	0.250*	0.151
	WHTR					1	0.499**	0.525**	0.508**	0.620**	0.762**
	CI						1	0.220*	0.173	0.100	−0.089
	PBF							1	0.971**	0.962**	0.340**
	FM								1	0.967**	0.320**
	FMI									1	0.524**
	BAI										1

*Correlation is significant at the 0.05 level (2 tailed).
**Correlation is significant at the 0.01 level (2 tailed).

Table 5: (a) Impact of age on overall and central adiposity measures among adult male Mundas ($n = 106$). (b) Impact of age on overall and central adiposity measures among adult male Oraons ($n = 104$).

(a)

Dependent variables	*B*	SEB	Beta	*t*	Sig	Adjusted R^2
WC	71.392	1.602	0.062	44.567	0.000	−0.006
BMI	21.739	0.765	−0.202	28.432	0.000	0.032
WHR	0.872	0.014	0.265	63.652	0.000	0.061
WHTR	0.440	0.010	0.137	44.363	0.000	0.009
CI	1.132	0.020	0.265	55.780	0.000	0.061
PBF	7.530	1.018	−0.046	7.394	0.000	−0.007
FM	4.099	0.630	−0.065	6.511	0.000	−0.005
FMI	1.560	0.238	−0.051	6.554	0.000	−0.007
BAI	21.673	0.772	−0.024	28.071	0.000	−0.009

Where; *B* refers to regression coefficient. SEB refers to standard error of *B*. Beta refers to estimated regression coefficient. Sig. means level of significance.

(b)

Dependent variables	*B*	SEB	Beta	*t*	Sig	Adjusted R^2
WC	71.524	1.674	−0.041	42.725	0.000	−0.008
BMI	19.945	0.593	−0.348	33.612	0.000	0.112
WHR	0.868	0.013	0.225	66.579	0.000	0.041
WHTR	0.444	0.011	0.007	38.626	0.000	−0.010
CI	1.126	0.021	0.256	54.755	0.000	0.056
PBF	8.343	0.925	−0.100	9.023	0.000	0.000
FM	4.631	0.589	−0.143	7.866	0.000	0.011
FMI	1.791	0.225	−0.136	7.946	0.000	0.009
BAI	22.418	1.034	−0.115	21.687	0.000	0.003

Where; *B* refers to regression coefficient. SEB refers to standard error of *B*. Beta refers to estimated regression coefficient. Sig. means level of significance.

All other used formulae are as follows.

WHR: waist circumference (cm)/hip circumference (cm) [20].

WHTR: waist circumference (cm)/height circumference (cm) [21].

CI = waist circumference (m)/0.109 $\times\sqrt{}$weight (kg)/$\sqrt{}$height (m) [22].

Fat mass (FM, kg) = body weight (Kg) × [PBF/100] [23].

Fat mass index (FMI, Kg/m^2) = [FM (Kg)/height^2 (m^2)] [23].

Body adiposity index (BAI) = [hip circumference (cm)/(height $\times\sqrt{}$height)] − 18 [24].

An independent Student's t-test was employed to compare the significance of the difference between anthropometric and their derived measured in cross validation. Ethnic difference in prevalence of CED based on BMI was also accessed by chi-square (χ^2) test. Pearson correlations and linear regression equations were computed to check the association of age with used adiposity measures. All computations were carried out using the Statistical Package for Social Sciences (SPSS-16) version. Statistical significance was set at $P < 0.05$.

3. Results

The mean age in years of Mundas (36.2 ± 13.3) and Oraons (35.1 ± 15.3) were similar. Table 1 shows the mean ± standard deviation and Student's t-test of anthropometric variables of the adult males belonging to two different communities. Both groups were almost similar except for chest circumference (79.32 ± 3.86; $t = 1.428$; $P < 0.05$) and anterior thigh skinfold (6.40 ± 2.09; $t = 0.461$; $P < 0.05$) that showed significant difference.

Table 2 shows the overall adiposity and central adiposity measures derived from anthropometric measurements. There existed no significant ethnic differences in all the derived overall and central adiposity measures. Thus we may conclude that these two communities do not vary with respect to overall and central adiposity.

In Table 3, nutritional status and health status of the studied two male communities measured and assessed by the WHO [16] recommended cut-off values of BMI, and Nieman [18] recommended cut-off point values for PBF are presented. The rates of undernutrition (CED; BMI ≤ 18.49 kg/m^2) in both male groups were observed to be very high (critical situation), and Mundas were found to have higher prevalence (50.0%) of CED compared to the Oraons (46.2%). Chi-square test results revealed that there was no significant ethnic difference between the two communities with respect to the nutritional status based on BMI ($\chi^2 = 0.467$, df = 2, sig = 0.792). It also presents the distribution of percent body fat (PBF) levels among the subjects. The results show that a considerable proportion of Mundas (29.3%) and Oraons (35.4%) have unhealthy (too low) PBF (i.e., ≤5%) levels of body fat. There was no significant community difference ($\chi^2 = 1.196$, df = 2, sig = 0.550) in body fat using PBF.

Table 4 shows the correlation matrix of age, Wt, BMI, WHR, WHTR, CI, PBF, FM, FMI, and BAI for both communities. The results revealed significantly negative correlations ($r = -0.202$, $P < 0.05$) between age and BMI among Mundas and positive correlation ($r = 0.265$, $P < 0.01$) between age, WHR, and CI. Similarly among Oraons significantly negative correlation ($r = -0.348$, $P < 0.01$) between age and BMI was observed. Positive correlation was observed between age with WHR ($r = 0.225$, $P < 0.01$) and CI ($r = 0.256$, $P < 0.01$).

Tables 5(a) and 5(b) show the linear regression analysis, carried out (with age as an independent variable) to record the impact of age on overall adiposity and central adiposity measures as the dependent variables (WC, BMI, WHR, WHTR, CI, PBF, FM, FMI, and BAI) in both communities. The results indicate that age has a significant impact on all overall adiposity and central adiposity measures of both the communities. The result of Tables 4 and 5 also demonstrates that the mean values of almost all the overall and central adiposity measures decrease with increasing age.

4. Discussion

Nutritional status based on BMI with age, sex, and ethnicity have been widely studied. The contribution we have made in this paper is to evaluate the health and nutritional status patterns, using a well-tested methods among two different adult tribal male groups using BMI and PBF. When using a weight-height index to assess body fat, it is necessary not only that this index has a high correlation with PBF, but also that this index is not correlated with body height [25] unless one assumes that body height and PBF are correlated [26]. The present study found that for all anthropometrical variables in Munda and Oraon male tribals, the mean values are not significantly different from each other except for CC, and ATSF.

In both clinical practice and epidemiology, BMI is the most used indicator to determine both the individual and collective general nutritional status. This index is considered to positively correlate with certain health and longevity indicators [27, 28]. In the present study, nutritional status as determined using the BMI (<18.5 kg/m^2) was higher in Mundas (50.0%) than in Oraons (46.2%). Similarly, the health status determined using PBF was slightly higher in Oraons (35.4%) than in Mundas (29.3%).

Low weight (BMI < 18.5) in men and women has been reported to be associated with decreased physical, social, and mental wellbeing. Both overweight and low weight values were associated with a lower quality of life, worse physical performance, and less physical wellbeing [29].

5. Conclusion

Our findings suggest that we can use BMI and PBF in identifying individuals who are experiencing nutritional stress. It had been clear that using BMI the prevalence of undernutrition was very high (critical situation), both among

Munda and Oraons males. On the other hand using PBF it showed that (29.3%) Mundas and (35.4%) Oraons had low body fat percentage. Prospective studies are required to determine the associations between health status and PBF as well as nutrition status and BMI in different indigenous ethnic groups of India and elsewhere. This is particularly important for a country like India which is a home to numerous indigenous populations. Of paramount necessity is the use of PBF to study nutritional and morbidity status. Hitherto, there is a paucity on information on these variables among tribal populations of India.

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