CHAPTER 11

Chronic Energy Deficiency among Tribal Communities of Orissa, India

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INTRODUCTION

It is an established fact that body mass index (BMI) is a useful anthropometric indicator of measuring nutritional status of the population (FAO, 1996) and is specifically suitable for large scale surveys (Ulijaszek and Kerr, 1999; WHO, 1995) spread over space (Adak, 2006a) and time (Gorstein and Akre, 1988). The prevalence of chronic energy deficiency (CED) measured through BMI (James et al., 1988; Ferro-Luzzi et al., 1992), can be used for assessing the differences in the standard of living between population groups (Nube et al., 1998). The appropriateness of using BMI less than 18.5 kg/ m^2 as chronic undernutrition are validated by many authors to predict poor demographic, economic, social and environmental conditions of the population (Pryer and Rogers, 2006; Subramanian and Smith, 2006). Chronic undernutrition reduces physical capacity (James, 1994), increases mortality (Harris et al., 1993) and morbidity (Khongsdier, 2002). In India, the most underprivileged group is the tribal communities both in terms of socioeconomic condition as well as nutritional status (Basu, 1994; Sharma, 2004). Several studies show these reflection as high chronic energy undernutrition among tribals across India (Ferro-Luzzi et al., 1992; Khongsdier, 1997; Adak et al., 2006a, 2006b) and specifically in the State of Orissa, which has largest number (62) of tribal communities (Ministry of Tribal Welfare, 2001). Orissa comprises of 22.13 percent (8.15 million) of total population of Orissa State (Census of India, 2001) and half of them is living below poverty line (Mahapatra et al., 2000). The manifestation of such poor living condition leads to high prevalence of chronic energy deficiencies among tribal communities of Orissa specifically among Dongria Khonds (Bulliyya et al., 2004), Bathudis (Bose and Chakrabarty, 2005), Santal (Bose et al., 2006a) and Savar (Bose et al., 2006b). But the degree of prevalence differs from one community to other. The present study is an attempt to find out this variation of the prevalence of chronic undernutrition across tribal communities.

MATERIALS AND METHODS

Seven tribal communities namely Bhuiya, Gond, Khond, Munda, Paroja, Santal and Savara from 13 districts of Orissa were chosen for the present study. The anthropometric data were obtained from a baseline cross sectional anthropometric survey conducted by Anthropological Survey of India in Orissa (Bhowmik and Basu, 1989). The sample consists of 655 adult males from 7 tribal communities, aged 18-62 years. The data were collected using standard techniques (Martin and Saller, 1956) and by the trained physical anthropologists. Efforts were also made to take measurements among apparently looking normal adult males and it is free from any selection bias.

In the present study, we have considered only the height (cm), sitting height (cm) and weight (kg). We computed Cormic Index (CI = sitting height/ height) and BMI (weight in kg / square of height in meter). The subjects were classified on the basis of CED grades (James et al., 1988). For anthropometric measurements, we calculated mean and standard deviation in each community. ANOVA was carried out along with post hoc multiple range test to understand the nature of differences in means of the anthropometric measurements between communities. Linear regression was computed to find out the relationship of BMI and CI.

RESULTS

Mean and standard deviation of height, weight, sitting height, BMI and CI among adult males of 7 tribal communities of Orissa are presented in table 1. Within these 7 tribal communities, Gond males are the tallest (160.64 cm) followed by Santal (160.27 cm) and Paroja (160.06 cm) males. Whereas, Bhuiya males are the shortest (155.87 cm) along with lower average values of sitting height (79.63 cm). Though the Bhuiya are the shortest as well as have low sitting height but they are heavier in weight (47.18 kg) and thus shows the highest average value of

Table 1: Mean and standard deviation of anthropometric measurements among tribals of Orissa.

Tribal comm-unities	*n*	*Height (cm)*		*Weight (kg)*		*Sitting height (cm)*		*BMI (kg/m²)*		*Cormic index (CI)*	
		Mean	*± SD*	*Mean*	*± SD*	*Mean*	*± SD*	*Mean*	*± SD*	*Mean*	*± SD*
Bhuiya	50	155.87	± 4.55	47.18	± 4.89	79.63	± 3.11	19.41	± 1.84	0.511	± 0.014
Gond	99	160.64	± 5.14	46.70	± 4.17	81.42	± 3.14	18.11	± 1.51	0.507	± 0.013
Khond	100	156.27	± 4.69	46.77	± 4.59	80.73	± 2.74	19.17	± 1.95	0.517	± 0.016
Munda	50	157.22	± 5.22	47.26	± 4.95	78.87	± 3.66	19.11	± 1.68	0.502	± 0.019
Paroja	50	160.06	± 5.77	44.28	± 4.64	81.32	± 3.01	17.31	± 1.84	0.508	± 0.017
Santal	106	160.27	± 5.28	47.00	± 4.70	81.65	± 2.98	18.28	± 1.47	0.510	± 0.014
Savara	200	158.70	± 5.53	46.50	± 4.66	80.96	± 3.22	18.46	± 1.59	0.510	± 0.016
ANOVA		11.089**		2.578*		6.634**		11.812**		6.679**	

Level of significance * p<0.05; **p<0.01

BMI (19.41 kg/m^2). On the other hand, Paroja are lighter in weight (44.28 kg) and thus have the lowest mean value of BMI (17.31 kg/m^2). The average values of cormic index vary from 0.502 for Munda to 0.517 for Khond. The one way analysis of variance (ANOVA) shows that the anthropometric measurements and indices between these 7 tribal communities are highly significant. The post hoc test of one way ANOVA for the difference between two tribal communities (Table 2) for BMI reveals that Bhuiya have significantly higher BMI than other tribal communities except Khond and Munda. Whereas Parojas have significantly lower average BMI compared to rest of the communities.

Table 2: Multiple range test (least significance difference) for BMI

Tribal comm-unities	*Bhuiya*	*Gond*	*Khond*	*Munda*	*Paroja*	*Santal*
Bhuiya						
Gond	+					
Khond	-	+				
Munda	-	+	-			
Paroja	+	+	+	+		
Santal	+	-	+	+	+	
Savara	+	-	+	+	+	-

Level of significance:+ p<0.05, - p>0.05.

The percentage distributions of the gradation of body mass index for distinguishing the prevalence of chronic energy deficiency among adult males are presented in table 3. As the Paroja are observed to have the lowest average values of BMI, the prevalence of CED is also the highest (18.0% for Grade-III and 28.0% for Grade-II) followed by Gond for Grade-III (7.07%) and Santal for Grade-II (14.15%). Maximum prevalence of CED is observed in Grade-I group for all the tribal communities and maximum prevalence is observed among Santal (45.28%). The gradation of BMI is significantly (p<0.001) distributed according to these 7 tribal communities. On the basis of 18.5 kg/m^2 BMI values as the cut off point for screening normal and CED groups (Fig. 1), the present study reported that the prevalence of CED (<18.5 kg/m^2) among the Paroja tribe is the highest (80.0%) followed by Gond (64.6%), Santal (63.2%) and Savara (53.0%). Recently Bose et al. (2006a; 2006b) reported comparatively less prevalence of undernutrition among Santal (26.2%) and Savar (38.0%) tribes of Orissa than the present studied communities.

The community wise bivariate scatter plot

Table 3. Distribution of BMI (%) according to chronic energy deficiency.

Tribal comm-unities	*CED Grade III (Severe) (BMI<16.0)*	*CED Grade II (Moderate) (BMI=16.0-16.99)*	*CED Grade I (Mild) (BMI=17.0-18.49)*	*Normal (BMI=18.50-24.99)*	*Obese (BMI>=25.0)*
Bhuiya	1 (2.00)	2 (4.00)	12 (24.00)	34 (68.00)	1 (2.00)
Gond	7 (7.07)	13 (13.13)	44 (44.44)	35 (35.35)	0 (0.00)
Khond	5 (5.00)	9 (9.00)	21 (21.00)	64 (64.00)	1 (1.00)
Munda	1 (2.00)	6 (12.00)	10 (20.00)	33 (66.00)	0 (0.00)
Paroja	9 (18.00)	14 (28.00)	17 (34.00)	10 (20.00)	0 (0.00)
Santal	4 (3.77)	15 (14.15)	48 (45.28)	39 (36.79)	0 (0.00)
Savara	8 (4.00)	26 (13.00)	72 (36.00)	94 (47.00)	0 (0.00)

Parentheses show percentage, Chi-square = 83.952, df = 24, p<0.001.

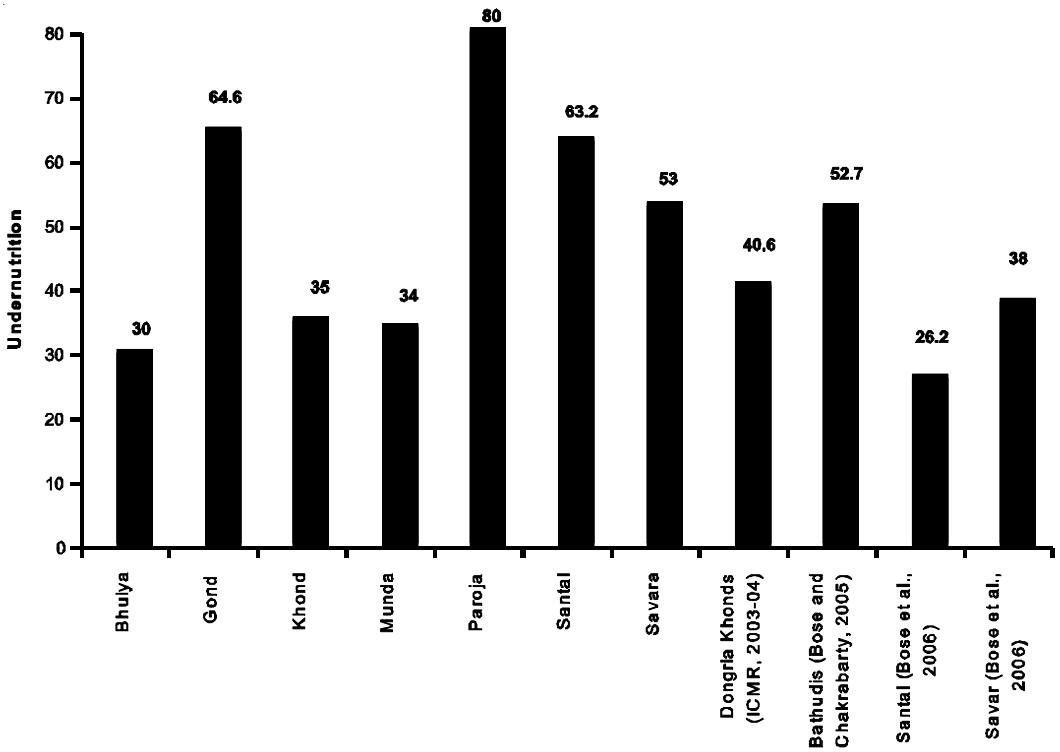

Fig. 1. Prevalence (%) of undernutrition (BMI < 18.50 kg/m^2) among adult male from selected tribal communities in Orissa.

between CI and BMI reveals (Fig. 2a-h) that there exits linear relationship between CI and BMI for most of the tribal communities. The relationship is not so conspicuous for Santal and Munda communities. This is further confirmed by the regression analysis. The regression coefficients of BMI on CI are shown in table 4. It reveals that the regression coefficient is found to be significant ($p<0.05$ or $p<0.01$) among Bhuiya, Gond, Khond, Paroja and Savara tribal communities but insignificant among Munda and Santal communities. These results are also equivalent to the positive significant values of their respective correlation coefficients (r). The relation between CI and BMI is also significant, if we combine all the seven tribal communities. The scatter diagram distinctly shows a linear trend. It only means that there is a common property, which exits in all the tribal groups so far as height and weight are concerned. However, on the basis of figure 3, Bhuiya, Khond, Santal and Savara can be categorized into a single group, who have higher mean values of BMI and CI. On the other hand, Gond and Paroja have comparatively low BMI and CI, which can be classified as distinct group. But only Munda community, have low CI but higher mean BMI.

Table 4: Linear regression coefficient of BMI on CI.

Tribal communities	*Coefficient of correlation*		*Coefficient of regression*		*t-value*
	R	*SE*	*b*	*SE*	
Bhuiya	0.417	1.694	55.65	17.53	3.175**
Gond	0.245	1.472	29.57	11.86	2.494*
Khond	0.323	1.851	39.03	11.54	3.383**
Munda	0.228	1.649	20.30	12.53	1.621
Paroja	0.514	1.597	56.73	13.65	4.155**
Santal	0.182	1.455	19.00	10.09	1.884
Savara	0.210	1.555	20.92	6.93	3.022**
All tribes	0.280	1.678	31.08	4.169	7.455**

Level of significance: * $p<0.05$, ** $p<0.01$.

DISCUSSION

The present study reveals that all the 7 tribal communities from Orissa are lean and thin. The

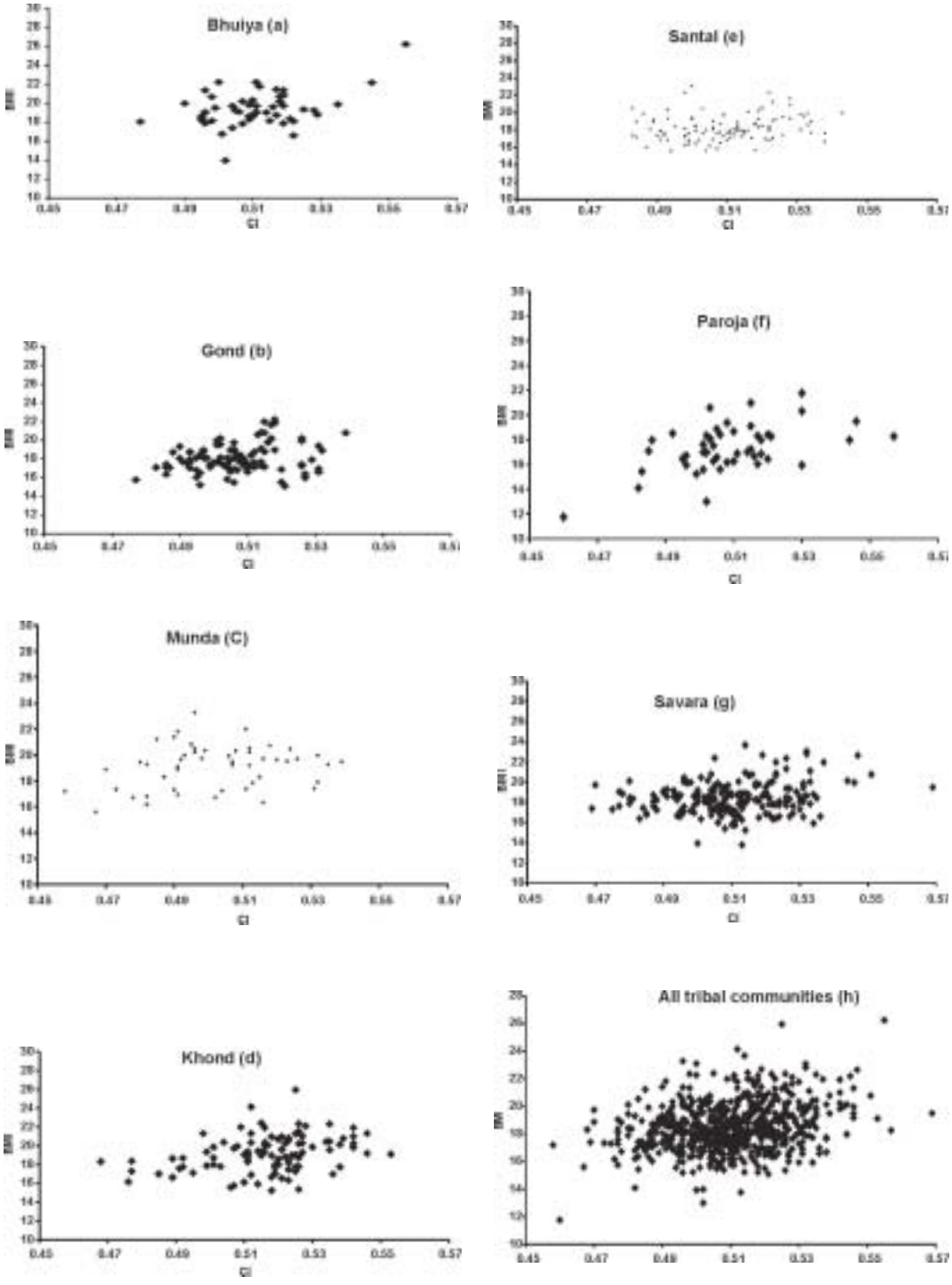

Fig. 2. Bivariate scatter diagram (a-h) of CI and BMI of the tribal communities.

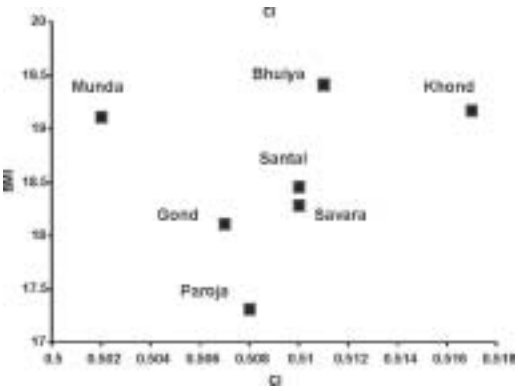

Fig. 3. Bivariate scatter diagram of mean values of CI and BMI of the tribal communities.

fact that the tribals are usually lean and thin is corroborated from studies reported by Khongsdier (2001) in North Eastern tribal communities, Adak et al. (2006a) in Central Indian tribal communities and in Maharashtra State of India (Adak et al., 2006b). Therefore, though the tribal communities are living into the different regions of India but the national picture of leanness and thinness among the tribals is similar. These similarities are also manifested through lower BMI among them. The lowest average of BMI is observed among Sonr (17.64) from Central India (Adak et al. 2006a), Warli (16.82) from Maharshtra (Adak et al. 2006b) and Paroja (17.13) from the present studied community. These may be due to their significant lower weight rather than higher height, which may directly relate to nutritional status. BMI may be considered as the major expression of nutritional consumption rather genetically predisposition (Rolland-Cachera, 1993). The prevalence of chronic energy deficiency through gradation of BMI has the same trends as average BMI. Thus Paroja adult males suffer more by CED compared to other communities studied here. The Sonr and Warli adult males also suffer more by CED. Apart from these spatial variations of nutritional status through BMI, temporally, interestingly, Bose et al. (2006a) reported a lower prevalence of undernutrition (26.2%) among the Santal adult males of the same state of Orissa than that of our present study among Santals. Savar (38.0%) adult males of Orissa are also reported (Bose et al., 2006b) to have less prevalence of undernutrition than found in our study. But the sub tribe of Khond like Dongria Khonds of Orissa is observed (Bulliyya et al., 2004) to have slightly higher prevalence of undernutrition (40.6%). High prevalence of malnutrition among Bathudis tribal adult males are observed in Orissa (Bose and Chakrabarty, 2005). Therefore, though the prevalence of under-nutrition of some tribes likes Santal, Savar have decreased but there are tribal communities, who still have high prevalence of undernutrition among themselves. This only shows that the development in different regions within the state of Orissa was not uniform.

The present study shows dependency and inverse relationship between BMI on CI as also found by Norgan (1994). Only Munda adult males do not have a statistically significant relationship between BMI and CI. Other researchers (Adak et al., 2006a, 2006b) also observe similar findings. Genetic predisposition may also plays an important role for determining BMI of these studied tribal communities. Differences of BMI among the tribal communities may be due to the combined effect of genetic and environmental factors (Khongsdier, 2001). It is known that linear bodies built with a low weight to surface area ratio is one of the general characteristics of the people living in tropical and subtropical climates (Schreider, 1968). Tribal communities of Orissa can not be an exception to this finding as seen from high prevalence of CED grade-I among them. But substantial proportion of CED grade-II and III among males points out to other reasons like hunger or severely low level of food intake for a longtime specifically among some tribal groups like Paroja. This can only arise from sustained poverty.

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KEYWORDS Body mass index (BMI); chronic energy deficiency (CED); cormic index (CI); adult males; tribe in Orissa

ABSTRACT Orissa is one of the most backward states in India. Naturally it's reflection will be felt in the tribal communities also. To find the prevalence of chronic energy deficiency (CED) among seven tribal communities of Orissa, data on height, sitting height and weight from 655 adult males aged 18 to 62 years are taken for the present analyses. The data have been collected by Anthropological Survey of India. Body mass index (BMI) and cormic index (CI) have been computed and subjects have been classified on the basis of chronic energy deficiency (CED). ANOVA along with post hoc multiple range test, chi square test and linear regression have been carried out. The results reveal that within these seven tribal communities Gond males have tallest mean height (160.64 cm) and Bhuiya males have the shortest mean height (155.87 cm). But Bhuiyas are heavier in weight (47.18 kg) and with highest average BMI (19.41 kg/m^2). On the other hand, Paroja have the lowest average value of BMI (17.31 kg/m^2) leading to the highest prevalence of chronic energy deficiency (18.0% for CED III and 28.0% for CED II) compared to rest of the groups. The tribal communities are spread out at different regions in India. The national picture of leanness and thinness along with high prevalence of chronic energy deficiencies are similar in all the tribal communities and Orissa is no exception. Beside these, significant ($p<0.01$) regression coefficient values of

BMI on CI of the tribal males indicate the genetic predisposition of BMI. High prevalence of CED III and CED II among the tribal communities in Orissa may be due to their poor socioeconomic condition.

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