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Nutritional Status and Its Correlates among the Adult Santhals of Bankura district of West Bengal, India

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ABSTRACT

The present study aims to determine the prevalence of chronic energy deficiency (CED) amongst adult Santhals. A cross sectional sample of 1262 adult Santhals (692 males and 570 females) were collected from West Bengal using multistage cluster random sampling. Body mass index (BMI) has calculated for each subject and categorized according to WHO classification. Linear regression has been computed to assess the effect of various socio-economic factors on nutritional status, which is estimated from BMI. Nutritional status of Santhals suggests high prevalence (46.9%) of undernutrition (BMI < 18.50 kg/m^2) in this population, which is more apparent in females (50.0%) as compared to their counterparts (44.4%). Negative and statistically significant coefficient of age^2 on BMI reflects that with the increase in age, effect of age on BMI increases. This results into a low BMI with increment of age. Economy has a crucial role in developing low BMI among Santhals (β = -1.194±0.171, $p<0.01$). Undernutrition is an increasing problem in West Bengal, especially in tribal communities. Poor socio-economic condition and necessity of doing labourious physical activity to sustain daily livelihood affects body mass index of these tribal people.

Key Words: *Body mass index, Tribes, Socio-economic factors, Linear regression*

INTRODUCTION

Anthropometry is the single most portable, easily applied, inexpensive and non-invasive method of assessing body composition, which reflects both health and nutrition (Ismail et al., 1995). Anthropometric measurements like body mass index (BMI) have long been used by the Anthropologists as one of the measures of health status, as it has proved to be an excellent estimator of body fatness. Although there are numerous methods applicable to assess nutritional status, but only a few methods are suitable in Anthropological studies. In 1869, Quetelet was the first person to observe that among adults of normal build but different heights, weight was roughly proportional to height square: Quetelet Index (weight/height^2). Later it was renamed as ‘body mass index’ (BMI) by Keys et al. in 1972. The use of body mass index as a measure of obesity has been widespread and has also been promoted for assessment of chronic energy deficiency (CED) in adults (Ismail, 1995).

Body mass index contains both fat mass and fat-free mass, where human body fat has physiological and medical importance (Durnin and Womersley, 1974). It is a widely known fact that distribution of body fat is an important indicator of nutrition and health. Further, body mass index is the product of continuous and complex interaction of biological or indigenous and environmental or exogenous factors. Biological factors influencing BMI, among other, are heredity or genetics, age and sex of an individual. Exogenous factors, on the other hand, include both environmental and socio-cultural factors such as nutrition, altitude, climate, socio-economic status, religious practices, cultural activities and mode of subsistence.

While discussing BMI, we can hardly ignore the fact that like majority of the Asian countries, undernutrition or chronic energy deficiency is still a major health problem in India. This occurrence is far more common among rural communities, especially among tribal populations (NFHS II, 1999). Santhals, a tribal population from West Bengal, is no exception to this. The requirements of strenuous and laborious physical activity to sustain daily livelihood under scarce nutritional resources perhaps affects body mass index of these tribal people. In line with this idea, even previous investigators have considered physical activity (Croppenstedt and Muller, 2000), socio-economic status (Ahmed et al., 1998), dietary intake (Ramachandran, 2007), morbidity (Khongsdier, 2002) and place of residence (Chakrabarty and Bharati, 2010), as important determinants of nutritional status. However, such studies in tribal populations are few. Keeping this information in mind, the present investigation aims to study the variations in body mass index of Santhals from West Bengal, in relation with socio-economic parameter.

MATERIALS AND METHODS

A cross-sectional sample of 1262 Santhals was collected from eighteen villages of Ranibandh block of Bankura district, West Bengal, using multistage random cluster sampling method (Figure 1). Measurements were taken on 692 males, aged 18-87 years (mean 44.4 years) and 570 females, aged 18-83 years (mean 41.5 years). Permission was taken from the subject for conducting investigation on them on a prescribed consent form.

West Bengal is one of the few states of India, having a considerable percentage of tribal population. The reason for selecting this particular region is that Ranibandh is a Santhal inhabited region, where there are villages with exclusive inhabitation of this community. It has been reported that the Santhals have been living in this part of West Bengal for at least five hundred years (Culshaw, 1949).

Body mass index (BMI)

In order to assess body mass index, anthropometric measurements like height, weight, mid upper arm circumference, skinfolds at triceps, biceps, suprailiac and sub scapular were taken on each participant following standardized techniques (Martin and Saller, 1957). BMI was calculated by the formula,

$$\text{body mass (kg)/stature (m}^2\text{)}$$

The World Health Organisation (WHO) regional office for Western Pacific Region, along with the International Association for the study of Obesity (IASO) and the International Obesity Task Force (IOTF), has recommended a BMI of 23.0 kg/m^2 as the cut-off point for defining overweight in Asian populations (WHO, 2000). Following BMI classification is used in the present study (WHO, 2000):

Classification	BMI cut-off points (kg/m^2)
CED Grade III (Severe)	< 16.00
CED Grade II (Moderate)	16.00 – 16.99
CED Grade I (Mild)	17.00 – 18.49
Normal weight	18.50 – 22.99
Overweight	≥ 23.00

Linear Regression

SPSS 15.0 and STATA 11.1 for Windows have been used for computing statistical analyses. Linear regression has been used to understand the effect of socio-economic factors on BMI. Categorical or nominal variables like economic status and gender have been incorporated into the regression model by means of dummy variables, ‘D’ and ‘Z’ respectively.

Where, $$D = \begin{cases} 1 & \text{if low economic group} \\ 0 & \text{if high economic group} \end{cases}$$

Here, the Santhals belonging to the primary occupational categories ‘Labourer’ and ‘Owner cultivator cum labourer’ are referred as ‘Low economic group’ (henceforth LEG) and the Santhals belonging to the primary occupational categories ‘Owner cultivator’, ‘Govt. employee’ and ‘Businessman’ are referred as ‘High economic group’(henceforth HEG).

and $$Z = \begin{cases} 1 & \text{if Male} \\ 0 & \text{if Female} \end{cases}$$

Map of India

Map of West Bengal

Map of Bankura

Figure 1: Map showing the position of West Bengal, Bankura and Ranibandh in the map of India, West Bengal and Bankura respectively (From top to bottom).

RESULTS

Nutritional status of Santhals suggests high prevalence (46.9%) of undernutrition in this population (Figure 2). Undernutrition is more evident in females (50.0%) as compared to their counterparts (44.4%), where differences are statistically significant at 1% probability level (χ^2 = 13.687). This information is reported elsewhere by the author (Ghosh, 2014). Age group-wise distribution of nutritional status indicates that the percentage of severe chronic energy deficiency (CED III) increases gradually from younger age groups to older age groups, as reported elsewhere by the author (Ghosh, 2014).

Table 1: Anthropometric variables according to nutritional status

Anthropometric Measurements	**Reported CED$^{\pm}$ (BMI < 18.5 kg./m^2)** N=592	**Non CED$^{\pm}$ (BMI ≥ 18.5 kg./m^2)** N=670	**Analysis of Variance (ANOVA)**
Stature (cm)	156.18±8.35	155.59±8.58	1.596
Body Weight (kg)	41.17±5.63	49.98±6.77	622.317*
Mid upper arm circumference (cm)	22.74±1.84	24.88±2.12	361.104*
Body Mass Index (kg/m^2)	16.82±1.35	20.61±1.93	1584.380*
Sum of Skinfolds (mm)	23.77±9.58	33.50±14.16	198.991*

* P < 0.05

± CED = Chronic energy deficiency

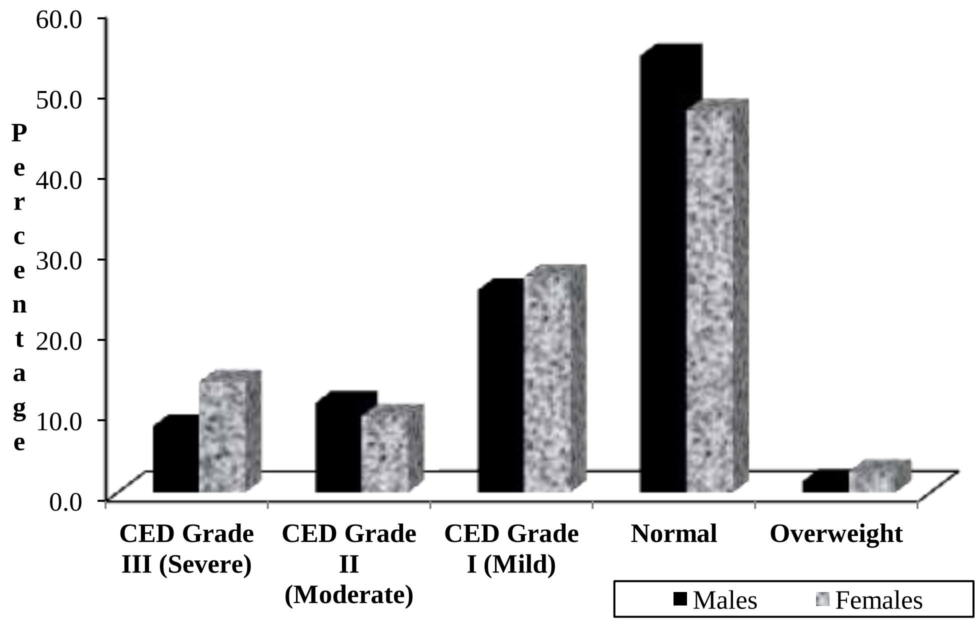

Figure 2: Nutritional Status among adult Santhals

Table 1 demonstrates anthropometric measurements for Santhals reported as CED and non CED during the present study. The ANOVA results suggest that all the fat and mass related variables, i.e., weight, mid upper arm circumference and sum of skinfold, exhibit considerably greater values among Santhals not considered as CED (mean BMI = 20.61±1.93) as compared to those considered as CED (mean BMI = 16.82±1.35). Moreover, these differences are statistically significant at 5% probability level. Stature, on the other side, does not show any statistically significant difference between these two groups of Santhals. This result further confirms that nutritional status of an individual is influenced more by the environmental factors than the genetic factors. As a consequence, the impact of nutritional status is more visible on fat-mass related measurements than linear or longitudinal measurements like stature.

The selection of predictor variables for linear regression model is based on the result of univariate analysis calculated on each predictor variable with BMI. Parameters used in regression model are those which have shown significant relation with BMI in univariate analysis (Table 2). The specification of the linear regression model in this paper includes $age^2 = age \times age$. Through this variable I capture the effect on *change in BMI due to change in age* as age changes.

Table 2: Result of Linear Regression: Effects of Socio-economic factors on BMI among Santhals

Predictor Variables	**β Coefficients**	**Standard error***	**t**	**P >| t |**
Age	0.055	0.021	2.61	0.009
Age^2	-0.001	0.000	-3.91	0.000
$Z_{\text{Males vs. Females}}$	0.368	0.142	2.58	0.010
$D_{\text{LEG vs. HEG}}$	-1.182	0.173	-6.80	0.000
Constant	19.088	0.471	40.49	0.000

* Standard errors are robust

Z and D are Dummy variables for gender and economic status respectively

The effect of age on BMI is captured by,

Coefficient of age+2×coefficient of age² ×arithmetic mean of age. (1)

I refer the reader to the appendix of this paper for the exact calculation of this formula.

In the present study, age has been found to significantly influence BMI. Negative and statistically significant coefficient of age^2 on BMI reflects that with the increase in age, BMI decreases. However the effect of age on BMI calculated by (1) is positive and significant. In other words, elderly Santhals tend to become more underweight or CED as compared to the younger Santhals, irrespective of their gender. In general, Santhal males are at lower risk of becoming underweight as compared to their counterparts (β = 0.368, p = 0.010), which is statistically significant. Economic level, as captured in the present study through primary occupation, has a crucial role on BMI among Santhals. It is observed that Santhals from lower economic groups, i.e. those engaged in occupations like agricultural or day labour, have significantly higher risk of becoming underweight or undernourished than Santhals from higher economic groups, i.e. owner cultivators, government employees or businessmen (β = -1.182, p = 0.000).

DISCUSSION

The focal point of this study is to investigate adult nutritional status and its correlates among Santhals from Bankura, West Bengal. The high prevalence of undernutrition in this population is more apparent among elderly people. Similar trend of high undernutrition is also observed in other tribal populations like Shabars of Orissa (Chakrabarty and Bharati, 2010), Dhimal of Darjeeling, West Bengal (Datta Banik et al., 2007), Munda (Ghosh and Bharati, 2006), Kora Mudi of Bankura, West Bengal (Bose et al. 2006), Lodha of Paschim Medinipur, West Bengal (c.f. Das and Bose, 2010), Oraon of Jalpaiguri, West Bengal (Mittal and Srivastava, 2006), Santal of Purulia, West Bengal (Das and Bose, 2010) and War Khasi of Meghalaya (Khongsdier, 2002). It is evident from these studies that the prevalence of undernutrition is significantly higher among females, in most of these tribal populations including the present study among the Santhals of Bankura, as compared to males.

Furthermore, it is observed that as compared to the neighbouring male tribal populations, such as Kora Mudi (48.0% CED), Lodha (45.2% CED), Munda (49.0% CED) and Oraon (47.0% CED) of West Bengal, the incidence of undernutrition is marginally lower among the Santhal males (44.4% CED). Nevertheless, this scenario changes abruptly among the females. It is evident that Santhal females exhibit higher incidence of undernutrition (50.0% CED) as compared to their counterparts from Dhimal (46.4% CED), Lodha (40.7% CED) and Oraon (31.7% CED). However, Santhal females of Bankura has lower incidence of undernutrition as compared to the Kora Mudi (56.4% CED) females and Santal females (63.4% CED) of Purulia (Das and Bose 2010).

Socio-economic determinants of nutritional status suggests that apart from age and economic conditions, gender play crucial roles in defining body dimension of Santhal adults.

Significant gender influence on BMI could be due to the difference in physical activity pattern between Santhal males and females. Santhal males basically carry out the agricultural activities and animal husbandry. Females on the other hand, in addition to assisting men in the above mentioned activities, perform household work that includes collecting fodder and fuel. For this purpose they often travel 10-15 km to and fro, as reported elsewhere (Ghosh and Malik, 2010).

The relationship between various anthropometric measurements and occurrence of CED indicates that BMI is more closely related to fat and mass related measurements rather than longitudinal or linear measurements, as also suggested by earlier researchers like James et al. (1988) and Ulijaszek and Lofink (2006). Perhaps, it is worth noting here that mid-upper arm circumferences of Santhals classified under CED are higher in both males (23.04cm) and females (22.41cm) than the cut-off point given by James et al. (1994). This observation suggests the fact that may be on an average, Santhals possess higher muscle mass and less fat mass. As a result, they show low BMI, which is due to the possession of low fat-mass but not fat-free mass. This is possible because BMI contains both fat-mass and fat-free mass (Durnin and Womersley, 1974).

Hence, the prevalence of low BMI in this population might be due to their painstaking daily hard work under low socio-economic status, to sustain their livelihood. However, such body dimension has an adaptive advantage for this forest dwelling population to survive under tropical conditions and low nutritional resources, as such body type needs less nutritional requirement to maintain.

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Appendix

Consider the following linear regression model,

$$Y=\beta_1 + \beta_2 X+ \beta_3 X^2+ \beta_4 Z+\text{Error}$$

Now take the partial derivative,

$$\frac{\partial Y}{\partial X}= \beta_2+2\,\beta_3 X.$$

In our model when X is age and Y is BMI, effect of age is calculated at the arithmetic mean of X. Now by taking partial derivative of $\frac{\partial Y}{\partial X}= \beta_2+2\,\beta_3 X$ with respect to X again we obtain,

$$\frac{\partial}{\partial X}\left(\frac{\partial Y}{\partial X}\right) = 2\,\beta_3.$$

Since 2 is a positive constant, coefficient of age^2 captures effect on *change in BMI due to change in age* as age changes. In other words letting Y to denote BMI and X to denote age,

$$\frac{\partial Y}{\partial X} = \text{change in BMI due to change in age}$$

and,

$$\frac{\partial}{\partial X}\left(\frac{\partial Y}{\partial X}\right) = \text{effect on change in BMI due to change in age as age changes.}$$