

## A Comparative Study of Physical Growth and Nutritional Status in Santal Children of Ghatsila and Bolpur

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### INTRODUCTION

The nutritional status of children is a good indicator of the health status of a community. The growth and nutritional status of the children of various sections of Indian population have been assessed (Chatterjee and Mondal, 1991; Agarwal et al., 1992), but the information about the tribal population in this regard is very limited (Mitra et al., 2002; Bose and Chakraborti, 2005). According to the Census of India (Census, 2001), the tribal population of India is over 84 millions which constitute 8.2% of its total population. Santals are the largest and the most resilient tribe in eastern India. This tribe is found to be socially and economically deprived (Saha and Saha, 1998) and their diets appear to be nutritionally deficient (Moitra and Chowdhury, 1991; Roy et al., 1982). The nutritional status of Santal has not been investigated elaborately excepting few studies (Bagchi, 1994; Rao and Vijay, 2006). The present study has been undertaken to evaluate and compare the physical growth pattern and nutritional status among 5-12 years old Santal children from two different regions, Ghatsila (in Jharkhand) and Bolpur (in West Bengal).

### METHODS AND MATERIALS

**Study Population:** The subjects for the present cross sectional study were collected from Powra and Burudi villages of Ghatsila in Jharkhand and some villages (Ballavpur, Danga, Fuldanga, Bonerpukur) surrounding Bolpur of Bhirbhum district in West Bengal. A sample of 123 (65 boys and 58 girls) Santal children of Ghatsila and 105 (42 boys and 63 girls) Santal children of Bolpur, aged 6-10 years were selected for the present study. The age of each child was verified from mothers of the child or from the school records. Data were collected after obtaining the necessary approval from the school authorities. Child suffering from any systemic disease or with major surgical operations was excluded from the study. The protocol and procedure employed was according to the human

ethical guidelines of Helsinki Declaration (Touitou et al., 2004).

**Anthropometric Measurements:** The anthropometric measurements like height, weight, and mid-upper arm circumference (MUAC) of each child were measured using standard technique (Lee and Nieman, 2003). Body mass index (BMI) was calculated as the ratio of [weight (kg)/height<sup>2</sup> (m)].

**Nutritional Status:** For assessing the nutritional status of subjects, weight deficit for age, height deficit for age and MUAC deficit for age have been calculated. The subjects were divided into three levels of malnutrition besides normal i.e. grade-I, grade-II and grade-III malnutrition. The classification for weight deficit for age, height deficit for age and MUAC deficit for age was followed from Gomez (Gomez et al., 1953), Waterloo (Waterloo et al., 1977) and Jelliffe (Jelliffe, 1966) respectively. Subjects were also categorized as severe, moderate and mild to normal undernutrition on the basis of their BMI, as described by World Health Organization (WHO, 1963)

**Statistical Analysis:** Mean and standard error of mean were computed for each anthropometric variable for each age group. Growth pattern of Santal children was compared with the reference data of National Centre for Health Statistics (NCHS) (CDC, 2000). One-way ANOVA was employed for comparison of the anthropometric data between sexes and also between the Santal children of two different regions. A significance level of  $p < 0.05$  was considered to be statistically significant. Pearson's correlation coefficient was used to evaluate the relationship among the different anthropometric parameters. The statistical analyses were performed using statistical package for social science (SPSS software).

### RESULTS

#### Growth Pattern

The mean and standard error of mean of different anthropometric parameters of each age

group of Santal children of Ghatsila and Bolpur are presented in table 1 and 2. There was no significant difference in height, weight, BMI and MUAC values between Santal boys of Ghatsila and Bolpur regions at all age groups and also between Santal girls of these two regions. Similarly, height, weight, BMI and MUAC values of Santal boys and girls are also not significantly different when compared between Ghatsila and Bolpur.

The mean heights of Santal boys of two regions (Fig. 1A) and girls of two regions (Fig. 1B) are placed around the 10<sup>th</sup> percentile and 5<sup>th</sup> percentile values of NCHS reference data, respectively. It has been found that the mean weights of Santal boys (Fig. 2A) and girls (Fig. 2B) at 6-10 years of age of both Ghatsila and Bolpur regions remain around the 5<sup>th</sup> percentile of NCHS reference data. The mean MUAC values of Santal boys (Fig. 3A) and girls (Fig. 3B) of two regions are placed under 5<sup>th</sup> percentile of NCHS reference data at all age groups. Figure 4A present that the mean BMI values for Santal boys of Ghatsila stay around the 5<sup>th</sup> percentile while those of Bolpur remain around the 25<sup>th</sup> percentile of NCHS reference data. Similar pattern of BMI in girls of Ghatsila (5<sup>th</sup> percentile) and Bolpur (25<sup>th</sup> percentile) was observed (Fig. 4B).

### Nutritional Status

**Weight-for-Age:** 92.31% Santal boys and 96.56% of girls of Ghatsila (Table 3) and 85.72% Santal boys and 88.89% girls of Bolpur are found to be underweight (table 4). In Bolpur, Santal girls show higher percentage (30.16%) of severe underweight than boys (14.28%), while boys show higher percentage (40.48%) of mild underweight than girls (19.04%). The percentage of different grades of malnutrition in boys and girls of Ghatsila are similar.

**Height-for-Age:** Santal children show high prevalence of stunting (in Ghatsila: 58.47% boys and 65.52% girls and in Bolpur: 61.91% boys and 68.26% girls) according to height-for-age parameter (table 3 and 4). In Bolpur, the percentage of severe stunting (grade-III) is higher in Santal girls (38.09%) than boys (14.28%). The percentage of severe stunting (grade-III) is also higher in girls of Bolpur (38.09%) than that of Ghatsila (5.18%).

**MUAC-for-Age:** According to MUAC-for-age, prevalence of undernutrition is found to be similar between Santal boys and girls of two surveyed regions, and also when compared between Ghatsila

**Table 1: Mean and standard error of mean of height, weight, body mass index (BMI) and mid-upper arm circumference (MUAC) for Santal boys and girls of Ghatsila.**

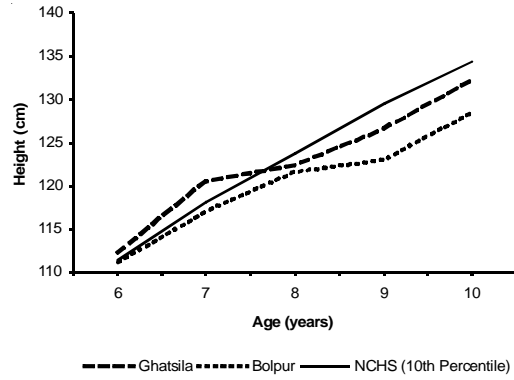
Age (years)	Santal boys					Santal girls				
	N	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	MUAC (cm)	N	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	MUAC (cm)
6	9	112.17 ± 2.36	17.67 ± 0.63	14.14 ± 0.73	14.95 ± 0.29	10	109.95 ± 1.63	16.31 ± 0.68	13.53 ± 0.65	14.71 ± 0.43
7	14	120.54 ± 2.19	20.86 ± 0.57	14.24 ± 0.76	16.36 ± 0.32	13	119.43 ± 2.12	18.66 ± 0.75	13.22 ± 0.42	16.47 ± 0.54
8	19	122.32 ± 2.68	21.27 ± 0.97	14.22 ± 0.44	16.51 ± 0.39	16	120.94 ± 1.16	21.13 ± 0.84	14.39 ± 0.47	16.54 ± 0.24
9	10	126.51 ± 3.47	22.51 ± 1.07	14.03 ± 0.44	16.55 ± 0.39	7	121.15 ± 2.22	20.51 ± 0.99	13.99 ± 0.57	15.92 ± 0.51
10	13	132.12 ± 2.47	24.62 ± 1.63	14.94 ± 0.67	17.77 ± 0.59	12	127.04 ± 4.47	22.84 ± 1.59	14.25 ± 0.46	17.17 ± 0.51

Values: Mean ± SE

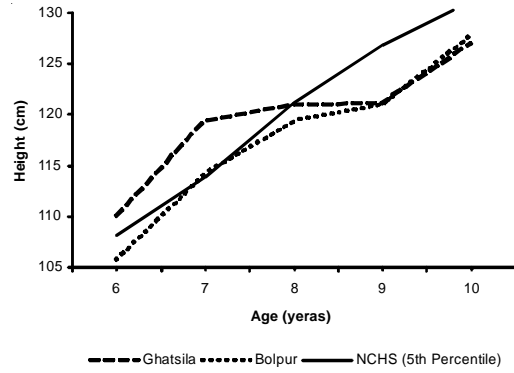
**Table 2: Mean and standard error of mean of height, weight, body mass index (BMI) and mid-upper arm circumference (MUAC) for Santal boys and girls of Bolpur.**

Age (years)	Santal boys					Santal girls				
	N	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	MUAC (cm)	N	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	MUAC (cm)
6	9	111.05 ± 2.74	17.39 ± 0.69	14.26 ± 0.84	15.29 ± 0.37	9	105.64 ± 3.69	14.62 ± 0.82	13.37 ± 1.01	14.79 ± 0.35
7	6	117.01 ± 3.23	21.08 ± 0.94	15.45 ± 0.64	15.47 ± 0.27	11	114.14 ± 3.82	20.14 ± 1.74	15.31 ± 1.09	16.39 ± 0.64
8	8	121.53 ± 2.42	23.59 ± 1.41	16.17 ± 1.31	15.58 ± 0.29	16	119.39 ± 3.23	21.97 ± 1.16	15.42 ± 0.56	16.54 ± 0.42
9	10	122.89 ± 6.19	23.95 ± 2.44	15.43 ± 0.29	16.54 ± 0.52	16	120.99 ± 4.78	22.19 ± 1.59	15.08 ± 0.49	16.62 ± 0.56
10	9	128.48 ± 4.85	25.56 ± 1.79	15.36 ± 0.35	16.64 ± 0.65	11	127.79 ± 3.88	24.32 ± 1.57	14.75 ± 0.37	17.01 ± 0.61

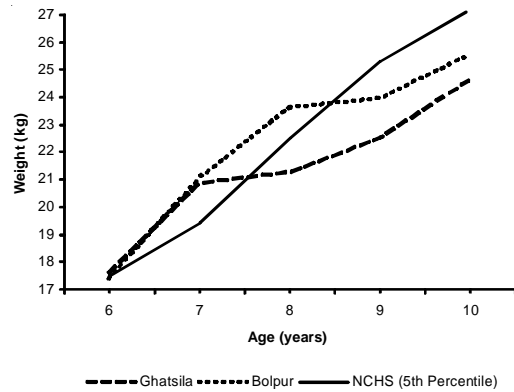
Values: Mean ± SE



**Fig. 1A. Mean height of Santal boys of Ghatsila and Bolpur, and NCHS reference.**



**Fig. 1B. Mean height of Santal girls of Ghatsila and Bolpur, and NCHS reference.**



**Fig. 2A. Mean weight of Santal boys of Ghatsila and Bolpur, and NCHS reference.**

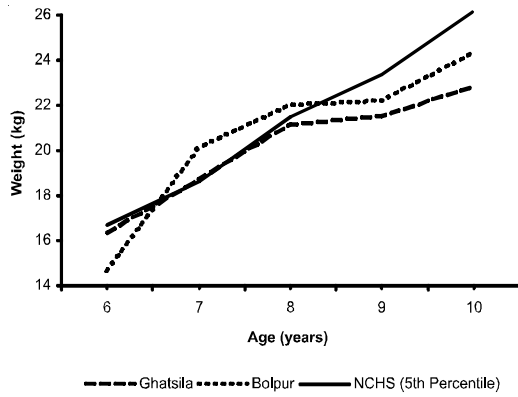


Fig. 2B. Mean weight of Santal girls of Ghatsila and Bolpur, and NCHS reference.

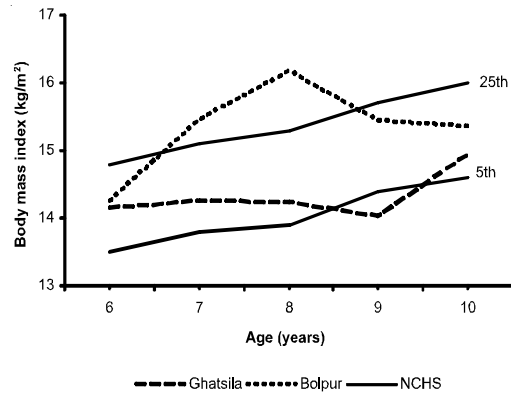


Fig. 4A: Mean body mass index values of Santal boys of Ghatsila and Bolpur, and NCHS reference.

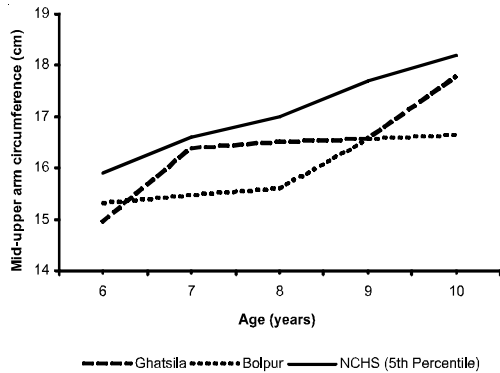


Fig. 3A. Mean mid-upper arm circumference values of Santal boys of Ghatsila and Bolpur, and NCHS reference.

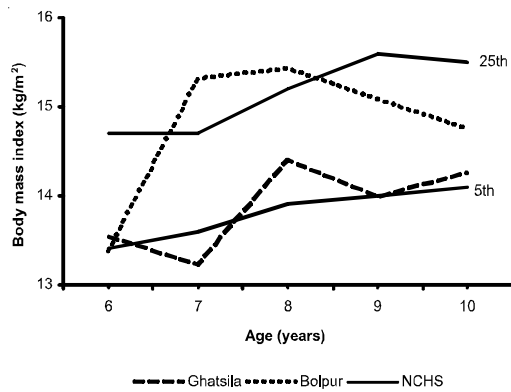


Fig. 4B. Mean body mass index values of Santal girls of Ghatsila and Bolpur, and NCHS reference.

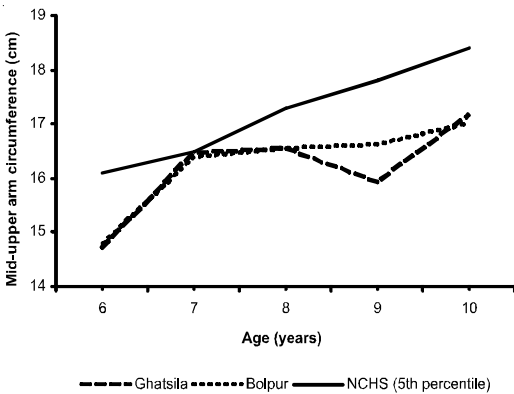


Fig. 3B. Mean mid-upper arm circumference values of Santal girls of Ghatsila and Bolpur, and NCHS reference.

and Bolpur the Santal boys or girls show similar percentage of undernutrition. 90.48% Santal boys and 90.48% girls of Bolpur (table 4), and 84.62% Santal boys and 93.11% girls of Ghatsila (table 3) are suffering from undernutrition.

**BMI:** The percentage of undernutrition as assessed by BMI values is similar between Santal boys or girls of Ghatsila (95.39% boys and 98.28% girls) and Bolpur (92.86% boys and 95.24% girls) regions. The percentage of severe undernutrition (grade-III) is found to be higher among Santal boys of Ghatsila (70.77%) than that of Bolpur (45.24%), but moderate undernutrition is higher among Santal boys of Bolpur (38.09%) than that of Ghatsila (20.01%). Severe undernutrition is also higher in Santal girls (66.67%) than boys (45.24%) in Bolpur region.

**Table 3: Classification of grades of malnutrition according to Gomez (weight-for-age), Waterloo (height-for-age), Jelliffe (MUAC-for-age) and WHO (BMI) classification for Santal children of Ghatsila.**

Types of malnutrition	N	Normal	Grade I (mild)	Grade II (moderate)	Grade III (severe)	Total malnourished
		No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
<i>Santal Boys</i>						
Weight-for-age	65	5 (7.69)	19 (29.24)	27 (41.54)	14 (21.54)	60 (92.31)
Height-for-age	65	28 (43.07)	19 (29.24)	11 (16.93)	8 (12.31)	38 (58.47)
MUAC-for-age	65	10 (15.39)	21 (32.31)	28 (43.07)	6 (9.24)	55 (84.62)
BMI	65	3 (4.62)	3 (4.62)	13 (20.01)	46 (70.77)	62 (95.39)
<i>Santal Girls</i>						
Weight-for-age	58	2 (3.45)	13 (22.42)	28 (48.28)	15 (25.87)	56 (96.56)
Height-for-age	58	20 (34.49)	20 (34.49)	15 (25.87)	3 (5.18)	38 (65.52)
MUAC-for-age	58	4 (6.89)	23 (39.66)	25 (43.11)	6 (10.34)	54 (93.11)
BMI	58	1 (1.73)	2 (3.45)	12 (20.69)	43 (74.14)	57 (98.28)

**Table 4: Classification of grades of malnutrition according to Gomez (weight-for-age), Waterloo (height-for-age), Jelliffe (MUAC-for-age) and WHO (BMI) classification for Santal children of Bolpur.**

Types of malnutrition	N	Normal	Grade I (mild)	Grade II (moderate)	Grade III (severe)	Total malnourished
		No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
<i>Santal boys</i>						
Weight-for-age	42	6 (14.28)	17 (40.48)	13 (30.96)	6 (14.28)	36 (85.72)
Height-for-age	42	16 (30.09)	9 (21.43)	11 (26.19)	6 (14.28)	26 (61.91)
MUAC-for-age	42	4 (9.53)	12 (28.58)	21 (50.00)	5 (11.91)	38 (90.48)
BMI	42	3 (7.15)	4 (9.53)	16 (38.09)	19 (45.24)	39 (92.86)
<i>Santal Girls</i>						
Weight-for-age	63	7 (11.12)	12 (19.04)	25 (39.69)	19 (30.16)	56 (88.89)
Height-for-age	63	20 (31.75)	9 (14.29)	12 (19.04)	24 (38.09)	43 (68.26)
MUAC-for-age	63	6 (9.53)	20 (31.75)	25 (39.69)	12 (19.04)	57 (90.48)
BMI	63	3 (4.77)	5 (7.94)	13 (20.64)	42 (66.67)	60 (95.24)

### Correlation Coefficient

Table 5 and 6 shows the correlation coefficient among different anthropometric parameters in Santal boys or girls of Ghatsila and Bolpur. In both regions, height, weight and MUAC of Santal children are significantly correlated to each other. But, BMI of the surveyed children did not show any significant relationship to height, weight and MUAC.

**Table 5: Correlation coefficient study of different anthropometric parameters of Santal boys and girls of Ghatsila.**

	Height	Weight	MUAC†	BMI††
<i>Boys</i>				
Height	-	0.76**	0.59*	0.18
Weight	-	-	0.66**	0.31
MUAC	-	-	-	0.14
<i>Girls</i>				
Height	-	0.77**	0.54*	0.06
Weight	-	-	0.59*	0.57
MUAC	-	-	-	0.14

\* p<0.01, \*\* p<0.001, † Mid-upper arm circumference  
†† Body mass index

### DISCUSSION

Present study shows that the growth pattern of Santal children of Ghatsila is similar to that of Bolpur. It has also been found that Santal boys showed almost similar growth pattern with Santal girls in both regions. The nutritional status of Santal children as assessed from height-for-age and weight-for-age curves showed that under-nutrition prevailed in these children compared to international standard. Poor growth pattern of Santal children compared to NCHS data of height and weight may be supported by other anthropometric parameter like MUAC. The MUAC-for-age curve, which is widely used as an indicator of nutritional status (Hop et al., 1998; Siziya and Matchaba, 1994), showed a remarkable undernutrition (around the 5<sup>th</sup> percentile of NCHS) in Santal children of both Ghatsila and Bolpur regions. Although, growth patterns in height, weight and MUAC of the surveyed children are similar in Ghatsila and Bolpur, the BMI-for-age curves of Santal children of Ghatsila

**Table 6: Correlation coefficient study of different anthropometric parameters of Santal boys and girls of Bolpur.**

	<i>Height</i>	<i>Weight</i>	<i>MUAC</i> †	<i>BMI</i> ††
<i>Boys</i>				
Height	-	0.85**	0.63*	0.12
Weight	-	-	0.74**	0.43
MUAC	-	-	-	0.25
<i>Girls</i>				
Height	-	0.86**	0.54*	0.19
Weight	-	-	0.61*	0.34
MUAC	-	-	-	0.15

\* p&lt;0.01

\*\* p&lt;0.001

† Mid-upper arm circumference

†† Body mass index

(i.e. around 5<sup>th</sup> percentile of NCHS standard) are remarkably different from that of Bolpur (around 25<sup>th</sup> percentile of NCHS standard). BMI is an indicator of overall or general adiposity (Lohman, 1988). The present study indicates the poor adiposity among Santal children compared to NCHS reference. The poor growth pattern of Santal children in Ghatsila and Bolpur may be attributed to their poor socio-economic status.

The present study suggests that undernutrition was found to be widely prevalent among the Santal children in Ghatsila and Bolpur regions. Overall prevalence of underweight (in terms of weight-for-age) and stunting (in terms of height-for-age) was found to be similar between Santal children of Ghatsila and Bolpur. Stunting and underweight are the results of chronic and acute undernutrition, respectively. So, it can be said that a large number of Santal children of Ghatsila and Bolpur are suffering from both acute and chronic undernutrition. Again, a difference in the prevalence of undernutrition between two sexes of children of Bolpur was noted. Severe undernutrition (Grade III), in terms of weight-for-age, height-for-age and BMI, was higher in Santal girls of Bolpur region than boys. While mild undernutrition (Grade I), in terms of weight-for-age, and moderate undernutrition (Grade II), in terms of BMI, was higher in Santal boys of Bolpur than girls. However, in Ghatsila prevalence of undernutrition is same in two sexes. It appears girls are discriminated nutritionally more in Bolpur than that of Ghatsila. Severe undernutrition, as measured by BMI, was higher in Santal boys of Ghatsila from that of Bolpur, but reverse trend happened in case of moderate undernutrition (grade II) where Santal boys of Bolpur shows higher per-

centage of undernutrition than that of Ghatsila. On the other hand, severe stunting was found to be higher in Santal girls of Bolpur from that of Ghatsila, but in case of mild form of stunting the Santal girls of Ghatsila showed higher percentage of stunting than that of Bolpur. Thus the severity of undernutrition is not same in many respects between the children of two surveyed regions.

MUAC-for-age is a useful parameter in the assessment of undernutrition. In developing countries, the reduced food intake was found to be resulted in parallel decrease in MUAC (Bray et al., 1978; Harris et al., 1984). In the present study, Santal boys and girls of Ghatsila and Bolpur show a high prevalence of undernutrition according to MUAC-for-age parameter.

BMI is also found to be a useful parameter for assessment of nutritional status of children (Venkaiaha et al., 2002). Though the prevalence of undernutrition, as measured by BMI, is almost equal among Santal children in Ghatsila and Bolpur, the adiposity is severely affected in Santal boys of Ghatsila than Bolpur and moderately affected in Santal boys of Bolpur than Ghatsila.. This total percentage of undernutrition from BMI of Santal children in the present study is much higher than the Kondth tribe (75%) of Orissa (Ghosh and Bala, 2006), Bathudi tribe (58%) of Orissa (Bose and Chakraborty, 2005), Oraon children (88%) of West Bengal (Mittal & Srivastava, 2006), and tribe adolescent of nine state (53%) (Rao et al., 2006).

The growth pattern in height and weight for Santal children of Ghatsila and Bolpur are also poor in comparison to Santal children of Puruliya district (Chowdhury et al., 2007). Height-for-age curves for Santal children of Puruliya district remained at 25<sup>th</sup> percentile of NCHS reference, which seems to be much higher than the Santal boys (10<sup>th</sup> percentile of NCHS) and girls (5<sup>th</sup> percentile of NCHS) of Ghatsila and Bolpur. Similarly, weight-for-age values for Santal boys (10<sup>th</sup> percentile of NCHS) and girls (15<sup>th</sup> percentile of NCHS) of Puruliya district were also higher than that of Santal children (5<sup>th</sup> percentile of NCHS) of both Ghatsila and Bolpur regions. Prevalence of undernutrition is also higher in Santal children of the present study compared to that of Puruliya district. For example, severe stunting in boys was 12.31% in Ghatsila and 14.28% in Bolpur compared to 4.17% in Puruliya. Rao and Vijay (2006) also observed a lower percentage of

severe underweight (6%) among the Santal children of Purnia district of Bihar than the present study.

There is a great variability in the prevalence of stunting and underweight among tribal population in different regions of India. Rao et al. (2005) reported widespread undernutrition (60% underweight and 51% stunting) among the preschool children of Gond tribe of Madhya Pradesh. High prevalence of underweight and stunting are also found among children of Kamar tribe (58% underweight and 63% stunting) of Chattisgarh (Mitra et al., 2007), preschool tribal children (55% underweight and 60% stunting) of Bihar (Yadav and Singh, 1999) and tribal adolescent (47% underweight and 44% stunting) of nine different states of India (Rao et al., 2006). In the present study, the prevalence of undernutrition in terms of underweight and stunting in the Santal children of Ghatsila and Bolpur is much more severe than the above mentioned studies.

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**KEYWORDS** Growth pattern; Nutritional status; Undernutrition; Santal

**ABSTRACT** A cross sectional study was made on 123 Santhal children of Ghatsila in Jharkhand and 105 Santal children of Bolpur in West Bengal (aged 6 to 10 years) to assess and compare the physical growth and nutritional status. Growth pattern of height, weight, BMI and mid-upper arm circumference was determined. It was observed that growth pattern of Santal boys or girls are similar between Ghatsila and Bolpur. However, the growth curves of height remained at lower level in boys (10<sup>th</sup> percentile) and girls (5<sup>th</sup> percentile) in both the regions compared to NCHS reference. The poor growth was also evident in Santal children of two regions by lower percentile value of weight-for-age (5<sup>th</sup> percentile) and MUAC-for-age (5<sup>th</sup> percentile) compared to NCHS reference. But the percentile of BMI-for-age was higher in Santal children of Bolpur (both boys and girls at 25<sup>th</sup> percentile) compared to that of Ghatsila (both boys and girls at 5<sup>th</sup> percentile) according to NCHS reference. Prevalence of undernutrition, though very high, was found to be similar between Santal boys and girls of two regions, and in between Santal children of Ghatsila and Bolpur. However, the percentage of severe stunting (grade III) was higher in Santal girls of Bolpur (38.09%) than that of Ghatsila (5.18%). In Santal boys, the severe undernutrition in terms of BMI was higher in Ghatsila (70.77%) compared to that of Bolpur (45.24%). The severe underweight and stunting were higher in Santal girls of Bolpur compared to the boys of same region. A poor growth rate and high prevalence of undernutrition were observed in the Santal children of two surveyed regions. Prevalence of undernutrition was higher in girls of Bolpur compared to boys.

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