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Nutritional Assessment by Body Mass Index and Mid Upper Arm Circumference of Adult Santals of Jhargram, West Bengal, India

S. Ghosh[1] and P. Ghosh[2]

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[1]Sayak Ghosh, former student, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India. E-mail: sayak1996ghosh@rediffmail.com

[2]Papia Ghosh, former student, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India. E-mail: ghoshpapia613@gmail.com

Corresponding author: Sayak Ghosh, former student, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India. E-mail: sayak1996ghosh@rediffmail.com

ABSTRACT*: A cross-sectional study was undertaken to determine the nutritional status based on Body Mass Index (BMI) and Mid Upper Arm Circumference (MUAC) of adult Santals of Jhargram District, West Bengal, India. A total of 348 (173 male and 175 female) adults (aged ≥18 years) Santals of two villages in Jhargram District (approximately 155 km from Kolkata) were studied. Some Anthropometric measurements (Height, Weight and MUAC) and age-sex were taken using standard protocols. Overall, the extent of Chronic Energy Deficiency (CED) (BMI<18.5 kg/m^2) was found to be fairly high (33.6%). The prevalence of CED (based on BMI) was higher in females (36.6%) compared to males (30.6%). Using World Health Organization (WHO) Criterion (WHO, 1995), the prevalence of undernutrition (based on BMI) was high and the situation was critical. Similarly, the extent of undernutrition (based on MUAC) was found to be fairly high (30.7%). The prevalence of undernutrition (based on MUAC) was higher in males (31.2%) than females (30.3%). In conclusion, this study provided evidence that the prevalence of adult Santals undernutrition (Both BMI & MUAC) was high. Thus, immediate appropriate nutritional intervention programs need to be implemented for this tribal population. Moreover, further research is needed not only among this ethnic group but also among all ethnic groups in India to find out the causes and consequences of adult undernutrition.*

Keywords: *Santals, BMI, MUAC, CED, WHO, Undernutrition.*

INTRODUCTION

In today's globalized and inter-connected world, India's population including those belonging to scheduled tribes (ST) is undergoing demographic, socio-economic and health transformation. The tribal population in India was 104 million (Census 2011), constituting 8.6% of country's population, up from 8.2% in 2001 census. There, 705 different ethnic groups, they are scattered across 30 States and Union Territories of India and having diverse cultural and life practices. The tribal population primarily inhabits rural and remote areas and is among the most vulnerable and marginalized sections of society. Moreover, they lag behind all other social groups in various social, health and developmental indicators (Ministry of Tribal Affairs, 2014). Without addressing the concerns of the vulnerable population, India's socio-economic transformation will remain incomplete and it will not be possible to achieve the UN Sustainable Development Goals for which India has committed itself along with other countries (NITI Aayog, 2015).

In 2011, while 40.6% of tribes were below the poverty line, the proportion among the rest was 20.5% (Census 2011). In the health area, the key indicators among tribes remain very poor. For example, according to the National Family Health Survey 4 (NFHS-4) (2015-2016), the under-5 mortality among the tribal population was 57.2 per 1000 live births compared to 38.5 among others, and the Infant Mortality Rate (IMR) 44.4 per 1000 live births versus others of 32.1 (International Institute of Population Sciences, 2017). A child born to an ST family in India has 19 per cent higher risk of dying in the neonatal period and 45% greater risk of dying in the post-neonatal period compared with other social classes (Anderson et al. 2016).

The nutritional status of an individual is usually a result of multiple factors that interact with each other at different levels (Park, 2009). The consumption of an adequate amount of food both in terms of quantity and quality is one of the key determinants, which has a significant impact on the nutritional status (Park, 2009). Furthermore, the eating pattern of an individual is a crucial factor that dictates the occurrence of a disease, especially some chronic conditions such as coronary heart disease, hypertension, stroke, diabetes mellitus, and cancer (Herder & Demmig-Adams, 2004). Besides, adverse outcomes such as low birth weight, malnutrition, disability, poor quality of life, and mortality are also related to the poor eating patterns, in both developed and developing countries (Shrivastava & Shrivastava (2013) and Nucci et al. (2001)). Recognizing the role of diet at the onset of many diseases, and assessing the nutritional status of an individual, family and community are important for public health (Herder & Demmig-Adams, 2004).

Malnutrition refers to deficiencies, excesses, or imbalances in a person’s intake of energy and/or nutrients. The term malnutrition addresses 3 broad groups of conditions:

- undernutrition, which includes wasting (low weight-for-height), stunting (low height-for-age) and underweight (low weight-for-age);
- micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
- Overweight, obesity and diet-related non-communicable diseases (such as heart disease, stroke, diabetes and some cancers).

In 2014, approximately 462 million adults worldwide were underweight, while 1.9 billion were either overweight or obese (who.int/news-room/fact-sheets/detail/malnutrition). The developmental, economic, social, and medical impacts of the global burden of malnutrition are serious and lasting, for individuals and their families, for communities and countries.

In our study, the objective was to evaluate the nutritional status, based on BMI and MUAC, of adult Santals of Jhargram, West Bengal, India. We also compared our findings with previous studies which have evaluated the nutritional status of various populations based on BMI.

MATERIALS AND METHODS

Participants and Area of study

This cross-sectional community-based study was conducted in two different villages of Jhargram District that are situated about 155 km from Kolkata (capital of West Bengal, India) and about 39 km from Kharagpur. This study was carried out from October 2018 to January 2019. A total of 348 (173 males and 175 females) adults (≥18 years) Santals were measured. According to Census 2011, Jhargram district contains a population of 1,136,548. 96.52% of the total population was rural and only 3.48% was urban population. 29.37% belonged to scheduled tribes. Santals is one of the largest tribe in Jhargram. It is known for its "wooded beauty" and hill ranges of Belpahari. There are the Kankrajhor River to the north and Subarnarekha to the south. It is a destination for tourists who visit its forests, ancient temples, royal palaces, and folk music sites. The district was formed on 4 April 2017, after bifurcation from the Paschim Medinipur district as the 22nd district of West Bengal. The district has its headquarters at Jhargram.

Anthropometry and Evaluation of Nutritional Status

Data were collected after obtaining the necessary approval from the villagers; participants were informed about the objectives before the commencement of measurements. Information on Age, Sex, Weight (kg), Height (cm) and MUAC (cm) were collected on a questionnaire by the house to house visit following interview and examination. Height and weight measurements were on each participant following the standard techniques. (Lohman *et al.* 1988). Height, weight and MUAC were recorded to the nearest 0.1 cm, 0.5 kg and 0.1 cm, respectively. Body Mass Index (BMI; kg/m^2) is derived from the measurements.

The age group is divided using percentile. The total age is divided into two percentile i.e. 33.3^{th} and 66.6^{th}. It gives three different groups. The age groups are 18-32 years, 33-51 years and 52 & above years.

The BMI was computed using the following standard equation:
BMI (kg/m^2) = Weight (kg) / Height^2 (m^2).

Nutritional status was evaluated using internationally accepted BMI guidelines (WHO, 1995).
The following cut-off points were used:
CED III: < 16.0 kg/m^2
CED II: 16.0-16.9 kg/m^2
CED I: 17.0-18.4 kg/m^2
Normal: 18.5-24.9 kg/m^2
Overweight: 25.0-29.9 kg/m^2

Obese: ≥30.0 kg/m^2

Here, CED stands for Chronic Energy Deficiency. Nutritional status was also evaluated using BMI Asia-Pacific guidelines (WHO, 2000). The following cut-off points were used:
CED III: < 16.0 kg/m^2
CED II: 16.0-16.9 kg/m^2
CED I: 17.0-18.4 kg/m^2
Normal: 18.5-22.9 kg/m^2
Overweight: 23.0-24.9 kg/m^2
Obese: ≥25.0 kg/m^2

We followed the World Health Organization's classification (WHO, 1995) of the public health problem of low BMI, based on adult populations worldwide. This classification prevalence according to the percentage of a population with a BMI <18.5 kg/m^2.
Low (5-9%): warning sign, monitoring required.
Medium (10-19%): poor situation.
High (20-39%): serious situation.
Very high (≥ 40%): critical situation.

MUAC is another good indicator of nutritional status. Nutritional status was also evaluated using the MUAC category (James et al. 1994). The following cut-off points were used:
Undernutrition: <22.0 cm (for female) and <23.0 cm (for male).
Normal: ≥22.0 cm (for female) and ≥23.0 cm (for male).

Statistical Analysis

Student's t-tests were performed to test for sex differences in mean Height, Weight, MUAC and BMI. Sex and Age group differences in Nutritional status were determined by the chi-square test. The impact of age on Height, Weight, MUAC and BMI were determined by Pearson's correlation (r). One-way ANOVA (F test) was done to find the deference of sex-specific mean of anthropometric values age groups. All statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS), version 18.0. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 shows the age and anthropometric characteristics of the studied participants. The mean (SD) of Age, Height, Weight, MUAC and BMI are 42.9 (15.79) years, 158.8 (11.17) cm, 50.6 (9.25) kg, 23.0 (1.49) cm and 19.9 (1.96) kg/m^2 respectively. **Table 2** presents the age group and sex distribution of the participants. **Table 3** presents the Student's T-test of Height, Weight, MUAC and BMI between male and female of different age groups. The mean BMI of 52 and above age group has no significant difference at $p<0.05$ between males and females. ANOVA of anthropometric variables among different age groups are found in **Table 4**. Here, Weight, MUAC and BMI have significantly difference ($p<0.001$ and $p<0.05$) among age groups. **Table 5** presents the prevalence of nutritional status based on BMI category (WHO, 1995) and BMI, Asia-Pacific category (WHO, 2000) of all participants and also significant association between BMI category (WHO, 1995) and BMI, Asia-Pacific category (WHO, 2000) [$\chi^2 = 1392.00$, df=20, $p<0.001$]. **Table 6** presents the classification of nutritional status of the participants based on the MUAC

category (James et al. 1994). The classification of sex-specific nutritional status of the participants based on BMI category (WHO, 1995) and BMI, Asia-Pacific category (WHO, 2000) found in **Table 7**. Here, BMI, Asia-Pacific category (WHO, 2000) is significantly associated with BMI category (WHO, 1995) in case of both male (χ^2 =519.000, df=12, p<0.001) and female (χ^2 =700.000, df=20, p<0.001). In **Table 8**, BMI category (WHO, 1995) is significantly associated with age group in males (χ^2=92.441, df=6, p<0.001) and females (χ^2 =46.609, df=8, p<0.001) separately. In **Table 9**, BMI, Asia-Pacific category (WHO, 2000) is significantly associated with age group in males (χ^2 =94.200, df=8, p<0.001) and females (χ^2 =46.960, df=10, p<0.001) separately. **Table 10** presents the sex specific between age group and MUAC category (James et al. 1994). Here, age group is significantly associated with MUAC category (James et al. 1994) in females (χ^2=21.318, df=2, p<0.001). The significant association between MUAC category (James et al. 1994) and BMI category (WHO, 1995) found in female (χ^2 =41.308, df=4, p<0.001) in **Table 11**. Like Table 11, almost same result found in **Table 12** where MUAC category (James et al. 1994) is significantly associated with BMI, Asia-Pacific category (WHO, 2000) in females (χ^2 =41.590, df=5, p<0.001). Pearson correlation co- efficient among age and all variables found in **Table 13**. Here, age is negatively co related with Height, Weight, MUAC and BMI but BMI is positively co related with Height, Weight and MUAC.

DISCUSSION

There is a large and diverse tribal population in India. There are wide variations among the groups in nutritional status and access to utilization of nutrition and health services. The present study evaluated the anthropometric assessment of Chronic Energy Deficiency based on BMI and MUAC among adult Santals of Jhargram, West Bengal. It demonstrated that females were more undernourished than males based on BMI but the opposite scenario was found in the case of CED prevalence of MUAC. The CED prevalence of the total population based on BMI and MUAC are 33.6% and 30.7% respectively. The CED prevalence based on BMI is higher in females (36.6%) than males (30.6%). The CED prevalence of MUAC is higher in males (31.2%) than females (30.3%).

According to World Health Organization's classification (WHO, 1995) of the public health problem of low BMI, based on adult populations worldwide, both males and females are in a serious situation as classified prevalence according to the percentage of the population.

Comparisons of mean BMI (kg/m^2) and CED prevalence based on BMI between males and females of the present study with various tribal populations of West Bengal and all over India are shown in Table 14. From table 14, it is clear that among males, Mech of Assam (Khongsdier, 2001) and Birhor of West Bengal (Das et al. 2013) have the highest mean value of BMI (20.5 kg/m^2) followed by the others studies and Oraon of Jharkhand (Chakraborty & Bose,08) has the lowest mean value of BMI (18.0 kg/m^2). Similarly among the females, the mean value of BMI was highest (21.2 kg/m^2) among Onge of Andaman (Rao et al, 2006) and Tangkhul Naga (Mungreiphy et al, 2012) and the lowest mean of BMI (17.9 kg/m^2) found in Mahali of West Bengal (Ghosh and Bose, 2017).

Table 14 also shows the prevalence of CED among the various tribes of India. The highest frequency of CED of males was found among Santals of West Bengal (55.0%) (Das and Bose,

2010) followed by the other studies and the lowest frequency of CED of male was found among Mech of Assam (6.0%) (Khongsdier, 2001). Similarly, the highest frequency of CED of females was found among Sabar of West Bengal (65.0%) (Bhandari et al. 2019).

According to National Family Health Statistics -4 Report, the prevalence of undernutrition in India is 19.6% in males and 22.4% in females. The Government of India has been implementing several nutritional interventions and developmental programs for the better health and nutritional status of tribal populations. This may be associated with low literacy, poor socio-economic conditions, lack of healthy drinking water, lack of awareness of healthy lifestyle and other associated factors.

Conclusions

In conclusion, the present study clearly showed that there was a need to identify, reorganize and reallocate resources for the tribe. It can be concluded that the nutritional status of Santals was unsatisfactory. They were experiencing critical nutritional stress.

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Table 1. Mean and SD of Age and Anthropometric Variables of studied participants.

Variables	Mean	SD
Age (years)	42.9	15.79
Height (cm)	158.8	11.17
Weight (kg)	50.6	9.25
Mid Upper Arm Circumference (MUAC; cm)	23.0	1.49
Body Mass Index (BMI; kg/m^2)	19.9	1.96

Table 2. Age group and Sex distribution of the participants.

Age group	Sex		Total
	Male	Female	
18 – 32 years	66	48	114
33 – 51 years	49	65	114
52 years ≤	58	62	120
Total	173	175	348

Table 3. Test of significance of Anthropometric Variables between Male and Female.

Variables	Age group (years)	Sex						t value
		Male			Female			
		n	Mean	SD	n	Mean	SD	
Height (cm)	**18 – 32 years**	66	169.8	5.22	48	148.2	2.45	26.574***
	33 – 51 years	49	167.9	5.71	65	148.9	3.77	21.413***
	52 years ≤	58	168.4	6.08	62	149.2	4.77	19.377***
Weight (kg)	**18 – 32 years**	66	61.8	5.33	48	45.2	3.52	18.843***
	33 – 51 years	49	59.2	5.91	65	43.8	3.56	17.255***
	52 years ≤	58	52.8	5.24	62	41.1	3.91	17.973***
MUAC (cm)	**18 – 32 years**	66	23.9	1.12	48	23.1	1.03	4.057***
	33 – 51 years	49	23.5	1.15	65	22.6	1.60	3.212**
	52 years ≤	58	23.3	1.23	62	21.7	1.52	6.355***
BMI (kg/m^2)	**18 – 32 years**	66	21.5	1.52	48	20.6	1.64	2.950**
	33 – 51 years	49	21.0	1.81	65	19.7	1.60	3.952***
	52 years ≤	58	18.6	1.33	62	18.4	1.61	0.532

Level of significant ***$p<0.001$ and **$p<0.01$

Table 4. ANOVA of Anthropometric variables among different age groups.

Variables	Sex	Age Groups									F value
		18 – 32 years			33 – 51 years			52 years ≤			
		n	Mean	SD	n	Mean	SD	n	Mean	SD	
Height (cm)	Male	66	169.8	5.21	49	167.9	5.71	58	168.4	6.08	1.672
	Female	48	148.2	2.45	65	148.9	3.77	62	149.2	4.74	0.908
Weight (kg)	Male	66	61.8	5.33	49	59.2	5.91	58	52.8	5.24	43.600***
	Female	48	45.2	3.52	65	43.8	3.57	62	41.1	3.91	18.471***
MUAC (cm)	Male	66	23.9	1.12	49	23.5	1.15	58	23.3	1.23	4.604*
	Female	48	23.1	1.03	65	22.6	1.57	62	21.7	1.52	14.355***
BMI (kg/m^2)	Male	66	21.5	1.52	49	21.0	1.81	58	18.6	1.33	58.826***
	Female	48	20.6	1.65	65	19.7	1.60	62	18.4	1.61	24.730***

Level of significant ***p<0.001 and *p<0.05

Table 5. Classification of nutritional status of the participants based on BMI according to WHO (1995) and Asia-Pacific Category, WHO (2000).

BMI category (WHO, 1995)	BMI category, Asia-Pacific (WHO, 2000)						Total
	CED III	CED II	CED I	Normal	Overweight	Obese	
CED III	2	0	0	0	0	0	2
CED II	0	8	0	0	0	0	8
CED I	0	0	107	0	0	0	107
Normal	0	0	0	212	11	0	223
Overweight	0	0	0	0	0	8	8
Total	2	8	107	212	11	8	348
$\chi^2 = 1392.00$, df=20, p<0.001							

Table 6. Classification of nutritional status of the participants based on MUAC according to James et al. (1994).

MUAC classification (James et al. 1994)	Sex		Total
	Male	Female	
Undernutrition	54	53	107
Normal	119	122	241
Total	173	175	348
$\chi^2 = 0.035$, df=1, Not Significant at p<0.05			

Table 7. Classification of sex specific nutritional status of the participants based on BMI according to WHO (1995) and Asia-Pacific Category, WHO (2000).

Sex	BMI category, Asia-Pacific (WHO, 2000)	BMI category (WHO, 1995)					Total	Value
		CED III	CED II	CED I	Normal	Overweight		
Male	**CED II**	0	1	0	0	0	1	χ^2 =519.000, df=12, p<0.001
	CED I	0	0	52	0	0	52	
	Normal	0	0	0	107	0	107	
	Overweight	0	0	0	8	0	8	
	Obese	0	0	0	0	5	5	
	Total	0	1	52	115	5	173	
Female	**CED III**	2	0	0	0	0	2	χ^2 =700.000, df=20, p<0.001
	CED II	0	7	0	0	0	7	
	CED I	0	0	55	0	0	55	
	Normal	0	0	0	105	0	105	
	Overweight	0	0	0	3	0	3	
	Obese	0	0	0	0	3	3	
	Total	2	7	55	108	3	175	

Table 8. Classification of age group and sex specific nutritional status of the participants based on BMI according to WHO (1995).

Sex	Age group	BMI category (WHO, 1995)					Total	Value
		CED III	CED II	CED I	Normal	Overweight		
Male	**18 – 32 years**	0	0	3	61	2	66	χ^2 =92.441, df=6, p<0.001
	33 – 51 years	0	0	5	41	3	49	
	52 years ≤	0	1	44	13	0	58	
	Total	0	1	52	115	5	173	
Female	**18 – 32 years**	0	0	6	40	2	48	χ^2 =46.609, df=8, p<0.001
	33 – 51 years	1	1	14	49	0	65	
	52 years ≤	1	6	35	19	1	62	
	Total	2	7	55	108	3	175	

Table 9. Classification of age-group and sex specific nutritional status of the participants based on BMI according to Asia-Pacific, WHO (2000).

Sex	Age group (years)	BMI category, Asia-Pacific (WHO, 2000)						Total	Value
		CED III	CED II	CED I	Normal	Over weigh t	Obese		
Male	18 – 32	0	0	3	55	6	2	2	χ^2 =94.200, df=8, p<0.001
	33 – 51	0	0	5	39	2	3	3	
	52≤	0	1	44	13	0	0	0	
	Total	0	1	53	107	8	5	5	
Female	18 – 32	0	0	6	39	1	2	48	χ^2 =46.960, df=10, p<0.001
	33 – 51	1	1	14	48	1	0	65	
	52≤	1	6	35	18	1	1	62	
	Total	2	7	55	105	3	3	175	

Table 10. Classification of age-group and sex specific nutritional status of the participants based on MUAC according to James et al. (1994).

Sex	MUAC category (James et al. 1994)	Age group (years)			Total	Value
		18 – 32	33 – 51	52≤		
Male	Undernutrition	18	16	20	54	χ^2 =0.813, df=2, Not Significant
	Normal	48	33	38	119	
	Total	66	49	58	173	
Female	Undernutrition	7	14	32	53	χ^2 =21.318, df=2, p<0.001
	Normal	41	51	30	122	
	Total	48	65	62	175	

Table 11. Association of sex specific nutritional status based on MUAC (James et al. 1994) with nutritional status based on BMI (WHO, 1995) of the participants.

Sex	MUAC category (James et al. 1994)	BMI category (WHO, 1995)					Total	
		CED III	CED II	CED I	Normal	Over weight		Value
Male	Undernutrition	0	0	16	36	2	54	χ^2 =0.639, df=3, Not significant
	Normal	0	1	36	79	3	119	
	Total	0	1	52	115	5	173	
Female	Undernutrition	1	5	32	15	0	53	χ^2 =41.308, df=4, p<0.001
	Normal	1	2	23	93	3	112	
	Total	2	7	55	108	3	175	

Table 12. Association of sex specific nutritional status based on MUAC (James et al. 1994) with nutritional status based on BMI (Asia-Pacific, WHO, 2000) of the participants.

Sex	MUAC category (James et al. 1994)	BMI category (Asia-Pacific, WHO, 2000)						Total	Value
		CED III	CED II	CED I	Normal	Over weight	Obese		
Male	Undernutrition	0	0	16	33	3	2	54	χ^2=0.792, df=4, Not significant
	Normal	0	1	36	74	5	3	119	
	Total	0	1	52	107	8	5	173	
Female	Undernutrition	1	5	32	15	0	0	53	χ^2=41.590, df=5, p<0.001
	Normal	1	2	23	90	3	3	122	
	Total	2	7	55	105	3	3	175	

Table 13. Pearson correlation co-efficient among age and anthropometric variables.

Variables	Variables				
	Age (years)	Height (cm)	Weight (kg)	MUAC (cm)	BMI (kg/m^2)
Age (years)	1	-0.112*	-0.384**	-0.320**	-0.547**
Height (cm)	-0.112*	1	0.849**	0.414**	0.155**
Weight (kg)	-0.384**	0.849**	1	0.531**	0.649**
MUAC (cm)	-0.320**	0.414**	0.531**	1	0.425**
BMI (kg/m^2)	-0.547**	0.649**	0.649**	0.425**	1

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

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

Table 14. Comparison of mean BMI (kg/m^2) and prevalence of CED based on BMI among the various tribal population of India.

Community	Mean BMI (kg/m^2)		CED Prevalence based on BMI (%)		Study area (state)	Reference
	Male	Female	Male	Female		
Mech	20.5	---	6.0	---	Assam	Khongsdier, 2001
Miris	19.6	---	34.0	---	Assam	Khongsdier, 2001
Pnars Khasis	19.9	---	14.3	---	Meghalaya	Khongsdier, 2001
War Khasis	20.1	---	35.0	---	Meghalaya	Khongsdier, 2002
Jarwa	18.9	19.8	5.5	---	Andaman and Nicobar Island	Sahani, 2004
Onge	19.7	21.2	12.9	29.2	Andaman and Nicobar Island	Rao et al, 2006
Oraon	18.0	---	53.1	---	Jharkhand	Chakraborty & Bose,08
Savara	18.5	---	53.0	---	Orissa	Chakrabarty *et al*, 2008
Mannan	20.2	19.1	23.1	52.2	Kerala	John & Ramadas, 2008
Kora Mudi	---	18.3	---	55.3	West Bengal	Bisai and Bose, 2009
Oraon	18.8	19.3	47.0	30.7	Orissa	Beck & Mishra, 2010
Santal	19.5	18.1	55.0	52.5	West Bengal	Das & Bose 2010
Santal	20.46	19.48	30.5	38.5	West Bengal	Mukhopadhyay, 2010
Munda	19.35	---	35.8	---	West Bengal	Bose et al. 2011
Oraon	19.46	---	37.5	---	West Bengal	Bose et al. 2011
Savar	18.9	19.3	38.0	49.0	Orissa	Bisai & Bose, 2012
Bhotias	19.5	---	45.3	---	Uttarakhand	Kapoor *et al*, 2012
Tangkhul Naga	---	21.2	---	16.3	Manipur	Mungreiphy *et al*, 2012
Birhor	20.5	20.2	19.4	33.3	West Bengal	Das *et al.* 2013
Bhumij	18.6	---	52.3	---	West Bengal	Ghosh & Bose 2015
Mahali	19.9	17.9	42.2	63.6	West Bengal	Ghosh & Bose 2017
Sabar	19.4	18.0	52.0	65.0	West Bengal	Bhandari et al. 2019
Santal	20.4	19.5	30.6	36.6	West Bengal	Present study