International Journal of Statistical Sciences *ISSN 1683-5603*
Vol. 20(1), 2020, pp 1-18
© 2020 Dept. of Statistics, Univ. of Rajshahi, Bangladesh

Undernutrition using Anthropometric Indices among the Bhumij Preschool Children of West Bengal, India

Biswajit Mahapatra[1, 2], Soma Pal[1], Kaushik Bose[1]* and Goutam Sahoo[1]

[1]Department of Anthropology, Vidyasagar University, Midnapore-721102, West Bengal, India

[2]Anthropological Survey of India, Head Office, 27, Jawaharlal Nehru Road, Kolkata-700016, West Bengal, India

*Correspondence should be addressed to Kaushik Bose (kaushikbose@cantab.net)

[Received Jan. 15, 2020; Revised February 17, 2020; Accepted March 3, 2020]

Abstract

Poor nutritional status among tribal preschool children observed in different regions of West Bengal as well as India. Nutritional status of tribal preschool children especially Bhumij children of West Bengal has not been investigated adequately. The present community based cross-sectional study was undertaken to determine the prevalence of undernutrition using stunting, underweight and wasting among Bhumij preschool children of West Bengal, India. A total of 245 (129 boys; 116 girls) Bhumij children aged from 1 to 5 years were studied from eleven villages of Keshiary, Dantan-I and Nayagram block of Paschim Medinipur and Jhargram district of West Bengal. Length/height and weight of children was measured according to standard procedures. Date of birth was collected from birth certificates or health immunization cards of children. WHO Child Growth Standards (2006) was used to evaluate the nutritional status of Bhumij preschool children. Results revealed that there were no significant sex differences in mean height. Only 5 years ($t=2.26$ and $p<0.05$) Bhumij boys were significantly heavier than girls counterpart. Significant age differences in mean height [Height: $F=213.66$, $p<0.001$ (boys) and $F=223.0$, $p<0.001$ (girls)] and weight [Weight: $F=116.95$, $p<0.001$ (boys) and $F=88.77$, $p<0.001$ (girls)] was observed for both sexes. Overall prevalence of stunting, underweight and wasting were 45.7%, 24.9% and 9.8%, respectively. The age combined prevalence of undernutrition among boys were higher than girls (stunting: 51.2% vs 39.7%; underweight: 27.9% vs 21.6% and wasting: 14.0% vs 5.2%). Very high prevalence of

stunting indicates critical situation of these communities. There is an urgent need to improve health care services to the tribal population and tribal children.

Key words: West Bengal; Bhumij; Undernutrition; Pre-school children.

AMS Classification: 62P10.

1. Introduction

Undernutrition is defined as insufficient energy intake and nutrients to meet an individual's dietary requirements and maintain good health (Maleta, 2006). It encompasses underweight, stunting, wasting and deficient in micronutrients (vitamins and minerals) (UNICEF, 2006). Health consequences of undernutrition includes children's retarded physical and mental development, increasing susceptibility to infections like sepsis, diarrhoea, pneumonia, and so on and further enhancing the probability of undernutrition (Ghai et al., 2009). An estimated 45% (3.1 million) deaths of children under five years are associated to undernutrition including fetal growth restriction, suboptimum breastfeeding, stunting, wasting and deficiencies of vitamin A and zinc (Black et al., 2013). The three most commonly used internationally recommended anthropometric indices to assess child growth status are stunting (low height-for-age), underweight (low weight-for-age) and wasting (low weight-for-height) (WHO, 1995; Lee and Nieman, 2003). Stunted growth reflects a process of failure to reach linear growth potential due to suboptimal health and/or nutritional conditions. Stunting is an indicator of chronic under nutrition, the result of prolonged food deprivation and/or disease or illness. While, underweight reveals low body mass relative to chronological age, which is influenced by both, a child's height and weight. Thus, underweight cannot distinguish between short children with adequate body weight and tall, thin children. On the other hand, wasting is an indicator of acute under nutrition, the result of more recent food deprivation or illness (WHO, 1995).

Pre-school children are one of the most vulnerable segments of any community and therefore their nutritional status is a sensitive indicator of health and nutritional status of community (Sachdev, 1995). In 2011, worldwide 101 million children under the age of five years were underweight (UNICEF-WHO, 2012). Meanwhile, in 2017, globally 150.8 million (22.2%) children under five years are stunted, 50.5 million (7.5%) are wasted (Global Nutrition Report, 2018). National

Family Health Survey-4 (2015-16) reports of India reveals that nearly 38.4% children under five years have stunted growth, the lives of 35.8% children under five to be threatened by underweight and 21.0% children under five years are wasted. Such children are at high risk of mortality and poor health (NFHS-4, India). While in West Bengal, 32.5% children under five have stunted growth, 31.6% children are suffering from underweight and 20.3% children are wasted (NFHS-4, West Bengal).

Indigenous population of India, also known as Adivasi or Scheduled Tribes (STs) are among the poorest, vulnerable and most marginalized groups (Ministry of Tribal Affairs, 2004). According to latest census of India (2011), tribes constitute 8.6% of the total population of India while West Bengal comprises 5.8% (52,96,953) tribal population. The Bhumij tribes are one of major tribal groups in eastern India mostly concentrated in the states of Jharkahnd, West Bengal and Odisha. They are also found in Assam and Bihar. The Bhumij are the fourth largest tribal community in West Bengal and mostly found in the district of Paschim Medinipur, Jhargram, Purulia, Bankura. The total population of Bhumij is 3,76,296 as per 2011 census of India (Bandyopadhyay, 2017). The Bhumij means owner of the soil. They speak their own Bhumij language (Austro-Asiatic). Agriculture is the main occupation and as supplementary occupation, they practice hunting and trapping of birds and animals in the jungles. They depend on various seasonal forest products for subsidiary source of income. They also work as labourers in agriculture and other sector. Animal husbandry, minor non-forest products and wage labour are the main source of income for the rural Bhumij (Mandal et al., 2002).

Bhumij tribe of West Bengal was studied inadequately. Bose et al., (2008) and Ghosh and Bose (2015) were studied adult male Bhumij of Paschim Medinipur district. Bisai et al., (2008), Bisai and Mallick (2011), Bisai et al., (2012), Bisai (2014), Mahapatra et al., (2019) attempted to assess tribal preschool children of West Bengal. However, Goswasmi (2016) was undertaken a study among Bhumij children of Baleswar district of northern Odisha, India to assess the prevalence of undernutrition through Composite Index of Anthropometric Failure. No previous literature was found regarding nutritional status among Bhumij preschool children of West Bengal. In view of above circumstances, present community based cross-sectional study was undertaken to assess the nutritional status utilizing WHO

Child Growth Standards (2006) among Bhumij preschool children of Paschim Medinipur and Jhargram districts of West Bengal, India.

2. Materials and Methodology

2.1 Study area and people

Our community based cross-sectional study was undertaken among Bhumij preschool children of Paschim Medinipur and Jhargram districts of West Bengal, India. Present study was carried out at eleven villages from three blocks (Keshiary and Dantan-I from Paschim Medinipur district and Nayagram block from Jhargram district). Seven villages from Keshiary block and two villages from each block Dantan-I and Nayagram block were selected as study area. Bhumij tribal children aged from 1 to 5 years were studied. Formal ethical approval was obtained from Vidyasagar University and Block Development Officers of the respective block. The present study was conducted in accordance with the ethical guidelines for human experiments, as laid down by the Helsinki Declaration of 2000 (Touitou et al., 2004).

2.2 Sample and sample size

Initially during study design, three blocks (viz. Keshiary and Dantan-I and Nayagram block) under Kharagpur subdivision (former subdivision of the Paschim Medinipur district, later Paschim Medinipur district was divided into two districts, namely Jhargram and Paschim Medinipur districst) were selected for the present study. Then, Bhumij tribal villages (eleven) were selected from the above mentioned blocks where they lived separately from other tribal and non-tribal communities. Block Child Development Project Officer helps us to select these tribal villages where they lived separately from non-tribals. We selected those households who depended on agriculture directly or indirectly. Children aged from 1 to 5 years from these households were eligible for the present study. The minimum estimated sample size (206) was calculated as per standard formula ($n=z^2pq/d^2$) (Cochran, 1963). The minimum sample size was calculated [$(1.96^2\times0.261\times0.739)/(0.06^2)$] based on 26.1% prevalence of stunting (p) in Lodha community based survey (Bisai et al., 2008) with desired precision (d) of ± 6%. Where, q = 1-p and z = 1.96. A total of 245 (129 boys and 116 girls) children aged from 1 to 5 years were measured from April to June, 2018.

2.3 Anthropometric measurements and assessment of nutritional status

Anthropometric measurements such as height (cm) and weight (kg) were taken by according to standard procedures (Lohman et al., 1988). If a child was less than two years old, we measured the recumbent length. In such instances, a child's length is measured lying down (recumbent). Infantometer (length board) was used to measure the child's recumbent length. It was placed on a flat, stable surface. The child lies straight along the board. The shoulders should touch the board and the spine should not be arched. The investigator holds down the child's leg with one hand and moves the footboard with the other. Gentle pressure is applied to the knees to straighten the legs as far as they can go without injury. While holding the knees, the footboard is pulled against the child's feet. The soles of the feet should be flat against footboard, toes pointing upwards. We noted the last completed 0.1 cm as the child's length. If the child is aged two years or older and able to stand, we measured standing height. Height is measured standing upright. Height is the vertical distance from floor to vertex (top most point) of the head. For measuring height and weight, children were measured bare footed. Date of birth of children was collected from their birth certificates and immunization card and confirmed by parents of the children. Data was collected using pre-tested questionnaire by household to household visit. Nutritional status of the children was assessed by stunting, underweight and wasting that reflect both previous and current nutritional status of the children. WHO Child Growth Standards (2006) were used to calculate Z-scores of height-for age (HAZ), weight-for-age (WAZ), and weight-for-height (WHZ). Z-scores were calculated following the standard formula: Z-Score = (X - Median of WHO, 2006)/ (Standard deviation of WHO, 2006). Where, X = Particular score of height or weight of a child. According to WHO recommendations, a child whose HAZ less than minus two (-2) Standard Deviation (SD) from the reference population median was defined as stunted, while a child with WAZ less than -2 SD from the reference population median was considered as underweight and a child with WHZ less than -2 SD from the reference population median was classified as wasted. The WHO (1995) classification was followed for assessing severity of malnutrition by percentage

prevalence ranges of these three indicators among children. The classification is following:

Classification	Low (%)	Medium (%)	High (%)	Very high (%)
Stunting	<20	20-29	30-39	≥40
Underweight	<10	10-19	20-29	≥30
Wasting	<5	5-9	10-14	≥15

2.4 Socioeconomic background of Bhumij tribe

Agriculture is the major occupation of the Bhumij tribe. In addition to cultivation, they also worked as agricultural labourer and daily wage labourer. Monthly family income of the most studied family was less than five thousand rupees (Indian). In general, the literacy rate of the parents of the children was low.

2.5 Statistical analysis

All data was analysed in Statistical Packages of Social Science (SPSS, version 16.0). Independent Sample t test was used to test for significant sex differences in mean height and weight. One-Way ANOVA (F test) was performed to observe significant age differences in mean height and weight.

3. Results and Discussions

Table 1: Descriptive statistics (mean and standard deviation) of height and weight of the participants

Age (years)	N		Height (cm)					Weight (kg)				
			Boys		Girls		t	Boys		Girls		t
	♂	♀	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
1	28	28	74.04	3.55	74.24	3.41	-0.22	8.11	0.96	8.11	0.97	0.00
2	32	20	84.67	4.78	83.25	4.47	1.08	10.28	1.42	9.80	1.06	-1.40
3	22	23	93.42	4.12	92.65	4.96	0.57	12.75	1.48	11.91	1.64	1.80
4	25	24	99.66	4.18	100.03	4.04	-0.31	13.76	1.39	13.67	1.69	0.21
5	22	21	105.71	4.91	105.07	3.75	0.48	15.68	1.69	14.57	1.53	2.26*
Total	129	116	90.35	11.98	90.36	12.19	-0.01	11.83	2.99	11.47	2.82	0.95
Height: F=213.66** (♂) & F=223.0**(♀)								Weight: F=116.95** (♂) & F=88.77** (♀)				

* Significance at the level of p<0.05. ** Significance at the level of p<0.001. ♂ and ♀ indicate boys and girls, respectively.

Descriptive statistics (mean and standard deviation) and sex and age variations of height and weight of Bhumij children was presented in table 1. Results of t-test revealed that no statistically significant sex variations were observed in all age groups for height and weight except at 5 years for weight ($t=2.26$; $p<0.05$). One-way analysis of variance (ANOVA) analysis (F test) showed that there were significant age differences in mean height and weight for boys (height: $F=213.66$; $p<0.001$ and weight: $F=116.95$; $p<0.001$) as well as for girls (height: $F=223.0$; $p<0.001$ and weight: $F=88.77$; $p<0.001$).

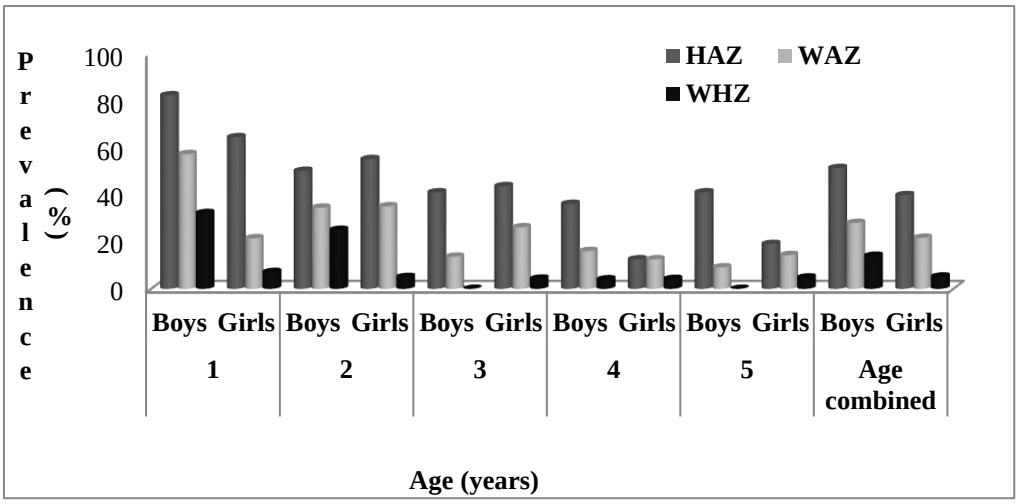

Figure 1: Age trends in prevalence of undernutrition among Bhumij children

Figure 1 presented the prevalence of under nutrition among study participants. The age combined prevalence of stunting, underweight and wasting were 51.2%, 27.9% and 14.0%, respectively for boys and 39.7%, 21.6% and 5.2%, respectively for girls. Bhumij boys had higher rate of prevalence than Bhumij girls counterpart in stunting, underweight and wasting. The overall (age and sex combined) prevalence of stunting, underweight and wasting were 45.7%, 24.9% and 9.8%, respectively. It was observed that stunting prevalence decreased with increasing age in both sexes except 5 years. However, underweight and wasting frequencies fluctuated with increasing age in both sexes.

Results of the present study revealed that overall stunting (45.7%) indicating very high (≥40%), underweight (24.9%) indicating high (20-29%) and wasting (9.8%) indicating medium (5-9%) percentage prevalence according to WHO (1995)

classification of severity of malnutrition. Highest rates of stunting, underweight and wasting were observed at age 1 year among boys (82.1%, 57.1% and 32.1%). A critical situation was observed among Bhumij preschool children when stunting was considered.

Child growth is the universalized tool to assess adequate nutrition, health and development of individual children, and to estimate overall nutritional status and health of populations. Compared to other health assessment tools, measuring child growth is a relatively inexpensive, easy to perform and non-invasive process. (WHO, 1995; Lee & Nieman, 2003; Blossner et al., 2006). Undernutrition among under five years continues to an imperative public health concerns in India. Our study evaluated the nutritional status among preschool Bhumij tribal children aged 1 to 5 years of West Bengal, India. Results of present study indicates overall stunting, underweight and wasting among Bhumij children was 45.7%, 24.9% and 9.8%, respectively.

Stunting often begins in utero and persists for at least the first 2 years of post-natal life or from conception through the first 2 years of life. Linear growth failure serves as a marker of multiple pathological disorders associated with increased morbidity and mortality, loss of physical growth potential, reduced neurodevelopmental and cognitive function and an elevated risk of chronic disease in adulthood (de Onis and Branca, 2016).

Table 2: Comparison of the prevalence of under nutrition with other tribal preschool children in West Bengal

Study tribal children	**Study area**	**Age group (years)**	**n**	**Prevalence (%)**			**References**
				HAZ	**WAZ**	**WHZ**	
Tribal children	West Bengal	<5	150	58.6	59.7	20.7	NFHS-3 (2007)
Lodha	Paschim Medinipur	1-5	74	35.1	47.3	20.3	Bisai et al., 2008
Kora-Mudi	Paschim Medinipur	2-5	47	51.1	61.7	27.7	Bisai and Mallick, 2011
Santal	Puruliya	2-6	251	26.3	38.2	12.7	Das and Bose, 2011
Munda and Oraon	Paschim Medinipur	1-5	65	38.5	61.5	55.4	Bisai et al., 2012
Santal	Paschim Medinipur	0-5	299	54.2	65.2	20.1	Bisai, 2014
Santal	Jhargram and	1-5	311	47.9	23.5	13.2	Mahapatra

Study tribal children	Study area	Age group (years)	n	Prevalence (%)			References
				HAZ	WAZ	WHZ	
	Paschim Medinipur						et al., 2019
Bhumij	Jhargram and Paschim Medinipur	1-5	245	45.7	24.9	9.8	Present study

n indicates Sample size.

Table 2 shows the comparison of the prevalence of undernutrition among tribal preschool children of West Bengal with present study. The magnitude of stunting among tribal preschool children was varies from 26.3% to 58.6%. Studies reported by NFHS-3 (2007), Bisai and Mallick (2011) among Kora-Mudi; Bisai (2014) among Santal; Mahapatra et al., (2019) among Santal and including present study among Bhumij children revealed that very high (≥40%) prevalence of chronic undernourishment i.e. stunting. Das and Bose (2011) were observed lowest prevalence (26.3%) of stunting among Santal children of Puruliya District which followed by Bisai et al., (2008) among Lodha and Bisai et al., (2012) among Munda and Oraon children. Underweight prevalence among tribal preschool children ranges from 23.5% to 65.2%. All previous investigations (NFHS-3, 2007; Bisai et al., 2008; Bisai and Mallick, 2011; Das and Bose, 2011; Bisai et al., 2012 and Bisai, 2014) except Mahapatra et al., (2019) reported higher prevalence of underweight than present study. Present investigation indicates lowest (9.8%) prevalence of wasting among Bhumij preschool children than other previous studies (NFHS-3, 2007; Bisai et al., 2008; Bisai and Mallick, 2011; Das and Bose, 2011; Bisai et al., 2012; Bisai, 2014; Mahapatra et al., 2019) conducted among tribal preschool children in West Bengal.

Table 3: Comparison of the prevalence of under nutrition with other Indian tribal preschool children with present study

Study tribal children	Study area	Age group (years)	Sample size (n)	Prevalence (%)			References
				HAZ	WAZ	WHZ	
Tribal children	Bihar	0-6	1847	60.0	55.0	25.0	Yadav et al., 1999
Gond	Jabalpur district, M.P	0-5	1022	51.7	61.7	32.8	Rao et al., 2005
Kodaku	Sarguja district,	1-5	182	43.0	59.8	35.0	Dolla et al., 2005

Study tribal children	Study area	Age group (years)	Sample size (n)	Prevalence (%)			References
				HAZ	WAZ	WHZ	
	Chattisgarh						
Raj Gond	Balaghat district, M.P	1-5	123	46.3	37.4	41.5	Sharma et al., 2006
Bharias	Chhindwara district, M.P	1-5	-	48.1	52.5	33.9	Dolla et al., 2006
Saharia	Baran district, Rajasthan	1-5	193	67.8	72.1	13.4	Rao et al., 2006
Tribal children	India	<5	4448	53.9	54.5	27.6	NFHS-3, (2007)
Tribal children	Khammam district, A.P	1-5	390	46.4	65.4	21.3	Laxmaiah et al., 2007
Gond	Korba district, Chhattishgarh	1-5	180	55.6	60.0	55.0	Mitra et al., 2007a
Kawar	Korba district, Chhattishgarh	1-5	199	47.7	48.2	48.2	Mitra et al., 2007a
Kamar	Raipur and Dhamtary district, Chhattishgarh	4-6	132	67.4	93.9	85.6	Mitra et al., 2007b
Tribal children	Thane district, Maharastra	0-6	40	60.4	68.7	30.2	Khandare et al., 2008
Kinnaura	Kinnaur district, H.P	0-6	327	84.7	90.5	85.0	Kshatriya and Ghosh, 2008
Dhodia	Valsad district, Gujarat	0-6	306	85.3	81.7	79.4	Kshatriya and Ghosh, 2008
Bhil	Barmer district, Rajasthan	0-6	356	82.0	83.1	80.6	Kshatriya and Ghosh, 2008
Baiga	Dindori district, M.P	1-5	251	44.3	61.0	37.2	Chakma et al., 2009
Tribal children	Maharashtra	1-5	1751	61.0	64.0	29.0	Meshram et al., 2012a
Tribal children	9 States of India	0-5	14587	51.0	49.0	22.0	Meshram et al., 2012b
Kadukuruba	Mysore district, Karnataka	0-5	101	55.4	60.4	43.0	Manjunath et al., 2014
Tribal children	Dibrugarh District,	0-5	500	30.4	29.0	21.6	Islam et al., 2014

Study tribal children	Study area	Age group (years)	Sample size (n)	Prevalence (%)			References
				HAZ	WAZ	WHZ	
	Assam						
Tribal children	Wayanad district, Kerala	1-6	438	38.1	39.0	20.5	Philip et al., 2015
Sugali	Chittor district, A.P	0-6	669	38.3	32.7	18.3	Reddy et al., 2016
Tribal children	Kinnaur district, H.P	1-5	350	27.4	21.4	11.1	Singh et al., 2016
Bhumij	Baleswar district, Odisha	1-6	136	32.4	42.6	25.0	Goswami, 2016
Tribal children	Wayanad district, Kerala	<5	228	41.0	62.0	43.0	Arjun et al., 2017
Karbi	Karbi Anglong district, Assam	2-5	400	35.5	26.7	18.5	Kramsapi et al., 2018
Sonowal Kachari	Lakhimpur district, Assam	<5	362	36.2	22.9	11.6	Bharali et al., 2019
Bhumij	Paschim Medinipur and Jhargram district, West Bengal	1-5	245	45.7	24.9	9.8	Present study

M.P, A.P and H.P indicates Madhya Pradesh, Andhra Pradesh and Himachal Pradesh, respectively.

Comparison of prevalence of undernutrition among Indian tribal preschool children with present study was presented in table 3. Magnitude of stunting ranges from 27.4% to 85.3%. Most of the previous studies (Yadav et al., 1999; Rao et al., 2005; Dolla et al., 2005; Sharma et al., 2006; Dolla et al., 2006; Rao et al., 2006; NFHS-3, 2007; Laxmaiah et al., 2007; Mitra et al., 2007a; Mitra et al., 2007b; Khandare et al., 2008; Kshatriya and Ghosh, 2008; Chakma et al., 2009; Meshram et al., 2012a; Meshram et al., 2012b; Manjunath et al., 2014 and Arjun et al., 2017) including present study revealed very high (≥40%) prevalence of stunting. Notably, recent previous studies (Islam et al., 2014; Philip et al., 2015; Reddy et al., 2016; Singh et al., 2016; Goswami, 2016; Kramsapi et al., 2018 and Bharali et al., 2019) indicates slow reduction in the prevalence of stunting. Underweight

prevalence among tribal preschool children of India varies from 21.4% to 93.5%. All previous studies (Yadav et al., 1999; Rao et al., 2005; Dolla et al., 2005; Sharma et al., 2006; Dolla et al., 2006; Rao et al., 2006; NFHS-3, 2007; Laxmaiah et al., 2007; Mitra et al., 2007a; Mitra et al., 2007b; Khandare et al., 2008; Kshatriya and Ghosh, 2008; Chakma et al., 2009; Meshram et al., 2012a; Meshram et al., 2012b; Manjunath et al., 2014; Philip et al., 2015; Reddy et al., 2016; Goswami, 2016; Arjun et al., 2017) showed very high (≥30%); Islam et al., (2014) and Kramsapi et al., (2018) indicated medium (20-29%) prevalence of underweight among tribal preschool children across the India. Only Singh et al., (2016) among tribal children of Kinnaur district of Himachal Pradesh and Bharali et al., (2019) among Sonowal Kachari children from Lakhimpur district of Assam revealed the lowest prevalence of underweight than present study.

It is noteworthy that Bhumij children (present study) revealed the lowest prevalence (9.8%) of wasting among tribal preschool children of India. Saharia children of Rajasthan studied by Rao et al., (2006); tribal children of Himachal Pradesh studied by Singh et al., (2016) and Sonowal Kachari children of Assam studied by Bharali et al., (2019) reported high (10-14%) prevalence of wasting. Other studies pointed out very high (≥15%) prevalence of wasting. Tribal children from Kinnaur district of Himachal Pradesh studied by Singh et al., (2016) shows overall lowest prevalence of undernutrition. Small sample size may be one of the reasons behind of very high amount of undernutrition among tribal preschool children.

Insufficient food (in terms of nutrient and quantity) intake, lack of awareness among studied Bhumij parents regarding child health care and nutrition may be probable causes of undernutrition among preschool Bhumij children. Most of the mothers were engaged in agricultural work during day time. They cannot spend much time with their children. In general, grandmother and elder sister or brother take care of the child including feeding them. Most of the children received cooked food from ICDS centre. The most prevalent illnesses among these children were common cold, cough and fever. In general, they use traditional medicine to treat their illnesses. However, cross-sectional study, small sample size and small study area are the limitations of present study.

Improvement in infant and young child feeding and caring through co-ordinated efforts of ICDS and National Rural Health Mission (NRHM) can result in substantial improvement in nutrition and health status and survival during the

critical period of life. However, our studied children had better nutritional status than other tribal children from other states of the country probably suggesting the impact of better public health policies, at least among this population. However, the current situation calls for an urgent need to improve health care services provided to tribal children.

4. Conclusion

The present study among Bhumij preschool children of West Bengal revealed poor nutritional status with a very high prevalence of stunting.

Acknowledgements: All participants and their parents are gratefully acknowledged for their cooperation during the data collection. Special thanks are due to the Child Development Project Officers and Block Development Officers of respective blocks and ICDS authorities. Department of Anthropology, Vidyasagar University is also acknowledged for instrumental support and partial financial assistance provided by UGC-SAP-DRS-I. University Grants Commission of India is also acknowledged for the financial support to SP in the form of Senior Research Fellow (UGC-Ref No.: 590/(NET-DEC.2013). Jhuma Dey and Barun Ghosh are also gratefully acknowledged for their support and cooperation. Anthropological Survey of India is also acknowledged for financial assistance to BM as Senior Research Fellow.

References

[1] Arjun, C. M. and Ajith, V. T. K. (2017). Nutritional status and its association with various socio demographic variables among preschool tribal children in Kerala. Journal of Medical Science and Clinical Research, 5(11), 30543-30548. https://dx.doi.org/10.18535/jmscr/v5i11.124.

[2] Bandyopadhyay, S. (2017). Trends of change in livelihood in two Bhumij villages of Purulia, West Bengal. The Indian Journal of Anthropology, 5(1), 87-104.

[3] Bharali, N., Singh, K. H. and Mondal, N. (2019). Composite Index of Anthropometric Failure (CIAF) among Sonowal Kachari tribal preschool

children of flood effected region of Assam, India. Anthropological Review, 82(2), 163–176.

[4] Bisai, S. (2014). Prevalence of Undernutrition among Santal tribal preschool children of Paschim Medinipur District, West Bengal, India. International Journal of Pediatrics, 2(4-3), 347-354.

[5] Bisai, S., Bose, K. and Ghosh, A. (2008). Prevalence of undernutrition of Lodha children aged 1-14 years of Paschim Medinipur district, West Bengal, India. Iranian Journal of Pediatrics, 18(4), 323-329.

[6] Bisai. S., Bose, K., Ghosh, T., De, G. K., Khongsdier, R., Kozial, S., Mahalanabis, S. and Mallick, P. (2012). Nutritional status based on Anthropometry of tribal preschool children in Paschim Medinipur district of West Bengal, India. International Journal of Innovative Research and Development, 1(3), 61-79.

[7] Bisai, S. and Mallick, C. (2011). Prevalence of undernutrition among Kora-Mudi children aged 2-13 years in Paschim Medinipur district, West Bengal, India. World Journal of Pediatrics, 7(1), 31-36.

[8] Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., De Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R. and Uauy, R. (2013). Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet, 382(9890), 427-451.

[9] Blossner, M., de Onis M. and Uauy R. (2006). Estimating stunting from underweight survey data. In: Culture, Ecology, Nutrition, Health and Disease (K. Bose ed.). pp. 145-152. Kamla Raj Enterprise: Delhi.

[10] Bose, K., Bisai, S., Mondal, P. S. and Ghosh, M. (2008). Body mass index and chronic energy deficiency among adult male Lodhas and Bhumijs: a comparison with other tribal populations of West Bengal, India. Journal of Public Health (Springer), 16, 117-121. http://doi.org/10.1007/s10389-007-0153-x.

[11] Census of India: Census of India 2011: Registrar General and Census Commissioner, India, Controller of Publication, New Delhi (2011).

[12] Chakma, T., Meshram, P. K., Rao, P. V., Singh, S. B. and Kavishwar, A. (2009). Nutritional status of Baiga-a primitive tribe of Madhya Pradesh. Anthropologist, 11, 39-43.

[13] Cochran, W. C. (1963). Sampling techniques. Wiley: New York.

[14] Das, S. and Bose, K. (2011). Assessment of nutritional status by anthropometric indices in Santal tribal children. Journal of Life science, 3(2), 81-85.

[15] deOnis, M. and Branca, F. (2016). Childhood stunting: a global perspective. Maternal and Child Nutrition, 12(Suppl. 1), 12–26. http://doi.org/10.1111/mcn.12231.

[16] Development Initiatives. (2018). 2018 Global Nutrition Report: Shining a light to spur action on nutrition. Bristol, UK: Development Initiatives.

[17] Dolla, C. K., Meshram, P., Karforma, C., Das, S. and Uike, M. (2005).Nutritional status of Kodaku pre-school children in central India. Journal of Human Ecology, 17(3), 229-231. https://doi.org/10.1080/09709274.2005.11905786.

[18] Dolla, C. K., Meshram, P., Verma, A., Shrivastav, P., Karforma, C. and Patel, M. L. (2006). Health and morbidity profile of Bharias- a primitive tribe of Madhya Pradesh. Journal of Human Ecology, 19(2), 139-141. https://doi.org/10.1080/09709274.2006.11905868.

[19] Ghai, O. P., Paul, V. K. and Bagga, A. (2009). Ghai Essentials Pediatrics, 7th ed. CBS Publishers and distributors, New Delhi, India.

[20] Ghosh, M and Bose, K. (2015). Assessment of undernutrition among male Bhumijs of West Bengal, India: a comparison of body mass index and mid-upper arm circumference. Human Biology Review, 4(2), 140-149.

[21] Goswami, M. (2016). Prevalence of undernutrition measured by Composite Index of Anthropometric Failure (CIAF) among the Bhumij children of Northern Odisha, India. Journal of Nepal Pediatrics Society, 36(1), 61-67.

[22] https://www.who.int/nutgrowthdb/jme_infosheet.pdf last accessed on 5th August, 2019.

[23]https://www.unicef.org/progressforchildren/2006n4/index_undernutrition.html last accessed on 5th August, 2019.

[24] India Ministry of Tribal Affairs. (2004). The National Tribal Policy: A policy for the Scheduled Tribes of India. New Delhi: Ministry of Tribal Affairs.

[25] International Institute for Population Sciences (IIPS) and ORC MACRO 2007. National Family Health Survey (NFHS -3), 2005-06: India. Mumbai: IIPS, Vol. 1.

[26] International Institute for Population Sciences (IIPS) and Macro International 2007. National Family Health Survey (NFHS-3), 2005-06: West Bengal. Mumbai: IIPS.

[27] International Institute for Population Sciences (IIPS) and Macro International 2017. National Family Health Survey (NFHS-4), 2015-16: West Bengal. Mumbai: IIPS.

[28] International Institute for Population Sciences (IIPS) and Macro International 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.

[29] Islam, S., Mahanta, T. G., Sarma, R. and Hiranya, S. (2014). Nutritional status of under 5 children belonging to tribal population living in riverine (Char) areas of Dibrugarh district, Assam. Indian Journal of Community Medicine: official publication of Indian Association of Preventive and Social Medicine, 39(3), 169-174.

[30] Khandare, A. L., Siruguri, V., Rao, A., Venkaiah, K., Reddy, G., Rao, G. S. (2008). Diet and nutrition status of children in four tribal blocks of Thane district of Maharastra, India. Pakistan Journal of Nutrition, 7(3), 485-488.

[31] Kramsapi, R., Singh, K. N. and Mondal, N. (2018). Composite Index of Anthropometric Failure (CIAF) among preschool (2-5 years) tribal children of Assam (India). Human Biology Review, 7(1), 1-18.

[32] Kshatriya, G. K. and Ghosh, A. (2008). Undernutrition among the tribal children in India: Tribes of Coastal, Himalayan and Desert Ecology. Anthropologischer Anzeiger, 66(3), 355-363.

[33] Laxmaiah, A., Rao, M. K., Kumar, R. H., Arlappa, N., Venkaiah, K. And Brahmam, G. N. V. (2007). Diet and nutritional status of tribal population in ITDA project areas of Khammam district, Andhra Pradesh. Journal of Human Ecology, 21(2), 79-86. https://doi.org/10.1080/09709274.2007.11905954.

[34] Lee, R. D. and Nieman, D. C. (2003). Nutritional Assessment. McGraw-Hill: New York.

[35] Lohman, T. G., Roche, A. F. and Martorell, R. 1988. Anthropometric Standardization Reference Manual. Human Kinetics Books, Chicago.

[36] Mahapatra, B., Dey, J., Pal, S. and Bose, K. (2019). Prevalence of Undernutrition among Santal Preschool Children of two Districts of West Bengal, India. Human Biology Review, 8(2), 180-196.

[37] Maleta, K. (2006). Undernutrition. Malawi Medical Journal: The Journal of Medical Association of Malawi, 18(4), 189-205.

[38] Mandal, H., Mukherjee, S. and Datta, A. (2002). India: An illustrated Atlas of Tribal World. Kolkata: Anthropological Survey of India.

[39] Manjunath, R., Jagadish, K. K., Kulkarni, P., Begum, K. and Gangadhar, M. R. (2014). Malnutrition among under five children of Kadukuruba Tribe: Need to reach the unreached. Journal of Clinical and Diagnostic Research, 8(7), 1-4. http://doi.org/10.7860/JCDR/2014/9436.4548.

[40] Meshram, I. I., Arlappa, N., Balakrishna, N., Laxmaiah, A., Mallikarjun Rao, K., Gal Reddy, C., Ravindranath, M., Sharad Kumar, S. and Brahmam, G. N.V. (2012a). Prevalence and determinants of undernutrition and its trends among pre-school tribal children of Maharashtra State, India. Journal of Tropical Pediatrics, 58(2), 125-132.

[41] Meshram, I. I., Arlappa, N., Balakrishna, N., Rao, K.M., Laxmaiah, A. and Brahmam, G.N.V. (2012b). Trends in the prevalence of undernutrition, nutrient & food intake and predictors of undernutrition among under five year tribal children in India. Asia Pacific Journal of clinical nutrition, 21(4), 568-576.

[42] Mitra, M., Sahu, P. K., Chakrabarty, S., Bharati, S. and Bharati, P. (2007a). Nutritional and health status of Gond and Kawar tribal pre-school children of Chhattisgarh, India. Journal of Human Ecology, 21(4), 293-299. https://doi.org/10.108009709274.2007.11905988.

[43] Philip, R. R., Vijayakumar, K., Indu, P. S., Shrinivasa, B. M., Sreelal, T. P. and Balaji, J. (2015). Prevalence of undernutrition among tribal preschool children in Wayanad district of Kerala. International Journal of Advanced Medical and Health Research, 2(1), 33-38. http://doi.org/10.4103/2349-4220.159135.

[44] Rao, K. M., Kumar, R. H., Venkaiah, K. and Brahmam, G. N. V. (2006). Nutritional status of Saharia- A primitive tribe of Rajasthan. Journal of Human Ecology, 19(2), 117-123.

[45] Rao, V. G., Yadav, R., Dolla, C. K., Kumar, S., Bhondeley, M. K. and Ukey, M. (2005). Undernutrition and childhood morbidities among tribal preschool children. Indian Journal of Medical Research, 122, 43-47.

[46] Reddy, V. B., Kusuma, Y. S., Pandav, C. S., Goswami, A. K. and Krishnan, A. 2016. Prevalence of malnutrition, diarrhea and acute respiratory infections among under-five children of Sugali tribe of Chittoor district, Andhra Pradesh, India. Journal of Natural Science, Biology and Medicine, 7(2), 155-160. http://doi.org/10.4103/0976-9668.184702.

[47] Sachdev, H. P. S. (1995). Assessing child malnutrition: some basic issues. Bulletin of the Nutrition Foundation in India, 16(4), 1-5.

[48] Sharma, B., Mitra, M., Chakrabarty, S. and Bharati, P. (2006). Nutritional status of preschool children of Raj Gond-A tribal population in Madhya Pradesh, India. Malaysian Journal of Nutrition, 12 (2), 147-155.

[49] Singh, H., Gupta, A., Sachdeva, A., Barall, D., Kumar, D. and Singh, S. (2016). Nutritional status of 1-5 Years children in a hilly tribal District of North India. International Journal of Contemporary Medical Research, 3(11), 3286-3288.

[50] Touitou, Y., F. Portaluppi, Smolensky, M. H. and Rensing, L. (2004). Ethical principles and standards for the conduct of human and animal biological rhythm research. Chronobiology International, 21(1), 161-170.

[51] World Health Organization. (1995). Physical Status: The Use and Interpretation of Anthropometry: Technical Report Series no. 854. Geneva: WHO.

[52] World Health Organization.(2006). WHO Child Growth Standards. Length/ Height for Age, Weight for Age, Weight for length, Weight for Height and Body Mass Index for Age. Methods and Development. Geneva: WHO Press.

[53] Yadav, R. J. and Singh, P. (1999). Nutritional status and dietary intake in tribal children in Bihar. Indian Pediatrics, 36(1), 37-42.