

# Prevalence of undernutrition among Kora-Mudi children aged 2-13 years in Paschim Medinipur District, West Bengal, India

Samiran Bisai, Chhanda Mallick

Midnapore, India

**Background:** Nutritional status of tribal children in West Bengal has not been investigated adequately. The present study was undertaken to determine the prevalence of underweight, stunting and wasting in Kora-Mudi children of Paschim Medinipur, West Bengal, India.

**Methods:** A cross sectional study was undertaken in two villages of the Paschim Medinipur District. Of 119 children aged 2-13 years, 59 boys and 60 girls were studied. Height and weight measurements were made by standard techniques. Children were considered as underweight, stunting and wasting if their weight-for-age, height-for-age and weight-for-height Z-scores  $< -2.0$  SD of the National Center for Health Statistics reference standards.

**Results:** The overall prevalence of underweight, stunting and wasting was 52.9%, 49.6% and 22.7%, respectively. About 16.0%, 24.4% and 1.7% of children were found to be severely underweight, stunted and wasted. The prevalence of underweight, stunting and wasting was higher in preschool children than in school going children. The chance of underweight, stunting and wasting was 1.80, 1.10 and 1.58 times greater in preschool children than in school going children. Moreover, the prevalence of underweight, stunting and wasting was higher in boys than in girls. The boys had 1.45, 1.66 and 2.02 times greater risk to be underweight, stunted and wasted. According to the WHO classification of severity in malnutrition, the overall prevalence of underweight,

stunting and wasting was as high as  $\geq 30\%$ ,  $\geq 40$  and  $\geq 15\%$ .

**Conclusions:** The nutritional status of Kora-Mudi children in West Bengal is critical. Appropriate measures should be taken by the respective authorities to improve childhood health and nutritional status.

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**Key words:** Kora-Mudi; stunting; undernutrition; underweight; wasting

## Introduction

Malnutrition is still considered one of the major public health problems in many countries, affecting more than 30% of children under 5 years of age. Undernutrition is the most important cause of death in this age group in developing countries,<sup>[1]</sup> in which nutritional deficit is common. Generally, three anthropometric indicators are often used to assess nutritional status during childhood: underweight (low weight-for-age), stunting (low height-for-age), and wasting (low weight-for-height).<sup>[2]</sup> Growth during childhood is widely used to assess adequate health, nutrition and development of children, and to estimate overall nutritional status as well as health status of a population. It is well documented that chronic undernutrition is associated with slower cognitive development and serious health impairment later in life which reduce the quality of life.<sup>[3]</sup> The majority of deaths associated with malnutrition occur in children who are marginally malnourished.<sup>[4]</sup> About 50% of the children under 5 years old in India are moderately or severely undernourished. Moreover, several studies have shown that the degree of undernutrition is higher among the underprivileged communities.<sup>[5,6]</sup> In general, tribal populations are considered to be underprivileged in India.<sup>[7,8]</sup>

Numerically, Kora is the fifth largest tribal community in West Bengal. According to the latest census the total population of Kora is 142 789, which

**Author Affiliations:** Department of Anthropology, North Eastern Hill University, Shillong, Meghalaya, India (Bisai S); Department of Anthropology, Vidyasagar University, Midnapore 721102, West Bengal, India (Bisai S); Society for Applied Studies, Salt Lake, Kolkata 700 064, West Bengal, India (Bisai S); Department of Bio-Medical Laboratory Science & Management, Vidyasagar University, Midnapore -721102, West Bengal, India (Mallick C)

**Corresponding Author:** Samiran Bisai, Department of Anthropology, Vidyasagar University, Midnapore 721102, West Bengal, India (Email: sbisai@hotmail.com)

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is 3.2% of the total tribal population of the state. Kora-Mudi speak the Kora tongue, which belongs to the Austro-Asiatic language group. More than 90% of the Kora people reside in rural areas of the country. They are distributed in three eastern provinces of India namely: West Bengal, Orissa and Bihar. The majority of the Koras in West Bengal are habitat in the districts of Bankura, Bardhaman, Birbhum, Hugli, Puruliya, and Paschim Medinipur. The Koras are mainly engaged in earth digging. They have four endogamous groups, i.e., Mudi Kora, Kurmi Kora, Nagbanshi Kora, Dhangar or Orang Kora.<sup>[9]</sup> Approximately, 43.3% (boys 58.2%, girls 28.2%) Kora Mudi children in the age group 5-14 years have been found to attend school. However, information on Kora-Mudis is extremely scanty and there is no published literature on anthropometric characteristics and nutritional status of Kora-Mudi children of the Paschim Medinipur District of West Bengal. In view of this, the present study was carried out to determine the prevalence of underweight, stunting and wasting among Kora-Mudi children in the Paschim Medinipur District of West Bengal.

## Methods

This cross sectional study was conducted from May 2008 to March 2009 in the Kora-Mudi tribal community in two villages of the Paschim Medinipur District. Midnapore is located at 22.25°N, 87.65°E and is 23 meters above the sea-level. These villages are situated just south of the Kasai River between two big towns: Midnapore and Kharagpur. The distance of these villages is approximately 10 km from both towns and 125 km from Kolkata city, the provincial capital of West Bengal. There is no health center in both villages. The vast majority of the adult population in the studied households are engaged in unskilled manual labor. Thus, they belong to lower socio-economic class. Data on age, sex, height and weight were made and recorded on a pre-tested questionnaire by house to house visit following interview and examination. Children's age was recorded as reported by mothers and verified further with other senior members of the household. Parents were informed about the objectives of the study and their written consent was obtained. The study protocol was approved by the institutional ethical committee prior to commencement of the study.

Altogether 119 children, 59 boys and 60 girls aged 2-13 years, were measured to evaluate the prevalence of underweight, stunting and wasting. The minimum estimated sample size was 116, calculated using standard formula ( $n = z^2 pq / d^2$ ) found elsewhere.<sup>[10]</sup> The calculation  $[(1.96^2 \times 0.261 \times 0.739) / (0.08^2)]$  was based on 26.1% prevalence (p) of stunting in community

based surveys<sup>[5]</sup> with desired precision (d) of  $\pm 8\%$ . Where,  $q = p - 1$  and  $z = 1.96$ .

Anthropometric measurements, i.e., height and weight of each subject, were taken according to the standard procedures.<sup>[11]</sup> Weight and height were measured using weighing scale and anthropometric rod to the nearest 0.1 kg and 0.1 cm, respectively. Age and sex specific mean height and weight of the Kora-Mudi children were compared with the Indian Council of Medical Research (ICMR) standards.<sup>[12]</sup> Children were considered with underweight, stunting and wasting if their weight-for-age, height-for-age and weight-for-height Z-scores below -2.0 SD of the National Center for Health Statistics reference standards.<sup>[13]</sup> While, severe and moderate undernutrition was defined as Z-scores below -3.0 and -3.0 to below -2.0, respectively. We followed the WHO<sup>[2]</sup> criteria for assessing severity of malnutrition by percentage prevalence ranges of these three indicators among children. The classification is shown in Table 1.

## Statistical analyses

Student's *t* test was undertaken to assess sex differences in height and weight. One-way ANOVA was employed to test age variations of height and weight. Proportion test was performed to test for differences in prevalence of underweight, stunting and wasting between sexes. Odds ratio (OR) and 95% confidence interval (CI) were also calculated following standard methods. All statistical analyses were performed using the EPI6 statistical package. Statistical significance was considered as *P* value less than 0.05.

## Results

The age and sex specific means of weight and height were analyzed. It was observed that the mean weight and height significantly increased with advancement of age. Compared with the ICMR mean values, the age and sex specific means of height and weight of the Kora-Mudi children were shorter and lighter than the ICMR standards at all ages.

The prevalence of undernutrition (underweight, stunting and wasting) of the studied children is presented in Table 2. The distributions of Z-scores for weight-for-age, height-for-age and weight-for-height

**Table 1.** Classification assessment for severity of malnutrition by percentage prevalence ranges (WHO 1995)

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

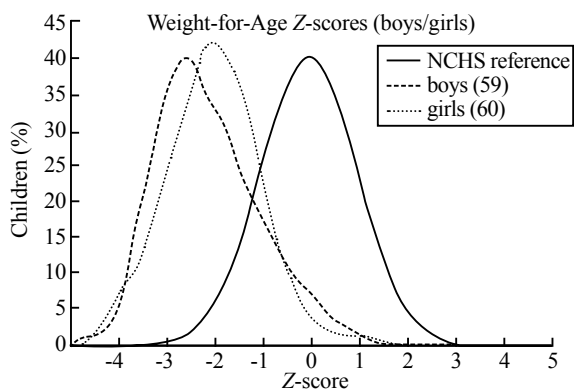


Fig. 1. Distribution of weight-for-age Z-score of Kora-Mudi children.

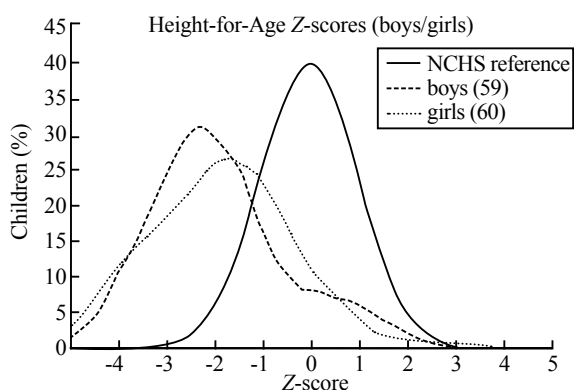


Fig. 2. Distribution of height-for-age Z-score of Kora-Mudi children.

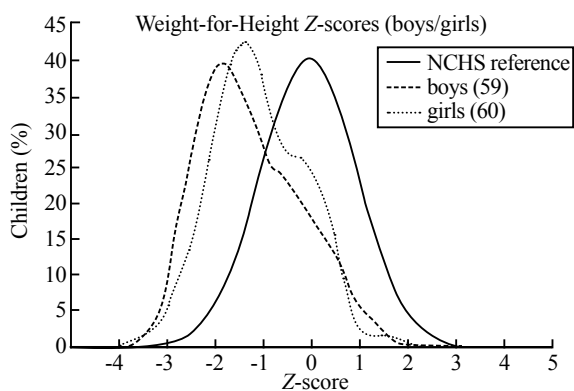


Fig. 3. Distribution of weight-for-height Z-score of Kora-Mudi children.

are shown in Figs. 1-3. If age and sex were combined, the prevalence of underweight (Z-score < -2.0), stunting and wasting was 52.9% (95%CI: 44.0-61.9), 49.6% (95%CI: 40.6-58.6) and 22.7% (95%CI: 15.2-30.2), respectively. As a result, 16.0%, 24.4% and 1.7% of children were found to be severely underweight, stunted and wasted, respectively. The prevalence of underweight, stunting and wasting was higher in boys (57.6%, 55.9% and 28.8%) than in girls (48.3%, 43.3% and 16.7%). The boys had a risk of 1.45 (95%CI: 0.71-2.99), 1.66 (95%CI: 0.75-3.69) and 2.02 (95%CI: 0.77-5.47) times greater to be underweight, stunted and wasted than the girls. Similarly, the rates of severe underweight (boys vs. girls: 18.6% vs. 13.3%) and stunting (25.4% vs. 23.3%) were higher in boys. However, the prevalence of severe wasting (1.7% vs. 1.7%) was similar in both sexes.

The prevalence of underweight, stunting and wasting was higher in preschool children (61.7%, 51.7% and 27.7%) than in school going children (47.2%, 48.6% and 19.4%) (Table 3). Preschool children had a chance of 1.80 (95%CI: 0.80-4.08), 1.10 (95%CI: 0.50-2.46) and 1.58 (95%CI: 0.61-4.10) times greater to be underweight, stunted and wasted than school going children. Moreover, the prevalence of wasting was higher in boys than in girls (43.5% vs. 12.5%; Chi-square test=4.19,  $P < 0.05$ ) in preschool children.

According to WHO<sup>[2]</sup> classification of severity of malnutrition, the high overall prevalence of underweight, stunting and wasting ( $\geq 30\%$ ,  $\geq 40\%$  and  $\geq 15\%$ ) indicated a critical situation. A similar critical situation was also observed when the age group and sex-specific prevalence of undernutrition was considered.

## Discussion

Studies have shown that undernutrition of children is increasing over the years, and researchers are also

Table 2. Prevalence of undernutrition among Kora-Mudi children aged 2-13 years

Nutritional indicators	Total undernutrition (%; 95% CI)	Moderate undernutrition (%; 95% CI)	Severe undernutrition (%; 95% CI)
<b>Underweight</b>			
All (119)	52.9 (44.0-61.9)	37.0 (28.3-45.6)	16.0 (9.4-22.5)
Boys (59)	57.6 (45.0-70.2)	39.0 (26.5-51.4)	18.6 (8.7-28.6)
Girls (60)	48.3 (35.7-61.0)	35.0 (22.9-47.1)	13.3 (4.7-21.9)
<b>Stunting</b>			
All (119)	49.6 (40.6-58.6)	25.2 (17.4-33.0)	24.4 (16.7-32.1)
Boys (59)	55.9 (43.3-68.6)	30.5 (18.8-42.3)	25.4 (14.3-36.5)
Girls (60)	43.3 (30.8-55.9)	20.0 (9.9-30.1)	23.3 (12.6-34.0)
<b>Wasting</b>			
All (119)	22.7 (15.2-30.2)	21.0 (13.7-28.3)	1.7 (-0.6 - 4.0)
Boys (59)	28.8 (17.3-40.4)	27.1 (15.8-38.5)	1.7 (-1.6 - 5.0)
Girls (60)	16.7 (7.2-26.1)	15.0 (6.0-24.0)	1.7 (-1.6 - 4.9)

**Table 3.** The prevalence of undernutrition in different studies conducted in tribal children compared with Kora-Mudi children of Paschim Midnapore

Tribe	District	State	Age group	Sample size	Underweight (%)	Stunting (%)	Wasting (%)
<b>Preschool children</b>							
Tribal children <sup>[33]</sup>	Khammam	Andhra Pradesh	1-5	390	65.4	46.4	21.3
Tribal children <sup>[28]</sup>	17 tribal districts	Bihar	0-6	1847	55.0	60.0	25.0
Gond <sup>[32]</sup>	Korba	Chhattisgarh	1-5	180	60.0	55.6	55.0
Kamar <sup>[27]</sup>	Raipur, Dhamtary	Chhattisgarh	4-6	132	93.9	67.4	85.6
Kawar <sup>[32]</sup>	Korba	Chhattisgarh	1-5	199	48.2	47.7	48.2
Baiga <sup>[22]</sup>	Dindori	Madhya Pradesh	1-5	251	61.0	44.3	37.2
Gond <sup>[30]</sup>	Jabalpur	Madhya Pradesh	0-5	1022	61.6	51.6	32.9
Kodaku <sup>[23]</sup>	Sarguja	Madhya Pradesh	1-5	182	59.8	43.0	35.0
Bharia <sup>[31]</sup>	Chhindwara	Madhya Pradesh	1-5	-	52.5	48.1	33.9
Raj Gond <sup>[24]</sup>	Balaghat	Madhya Pradesh	1-5	123	37.4	46.3	41.5
Tribal children <sup>[29]</sup>	Thane	Maharashtra	0-6	40	68.7	60.4	30.2
Saharia <sup>[26]</sup>	Baran	Rajasthan	1-5	193	72.1	67.8	13.4
Lodha <sup>[25]</sup>	Paschim Medinipur	West Bengal	1-5	74	47.3	35.1	20.3
Tribal children <sup>[20]</sup>		West Bengal	<5	150	59.7	58.6	20.7
Tribal children <sup>[21]</sup>		India	<5	4448	54.5	53.9	27.6
Kora-Mudi (present study)	Paschim Medinipur	West Bengal	2-5	47	61.7	51.1	27.7
<b>School going children</b>							
Kamar <sup>[27]</sup>	Raipur, Dhamtary	Chhattisgarh	7-12	177	48.0	60.5	45.2
Jenukuruba <sup>[35]</sup>	Mysore	Karnataka	6-10	135	60.0	46.0	30.4
Lodha <sup>[25]</sup>	Paschim Medinipur	West Bengal	6-14	91	23.1	18.7	18.9
Santal <sup>[19]</sup>	Paschim Medinipur	West Bengal	5-12	442	33.7	17.9	29.4
Kora-Mudi (present study)	Paschim Medinipur	West Bengal	6-13	72	47.2	48.6	19.4

conducting more studies on this problem since it poses a major threat to the health and well-being of any population. This problem is not only associated with serious long-term consequences for the child but also adversely related to the economic development of a nation.<sup>[14]</sup> Undernutrition continues to be a cause of ill health and premature mortality among children in developing countries including India.<sup>[15]</sup> It has been found that undernutrition during childhood is a major health problem in most of the provinces of India including West Bengal. In different parts of West Bengal numerous studies have been conducted on the health and nutritional status of tribal children and adolescents.<sup>[4,16-19]</sup> However, the nutritional status of Kora Mudi tribal children in West Bengal has not been investigated previously. Therefore, we preliminarily reported the results of maternal and child health (MCH) pilot study.

In general, the prevalence of underweight in tribal preschool children of India ranged from 37.4% to 93.9%. The prevalence of underweight in the present study (61.7%) was similar to that in West Bengal<sup>[20]</sup> and slightly higher than the national<sup>[21]</sup> prevalence as assessed during 2005-2006.

The prevalence of stunting ranged between 35.1% and 67.8% (Table 3). But it was higher in the present study than in tribal preschool children of Baiga,<sup>[22]</sup> Kodaku,<sup>[23]</sup> Raj Gond<sup>[24]</sup> and Lodha.<sup>[25]</sup> In contrast, the prevalence of stunting was lower in the present study

than in the Saharias,<sup>[26]</sup> Kamars<sup>[27]</sup> and tribal children from Bihar,<sup>[28]</sup> Maharashtra<sup>[29]</sup> and West Bengal.<sup>[20]</sup> However, the rate of stunting was similar to that of the national tribal population, and higher than that of the other national population (40.7%).<sup>[21]</sup>

Moreover, the prevalence of wasting was lower in Kora-Mudi children than tribal children from Madhya Pradesh,<sup>[22-24,30,31]</sup> Chhattisgarh,<sup>[27,32]</sup> and Maharashtra.<sup>[29]</sup> However, the prevalence of wasting in the present study was comparable to the national figure.<sup>[21]</sup> In contrast, this prevalence was higher in the present study than that in Saharias,<sup>[26]</sup> Lodhas<sup>[25]</sup> and tribal children from Andhra Pradesh,<sup>[33]</sup> Bihar<sup>[28]</sup> and West Bengal,<sup>[20]</sup> respectively. There were large variations in the rate of wasting: 13.4% for Saharia<sup>[26]</sup> children to 85.6% for Kamar tribal children.<sup>[27]</sup> Thus, these studies clearly indicated that tribal preschool children were experiencing acute malnutrition.

The prevalence of undernutrition (underweight, stunting and wasting) in almost all studies was in the category high to very high (Table 3). However, there are differences in childhood undernutrition as observed by intra- and inter-district/state variation. This may be due to the small sample size and/or different study design used for data collection. Apart from this, tribal food patterns may also influence the variation of undernutrition within the region. Ethnic differences of body size and shape may also play an important role in growth pattern. During childhood one cannot ignore



the socio-economic status of a community. In general, tribal communities in India are neglected, discriminated in terms of income distribution and social status, which tend to have higher rates of undernutrition.<sup>[34]</sup> Therefore, tribal communities need much greater access to health care information, and opportunities and resources to improve their children's nutritional status.

In school going children, the prevalence of underweight and wasting in the present study was lower than that in Jenukurubas from Karnataka.<sup>[35]</sup> The rates of underweight and stunting in the present study were higher than those in Lodha<sup>[25]</sup> and Santal<sup>[19]</sup> children from West Bengal. Moreover, the prevalence of wasting was lower than that in Santal<sup>[19]</sup> children and comparable to Lodha<sup>[25]</sup> children, indicating that the children in both communities were experiencing acute undernutrition.

In the present study, the overall prevalence of underweight, stunting and wasting was 52.9%, 49.6% and 22.7%, respectively. Another study from Meghalaya showed that the prevalence of underweight, stunting and wasting was 60.0%, 29.0% and 6.0% respectively in Khasi children aged 3-18 years.<sup>[36]</sup> A study conducted in the Purulia district of West Bengal found that the prevalence of underweight, stunting and wasting in Santal children was 33.7%, 17.9% and 29.4%, respectively.<sup>[18]</sup> Bisai et al<sup>[5]</sup> recently reported that the prevalence of underweight, stunting and wasting was 33.9%, 26.1% and 19.4%, respectively. In the present study the prevalence of wasting was intermediated between the studies conducted in Santal<sup>[19]</sup> and Lodha<sup>[25]</sup> children. However, the prevalence of underweight and stunting in Kora-Mudi children was much higher than in Santal<sup>[19]</sup> and Lodha<sup>[25]</sup> children.

In the present study, 16.0%, 24.4% and 1.7% of children were found to be severely underweight, stunted and wasted, respectively. A recent study reported that 9.1%, 12.7% and 3.6% of children were found to be severely underweight, stunted and wasted.<sup>[5]</sup> Chowdhury et al<sup>[19]</sup> reported the rates of severe underweight, stunting and wasting as 7.9%, 5.0%, and 9.5%, respectively. These results clearly indicated that the prevalence of severe underweight and stunting was much higher in Kora-Mudi children. Underweight is used as a composite indicator to reflect both acute and chronic undernutrition but stunting is an indicator of chronic or long-term nutritional deficiency and/or disease or illness.<sup>[37]</sup> Thereby, the children in the present study experienced instant and prolonged nutritional stress.

As found in the previous study,<sup>[25]</sup> this study found that preschool children are more likely to suffer from undernutrition than school going children. It is well documented that dietary insufficiencies are mainly reflected through the high prevalence of underweight,

stunting and wasting in Indian preschool children.<sup>[38]</sup>

The prevalence of underweight, stunting and wasting was higher in boys than in girls. The higher prevalence of undernutrition in boys is consistent with those reported.<sup>[5,39]</sup> It is well documented that boys are more likely to suffer from undernutrition than girls due to increased nutritional needs in boys than in girls and/or influences of early childhood diseases in boys.<sup>[24]</sup>

However, it must be mentioned that there are limitations in the present study including the small sample size, lack of detailed information on socioeconomic status, and non-availability of data on dietary intake. We conclude that the nutritional status of the sample population reveals a gloomy picture. An urgent need is required to take appropriate steps for improvement of nutritional status of this marginalized scheduled tribe community. It may be recommended that more empirical and field based studies should be undertaken on the nutritional status of similar small and underprivileged tribal communities. India has approximately 400 tribal groups, who constitute more than 8% of India's population; and they are distributed all over the hilly and dense forest regions of the country.<sup>[5,22,40]</sup> Therefore, improvement of their nutritional status is of vital importance from public health point of view at the national level.

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**Competing interest:** None declared.

**Contributors:** Bisai S proposed the study and wrote the first draft. Both authors collected and analyzed the data. Both authors contributed to the design and interpretation of the study. Bisai S is the guarantor.

## References

- 1 Sawaya AL, Sesso R, Florêncio TM, Fernandes MT, Martins PA. Association between chronic undernutrition and hypertension. *Matern Child Nutr* 2005;1:155-163.
- 2 World Health Organization. Physical Status: The Use and Interpretation of Anthropometry. Technical Report Series No. 854. Geneva: WHO, 1995.
- 3 Scrimshaw NS. The new paradigm of public health nutrition. *Am J Public Health* 1995;85:622-624.
- 4 Pelletier DL. The relationship between child anthropometry and mortality in developing countries: implications for policy, programs and future research. *J Nutr* 1994;124:2047-2081S.

- 5 Bisai S, Bose K, Ghosh A. Nutritional status of Lodha children in a village of Paschim Medinipur district, West Bengal. *Indian J Public Health* 2008;52:203-206.
- 6 Bisai S, Bose K, Dikshit S. Undernutrition among slum children aged 3-6 years in Midnapore town, India. *Internet J Biol Anthropol* 2009;2:2.
- 7 Ghosh R, Bharati P. Nutritional status of adults among Munda and Pod populations in a peri urban area of Kolkata City, India. *Asia Pac J Public Health* 2006;18:12-20.
- 8 Bisai S, Bose K. Undernutrition in the Kora Mudi tribal population, West Bengal, India: a comparison of body mass index and mid-upper-arm circumference. *Food Nutr Bull* 2009;30:63-67.
- 9 Mandal H, Mukherjee S, Datta A. India—an illustrated atlas of tribal world. Kolkata: ASI, 2002.
- 10 Cochran WC. Sampling techniques. New York: Wiley, 1963.
- 11 Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Chicago: Human Kinetics Books, 1988.
- 12 Indian Council of Medical Research (ICMR). Growth and development of Indian infants and children. Technical Report Series No. 18. New Delhi: ICMR, 1972.
- 13 Hamill PV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr* 1979;32:607-629.
- 14 Nyaruhucha CNM, Mamiro PS, Kerengi AJ, Shayo NB. Nutritional status of under five children in a pastoral community in Simanjiro district, Tanzania. *Tanzan Health Res Bull* 2006;8:32-36.
- 15 Nandy S, Irving M, Gordon D, Subramanian SV, Smith GD. Poverty, child undernutrition and morbidity: new evidence from India. *Bull World Health Organ* 2005;83:210-216.
- 16 Tiwari DK, Sharma KKN, Dubey VS. Health profile among Lodha and Munda tribal children of Midnapur district, West Bengal. *Anthropologist* 2001;3:189-190.
- 17 Halder DB. Nutritional status among the pre-school children of Bhumij Tribe of Midnapur District, West Bengal. In: Sharma KKN, eds. Reproductive and Child Health Problems in India. Delhi: Academic Excellence, 2005.
- 18 Mittal PC, Srivastava S. Diet, nutritional status and food related traditions of Oraon tribes of New Mal (West Bengal), India. *Rural Remote Health* 2006;6:385.
- 19 Chowdhury SD, Chakraborty T, Ghosh T. Prevalence of undernutrition in Santal children of Puruliya district, West Bengal. *Indian Pediatr* 2008;45:43-46.
- 20 International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-3), India, 2005-06: West Bengal. Mumbai: IIPS, 2008.
- 21 International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-3), 2005-06: India. Mumbai: IIPS, 2007.
- 22 Chakma T, Meshram PK, Rao PV, Singh SB, Kavishwar A. Nutritional status of Baiga—a primitive tribe of Madhya Pradesh. *Anthropologist* 2009;11:39-43.
- 23 Dolla CK, Meshram P, Karforma C, Das S, Uike M. Nutritional status of Kodaku pre-school children in central India. *J Hum Ecol* 2005;17:229-231.
- 24 Sharma B, Mitra M, Chakraborty S, Bharati P. Nutritional status of preschool children of Raj Gond—a tribal population in Madhya Pradesh, India. *Malays J Nutr* 2006;12:147-155.
- 25 Bisai S, Bose K, Ghosh A. Prevalence of undernutrition of Lodha children aged 1-14 years of Paschim Medinipur district, West Bengal, India. *Iran J Pediatr* 2008;18:323-329.
- 26 Rao KM, Kumar RH, Venkaiah K, Brahmam GNV. Nutritional status of Saharia—a primitive tribe of Rajasthan. *J Hum Ecol* 2006;19:117-123.
- 27 Mitra M, Kumar PV, Chakraborty S, Bharati P. Nutritional status of Kamar tribal children in Chhattisgarh. *Indian J Pediatr* 2007;74:381-384.
- 28 Yadav RJ, Singh P. Nutritional status and dietary intake in tribal children in Bihar. *Indian Pediatr* 1999;36:37-42.
- 29 Khandare AL, Siruguri V, Rao A, Venkaiah K, Reddy G, Rao GS. Diet and nutrition status of children in four tribal blocks of Thane district of Maharashtra, India (nutrition status of children). *Pakistan J Nutr* 2008;7:485-488.
- 30 Rao VG, Yadav R, Dolla CK, Kumar S, Bhoneley MK, Ukey M. Undernutrition and childhood morbidities among tribal preschool children. *Indian J Med Res* 2005;122:43-47.
- 31 Dolla CK, Meshram P, Verma A, Shrivastav P, Karforma C, Patel ML, et al. Health and morbidity profile of Bharias—a primitive tribe of Madhya Pradesh. *J Hum Ecol* 2006;19:139-141.
- 32 Mitra M, Sahu PK, Chakraborty S, Bharati S, Bharati P. Nutritional and health status of Gond and Kavar tribal pre-school children of Chhattisgarh, India. *J Hum Ecol* 2007;21:293-299.
- 33 Laxmaiah A, Rao MK, Kumar RH, Arlappa N, Venkaiah K, Brahmam GNV. Diet and nutritional status of tribal population in ITDA project areas of Khammam district, Andhra Pradesh. *J Hum Ecol* 2007;21:79-86.
- 34 International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-1), 1992-93: Karnataka. Mumbai: IIPS, 1995.
- 35 Jai Prabhakar SC, Gangadhar MR. Nutritional status of Jenukuruba tribal children in Mysore district, Karnataka. *Anthropologist* 2009;11:83-88.
- 36 Khongsdier R, Mukherjee N. Growth and nutritional status of Khasi boys in Northeast India relating to exogamous marriages and socioeconomic classes. *Am J Phys Anthropol* 2003;122:162-170.
- 37 Bose K, Biswas S, Bisai S, Ganguli S, Khatun A, Mukhopadhyay A, et al. Stunting, underweight and wasting among Integrated Child Development Services (ICDS) scheme children aged 3-5 years of Chapra, Nadia District, West Bengal, India. *Matern Child Nutr* 2007;3:216-221.
- 38 Bharati P, Bharati S, Pal M, Chakraborty S, Som S, Gupta R. Growth and nutritional status of pre-school children in India: rural-urban and gender differences. *Coll Antropol* 2009;33:7-21.
- 39 Marcoux A. Sex differentials in undernutrition: a look at survey evidence. *Popul Dev Rev* 2002;28:275-284.
- 40 Bose K, Bisai S, Mondal PS, Ghosh M. Body mass index and chronic energy deficiency among adult male Lodhas and Bhumijis: a comparison with other tribal populations of West Bengal, India. *J Public Health* 2008;16:117-121.

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