Anthropometric characteristics and nutritional status of rural school children

K Bose, S Bisai, S Mukherjee

Citation

K Bose, S Bisai, S Mukherjee. *Anthropometric characteristics and nutritional status of rural school children*. The Internet Journal of Biological Anthropology. 2007 Volume 2 Number 1.

Abstract

Undernutrition among children is a major public health problem in rural areas of developing countries like India. The objective of the present study was to assess the prevalence of underweight, stunting and thinness among rural school children of Onda, Bankura District, India. A total of 454 (201 boys and 253 girls) Bengalee Hindu children aged 6-14 years were included in this cross-sectional study. Height and weight were measured and the body mass index (BMI) was calculated. Three indicators of nutritional status namely underweight, stunting and thinness, were used based on the National Centre of Heath Statistics (NCHS) < - 2 Z score values. Mean Z scores for weight-for-age (WHZ), height- for-age (HAZ) and BMI-for-age (BMIZ) were less than those of NCHS in both boys as well as girls. Public health problem of undernutrition was classified according to the World Health Organization (WHO).

The overall age and sex combined prevalence of underweight, stunting and thinness were 16.9%, 17.2% and 23.1%, respectively. Both sexes had similar rates of stunting (boys = 14.4%; girls = 19.4%). However, there were significant ($p < 0.05$) sex differences in the frequency of underweight (chi-square = 3.97) and thinness (chi-square = 4.54). Significantly more boys were underweight (boys = 20.9%, girls = 13.8%) and thin (boys = 27.8%, girls = 19.4%). Based on the WHO classification of severity of malnutrition among children, the overall age and sex combined rates of underweight, stunting and thinness were medium (10-19%), low (< 20%) and very high (³ 15%), respectively. While both boys (14.4%) and girls (19.4%) had low rates of stunting (< 20%), the rates for thinness among both sexes (boys = 27.8%, girls = 19.4%) were very high. The rates of underweight were high (20-29%) and medium (10-19%), among boys (20.9%) and girls (13.8%), respectively.

In conclusion this study provided evidence that these children were under acute and chronic nutritional stress indicating the requirement of immediate appropriate public health nutritional intervention programmes.

INTRODUCTION

Undernutrition continues to be a primary cause of ill-health and premature mortality among children in developing countries [1]. Undernutrition among children is prevalent in almost all the states in India [2]. The children living in rural areas of India disproportionately suffer from undernutrition compared with their urban counterparts [3]. Although several recent studies have studied the problem of undernutrition among rural children in different parts of India [4,5,6,7,8,9,10,11,12,13], there is a scanty information regarding undernutrition among rural children of Bankura District, West Bengal.

Three commonly used indicators of undernutrition among children are stunting (low height for age), thinness (low body mass index for age) and underweight (low weight for age). Stunting is an indicator of chronic undernutrition, the result of prolonged food deprivation and/or disease or illness; thinness is an indicator of acute undernutrition, the result of more recent food deprivation or illness; underweight is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them [14]. In view of this, the present investigation assessed the prevalence of undernutrition among 6-14 year old rural school children of Onda, Bankura District, West Bengal, India.

MATERIALS AND METHODS

STUDY AREA AND SUBJECTS

This cross sectional study was carried out (during the period of December 2006 to May 2007) at 7 primary and secondary schools in Onda, Bankura District, West Bengal, India. Onda is a rural area about 20 kms from Bankura town, the district capital of Bankura District. It is 177 kms from Kolkata, the provincial capital of West Bengal. All 6-14 years old students enrolled at these schools were invited to participate

in this study. The response rate was 91%. Information on ethnicity and age of all subjects were obtained from questionnaires and verified from school records. The completion of questionnaires and measurement of subjects were done during school working hours.

Permission for the study was obtained from the school authorities prior to commencement of the study. Ethical permission was also obtained from Vidyasagar University authorities. The sample size of the study was 454 (201 boys and 253 girls). The age range of the subjects was 6-14 years. The samples were classified into 9 age groups by one-year interval. The vast majority (n = 451) of the students were Bengalee Hindus.

ANTHROPOMETRIC MEASUREMENTS

Height and weight measurements were taken by one observer (SM) following the standard techniques [15] . These were recorded with the subject wearing minimal clothing, to the nearest 0.1 cm and 0.5 kg., respectively. Technical errors of measurement (TEM) were calculated and they were found to be within reference values [16] .

The body mass index (BMI) was computed following the standard formula:

BMI (kg/m^2) = Weight (kg) / Height ^{2} (m^2).

EVALUATION OF NUTRITIONAL STATUS

Three commonly used undernutrition indicators, i.e., underweight, stunting and thinness were used to evaluate the nutritional status of the subjects. The United States National Centre for Health Statistics (NCHS) [17,18] age and sex specific – 2 z-scores were followed to define underweight, stunting and thinness. The following scheme was utilized:

Underweight : < - 2 WAZ (Z-score for weight-for age)
Stunting : < - 2 HAZ (Z-score for height-for age)
Thinness : < - 2 BMIZ (Z-score for BMI-for-age)

where WAZ, HAZ and BMIZ to height-for-age, weight-for-age and BMI- for- age, age and sex specific z scores, respectively, of NCHS [19] .

The WHO [14] classification (Table 1) was followed for assessing severity of malnutrition by percentage prevalence ranges of these three indicators among children.

Figure 1

Table 1: WHO classification of severity of malnutrition.

	Low (%)	Medium (%)	High (%)	Very High (%)
Underweight	< 10	10 –19	20 – 29	≥ 30
Stunting	< 20	20 – 29	30 – 39	≥ 40
Thinness	< 5	5 – 9	10 – 14	≥ 15

STATISTICAL ANALYSES

The distributions of height and weight were not significantly skewed therefore not necessitating their normalization. Technical errors of measurements (TEM) were found to be within reference values [16] and thus not incorporated in statistical analyses. Between sexes differences in means of height and weight were tested by students t-test. Statistical significant was considered at p value < 0.05.

RESULTS

Details age and sex wise distribution of the study sample are given in Table 2.

Figure 2

Table 2: Age-sex distribution of study population.

Age (Years)	Boys (n)	Girls (n)	Total (n)
6	20	19	39
7	35	32	67
8	26	30	56
9	32	23	55
10	20	35	55
11	20	23	43
12	24	38	62
13	14	29	43
14	10	24	34
Total	**201**	**253**	**454**

The age-wise means and standard deviations of weight, height and BMI, in both sexes, are presented in Table 3. There were no significant sex differences in mean weight and BMI. There were significant ($p < 0.05$) sex differences in mean height at ages 10 ($t = 2.19$) and 12 ($t = 3.11$) years.

Figure 3

Table 3: Age and sex-specific mean weight (kg), height (cm) and BMI (kg/m) of the children.

Age (Years)	Weight (kg)			Height (cm)			BMI (kgm^2)		
	Boys	Girls	t	Boys	Girls	t	Boys	Girls	t
6	18.8 (2.1)	17.8 (1.8)	1.59	115.1 (4.9)	115.3 (4.7)	0.13	14.2 (1.4)	13.4 (0.8)	1.48
7	18.8 (2.9)	18.3 (2.9)	0.70	116.2 (6.4)	114.6 (8.1)	0.90	13.9 (1.1)	13.9 (1.3)	0.00
8	21.5 (2.7)	21.2 (2.9)	0.40	121.8 (5.4)	122.9 (7.2)	0.64	14.5 (1.3)	13.9 (1.0)	1.95
9	23.7 (3.3)	23.5 (3.8)	0.21	127.5 (7.5)	127.0 (6.2)	0.26	14.5 (1.0)	14.5 (1.7)	0.00
10	24.3 (2.7)	26.1 (5.9)	1.28	127.4 (4.4)	132.3 (9.4)	2.19*	15.0 (1.1)	14.7 (1.8)	0.68
11	26.1 (4.6)	27.1 (5.1)	0.67	131.3 (5.1)	133.6 (7.2)	1.19	15.1 (1.8)	15.1 (1.6)	0.00
12	31.2 (6.9)	32.4 (4.6)	0.82	137.1 (7.6)	142.6 (6.2)	3.11*	16.4	16.8	1.10
13	35.8 (9.9)	37.2 (6.9)	0.54	147.5 (11.6)	148.3 (8.8)	0.25	16.1 (2.4)	16.8 (1.7)	1.70
14	38.5 (9.6)	36.5 (7.1)	0.67	151.9 (10.8)	146.5 (6.6)	1.79	16.4 (2.1)	16.9 (2.9)	0.49

Standard deviations are given in parentheses.
* $p < 0.05$.

Table 4 presents the mean WAZ, HAZ and BMIZ. Mean z scores had negative values in both boys as well as girls. The overall (sex combined) mean (sd) WAZ, HAZ and BMIZ were -1.09 (0.95), -0.79 (1.28) and -1.26 (1.17), respectively. The mean z-scores ranged from – 1.29 (BMIZ, boys) to – 0.77 (girls, HAZ).

Figure 4

Table 4: Mean WAZ, HAZ and BMIZ of the subjects.

Sex	WAZ	HAZ	BMIZ
Boys (n = 201)	-1.13 (1.00)	-0.81 (1.27)	-1.29 (1.26)
Girls (n = 253)	-1.06 (0.91)	-0.77 (1.29)	-1.22 (1.09)
Sex Combined (n = 454)	**-1.09 (0.95)**	**-0.79 (1.28)**	**-1.26 (1.17)**

WAZ: Z-score for weight-for age,
HAZ: Z-score for height-for age,
BMIZ: Z-score for BMI-for-age.

Table 5 presents the prevalence underweight, stunting and thinness by age and sex. The overall age and sex combined prevalence of underweight, stunting and thinness were 16.9%, 17.2% and 23.1%, respectively. According to the WHO [14] public health problem of undernutrition among children, these rates were medium (10-19%), low (< 20%) and very high (15%), respectively. Among boys, underweight was high (20.9%) while thinness was very high (27.8%). In case of girls, underweight was medium (13.8%) while thinness was very high (19.4%). Both sexes had low (< 20%) rates of stunting.

Figure 5

Table 5: Prevalence underweight, stunting and thinness by age and sex.

Age (Years)	Underweight			Stunting			Thinness		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
6	0.0	0.0	0.0	0.0	0.0	0.0	35.0	26.3	30.8
7	34.3	15.6	25.4	17.1	25.0	20.9	40.0	31.2	35.8
8	19.2	3.3	10.7	7.7	6.7	7.1	26.9	16.7	21.4
9	15.6	4.3	10.9	9.4	8.7	9.1	21.8	0.0	12.7
10	15.0	22.8	20.0	15.0	17.1	16.4	15.0	20.0	18.2
11	15.0	26.1	20.9	15.0	34.8	25.6	30.0	17.4	23.3
12	20.8	5.3	11.3	25.0	13.2	17.7	16.7	15.8	16.1
13	35.7	17.2	23.2	21.4	24.1	23.2	35.7	13.8	20.9
14	40.0	29.2	32.3	30.0	45.8	41.2	30.0	33.3	32.3
Total	20.9	13.8	16.9	14.4	19.4	17.2	27.8	19.4	23.1

Sex difference:
Underweight: chi-square (df =1) = 3.97, p = 0.046.
Stunting: chi-square (df =1) = 1.92, p = 0.166.
Thinness: chi-square (df =1) = 4.54, p = 0.033.

DISCUSSION

Improved child health and survival are considered universal humanitarian goals. In this respect, understanding the nutritional status of children has far-reaching implications for the better development of future generations [4]. However, reports have stated that child malnutrition has risen in recent years in India [20].

Malnutrition continues to be a problem of considerable magnitude in most developing countries of the world [2]. Several studies [21,22,23,24,25,26] have shown that dietary and environmental constraints are the major determinants of differences in growth performance between children of developing and developed countries. In the present study, the overall age and sex combined prevalence of underweight, stunting and thinness were 16.9%, 17.2% and 23.1%, respectively. Both sexes had similar rates of stunting but significantly more boys were underweight and thin. According to the WHO classification of severity of malnutrition among children, the overall age and sex combined rates of underweight, stunting and thinness were medium, low and very high, respectively. The rates of undernutrition in the present study were lower than those reported among similar aged school children of tea workers of Assam, North East India [5] as well as Kamar tribal children of Chhattisgarh, central India [7].

While stunting reflects a failure to reach linear growth potential due to sub optimal health and/or nutritional conditions, underweight reveals low body mass relative to chronological age, which is influenced by both, a child's height and weight. Underweight thus cannot distinguish between a child that is small in weight relative to his/her height and a child that is low in height relative to his/her age, but who may be normal in weight-for-height. On the other hand, thinness is an indicator of acute undernutrition, the results of more recent food deprivation [14].

In conclusion, this study provided evidence that these children were under acute and chronic nutritional stress indicating the requirement of immediate appropriate public health nutritional intervention programmes. This has important implications for public health policy-makers, planners and organizations seeking to meet national and international development targets. However, it must be noted here that the conclusion drawn may not be applicable for all districts of India but to a certain extent, it may be true for West Bengal State.

ACKNOWLEDGEMENTS

All subjects who participated in the study are thanked. The authors also express their grateful thanks to the school authorities for their help and cooperation.

CORRESPONDENCE TO

Kaushik Bose, Reader, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India. e-mail: banda@vsnl.net Tel: (91) (3222) 276554 Fax: (91)(3222) 275329.

References

1. Nandy S, Irving M, Gordon D, Subramanian SV, Smith GD. Poverty, child undernutrition and morbidity: new evidence from India. Bull World Organ 2005; 83 (3): 210-216.
2. Som S, Pal M, Bhattacharya B, Bharati S, Bharati P. Socieconomic differentials in nutritional status of children in the states of West Bengal and Assam. J Biosoc Sci 2006; 38 (5): 625-642.
3. Rajaram S, Zottarelli LK, Sunil TS. Individual, household, programme and community effects on childhood malnutrition in rural India. Matern Child Nutr 2007; 3 (2): 129-140.
4. Rajaram S, Sunil TS, Zottarelli LK. An analysis of childhood malnutrition in Kerala and Goa. J Biosoc Sci 2003; 35 (3): 335-351.
5. Medhi GK, Hazarika NC, Shah B, Mahanta J. Study of health problems and nutritional status of tea garden population of Assam. Indian J Med Sci 2006; 60 (12): 496-505.

6. Bose K, Biswas S, Bisai S, Ganguli S, Khatun A , Mukhopadhyay A , Bhadra M. 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.
7. Mitra M, Kumar PV, Chakrabarty S, Bharati P. Nutritional status of Kamar tribal children in Chhatisgarh. Indian J Pediatr 2007; 74 (4): 381-4.
8. Tiwari MK, Sharma KK, Bharati S, Adak DK, Ghosh R, Bharati P. Growth and nutritional status of the Bharia - a primitive tribe of Madhya Pradesh. Coll Antropol 2007; 31 (1): 95-101.
9. Das DK, Biswas R. Nutritional status of adolescent girls in a rural area of North 24 Parganas district, West Bengal. Indian J Public Health 2005; 49(1):18-21.
10. Griffiths PL, Bentley ME. The nutrition transition is underway in India. J Nutr 2001; 131(10):2692-700.
11. Malhotra A, Passi SJ. Diet quality and nutritional status of rural adolescent girl beneficiaries of ICDS in north India. Asia Pac J Clin Nutr 2007; 16 Suppl 1: 8-16.
12. Singh MB, Lakshminarayana J, Fotedar R, Anand PK. Childhood illnesses and malnutrition in under five children in drought affected desert area of western Rajasthan, India. J Commun Dis 2006; 38(1):88-96.
13. Vashisht RN, Krishan K, Devlal S. Physical growth and nutritional status of Garhwali girls. Indian J Pediatr 2005; 72 (7): 573-578.
14. World Health Organization. Physical Status: the Use and Interpretation of Anthropometry: Technical Report Series no. 854. Geneva: World Health Organization, 1995.
15. Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Chicago: Human Kinetics Books, 1988.
16. Ulijaszek SJ, Kerr DA. Anthropometric measurement error and the assessment of nutritional status. Br J Nutr 1999; 82: 165-177.
17. 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: 607-29
18. World Health Organization. Measuring Change in Nutritional Status. Geneva: World Health Organization, 1983.
19. National Center for Health Statistics. NCHS growth curves for children birth-l8 years: United States. Hyattsville, MD: US Department of Health, Education and Welfare, 1977. [Vital and health statistics series II, DHEW publication (PHS) 78-1650.]
20. Chaterjee P. Child malnutrition rises in India despite economic boom. Lancet 2007; 369: 1417-1418.
21. Graitcer PL, Gentry EM. Measuring children: one reference for all. Lancet 1981; 2:297-9.
22. Serenius F (1988) Attained growth of privileged Saudi children during the first three years of life. Acta Pediatr Scand 1988; 1346 (Suppl): 80-92.
23. Dugdale AE, Muller M, Alsop-Shields L. Patterns of weight growth in Aboriginal children on Queensland communities. J Pediatr Child Health 1994; 30:55-8.
24. Loka P, Nossar V, Bauman AE. A comparative study of the growth of South-East Asian children in south-west Sydney born in Australia and overseas. J Pediatr Child Health 1994; 30: 436-8.
25. Quinn VJ, Chiligo-Mpoma MO, Simler K, Milner J. The growth of Malawian preschool children from different socioeconomic groups. Eur J Clin Nutr 1995; 49:66-72.
26. Mei Z, Yip R, Trowbridge F. Improving trend of growth of Asian refugee children in the USA: evidence to support the importance of environmental factors on growth. Asia Pac J Clin Nutr 1988; 7:111-6.

Author Information

Kaushik Bose, Ph.D.
Department of Anthropology, Vidyasagar University

Samiran Bisai, M.Sc.
Department of Anthropology, Vidyasagar University

Soma Mukherjee, M.Sc.
Department of Anthropology, Vidyasagar University