Coll. Antropol. **32** (2008) 1: 73–77
Original scientific paper

Extreme Levels of Underweight and Stunting Among Pre-Adolescent Children of Low Socioeconomic Class from Madhyamgram and Barasat, West Bengal, India

Kaushik Bose, Samiran Bisai, Jayanta Chakraborty, Nandini Datta and Parsati Banerjee

Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India

A B S T R A C T

A cross-sectional study on 1206 children (788 boys, 618 girls) aged 1–12 years, belonging to low socioeconomic status, of Barasat and Madhyamgram, West Bengal, India, was undertaken to investigate age and sex variations in height and weight. It also evaluated the levels of underweight and stunting among them. Anthropometric measurements included weight and height. Weight-for-age (WA) and height-for-age (HA) <–2 z-scores were used to evaluate underweight (UW) and stunting (ST), respectively, following the National Center for Health Statistics (NCHS) Guidelines. Results showed that boys aged 4 and 11 years were significantly heavier than girls of corresponding ages. Boys aged 7 years were significantly taller than girls of the same age. Significant ($p<0.001$) age differences existed in mean weight and height in boys (weight: $F=336.762$; height: $F=565.160$) as well as girls (weight: $F=275.320$; height $=498.715$). Results also revealed that the mean z-scores of WA (WAZ) and HA (HAZ) were less than (negative values) those of NCHS for both sexes at all ages. The overall (age combined) rate of UW was 60.4% and 51.3%; while that of ST was 51.7% and 48.4%, in boys and girls, respectively. Based on World Health Organization classification of severity of malnutrition, the prevalence of UW and ST were very high (≥30%) in both sexes. In conclusion, this study demonstrated that the prevalence of UW and ST were very high among the subjects. Since the nutritional status of the subjects is not satisfactory, there is need for immediate supplementary nutrition.

***Key Words**: India, West Bengal, underweight, stunting*

Introduction

Malnutrition continues to be a major public health problem throughout the developing world, particularly in sub-Saharan Africa and southern Asia including India[1–5]. Two of the internationally recommended indicators most commonly used are *child stunting* (low height-for-age) and *underweight* (low weight-for-age). While stunting reflects a failure to reach linear growth potential due to suboptimal 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[1]. Experts have concluded that, in the absence of high wasting levels, underweight and stunting can provide similar information[1,6].

It has now been well established that poverty is the main underlying cause of malnutrition and its determinants[7,8]. It has been unequivocally stated, that to achieve the hunger- and malnutrition-related Millennium Development Goals, we need to address poverty, which is clearly associated with the insecure supply of food and nutrition[5]. There have been numerous studies that have dealt with the frequency of underweight and stunting among poor pre-adolescent children from different developing countries[9,10]. However, such studies are lacking from West Bengal, India.

In view of the strong association between socio-economic status with stunting and/or underweight observed

Received for publication June 6, 2006

worldwide[7,8], the objective of the present study was to evaluate the extent of underweight and stunting present among 1–12 years old children, belonging to low socio-economic status, from Madhyamgram and Barasat, West Bengal, India.

Materials and Methods

Study area and subjects

The present study was undertaken at ward numbers 27 and 28 of Barasat and ward number 1 of Madhyamgram, located approximately 15 km from the centre of Kolkata, the provincial capital of West Bengal. The study involved a random survey of children belonging to the low socioeconomic class. Specific information on age and ethnicity of all subjects were obtained by the investigators. All the subjects belonged to the low socio-economic status as evidenced from their income and occupation. The majority of the subjects were low-paid daily manual labourers. Formal approval was obtained from Vidyasagar University and local authorities prior to the commencement of the study. A total of 1406 children aged (male=788; female=618) aged 1–12 years were included in the study.

Anthropometric measurements and evaluation of nutritional status

Height and weight measurements were taken on each subject following the standard techniques[11]. Technical errors of measurements (TEM) were found to be within reference values[12]. Thus, TEM was not incorporated in statistical analyses.

Two commonly used undernutrition indicators, i.e., UW and ST were used to evaluate the nutritional status of the subjects. The United States National Centre for Health Statistics (NCHS)[13] age and sex specific –2 z-scores were followed to define UW and ST. The following scheme was utilized:

UW: <–2 WAZ

ST: <–2 HAZ

Where WAZ and HAZ refer to weight-for-age and height-for-age sex specific z scores, respectively, of NCHS.

We followed the WHO[1] classification for assessing severity of malnutrition by percentage prevalence ranges of these two indicators among children. The classification is:

	Low (%)	Medium (%)	High (%)	Very high (%)
ST	<20	20–29	30–39	≥40
UW	<10	10–19	20–29	≥30

Statistical Analyses

The distributions of height and weight were not significantly skewed therefore not necessitating their normalization. Between sexes differences in means of weight and height were tested by students t-test. ONEWAY (Scheffe's Procedure) analyses were undertaken to test for age differences in mean weight and height in each sex.

Results

The means and standard deviations of weight and height by age and sex are presented in Tables 1 and 2. Significant sex differences (Table 1) were observed in mean weight at age 4 and 11 years. Significant sex difference (Table 2) existed in mean height at age 7 years. There existed significant ($p<0.001$) age differences existed in mean weight and height in boys (weight: F=

TABLE 1
MEAN AND STANDARD DEVIATION OF WEIGHT (KG) BY AGE AND SEX

Age (yrs)	n		Boys		Girls		t
	Boys	Girls	X	SD	X	SD	
1	54	47	6.94	1.71	6.62	1.24	1.08
2	100	65	9.36	1.69	8.84	1.45	2.05*
3	92	82	10.58	1.40	10.65	1.46	0.33
4	114	84	12.56	1.65	11.95	1.62	2.61**
5	157	104	13.86	1.97	13.49	1.87	1.52
6	52	53	15.87	2.09	15.72	2.33	0.35
7	54	52	18.36	3.41	17.21	2.54	1.97
8	46	39	18.91	2.83	19.71	4.18	1.04
9	50	31	21.26	3.27	20.18	3.39	1.43
10	29	25	23.53	3.67	24.26	4.38	0.69
11	22	24	24.37	3.29	26.75	4.02	2.19*
12	18	12	28.39	3.97	27.83	2.86	0.42
			F=336.762***		F=275.320***		

*p<0.05, **p<0.01, ***p<0.001

TABLE 2
MEAN AND STANDARD DEVIATION OF HEIGHT (CM) BY AGE AND SEX

Age (yrs)	n		Boys		Girls		t
	Boys	Girls	X	SD	X	SD	
1	54	47	69.15	6.43	67.08	5.87	1.68
2	100	65	78.22	6.35	77.52	6.63	0.67
3	92	82	84.35	5.33	84.29	4.96	0.06
4	114	84	91.73	4.89	90.57	5.33	1.59
5	157	104	98.54	5.51	97.47	5.67	1.52
6	52	53	104.53	5.38	105.13	5.31	0.58
7	54	52	112.15	6.14	109.64	5.29	2.25*
8	46	39	114.08	6.10	116.01	5.56	1.52
9	50	31	120.15	6.47	118.62	7.29	0.99
10	29	25	124.11	7.09	124.82	6.19	0.39
11	22	24	126.49	7.48	131.13	8.56	1.95
12	18	12	134.54	7.79	134.03	5.79	0.19
			F=565.160***		F=498.715***		

*p<0.05, **p<0.01, ***p<0.001

336.762; height: F=565.160) as well as girls (weight: F=275.320; height: F=498.715).

Table 3 present the mean z-scores for WA (WAZ), and HA (HAZ). Results revealed that mean WAZ and HAZ were less than (negative value) those of NCHS for both sexes at all ages. It is noteworthy that in several instance, these mean values were less than –2.00. These overall (age combined) mean WAZ were –2.068 and –1.904 for boys and girls, respectively. These values were –2.101 (boys) and –1.946 (girls) for HAZ.

The frequencies of UW and ST are presented in Table 4. The overall (age combined) rates of UW were 60.4% and 51.3%; while those of ST were 51.7% and 48.4%, in boys and girls, respectively. Based on World Health Organization classification of severity of malnutrition, the prevalence of UW and ST were very high (>30%) in both sexes.

Discussion

Anthropometric indicators have been widely used in population-based studies directed to nutritional evaluation. Although they are proxy indicators, that is, they represent indirect measures of undernutrition that do not take into account nutrient intake or biochemical examination, their wide use is justified due to the ease of the method and its high sensitivity to nutritional alterations in a population[14]. Cohort studies, ideal for nutritional conditioning monitoring, suffer, in Third World countries, from the logistic difficulties usually associated

TABLE 3
MEAN WEIGHT FOR AGE AND HEIGHT FOR AGE Z-SCORE BY AGE AND SEX

Age (yrs)	n		Weight for Age Z-score		Height for Age Z-score	
	Boys	Girls	Boys	Girls	Boys	Girls
1	54	47	–2.329	–1.773	–1.373	–1.090
2	100	65	–2.178	–2.111	–1.721	–1.615
3	92	82	–2.362	–2.157	–2.328	–2.197
4	114	84	–2.065	–2.185	–2.402	–2.338
5	157	104	–2.196	–2.057	–2.325	–2.235
6	52	53	–1.893	–1.586	–2.100	–1.718
7	54	52	–1.670	–1.624	–1.760	–1.883
8	46	39	–1.969	–1.459	–2.222	–1.645
9	50	31	–1.765	–1.894	–2.005	–2.080
10	29	25	–1.663	–1.543	–2.122	–1.942
11	22	24	–1.886	–1.546	–2.379	–1.790
12	18	12	–1.724	–1.851	–1.977	–2.338
Total	788	618	–2.068	–1.904	–2.101	–1.946

TABLE 4
FREQUENCY OF UNDERWEIGHT AND STUNTING BY AGE AND SEX

Age (yrs)	n		Underweight		Stunting	
	Boys	Girls	Boys (%)	Girls (%)	Boys (%)	Girls (%)
1	54	47	72.2	48.9	37.0	29.8
2	100	65	65.0	64.6	42.0	38.5
3	92	82	67.4	57.3	51.1	50.0
4	114	84	59.6	67.9	64.0	64.3
5	157	104	66.9	61.5	60.5	60.6
6	52	53	53.8	41.5	44.2	37.7
7	54	52	50.0	34.6	40.7	46.2
8	46	39	56.5	28.2	54.3	30.8
9	50	31	44.0	48.4	46.0	48.4
10	29	25	55.2	28.0	58.6	44.0
11	22	24	50.0	29.2	54.5	50.0
12	18	12	38.9	33.3	44.4	66.7
Total	788	618	60.4	51.3	51.7	48.4

with population studies of large magnitude. In such cases, cross-sectional studies can provide relevant elements for understanding the connection between health status and physical conditions of life. These studies have the advantage of relatively low costs, and they can also provide fundamental information for the implementation of health surveillance systems and the definition of long-term health intervention strategies[15–17].

Undernutrition continues to be a cause of ill-health and premature mortality among children in developing countries like India[18]. Two commonly used indicators of undernutrition among children are wasting (low weight for height) and stunting (low height for age). Underweight is used as a composite indicator to reflect both acute and chronic undernutrition, although it cannot distinguish between them, while stunting is an indicator of chronic undernutrition, the result of prolonged food deprivation and/or disease or illness; These indices are compared against an international reference population developed from anthropometric data collected in the United States by the NCHS[13]. Children whose measurements fall below –2 z-scores of the reference population median are considered undernourished, i.e. to have underweight or stunting. These indices reflect distinct biological processes, and their use is necessary for determining appropriate interventions[1].

The results of the present study clearly indicated that, based on WHO classification of severity malnutrition, the prevalence of UW and ST were very high (≥ 30%). Studies on UW, which is used as a composite indicator to reflect both acute and chronic undernutrition, demonstrated that the level was very high. These rates are higher than those reported among the general Indian population (47%) by UNICEF[19]. Similarly results on ST indicated that, among these children, there existed very high level of chronic undernutrition due to prolonged food deprivation. These findings suggested widespread severely adverse nutritional experience of the subjects.

It has been suggested that since undernutrition is a function of both food deprivation and disease, which are in turn the consequences of poverty, anthropometric indices can serve only as proxies for evaluating the prevalence of undernutrition among children[18]. Efforts to reduce undernutrition, morbidity and mortality depend on reducing poverty and raising people's living standards by improving the quality of homes and by increasing access to clean drinking water and adequate sanitation. Such interventions have positive impacts on health, and implementing these also goes some way towards fulfilling people 's basic human rights[18]. Since the nutritional status of the subjects of the present study is not satisfactory, it seems that there is scope for much improvement in dietary intake in the form of supplementary nutrition. Because malnutrition has many causes, only multiple and synergistic interventions embedded in true multisectoral programmes can be effective[20]. This important point must be borne in mind before the authorities plan effective strategies to reduce the prevalence of undernutrition among children in this population.

Acknowledgements

All subjects who participated in the study are gratefully acknowledged.

REFERENCES

1. WORLD HEALTH ORGANIZATION, Technical Report Series no. 854. (Geneva, The Organization, 1995). — 2. WORLD HEALTH ORGANIZATION, World Health Report. (Geneva, The Organization, 2002). — 3. WORLD HEALTH ORGANIZATION, UNITED NATIONS CHILDREN'S FUND, (Geneva: The Organization, 2004). — 4. Food and Agriculture Organization of the United Nations, The state of food insecurity in the world, (Rome The Organization, 2004). — 5. MÜLLER M, KRAWINKEL M, CMAJ, 173 (2005) 279. — 6. WATERLOW JC, London: Edward Arnold; 2nd ed., (1992) p.212. — 7. DUNCAN T, CMH working paper no WG1: 7. (Geneva: World Health Organization; 2001). — 8. SACHS JD, MCARTHUR JW, Lancet, 365 (2005) 347. — 9. JULIA M, VAN WEISSENBRUCH MM, DE WAAL HA, SURJONO A, Food Nutr Bull, 25 (2004) 354. — 10. SCHOFIELD C, ASHWORTH A, Bull World Health Organ, 74 (1996) 223. — 11. LOHMAN TG, ROCHE AF, MARTORELL R, Human Kinetics Books; 1988. — 12. ULIJASZEK SJ, KERR DA, Br J Nutr, 82 (1999) 165. — 13. HAMILL PV, DRIZD TA, JOHNSON CL, REED RB, ROCHE AF, MOORE WM, Am J Clin Nutr, 32 (1979) 607. — 14. POST CL, VICTORIA CG, J Nutr, 131 (2001) 1133. — 15. WATERLOW JC, BUZINA W, KELLER R, LANE JM, NICHMAN MZ, TANNER JM, Bull WHO, 55 (1977) 489. — 16. SATYANARAYANA K, RADHAIAH G, MOHAN JM, THIMMAYAMMA BV, RAO NP, RAO BS, AKELLA S, Ann Hum Biol, 16 (1989) 289. — 17. MARTOREL R, RIVERA, KAPLOWITZ H, Ann Nestle, 48 (1996) 85. — 18. NANDY S, IRVING M, GORDON D, SUBRAMANIAN SV, DAVEY SMITH G, Bull WHO, 83 (2005) 210. — 19. UNICEF. Report Progress for Children – A report card on nutrition (2006). — 20. BHARGAVA A, CMH working paper (Geneva, World Health Organization, 2001).

K. Bose

Reader and Head of Department, Department of Anthropology, Vidyasagar University, Midnapore – 721 102, West Bengal, India
e-mail: banda@vsnl.net

EKSTREMNA RAZINA POTHRANJENOSTI I ZAOSTALOG RASTA KOD PRE-ADOLESCENTSKE DJECE, SLABIJEG SOCIO-EKONOMSKOG STATUSA IZ MADHYANGRANA I BARASATA, ZAPADNI BENEGAL, INDIJA

SAŽETAK

Istraživanja su provedena u Barasatu i Madhyamgramu, a sadržavala su 1206 djece (788 dječaka i 618 djevojčica) nižeg socioekonomskog statusa u dobi od 1–12 godina. Ispitivane su varijacije u dobi i spolu te težini i visini. Ocjenjivana je i razina pothranjenosti i zaostalog rasta. Antropometrijska mjerenja uključivala su mjere težine i visine. Mjere, visina prema godinama (WA) i težina prema godinama (HA) trebali su ukazati na pothranjenost (UW) i zaostali rast (ST), a ocjenjivani su prema podacima Nacionalnog centra za zdravstvenu statistiku (NCHS). Rezultati su pokazali kako su dječaci između 4 i 11 godina značajno teži u odnosu na djevojčice iste dobi. Dječaci u dobi od 7 godina bili su značajno viši od djevojčica iste dobi. Značajna razlika ($p<0,001$) pokazala se u visini i težini kod dječaka različite dobi (težina: $F=275,320$; visina: $F=565,160$), kao i kod djevojčica (težina; $F=275,320$; visina; $F=498,715$). Rezultati su također pokazali kako su vrijednosti za WA i HA niže(negativne vrijednosti) od onih prema NCHS za oba spola. Rata pothranjenosti iznosila je 60,4 i 51,3%; a zaostalog rasta bila je 51,7 i 48,4% kod dječaka odnosno djevojčica. Prema podacima WHO, stopa pothranjenosti i zaostalog rasta bila je prilično velika kod oba spola (>30%). Zaključena je visoka prevalencija pothranjenosti i zaostalog rasta kod svih subjekata te da stoga postoji potreba za dodatnom prehranom.