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Anthropometric Assessment of Physical Growth and Nutritional Status among School Children of North Bengal

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ABSTRACT The study was carried out on 4457 primary school going children to investigate the physical growth as well as nutritional status of Darjeeling and Jalpaiguri districts (part of North Bengal) of West Bengal. Standard anthropometric methods were applied to measure the height and weight of the children. The children were selected randomly from the low socio-economic group as per guideline of our State Government. Our study shows that average height of the girls was more than the boys. From the view of weight for age, nutritional status shows poorer when it was compared with the nutritional status from the light of height for age as per Waterlow's classification. The weight of children was not increasing with the advancement of age. Physical growth as well as nutritional status of boys was affected more than the girls. Children of higher age group were more affected nutritionally. The weight for age classification shows that no child of 12+ year age was normal. Only 5.14 % children of 12+ year age were found with normal physical growth considering the nutritional status from the view of height for age.

INTRODUCTION

Children belong to 5-12 years age group are vulnerable because of their rapid growth rate. They need more attention and care for the physical and mental development. Physical growth, development and well-being are directly related to the nutritional status. Chronic under-nutrition is considered to be the primary cause of ill-health and premature mortality among children in developing countries (Nandy et al. 2005). Under-nutrition among children is prevalent in almost all the states in India (Som et al. 2006). Child malnutrition has risen in recent years in India (Chaterjee 2007). India accounts for about 40 percent of undernouri- shed children in the world (James 1998). Children belonging to socially backward groups like scheduled castes (Uppal et al. 2005) and tribes (National Institute of Nutrition 2000) are highly susceptible to under-nutrition. Most of the tribal people of India have their own geographically isolated life style. Inadequate food habits along with traditional socio-cultural and biological activities may lead to a high proportion of under-nutrition in their children that also interferes with their body growth and development (Balgir et al. 2002 ; Rao et al. 2006a). Therefore, the dietary intake is considered as one of the most important determinants of nutritional status (Grover and Singh 2006). Information of this pattern is an essential pre-requisite for planning food needs (Das and Biswas 2005; Malhotra and Passi 2007). In the global campaign of 'Health for all', promotion of proper nutrition is one of the eight elements of primary health care (WHO 1978). Nutrition plays a vital role, as inadequate nutrition during childhood may lead to malnutrition, growth retardation, reduced work capacity and poor mental as well as social development (Awasthi and Kumar 1999). Children from socially and economically backward families are associated with inadequate food habits and disease susceptibility. But there is hardly any study available about the poor children of Darjeeling and Jalpaiguri districts of North Bengal. Under this backdrop, the present study was carried out among the primary school children of 5-12 years age group from poor families of the two districts to find out their physical growth as well as nutritional status on the basis of an-

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thropometric indices which are very closely concerned for the assessment of nutritional condition of growing children.

METHODOLOGY

Four thousand four hundred fifty- seven children of 5 to 12 years age from low socio- economic group were selected randomly without any bias from the two districts during the period of March 2005 to December 2007. The children were collected from the four blocks - Naxalbari, Kharibari, Matigara and Phansidewa of Darjeeling district and three blocks - Malbazar, Banarhat and Haldibari of Jalpaiguri district. Out of these blocks, Naxalbari and Kharibari blocks are located in the Nepal border, Haldibari and Phansidewa blocks are located in the Bangladesh border and Banarhat block is situated in the Bhutan border. Out of randomly selected families, 68% parents were tea garden workers, 16% parents were agricultural workers, 10% parents were daily labors and 6% parents were shopkeepers. Before the recording of anthropometric measurements, parents were informed about the purpose and benefits of the experiments. All the children were primary school students. Out of the total children, 2221 were boys and 2236 were girls. Heights of these children were measured by standard anthropometer and weights were measured by weighing machine. The height was taken nearest to 0.1 cm and the weight was taken nearest to 200 gm. To assess the nutritional status of an individual or population, anthropometry is widely recognized as one of the useful techniques because it is highly sensitive to detect under-nutrition (National Institute of Nutrition 2005). Gomez classification and Waterlow's classification were applied to calculate the stunting (height for age) and underweight (weight for age) types of malnu- trition to explain the level of their physical growth and development (Gomez et al.1956).

Statistical Analysis: All the data were evaluated statistically by two tail't' test and χ^2 test. Two tail 't' test was performed using the Origin Lab (Ver.6.0) software and χ^2 test was performed using SPSS 16 version. p-values of less than 0.05 were considered to indicate statistical significance.

RESULTS AND DISCUSSION

The study was conducted to know the physical growth and nutritional status of the low socio-economic group children.

There is a significant difference between the mean height of boys and girls at all the ages except 6+ which are presented in Table 1. Girls were found taller than the boys. Our study is quiet different from the study of Saheb and Rajendra Prasad (2009) which showed the boys being slightly taller than girls up to the age of 9 years, while girls take a slight lead value at 10 years and the study by Medhi et al. (2006a) on tea garden children which showed that boys were heavier and taller than girls till the age of 10 years. However, from the age of 11 onwards, the mean height and weight of girls exceeded the mean height and weight of boys. The study by Medhi et al. (2007) showed that the mean height of girls are higher at the ages 10,11,12 than boys and that study is similar to our study.

Table 2 executed that the mean weight of girls were more than the boys except for the age group of 6+ and 8+. The study by Saheb and Rajendra Prasad (2009) showed that the mean weight for boys and girls at 6 years is 18.26 kg and 17.72 kg respectively, indicating that boys were slightly heavier than girls. Our study

Table 1: Mean height of the boys and girls

Age	*Boys*			*Girls*			*t- value*	*p value*
	No.	*Mean height*	*SD*	*No.*	*Mean height*	*SD*		
5+	282	104.82	4.77	274	105.59	4.29	2.02	p≤0.01
6+	303	109.78	2.95	296	110.02	2.9	1.011	p≤0.001
7+	296	115.61	3.65	300	116.36	4.98	2.094	p≤0.01
8+	248	119.04	3.33	260	120.83	4.75	4.931	p≤0.01
9+	277	122.09	4.32	271	123.6	4.49	4.037	p≤0.01
10+	260	125.3	5.6	255	128.61	6.98	7.124	p≤0.01
11+	298	130.29	6.07	312	131.63	4.48	3.489	p≤0.01
12+	257	132.15	5.95	268	134.67	6.23	5.490	p≤0.01

Table 2: Mean weight of the boys and girls

Age	*Boys*			*Girls*			*t- value*	*p value*
	No.	*Mean weight*	*SD*	*No.*	*Mean weight*	*SD*		
5+	282	16.58	2.32	274	17.28	2.24	0.019	p≤0.05
6+	303	18.57	1.413	296	18.35	1.96	0.153	p≤0.001
7+	296	19.27	.058	300	19.28	2.09	0.94	p≤0.001
8+	248	20.82	.36	260	20.73	3.14	0.71	p≤0.01
9+	277	22.50	.088	271	22.53	4.13	0.94	p≤0.001
10+	260	22.74	3.535	255	24.00	4.24	0.000	p≤0.05
11+	298	25.74	2.191	312	26.45	3.76	0.024	p≤0.01
12+	257	27.08	2.75	268	28.04	4.28	0.006	p≤0.05

is similar and shows that the mean weight for boys and girls at 6 years is 18.57 kg and 18.35 kg. The study by Saheb and Rajendra Prasad (2009) also showed that the mean values of boys at 10 years (24.77 kg) were lower by 1.79 kg than girls (26.56 kg) at the same age. Our study also suggested that the mean values of boys at 10 years (22.74 kg) were lower by 1.26 kg than girls (24 kg) at the same age group.

The mean deficit from ICMR standards has been highlighted in Table 3. The average height of the children was much lower in comparison to ICMR specifications. The weight of the children was also less than the National standard. The mean deficit of height of boys was over 10 at the ages 9+, 10+, 11+ and 12+ but in case of girls it was only at the ages 11+ and 12+. The mean deficit of weight of boys was over 10 at the ages 10+,11+ and 12+ and in girls at the ages 11+ and 12+. The mean deficit of both height and weight almost increase in an ascending order.

Table 3: Mean deficit in height and weight of the sample from ICMR standard

Age	*Mean deficit from ICMR standard*			
	Height (cm)		*Weight (kg)*	
	Boys	*Girls*	*Boys*	*Girls*
5+	3.55	1.58	3.32	1.4
6+	4.84	5.68	1.00	2.38
7+	4.02	4.41	3.45	3.64
8+	7.42	4.19	5.88	4.55
9+	10.21	7.91	8.02	7.2
10+	14.24	6.95	13.91	9.46
11+	13.28	11.27	12.11	10.09
12+	18.14	17.55	13.49	14.57

Nutritional status according to Gomez classification (weight for age) was calculated and the Table 4 showed that no age group had 50% or more normal children except 6+. The study by Medhi et al. (2006b) showed that prevalence of underweight among children was 59.9%. Age group 5+ showed 46.4% normal children. Number and degree of severity of malnutrition were increased with the advancement of age. Age group 12+ showed 0.00% normal child which is very much significant and sensitive. The study by Mitra et al. (2007) showed that more than 90 % of children (both boys and girls) in the age group of 4-6 years suffered from underweight (<-2 SD weight for age), which was comparatively lower in 7-9 and 10-12 years age group children. There was a certain percentage of mild malnutrition at all ages. The percentage of mild malnutrition was over 40% in age group 5+ to 8+. The age group of 9+, 11+ and 12+ showed maximum number of moderate malnutrition, which is very much alarming. The study of Singh et al. (2006) showed that the extent of malnutrition was significantly higher in females than males which were different from our study. The percentages of severe malnutrition were higher at the ages 10+, 11+ and 12+. So, it may be noted that the number and percentages of malnutrition in children were increased with the advancement of age.

Table 5 focused the sex wise distribution of nutritional status and we found that only 19.99% boys and 22.14 % girls were normal. So, 80.01% boys and 77.86% girls were suffering from different degrees of malnutrition. The study by Bose et al.(2007) showed that the rate of underweight was higher among girls (underweight = 35.1%) compared with boys (underweight = 26.5%,) and the overall rate of underweight was 31%.The total percentages of boys of moderate and severe malnutrition were 44.89% and the total percentage of girls of moderate and severe malnutrition were 38.33%. The study by Jai Prabhakar and Gangadhar (2009) showed that 45.2% children were moderately malnourished in respect to weight for

Table 4: Nutritional status (weight for age) as per age group

Age	*No.*	*Normal*	*Percent*	*Malnutrition*					
				Mild	*%*	*Moderate*	*%*	*Severe*	*%*
5+	556	258	46.4	233	41.9	65	11.69		
6+	599	306	51.08	283	47.24	10	1.66		
7+	596	170	28.52	325	54.53	97	16.27	4	0.67
8+	508	77	15.15	254	50.00	174	34.25	3	0.59
9+	548	81	14.78	149	27.18	258	47.08	60	10.94
10+	515	24	4.66	130	25.24	172	33.39	189	36.69
11+	610	23	3.77	187	30.65	278	45.57	122	20.00
12+	525	00	0.00	103	19.61	275	52.38	147	28.00

χ^2=916.06, df =7, p<0.000001 (chi square with normal and malnutrition)

age, whereas 4.4% were normal and remaining children had mild and severe form of malnutrition. So, our study showed much higher percentage of normal children.

The nutritional status according to Waterlow's classification (height for age) is highlighted in Table 6 and it showed that there was no severely impaired nutritional status except for the age groups 10+, 11+ and 12+. The percentage of moderately impaired children was noted in the age group 8+, 9+, 10+, 11+ and 12+. Children of 12+ ages were having very high percentage (41.33%) of moderately impaired nutritional status. The percentages of mildly impaired children were over 50% at the ages 6+, 9+, 10+ and 11+. The highest percentage of mildly impaired children was found in 9+ age. Age groups of 8+ and 12+ also had higher percentages of mildly impaired children.

The study by Jai Prabhakar and Gangadhar (2009) showed that about 41.5% of mild (-2 SD to -1 SD) stunting was recorded in all the age groups and gender, followed by moderate (39.3%) and severe (6.7%). Our study also showed quiet similar percentage of mild stunting, but less percentages of moderate and severe stunting. Shakya et al. (2004) reported that 21.5% of East Nepal primary school children were more stunted than wasted (10.4%).

Table 7 established the nutritional status as per sex according to Waterlow's classification (height for age) and it showed that girls were

Table 5: Nutritional status (weight for age) as per sex

Sex	*No.*	*Nutritional status*							
		Normal	*%*	*Malnutrition*					
				Mild	*%*	*Moderate*	*%*	*Severe*	*%*
Boys	2221	444	19.99	780	35.12	682	30.71	315	14.18
Girls	2236	495	22.14	884	39.53	647	28.94	210	9.39

χ^2=19.79, df=2, p<0.001 (moderate and severe are taken together)

Table 6: Nutritional status (height for age) as per age

Age	*No.*	*Nutritional status*							
		Normal	*%*	*Stunting*					
				Mild	*%*	*Moderate*	*%*	*Severe*	*%*
5+	556	386	69.42	170	30.58				
6+	599	298	49.75	301	50.25				
7+	596	387	64.93	209	35.07				
8+	508	261	51.38	243	47.83	04	0.79		
9+	548	158	28.83	373	68.07	17	3.10		
10+	515	148	28.73	287	55.73	69	13.40	11	2.14
11+	610	120	19.67	395	64.75	76	12.46	19	3.12
12+	525	27	5.14	256	48.77	217	41.33	25	4.76

χ^2 =832.26, df=7 p<0.000001 (chi square with normal and malnutrition)

more normal than the boys. Similarly, the number and percentages of boys with mild and moderately impaired nutritional status were higher than the girls. In case of severely impaired nutritional status we also found that boys were suffering more than the girls. So, on an average it may be stated that the percentages of children with normal nutritional status gradually decreased with the advancement of age. The number and percentages of children having mild, moderate and severely impaired nutritional status were more at higher ages than the lower ages. Sing et al. (1998) reported that in India, prevalence of stunting, underweight was almost sixty percent among rural preschool children and prevalence of wasting was also high. Our study showed that the stunting underweight for boys was 65.29% and stunting underweight for girls was 54.65%.

Age and sex wise malnutrition percent according to Gomez classification and Waterlow's classification was recorded in Table 8. We found lowest malnutrition percent (48.9%) at age group 6+ and highest (100%) at age group 12+ in Gomez classification. Waterlow's classification showed lowest (30.58%) at age group 5+ and highest (94.86%) at age group 12+. But in both the cases the percentage increases with the advancement of age. The malnutrition percentages of boys and girls clearly indicate that the boys are suffering more than the girls. The study by Medhi and Mahanta (2004) suggests that present level of prevalence of stunting among children was not unexpected considering high prevalence nutritional assaults during early childhood among tea garden children. The study by Nyaruhucha et al. (2006) showed that the result of weight-for-age and height-for-age indicated that 31.2% of the children were underweight and 6.0% were severely underweight. Severely stunted children were 3.2% while 14% were moderately stunted. The study by Chowdhury et al. (2008) showed that the prevalence of undernutrition among Santal children was as follows: stunting (17.9%) and underweight (33.7%). Severe stunting and underweight were found in 4.98% and 7.92% of Santal children respectively.

The standards of nutrition among school children in the present study were much lower than those found in Delhi Corporation School by Dhingra et al. (1977) as well as that in urban school children in Tirupati as reported by Indirabai and Malika (1976). They found that prevalence of malnutrition were 50% and 47% respectively. Another report by Gangadharan (1977) focused that prevalence of malnutrition up to 34.20% in Kerala school children. However, the school children in the present study were found to be nutritionally better than the rural Punjab school children as reported by Panda et al. (1997), where the prevalence of malnutrition was 87.4%. The degrees of mal-

Table 7: Nutritional status (height for age) as per sex

Sex	*No.*	*Normal*	*%*	*Stunting*					
				Mild	*%*	*Moderate*	*%*	*Severe*	*%*
Boys	2221	771	34.71	1183	53.27	235	10.58	32	1.44
Girls	2236	1014	45.35	1051	47.00	148	6.62	23	1.03

χ^2=61.87, df=2, p<0.001 (moderate and severe are taken together)

Table 8: Age and sex wise distribution of malnutrition percent

Age	*Malnutrition (%)*		*Sex*	*Malnutrition (%)*	
	Gomez classification	*Waterlow's classification*		*Gomez classification*	*Waterlow's classification*
5+	53.59	30.58	Boys	80.01	65.29
6+	48.9	50.25			
7+	71.47	35.07			
8+	84.84	48.62	Girls	77.86	54.65
9+	85.2	71.17			
10+	95.32	71.27			
11+	96.22	80.33			
12+	100.00	94.86			

nutrition among the children of the study area were more than the study done by Medhi et al. (2007) on tea garden workers (boys-47.4% and girls 51.9%) of Dibrugarh, Assam. The study by Mittal and Srivasatava (2006) showed that 90% of the Oraon children of 6-12 years were undernourished. Rao et al. (2006b) found that about 63% of adolescent boys and 42% of girls were undernourished. The study by Tiwari et al. (2007) showed that boys remained undernourished after adolescence, while girls reached the normal growth patterns.

Regarding the possible explanation of such results, it may be stated that the children frequently suffer from different types of diseases. The health service system was not so well developed at the concerned zone. The major diseases were diarrhoea, malaria, jaundice, fever, skin disease and common cold. Parents cannot buy a variety of vegetables. They were habituated to consume rice and one locally available vegetable but not in recommended amount. So, the fewer intake in amount and the absence of variation in vegetables are causing deficiency in energy, proteins and vitamins. Again boys of 8 to 12 years of age were regularly being engaged in different types of hard work with their parents but girls were engaged in household work. As the boys remain outside they can get food only for three times but the girls take some light food one or two time daily in addition to three times of heavy foods. All these are directly related to malnutrition. Less physical labour and extra light food are the causes of less percentage of malnutrition of girls.

CONCLUSION

In conclusion it may be stated that the nutritional status of the children belonging to low socio-economic group of Darjeeling and Jalpaiguri districts is more severe. Nutritional status as per 'weight for age' focused more severity than the nutritional status as per 'height for age'. Children are not gaining required percentages of weight with the advancement of age. In comparison to weight, the height of the children was showing less severity. Boys are affected more than the girls. We feel that –

1. The economic status of the parents must be improved.
2. Parents will be acknowledged about the nutritive values of locally available foods so that the children can get sufficient amount of nutritious foods.
3. Children have to supply with the foods having proper balance of protein, carbohydrate, fat and minerals.
4. Moreover, the parents must be cautious about the children health and development.
5. Target type of supplementary nutritional programme maybe started from the Government level.

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