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Assessment of Nutritional Status among 2 to 12 Years Children of Two Districts in West Bengal, India

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ABSTRACT The present study aims to provide the prevalence of thinness among children. The cross-sectional study using weight and stature were conducted on a sample of 2,310 children (1,144 boys and 1,166 girls) aged 2 to 12 years. Participants and their caretakers were informed about the objectives of the study prior to commencement of the study. Overall prevalence of under-nutrition shows that both boys (62.2%) and girls (62.6%) have very high (critical situation) prevalence of thinness. Highest prevalence of thinness among boys was found at the age of 8 years (67.6%) and among girls at age 4 years (82.2%). This study exemplifies the magnitude of childhood under-nutrition (thinness) in the above studied area. A similar study will serve as a resource for future child health interventions in the said areas. To fight under-nutrition among children, an integrated approach is recommended, combining effective community outreach and monitoring, nutrition therapy and expanded partnerships with nutrition-related organizations in the region.

INTRODUCTION

India is the country with genetic and cultural diversity (Das 2006). Each and every state in India is practically equivalent to a country with its specific socioeconomic level, different ethnic groups, food habits, health infrastructures and communication (Das and Bose 2012). Several types of nutritional programs are also being run in India, but the result of this progress has failed to improve the nutrition status of the children (Shahnawaz and Singh 2014). Nutritional status of the children remains very poor for most of the states, especially in the tribal populous regions and lower socioeconomic groups among urban populations. Nutritional deficiencies are quite prevalent in the country, which is why the physical condition of children in India is very pathetic and disappointing (Shinde et al. 2015). Young children need high protein and energy for proper growth and development, which improve their immune system and cognitive development and they are more susceptible to infections than adults and are more prone to malnutrition (Galgamuwa et al. 2017; Endris et al. 2017; Purohit et al. 2017). For socio-economic development of the country, nutrition is very important, and therefore it was made an important part of the Millennium Development Goals by United Nations (Chataut and Khanal 2016). About half of all child deaths worldwide is a result of malnutrition (Priyanka et al. 2016). Malnutrition is the major cause of illness and death among children in early age and also decreases the educational status and labor productivity in the later ages of life (WHO 2013). One-third of the world's malnourished children have been found in India, whose health is very bad, which has become one of the major public health issues (Amirthaveni and Barikor 2001; Bhandari and Chhetri 2013). Several studies have explored health and nutritional status of children in India, which shows high rate of malnutrition (Lokshin et al. 2005; Renuka et al. 2014; Katyal et al. 2016). Health and nutritional status of the children directly or indirectly reflect the overall socioeconomic growth and development of the society and nation (Pujar et al. 2016). It also influences the progress in human resources and economic development of a country (Amirthaveni and Barikor 2001).

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Objective

Nutritional status is the status of an individual with respect to their health is defined by their nutrition. Thus, the nutritional status of the population shows major variation between countries. However, poor nutritional health status contributes to an array of morbidities and mortality. With this brief review above, this paper tried to evaluate the nutritional status of Bengali children of West Bengal using internationally accepted cut-offs of Body Mass Index (BMI).

METHODOLOGY

The present study was conducted among the children aged 2-12 years having Bengali ethnicity of West Bengal (a state situated on the eastern part of India), on a sample size of 2,310 children (1,144 boys and 1,166 girls). The present study was carried out from November 2009 to December 2010 as a part of the research. Data on age, sex, weight and height were collected from all the subjects using a pretested questionnaire by household visits following interview and anthropometric measurements. Age of children was documented from their birth certificates provided by the nearest Primary Health Centre (PHC) or polio vaccination card provided by the teachers of *Anganwadi* (an integrated child development program by the Government of India) and subsequently confirmed by their parents. Age of the subjects was considered to the nearest whole number. Thus, the appropriate (to the nearest whole age) cut-off values were utilized. The study children basically comprised of Bengali ethnicity of the state. Anthropometry is one of the best methods to evaluate the nutritional status of the group of people, especially in a rising country like India (WHO 1995). Anthropometric measurements like stature and body weight were taken from all children recruited in the present study only after obtaining prior consent from them and their parents (caretakers). Individuals were categorized into eleven ages from 2 to 12 years. For evaluating the nutritional status the body mass index (BMI; kg/m^2) was computed following internationally accepted standard equation of BMI = weight (kg)/height (m^2) (WHO 1995). Stature and body weight were recorded from each participant by the first author (SD) following standard techniques (Lohman et al. 1988). Technical errors of measurement were found to be within reference label (Ulijaszek and Kerr 1999) and thus not incorporated in statistical analyses. Participants were informed prior to taking all data from them and about the objectives. Visits have been made mostly in the daytime when most of the responders (females) were expected to be at home. Ethical approval was obtained from the competent authority before commencement of the study. Nutritional status was evaluated using the age-sex specific cut-off points of BMI for children described by (Cole et al. 2007). The thinness Grades III, II and I refer to severe, moderate and mild under-nutrition, respectively. The World Health Organization's classification (1995) of public health problem of low BMI between populations worldwide was followed. The classification categorizes prevalence according to percentage of population with BMI <18.5 kg/m^2 as follows:

- Low prevalence (5-9%): Warning sign (monitoring required)
- Medium prevalence (10-19%): Poor situation
- High prevalence (20-39%): Serious situation
- Very high prevalence (40%): Critical situation

Statistical analysis was performed using SPSS software (16.0 Version) and MS Excel. Statistical significance was set at $p<0.05$.

RESULTS

Age and sex wise distribution of studied children is shown in Table 1. The total number of subjects is 2,310, wherein 1,144 (49.5%) are

Table 1: Age and sex wise distribution of the studied children

Age (years)	*Sex*		*Total*	
	Boys (n)	*Girls (n)*	*Frequency*	*%*
2	122	127	249	10.78
3	205	145	350	15.15
4	178	118	296	12.81
5	174	192	366	15.84
6	132	143	275	11.90
7	82	71	153	6.62
8	68	78	146	6.32
9	74	92	166	7.19
10	56	66	122	5.28
11	25	59	84	3.64
12	28	75	103	4.46
Total	1144	1166	2310	100

boys and 1,166 (50.4%) are girls. The overall female to male ratio (FMR) of subjects is 1,019 females per 1,000 males. The highest frequency of subjects is of 5 years, which is 15.8 percent, where 174 were boys and 192 were girls, followed by 3 years (15.1%), which comprises 350 respondents, and the lowest frequency was observed at age 11 years (3.6%), which comprised 84 respondents. Table 2 shows the overall sex specific descriptive statistics of weight, height and BMI of the studied children. Negative significant sex difference is observed for weight (t=-6.017; sig. =0.001) and height (t=-6.847; sig. =0.001). On the other hand, positive significance is observed for BMI (t=2.719; sig. =0.001). Table 3 shows age and sex wise descriptive statistics of mean weight, height and BMI of studied children. Positive significance in weight is observed at age 4 years (t=2.033; sig.= 0.05), 6 years (t=2.231; sig.= 0.05), 7 years (t=2.081; sig.= 0.05), 8 years (t=1.977; sig.= 0.05) and 9 years (t=2.254; sig.= 0.05). For height, positive significance is observed at age 6 years (t= 1.854; sig.=0.05),7 years (t= 1.974; sig.=0.05) and 9 years (t= 2.779; sig.=0.001). Positive significance in BMI is observed at age 2 years (t=2.746; sig.=0.01), 4 years (t=5.648; sig.=0.001), 5 years (t=4.808; sig.=0.001) and 8 years (t= 2.099; sig.=0.05). On the other hand, the negative significance in weight is observed at age 3 years (t= -3.254; sig.= 0.001), 10 years (t= -2.574; sig.=0.01), 11 years (t= -3.441; sig.=0.001) and 12 years (t= -3.716; sig.=0.001). For height, negative significance is observed at age of 4 years (t=-3.175; sig.= 0.01), 10 years (t=-

Table 2: Age combined and sex specific mean, SD. t- test and significance of weight, height and BMI of the subjects

Variables	*Sex*	*N*	*Mean*	*Std. deviation*	*t*	*Sig.*
Weight (Kg)	Boys	1144	15.5921	5.40802	-6.017	.000
	Girls	1166	17.2643	7.72454		
Height (Cm)	Boys	1144	1.0343E2	16.71013	-6.847	.000
	Girls	1166	1.0843E2	18.27271		
BMI (Kg/m^2)	Boys	1144	14.4083	2.49848	2.719	.007
	Girls	1166	14.1356	2.31973		

Table 3: Age and sex specific descriptive statistics of weight, height and BMI of the children

Variables	*Weight (Kg)*			*Height (Cm)*			*BMI (Kg/m^2)*		
Age (Years)	*Boys Mean (SD)*	*Girls Mean (SD)*	*t -test*	*Boys Mean (SD)*	*Girls Mean (SD)*	*t -test*	*Boys Mean (SD)*	*Girls Mean (SD)*	*t -test*
2	10.52 (1.64)	10.40 (1.87)	0.543	84.97 (8.01)	86.12 (8.49)	-1.106	14.20 (1.98)	14.04 (1.73)	2.746**
3	10.94 (1.39)	11.77 (3.27)	-3.254***	89.40 (9.53)	90.33 (10.78)	-850	14.30 (2.62)	14.07 (2.47)	-1.676
4	13.45 (1.69)	12.98 (2.66)	2.033*	94.36 (9.66)	97.83 (8.49)	-3.175**	(3.39) (3.39)	13.56 (1.60)	5.648***
5	15.20 (2.54)	14.73 (2.34)	1.846	101.85 (10.18)	103.69 (8.30)	-1.904	14.04 (2.64)	13.70 (1.62)	4.808***
6	16.17 (2.54)	15.50 (2.42)	2.231*	108.54 (7.38)	106.92 (7.12)	1.854*	13.68 (1.32)	13.54 (1.57)	0.790
7	18.71 (3.80)	17.63 (2.28)	2.081*	115.91 (7.99)	113.66 (5.71)	1.974*	13.80 (1.35)	13.63 (1.27)	0.810
8	20.37 (4.88)	19.02 (3.29)	1.977*	120.50 (7.26)	119.53 (6.03)	0.881	13.90 (2.18)	13.25 (1.53)	2.099*
9	22.58 (5.84)	20.66 (5.15)	2.254*	125.86 (7.72)	122.42 (8.09)	2.779***	14.08 (2.36)	13.61 (1.97)	1.377
10	22.38 (5.23)	25.26 (6.85)	-2.574**	125.03 (8.41)	129.12 (8.14)	-2.723***	14.13 (1.91)	14.94 (2.83)	-1.817
11	22.78 (4.37)	29.51 (9.33)	-3.441***	125 (8.45)	136.2 (10.5)	-4.708***	14.55 (2.79)	15.55 (3.22)	-1.344
12	25.95 (8.00)	33.11 (8.94)	-3.716***	130.34 (12.46)	139.05 (11.74)	-3.295***	14.90 (2.31)	17.02 (3.77)	-2.772***
ANOVA	198.90***	247.85***		285.19***	403.67***		6.71***	22.76***	

2.723; sig.=0.001), 11 years (t=-4.708; sig.=0.001) and 12 years (t=-3.295;sig.=0.001). Negative significance in BMI is observed only at age 12 years (t=-2.772; sig.=0.001). Significant age difference in mean weight (F= 198.90; sig.= 0.001), height (F= 285.19; sig.=0.001) and BMI (F= 6.71; sig.= 0.001) for boys is observed. Similarly, among girls significant age difference in mean weight (F= 247.85; sig.= 0.001), height (F= 403.67; sig.= 0.001) and BMI (F= 22.76; sig.= 0.001) is also observed. According to the Table 4, highest prevalence of thinness among boys was found at the age of 11 years (72.0%) and among girls it was at the age of 4 years (82.20%). Grade I thinness in boys is highest (32.1%) at the age of 12 years and in girls it was 30.8 percent at the age of 8 years similarly. Grade II thinness (44.0%) is the highest percentage among 11 year aged boys and among the girls that is (20.7%) at the age of 9 years are affected from grade II thinness. In boys grade III thinness is highly found (33.0%) at the age of 6 years and in girls it was (44.9%) at the age of 4 years. Overall the prevalence of grade I thinness is highest among girls (20.8%) than boys (18.1%), whereas grade II thinness is found to be higher among boys (17.1%) than girls (15.3%). Similarly, grade III is also found to be more prevalent among boys (26.8%) than girls (26.4%). Age-sex combined prevalence of under-nutrition (Grade I, II, and III combined) among boys and girls was 62.1 percent and 62.6 percent respectively, with girls being at a higher risk of under-nutrition than boys.

DISCUSSION

Child malnutrition has become a major problem and continuous cause for deaths, especially in developing countries like India (Victoria et al. 2010, WHO 2015). Nutritional deficiency causes several morbidities that may lead to high mortality (Mohsena et al. 2017). Good quality of nutrition is essential from the very early stages of life for the proper growth, development of young children, and if they do not get a proper diet, it can affect the later period of life and can have short and long-term effects (Singh and Sadhu 2014). Worldwide, 60 million and 30 million children are suffering with problem of malnutrition (Glewwe and Miguel 2007). Between 8 to 11 million under five years of age children die each year globally (Singer et al. 2011).

Table 5 shows the comparative prevalence of under-nutrition (thinness) for the present study with other existing studies. Previous studies such as ICDS children (62.9%) (Bhalani and

Table 4: Prevalence of nutritional status (age and sex wise) among the children

Age (Years)	*Sex*	*Nutritional status*					*Chi-square*
		Thinness I (%)	*Thinness II (%)*	*Thinness III (%)*	*Overall thinness (%)*	*Normal (%)*	
2	Boys	16.4	11.5	32.0	59.8	40.2	7.730; df=3; p=0.052
	Girls	28.3	15.7	22.0	66.1	33.9	
3	Boys	29.8	5.9	19.5	55.1	44.9	8.845; df=3; p=0.031
	Girls	20.0	13.1	23.4	56.5	43.4	
4	Boys	12.4	11.2	28.1	51.7	37.0	8.362; df=3; p=0.39
	Girls	22.9	14.4	44.9	82.2	34.7	
5	Boys	10.9	9.8	31.0	51.7	48.3	6.911; df=3; p=0.075
	Girls	19.8	12.0	29.2	60.9	39.1	
6	Boys	17.4	15.9	33.3	66.7	33.3	1.970; df=3; p=0.579
	Girls	16.8	20.3	26.6	63.6	36.4	
7	Boys	9.8	24.4	30.5	64.6	35.4	3.505; df=3; p=0.320
	Girls	16.9	18.3	22.5	57.7	42.2	
8	Boys	23.5	13.2	30.9	67.6	32.3	1.698; df=3; p=0.637
	Girls	30.8	16.7	25.6	73.0	26.9	
9	Boys	23.0	13.5	29.7	66.2	33.8	3.814; df=3; p=0.282
	Girls	30.4	20.7	20.7	71.7	28.3	
10	Boys	12.5	28.6	30.4	71.4	28.8	5.971; df=3; p=0.113
	Girls	15.2	13.6	25.8	54.5	45.6	
11	Boys	12.0	44.0	16.0	72.0	28.0	7.031; df=3; p=0.071
	Girls	13.6	16.9	23.7	54.2	45.8	
12	Boys	32.1	10.7	14.3	57.1	42.7	5.322; df=3; p=0.150
	Girls	14.7	6.7	26.7	48.0	52.0	

Table 5: Comparative prevalence of undernutrition among studied children (previous research) with present children

S. No.	*Population*	*Total number*	*Age group*	*Under nutrition (%)*	*Study area*	*Reference*
1.	Drought affected children	914	<5 years	28.0	Western Rajasthan, India	Singh et al. 2006
2.	Army children	760	5-11 years	30.3	Pune	Mukharjee et al. 2008
3.	ICDS children	3157	< 5 years	62.9	Vadodara city, India	Bhalani and Kotecha 2009
4.	ICDS children, Hooghly	1012	2-6 years	85.2	West Bengal	Mandal et al. 2009
5.	Bauri scheduled caste children	219	2-6 years	65.3	West Bengal	Das and Bose 2008
6.	Kharagpur children	500	6-12 years	77.0	West Bengal	Das et al.2012
7.	Primary school	3654	8-9 years	42.6	West Bengal	Mondal et al. 2015
8.	School children	394	4-15 years	29	Hyderabad	Syed and Rao 2015
9.	Urban children	823	5-11 years	15.8	Pune	Yadav et al. 2016
10.	Slum and non-slum children	650	< 5 years	31.5	Maharashtra	Purohit et al. 2017
11.	Rural area	182	< 5 years	47.5	West Bengal	Manjula et al. 2017
12.	Bengalee children	2310	2-12 years	62.4	West Bengal	Present work

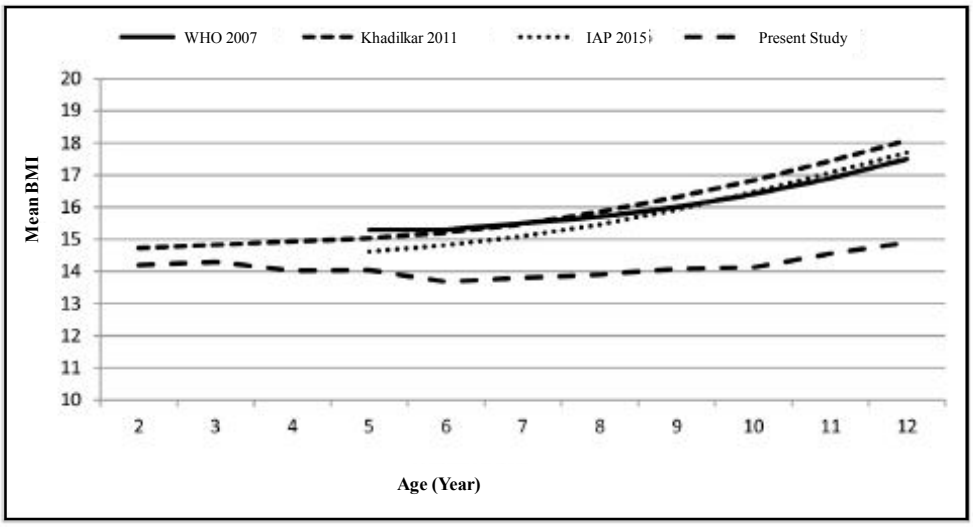
Kotecha 2009), ICDS children, Hooghly (85.2%) (Mandal and Bose 2009), Bauri children (65.3%) (Das and Bose 2009) and Kharagpur children (77%) (Das et al. 2012) have reported higher prevalence of thinness than the present study (62.4%), and other studies for drought-affected children (28%) (Singh et al. 2006), army children (30.3%) (Mukherjee et al. 2008), primary school children (42.6%) (Mondal et al. 2015), school children (29%) (Syed and Rao 2015), urban children (15.1%) (Yadav et al. 2016), slum and non-slum Children (31.5%) (Purohit et al. 2017) and rural area children (47.5%) (Manjula et al. 2017) have reported lower prevalence of thinness than the present study. The present study revealed that the nutritional status of Bengali children of West Bengal is very poor (62.4%) with very high rates of thinness.

Figure 1(boys) and Figure 2 (girls) present the comparative chart showing mean BMI values of the present study with 50th percentile of de Onis(2007), Khadilkar and Khadilkar (2011) and Khadilkar (2015). It has been clear from the figures that as the data of present study were collected from underprivileged section (SC and STs) children of West Bengal the values of all the references underestimate the mean values of present study. It may be the genetic protocol of the studied population. Because except the age at 4 years (boys) and age at 3 years (girls) all the studied ages show significant mean deviation from references published earlier. It has been recommended that due to huge biological or physical variation in the country (India) any single reference is not comparable that covers all the population. Therefore, at least state specific cut-off points should be developed covering all sections of population that better reflect the actual situation of any ethnic group under study.

This study indicates the requirement of immediate appropriate public health intervention programs, which may help policymakers, planners and organizations to develop new health policies. The present study shows very high (62.4%) (critical situation) levels of under-nutrition. Thus, the nutritional status of 2-12 years children was in a very critical situation not only in the present study but also among other studied populations of India. To overcome such problems of under-nutrition more state specific policies should be designed on a priority basis to size the level of under-nutrition among children and improve the nutritional status of children.

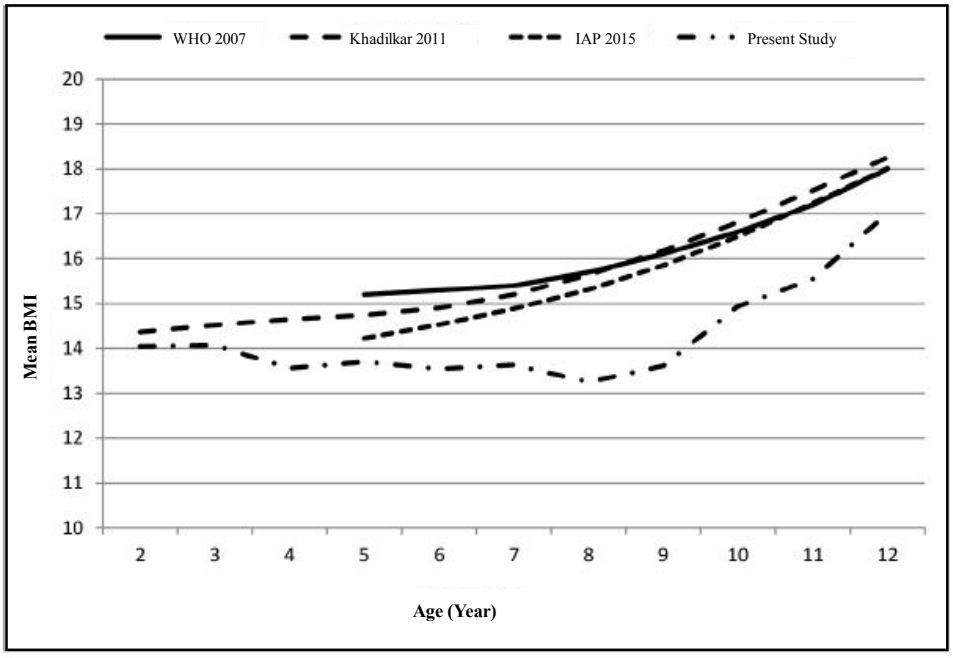
CONCLUSION

The researchers can conclude that childhood under-nutrition still remains a significant and urgent public health issue in West Bengal. The present study illustrates the magnitude of under-nutrition (thinness) in the 2-12 years age children in West Bengal. Both boys and girls have very high (62.4%) (critical situation) rate of prevalence of thinness. It revealed age-combined prevalence of under-nutrition (Grade I, II, and III combined) among boys and girls was (62.1%)



IAP = Indian Association of Pediatrics.
WHO = World Health Organization.

Fig. 1. Comparative figure showing mean BMI of present studied boys with National and International references



IAP = Indian Association of Pediatrics.
WHO = World Health Organization.

Fig. 2. Comparative figure showing mean BMI of present studied girls with National and International references

and (62.6%), respectively, with girls being at higher risk of under-nutrition than boys. The present study is limited to the rural region and may not be representative of all regions of West Bengal. This specific information is valuable for national nutrition policy planning. It can also serve as a resource and evidence base for information of future research on child health and nutrition interventions in the study area. Community specific intervention programs should be recommended to fight with the problem of malnourishment.

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