Effects of certain socio-economic, socio-demographic and life style factors on the prevalence of thinness among pre-school children of North Bengal, India

Pushpa Lata Tigga[(1)], Nitish Mondal[(2)], Jaydip Sen[(1)]

ABSTRACT

BACKGROUND: Undernutrition is generally considered to be a major public health issue and is a principal cause of ill-health in many of the developing countries such as India. It increases the incidence of premature mortalities, morbidities and causes long-lasting physiological effects among children. The present cross-sectional study determines the prevalence of thinness [low Body Mass Index (BMI)-for-age] among pre-school children. It also studies the effects of certain socio-economic, socio-demographic and lifestyle variables on thinness.

METHODS: The study was conducted among 1163 children (boys: 546; girls: 617) aged 2-5 years. All the children were covered by the Integrated Child Developed Scheme (ICDS) of the Government of India and were the beneficiaries of 24 ICDS centers located in Matigara block of Darjeeling district, West Bengal, India. Data was collected by visiting both the ICDS centers and the households of the children. Height and weight of the children were measured and BMI (weight/height2, kg/m2) was calculated. The new international BMI-based cut-off points of Cole et al. (2007) were utilized to determine the prevalence of thinness. Parents of the children were interviewed for data on socio-economic, socio-demographic and lifestyle variables. The data was statistically analyzed using SPSS (Version 17.0). The statistical tests performed were chi-square analysis, ANOVA and multinomial logistic regression.

RESULTS: The overall mean BMI among the boys and girls were 14.42 ±1.73 kg/m² and 13.91 ±1.64 kg/m², respectively ($p<0.05$). The sex-specific prevalence of thinness was significantly greater among girls (67.91%) than boys (55.12%) ($p<0.05$). The age-specific overall thinness was observed to be the greater in case of boys and girls aged 5 years (57.95% and 71.49%). Results of the multinomial logistic regression analysis showed that sex, age, study area, father's occupation and toilet facility exhibited significant effects on the grades of thinness ($p<0.05$).

CONCLUSIONS: Very high prevalence of thinness was present among the pre-school children and this was indicative of major nutritional deprivation. Appropriate nutritional intervention and proper monitoring of the ongoing intervention programmes are necessary to ameliorate their existing nutritional status among children.

Key words: BMI, Thinness, Anthropometry, Undernutrition, Pre-school children, India, Public health

(1) Department of Anthropology, University of North Bengal, West Bengal, India
(2) Department of Anthropology, Assam University (Diphu Campus), Assam, India

CORRESPONDING AUTHOR: *Jaydip Sen, Department of Anthropology, University of North Bengal, West Bengal, India. e mail: jaydipsen@rediffmail.com*

DOI: ***10.2427/10282***
Accepted on February 4, 2015

INTRODUCTION

Undernutrition is considered to be a major public health issue in the developing countries. It remains a principal cause of increased ill-health and premature mortalities and morbidities among children apart from causing long-lasting physiological effects [1-3]. The World Health Organization (WHO) estimated that in the year 2012, a total of 6.6 million deaths occurred among children aged under-5 years and that undernutrition was identified as the principal underlying cause of mortality in an estimated 45.0% of all deaths among children (4). Undernutrition has also been observed to have significant adverse health effects among those children who survive to adulthood [4, 5] and was the largest contributor to the global burden of disease [6, 7]. Global estimates portray that about 1/3rd of the children aged under-5 years (178 million) were stunted, while 112 million were underweight [3, 8]. In India, the National Family Health Survey-3 in 2005-06 has observed the prevalence of stunting to be around 50.0% among children aged below 5 years, while the proportion of underweight (43%) was almost double than that reported from sub-Saharan Africa [9]. It has also been already reported that with its large population size and widespread poverty, in India a majority of the individuals are undernourished and underprivileged [10-12]. Discrimination against the female child has also been observed among nutritionally vulnerable segments of the Indian population [13-15]. The country has also shown the highest occurrence of child undernutrition in the world and it has been estimated that more than half of the Indian children remain undernourished [3, 6, 12]. Therefore, nutritional assessments of children are a priority and have potential roles to play in formulating developmental strategies and intervention programmes in the country.

Anthropometry is the single most universally applicable, easy to use, quick, non-invasive and inexpensive technique of choice to researchers to determine nutritional status of children [13-15, 16]. A variety of conventional anthropometric measures have been used to assess undernutrition on the basis of stunting (low height-for-age), wasting (low weight-for-height) and underweight (low weight-for-age) [1, 5, 13, 14, 15, 17]. These conventional anthropometric measurements reflect certain distinct biological processes of human life and their usages are very important for determining appropriate nutritional interventions [5, 17]. However, due to their overlapping nature, often the actual magnitude of undernutrition often remains shrouded [1, 15, 16]. A number of studies have reported the prevalence of undernutrition among Indian children using these conventional anthropometric measures [1, 13-15, 18].

The body mass index (BMI) is a surrogate and proxy anthropometric measure that has been extensively used to assess nutritional status in terms of thinness (low BMI-for-age) or chronic energy deficiency [4, 19]. It has been suggested that BMI-for-age is a better indicator than weight-for-age to assess the risk of infections associated with undernutrition [17, 19]. Recently, BMI in relation to age (BMI-for-age) has been recommended to be the best surrogate anthropometric measure of thinness among children and adolescents aged between 2-18 years [19]. International age-sex specific reference cut-offs have also been proposed to assess the prevalence of thinness [16, 19]. These cut-off points were derived based on multicentre data from the United States, Great Britain, Hong Kong, the Netherlands (all developed countries) and Brazil (a developing country) [19]. It has been subsequently opined that undernutrition could be better assessed in terms of thinness (low BMI-for-age) [16, 20]. Prior to this proposal of Cole et al. [19], there were no suitable cut-off points for thinness that would have encouraged direct comparisons of worldwide trends in thinness among children and adolescents and provide a classification for the purposes of public health. Recently a number of studies have utilized these cut-offs to report the magnitude of thinness among Indian children [21-28].

Studies have consistently reported that the prevalence of child undernutrition is influenced by several socio-economic and socio-demographic variables [14, 15, 18, 29-31]. Examples of such variables are age, sex, family size, number of siblings, birth order, birth intervals (both preceding and following), mother's age at childbirth, residence and family income. It has also been observed that the socio-economic status has an important role in influencing a child's nutritional status [14, 18, 30, 31]. Maternal education is another important contributing factor, where better educated mothers are in a position to make better use of health services, provide better child care, have increased knowledge of appropriate child rearing, have more hygienic household practices and personal habits and also have higher status in the family [18, 30-31]. Children of uneducated or primary educated mothers run a higher risk of suffering from undernutrition [18-19]. Lower maternal education has also been highlighted as a potential risk factor for malnutrition in the rural areas. It has now been opined that education of parents, especially of the mother, has emerged as an important determinant of health and survivability of children [30, 31]. Another important contributing factor is occupation, where studies have shown a negative association between nature of parental occupation and child survival in the developing countries [19-31].

Therefore, information on prevalence of thinness among children of the developing countries like India where a vast segment of the populations are undernourished and underprivileged, are needed to be generated for international and national comparisons. Effects of different socio-economic, socio-demographic and lifestyle factors on thinness also need to be documented. With these issues in mind, the present study has been conducted to determine prevalence of thinness among pre-school children aged between 2-5 years using the recently proposed international cut-offs of Cole et al. [19]. An attempt has been also made to ascertain the associations of certain socio-economic, socio-demographic and lifestyle variables on the prevalence of thinness.

METHODS

Study area, subjects and method of sampling

The northern part of the state of West Bengal, India is popularly known as North Bengal and comprises of six districts. The area is inhabited by a number of indigenous tribal (such as Rabha, Meche, Toto, Oraon, Santal and Munda) and non-tribal (Rajbanshi, Bengali caste and Bengali Muslim) populations. Given the area's general backwardness, the communities of the region remain vulnerable to undernutrition [14-16, 18, 32]. The present community based cross-sectional study was carried out among 1163 pre-school children aged between 2-5 years and residing in a rural and an urban area in the district of Darjeeling, West Bengal. The children covered in course of the study belonged to the Proto-Australoid tribal (Oraon, Santal and Munda) and the heterogeneous Bengalee caste populations, natures of which have been described elsewhere [14, 33]. The data was recorded when the children visited different centers of the Integrated Child Development Scheme (ICDS) of the Government of India and also by household visits. A total of 24 ICDS centers located in the rural and urban areas of Matigara, Chandmuni tea estate and New Chamta tea estate of Matigara Gram Panchayet were covered in course of the study. The ICDS centers were selected on the basis of identical subject strengths and easy road accessibility, and were situated at approximate distances of 8-12 kms from the sub-divisional town of Siliguri.

The Government of India launched the ICDS on 2nd October 1975 as an experimental project in 29 rural and tribal blocks and 4 urban slums. It now includes pre-school children, pregnant and lactating mothers and women in the age group of 15-44 years [34]. It is the largest national program for the promotion and development of health of the mother and child and provides non-formal pre-school education, supplementary nutrition, immunization, health check-up, referral services, nutrition and health education to the beneficiaries [34]. The children covered by the ICDS are served a daily food supplementation in the form of porridge, consisting approximately of 50 grams of rice and 25 grams of lentil in the ICDS centers.

The children were selected using a multi-stage stratified random sampling method. Initially 1298 children (boys: 626; girls: 672) were approached to take part in the study. One hundred twenty nine of them (boys: 78; girls: 51) were subsequently excluded from the study as either their dates of birth were not available in the ICDS records or they did not belong to the age group selected. The final sample size consisted of 1163 children (boys: 546; girls: 617). The rural group comprised of 962 children (82.7%), while the urban group comprised of the rest 201 children (17.3%). Age and ethnicity of these children were determined from the ICDS records and subsequently verified from the official documents of the Government. All the children were free from any physical deformities, nutritional deficiency symptoms, and were not suffering from any diseases at the time of data collection. Permissions for the study were taken from ICDS centers and local Panchayets (a village level governing authority) prior to data collection. An informed consent was obtained from either parent of the children. Necessary research approvals and clearances were obtained from the University of North Bengal. The study was conducted in accordance with the ethical guidelines for human experiments as laid down in the Helsinki Declaration of 2000 [35].

Socio-economic, socio-demographic and life style data recorded

The socio-economic and socio-demographic variables were recorded using interview and structured schedule methods. The parents were interviewed to obtain the required information. A modified version of the scale of Kuppuswamy [36] was utilized so as to ascertain the socio-economic status (SES) of the children. Based on this scale, all the children belonged to a lower SES. The data recorded were sex, age, birth order, study area, mother's age as child birth, birth interval, mother's education, father's education, ethnic group, media exposure, number of sibling, family size, electricity facility, toilet facility, electricity facility, mother's occupation, father's occupation and household income.

Anthropometric measurements recorded

Measurements of height and weight were recorded following standard procedures [37]. Height of the children was recorded using an anthropometer rod to the nearest 0.10 cm. Weight of the children wearing minimum clothing and with bare feet was taken using a portable weighing scale to the nearest 0.10 kg. Intra-observer and inter-observer technical errors of the measurements (TEM) were calculated using a standard procedure [38]. The TEM was calculated using the following equation:

$TEM=\sqrt{(\Sigma D^2/2N)}$, D=difference between the measurements, N=number of individuals.
The co-efficient of reliability (R) was subsequently calculated from TEM using the following equation:

$R=\{1-(TEM)^2/SD^2\}$, SD= standard deviation of the measurements.

For calculating TEM, height and weight were recorded from 50 children other than those selected for the study by two of the authors (PT and JS). Very high values of R (>0.975) were obtained for TEM and these values were observed to be within acceptable limits (R=0.95) [38]. Hence, the measurements recorded by PT and JS were considered to be reliable and reproducible. All the measurements in course of the present study were subsequently recorded by one of the authors (PT).

Assessment of Nutritional Status

The BMI was calculated following the internationally accepted standard equation [5] which is as follows:

$BMI=weight/height^2$ kg/m^2

The prevalence thinness (low BMI-for-age) has been assessed following the international BMI cut-off points as proposed by Cole et al. [19]. The BMI values were used to determine the definite grades of thinness (Grade-I: mild, Grade-II: moderate, Grade-III: severe). These grades are similar to the different chronic energy deficiency grades based on BMI among adults [5, 19]. Hence, a child observed to be below the thinness Grades I, II and III of the age and sex specific cut-offs has been classified as mild, moderate and severely thin respectively [19].

Statistical Analysis

The data was statistically analyzed using the Statistical Package for Social Sciences (SPSS; version 17.0). Chi-square (χ^2) analysis was utilized to assess differences in prevalence of different thinness categories between sexes. One way analysis of variance (ANOVA) based on the general linear model was used to assess age-sex specific mean differences in the anthropometric variables. A multinomial logistic regression using maximum likelihood estimation model was fitted to estimate the odds of being affected by Grades I, II, I and overall thinness (low BMI-for-age). The univariate logistic regression model allowed the creation of categorical depended variables dichotomously and the odds were obtained by comparison with the reference categories. The predictor variables of sex, age, birth order, family size, mother's age at child birth, ethnic group, study area, religion, birth interval, mother's education, father's education, family monthly income, mother's education, father's occupation, media exposure and hygienic toilet facilities were used in this model. A child observed to be undernourished in any of the categories of mild, moderate, severe and overall thinness were coded separately as '0' and those being normal as '1'. Similarly, the predictor variables were entered in the multinomial logistic regression model as a set of dummy variable separately for each regression model. The results obtained were subsequently compared with the reference categories. An odds ratio of 1 indicated that the odds of being undernourished were not different from the reference category. If the estimated odds ratio was greater than 1, then the likelihood of being affected by undernutrition was higher relative to the reference category. If the odds were observed to be lower than the reference, then the probability of being undernourished was lower relative to the reference category. The p-values of <0.05 and <0.01 were considered to be statistically significant.

RESULTS

The age and sex specific mean BMI and prevalence of different grades of thinness is presented in Table 1. The overall mean BMI among boys and girls were 14.42 ±1.73 kg/m² and 13.91 ±1.64 kg/m² respectively and the difference was observed to be statistically significant (p<0.05). The age specific mean BMI values gradually decreased with age among both sexes and greater mean values were observed in the early ages (such as 1 year and 2 years). Using ANOVA, mean differences between age groups were statistically significant (p<0.05), the only exception being observed among children aged 4 years (p>0.05). A very high prevalence of overall thinness was observed among the children (boys: 55.12%; girls: 67.91%) (Figure 1). The age-specific overall thinness was observed to be highest among children aged 5 years (boys: 57.95%; girls: 71.49%), while it was the lowest in case of 3 years old boys (48.00%) and 2 years old girls (63.50%). The overall prevalence of thinness showed that girls were more affected by different grades of thinness as compared to boys (mild: 30.5% vs. 28.4%; moderate: 16.4% vs. 13.9%; severe: 21.1% vs. 12.8%). The age-specific prevalence of mild, moderate and severe grades thinness also showed that girls were more affected than boys, except among those aged 2 years (in moderate thinness) and 5 years (in mild thinness) (p>0.05). Using χ^2-analysis, the age-specific and overall sex difference in the different categories of prevalence of thinness were observed to be statistically not significant (p>0.05) but the differences were statistically significant in the categories of overall thinness (χ^2 value= 4.75; p<0.05), severe thinness (grade III) (χ^2 value= 9.84; p<0.05) and age-specific thinness categories of moderate (grade II) (χ^2 value= 5.05; p<0.05) and severe (χ^2 value= 5.09; p<0.05) in children aged 5 years. The age and sex specific prevalence of overall thinness among the boys and girls is also depicted in Figure 1.

Effects of socio-economic, demographic and life style factors on prevalence of thinness

The results of the multinomial logistic regression model fitted to estimate the odds of being affected by mild, moderate, severe and combined overall thinness with different socio-economic, socio-demographic and lifestyle variables are depicted in Table 2. Girls were observed to exhibit significantly 1.50 times, 1.64 times, 2.30 times and 1.72 times greater odds than boys in mild, moderate, severe and overall categories of thinness (p<0.01). The odds were significantly higher (1.38 times) among children belonging to the higher age of 5 years in case of overall prevalence of thinness (p<0.05). The results also showed that children belonging to the 'manual worker' father occupation category exhibited 1.66 times, 2.06 times and 1.60 times significant greater odds for being affected by mild, moderate and overall thinness respectively (p<0.01). However, children belonging to the 'tribal ethnic group' and residing in 'rural area' exhibited significantly greater risks of being affected in the mild and overall thinness that their respective reference counterparts (p<0.05). The odds were also observed to be significant higher (p<0.05) among those children residing households with no toilet facility (mild thinness: 1.48; moderate thinness: 1.68; severe thinness: 1.44; overall thinness: 1.51) (p<0.05). A significantly lower risk of severe thinness (Grade-III) and overall thinness were observed in case of children exposed to better maternal

TABLE 1

AGE AND SEX SPECIFIC SUBJECT DISTRIBUTION, DESCRIPTIVE STATISTICS AND PREVALENCE OF DIFFERENT GRADES OF THINNESS AMONG THE CHILDREN

AGE	NO OF SUBJECTS		BMI			PREVALENCE OF DIFFERENT GRADES OF THINNESS (LOW BMI-FOR-AGE)						
						MILD THINNESS (GRADE I)		MODERATE THINNESS (GRADE II)		SEVERE THINNESS (GRADE III)		SEX-DIFFERENCE (χ^2-VALUE)
	BOYS	GIRLS	BOYS	GIRLS	F-VALUE	BOYS	GIRLS	BOYS	GIRLS	BOYS	GIRLS	
2 YEAR	120	137	15.11 ±1.97	14.51 ±1.38	8.03**	34 (28.3)	44 (32.1)	19 (15.8)	18 (13.1)	15 (12.5)	25 (18.2)	1.80
3 YEAR	125	128	14.55 ±1.34	14.16 ±1.25	5.46*	29 (23.2)	46 (35.9)	19 (15.2)	24 (18.8)	12 (9.6)	16 (12.5)	2.95
4 YEAR	125	138	14.15 ±1.23	13.84 ±1.33	3.75	36 (28.8)	47 (34.1)	22 (17.6)	20 (14.5)	13 (10.4)	26 (18.8)	3.69
5 YEAR	176	214	14.11 ±1.77	13.40 ±2.00	10.53**	56 (31.8)	51 (23.8)	16 (9.1)	39 (18.2)	30 (17.10)	63 (29.4)	13.24**
TOTAL	546	617	14.42 ±1.73	13.91 ±1.64	27.07**	155 (28.4)	188 (30.5)	76 (13.9)	101 (16.4)	70 (12.8)	130 (21.1)	10.17*

Figures in parenthesis indicates percentages, *p<0.05, **p<0.01

FIGURE 1

AGE AND SEX SPECIFIC PREVALENCE OF OVERALL THINNESS AMONG THE CHILDREN

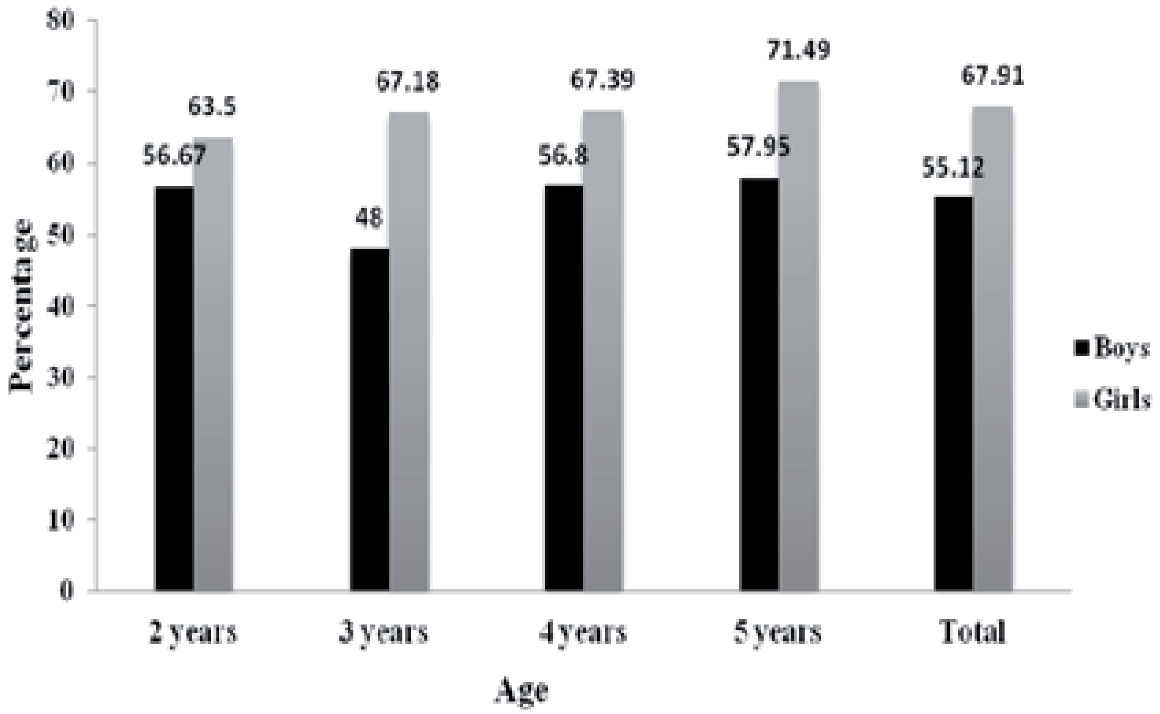

TABLE 2

RESULTS OF MULTINOMIAL LOGISTIC REGRESSION ANALYSIS SHOWING THE ASSOCIATION OF DIFFERENT GRADES OF THINNESS WITH SOCIO-ECONOMIC, SOCIO-DEMOGRAPHICS AND LIFESTYLE RELATED FACTORS

CATEGORY	SUB-CATEGORY	N (1163)	MILD THINNESS: GRADE I (N=343)		MODERATE THINNESS: GRADE II (N=177)		SEVERE THINNESS: GRADE III (N=200)		OVERALL THINNESS (N=720)	
			ODDS	95% CI	ODDS	95% CI	ODDS	95% CI	ODDS	95% CI
SEX	Male®	546	-	-	-	-	-	-	-	-
	Female	617	1.50**	1.13-1.99	1.64**	1.16-2.34	2.30**	1.63-3.25	1.72**	1.35-2.18
AGE	2 year	257	1.09	0.72-1.66	0.90	0.54-1.51	1.50	0.86-2.61	1.11	0.78-1.59
	3 year®	253	-	-	-	-	-	-	-	-
	4 year	263	1.20	0.79-1.81	1.06	0.64-1.75	1.51	0.86-2.63	1.21	0.85-1.73
	5 year	390	1.13	0.76-1.67	1.01	0.63-1.63	2.63*	1.61-4.31	1.38*	1.00-1.92
BIRTH ORDER	1®	396	-	-	-	-	-	-	-	-
	2	422	1.13	0.81-1.59	0.81	0.53-1.23	1.05	0.71-1.56	1.02	0.77-1.35
	3≥	345	1.13	0.79-1.62	0.99	0.64-1.52	0.99	0.65-1.52	1.05	0.78-1.42
STUDY AREA	Rural	982	1.33	0.91-1.95	1.69*	1.01-2.82	1.40	0.88-2.22	1.43*	1.04-1.96
	Urban®	181	-	-	-	-	-	-	-	-
MOTHER'S AGE AT CHILDBIRTH	≤ 18 years	879	1.16	0.83-1.61	1.15	0.76-1.73	0.86	0.59-1.25	1.06	0.80-1.39
	≥19 years®	284	-	-	-	-	-	-	-	-
BIRTH INTERVAL	< 24 months®	474	-	-	-	-	-	-	-	-
	≥ 24 months	689	1.16	0.87-1.55	1.15	0.81-1.65	1.02	0.73-1.43	1.12	0.88-1.42
MOTHER'S EDUCATION	Illiterate	682	-	-	-	-	-	-	-	-
	Literate and above®	481	0.81	0.61-1.08	0.80	0.56-1.14	0.63**	0.44-0.89	0.76*	1.04-1.68
FATHER'S EDUCATION	Illiterate	411	-	-	-	-	-	-	-	-
	Literate and above®	752	1.01	0.75-1.36	0.87	0.61-1.25	1.08	0.76-1.54	1.01	0.79-1.29
ETHNIC GROUP	General Caste®	572	-	-	-	-	-	-	-	-
	Tribal population	591	1.26	0.95-1.67	1.74**	1.22-2.48	1.07	0.77-1.50	1.30*	1.03-1.65
MEDIA EXPOSURE	Regularly®	664	0.84	0.63-1.12	0.90	0.63-1.28	0.70*	0.50-0.98	1.23	0.97-1.57
	Not regularly	499	-	-	-	-	-	-	-	-
NUMBER OF SIBLINGS	1-2®	514	-	-	-	-	-	-	-	-
	3 ≥	649	1.03	0.78-1.37	1.07	0.75-1.52	1.11	0.80-1.56	1.06	0.84-1.35
FAMILY SIZE	≥ 4®	585	-	-	-	-	-	-	-	-
	5 ≥	578	1.06	0.80-1.41	1.09	0.77-1.55	0.93	0.67-1.30	1.03	0.82-1.31
TOILET FACILITY	No	568	1.48**	1.12-1.97	1.68**	1.18-2.39	1.44*	1.03-2.01	1.51**	1.19-1.92
	Yes®	594	-	-	-	-	-	-	-	-
ELECTRICITY FACILITY	No	269	1.12	0.80-1.57	1.11	0.73-1.68	1.13	0.76-1.67	1.12	0.84-1.49
	Yes®	894	-	-	-	-	-	-	-	-
MOTHER'S OCCUPATION	Housewife®	679	0.83	0.62-1.10	0.72	0.51-1.02	0.95	0.68-1.34	1.20	0.95-1.53
	Manual worker	484	-	-	-	-	-	-	-	-
FATHER'S OCCUPATION	Manual worker®	925	1.66**	1.17-2.37	2.06**	1.28-3.31	1.24	0.83-1.84	1.60**	1.20-2.13
	Others/Service	238	-	-	-	-	-	-	-	-
INCOME (RUPEES)	≤ Rs. 2000	203	0.81	0.50-1.32	1.15	0.60-2.20	1.06	0.62-1.83	0.95	0.63-1.43
	Rs.2001-4000	774	1.07	0.72-1.58	1.56	0.92-2.64	0.85	0.54-1.34	1.09	0.79-1.51
	≥ Rs. 4001®	186	-	-	-	-	-	-	-	-

education (e.g., literate and above) (odds 0.63; $p<0.01$ and 0.73;$p<0.05$) and to regular media exposure (odds 0.70; $p<0.05$) (Table 2).

DISCUSSION

Assessments of nutritional status are an integral component for documenting the overall health of an individual and/or population, and are an indicator of the well-being of a particular region. Despite economic developments, prevalence of undernutrition among children especially those aged under-5 years pose a major public health problem in many of the developing countries including India [1, 3, 13-14]. Such prevalence is generally attributed to a large population size, illiteracy, poverty, poor infrastructure and inappropriate healthcare facilities [1-9, 11, 13-15, 18, 31]. It also reflects inadequate nutrition during early childhood and is likely to be a consequence of well-known phenomenon of inadequate weaning food with lower energy-density as observed in India [9, 11-12]. The importance of assessing nutritional status of these nutritionally vulnerable children should be recognized, not only for improvement of the overall health condition of the future generations, but also for overall developments of the concerned region. The results of the present study undoubtedly shall be useful for policy makers in their endeavor to formulate various developmental and healthcare programmes and appropriate nutritional interventions and proper monitoring of the ongoing intervention programmes. Priority interventions are necessary in terms of appropriate complementary feeding, supplementation with proper balance food, micronutrient, breast feeding promotion and acute undernutrition and related morbidity management.

In the present study, an assessment of thinness (low BMI-for-age) among pre-school children aged 2-5 years was undertaken using the newly proposed cut-offs of Cole et al. [19]. A very high prevalence of thinness has been documented (62.0%) among them (Figure 1). Existing studies have consistently reported very high prevalence of thinness among Indian children and here the studies of Biswas et al. [22] among Bengalee children (51%), Das and Bose [25] among Santal children (56%), Mandal and Bose [26] also among Santal children (76%), Chakraborty and Bose [27] among Bengalee children (62%), Bisai and Manna [23] among urban children (47%), Mandal et al. [21] among Bengalee children (85%) and Bisai et al [24] among Kora-Mudi children (67%) are mentionable. Evidently, the problem of thinness is persistent transversely across Indian populations with consistent proportions of children, especially pre-school children being affected. It has also been observed that high prevalence of thinness is a major nutritional problem among both tribal and non-tribal pre-school children of the country. It has been estimated that more than half of the children in the age group of below 5 years remained nutritionally affected by thinness [22, 24, 26-28] and they require immediate attention in terms of nutritional interventions. A greater prevalence of thinness indicates current chronic energy deficiency and early detection and correction of the current energy deficit might reduce the risk of infections and related co-morbidities and also enable the children to continue in their physical growth trajectories [3, 20]. This is because of the fact that children suffering from thinness were more likely to develop into thin adult individuals with a low BMI (such as those suffering from chronic energy deficiency that would have an adverse impacts on their reduced work productivity and poor reproductive outcome, and lead to greater prevalence of morbidity and mortality [5]. Moreover, the prevalence of undernutrition during childhood not only delays growth attainment and cognitive development but affects the overall linear mechanism of physical growth processes [5, 8, 30]. Researchers have opined that although a lot of progress has been achieved in different disciplines and unprecedented improvements in many health indicators, high undernutrition rates continue to persist so as to generally increase the societal and economic burdens among populations [3, 39]. As a result, India continues to exhibit the highest proportion of child undernourishment in the world [40].

The major underlying factors for the prevalence of undernutrition in the developing countries are poor socio-economic conditions and environmental, ethnic, socio-economic and socio-demographic disparities [3, 14, 30]. In almost all Indian populations, boys have a better access to food, basic amenities and resource allocation than girls and there is a pronounced preference for the male child [14-15]. Studies documenting nutritional status in India have further observed that girls were more affected by undernutrition than boys [13-15, 18]. The present study has also reported that girls were more affected by thinness than boys. The odds were significantly greater among girls than boys in all the three Grades of thinness ($p<0.01$). Studies have reported that rural girls were more likely to be severely undernourished than rural boys [14, 29]. Results of multinomial logistic regression analysis showed that children belonging to higher ages (e.g., 5 years) had greater risk odds to being affected by thinness, thus agreeing with the studies of Mandal et al. [21] and Biswas et al. [22]. The children residing in the rural area were more affected by both moderate and overall thinness categories than children residing in the urban area ($p<0.05$), thereby being in accordance with the results of similar studies [31, 40]. It has also been observed that children belonging to 'no-toilet' and 'no-electricity' facility households had greater odds ($p<0.05$) of being affected by thinness than those having hygienic toilets and electricity. It is further evident from the results that children belonging to poor socio-economic and adverse environments, including low income, were more affected by undernutrition (thinness), thereby agreeing with the results of other existing studies [17, 29-30]. The present study showed the risk of moderate and overall thinness prevalence to be significantly greater among tribal children ($p<0.05$). Several studies have showed that the tribal children were more vulnerable to being affected by thinness when compared with those from the caste populations [14-15, 18].

Researchers have pointed out that the nutrition levels are not merely dependent on access to nutritious foods and several other supporting factors like clean drinking water, a proper sanitary environment and appropriate caring practices, particularly in case of children, are equally important and play major roles in the nutritional status of children [31, 40]. The present study has observed that children belonging to tribal ethnic populations having 'no toilet facilities' had greater vulnerability to undernutrition. The multinomial logistic regression analysis has also depicted greater odds ratios in cases of poor mother's and father's education (such as illiterate) with the children being affected by thinness ($p<0.05$). The odds were significantly lower with higher mother's education (e.g. literate and above) with severe thinness ($p<0.05$). A similar study had also reported that illiterate household showed significantly greater risks to undernutrition [29]. The present study has also observed significantly 1.66 times higher odds (in mild thinness) and 2.06 times higher odds (in mild moderate) for manual worker father's occupation as compared to service/other occupations ($p<0.01$). This could be attributed to higher education and occupation status that are associated with better living conditions of the family, improved environmental conditions and better awareness about the child rearing practices. Several researches have shown that prevalence of child undernutrition was higher in poor households and children born to mothers with low education levels and residing in rural habitats. Existing studies have shown that the highest odds for undernutrition occurred in households falling in the poorest and poorer quintiles of the wealth index [14-15, 31, 40]. Therefore, the proper dissemination of knowledge and awareness level related to nutritional requirement, use of energy dense food, feeding practices and appropriate dietary modification among nutritionally vulnerable segments would be helpful to reduced such prevalence.

CONCLUSION

The present study has documented a high prevalence of undernutrition in terms of thinness among pre-school children aged 2-5 years from North Bengal, India. Several socio-economic, socio-demographic and lifestyle factors have been observed to be significantly associated with the prevalence of different grades of thinness, among them, sex, father's occupation and toilet facility exhibited significant effects on the prevalence of different grades of thinness among children ($p<0.05$). However, it needs to be mentioned here that due to the cross-sectional design of the present study, lack of information related to dietary intake, resource allocations and cultural practices, it was difficult to draw major conclusions and/or identify the actual cause(s) of such higher prevalence of thinness among the children. Further research is also needed to determine the ability of these new BMI criteria to predict health risks associated with thinness and studies should be conducted using the newly proposed cut-offs for assessing thinness among pre-school children of different Indian populations.

ACKNOWLEDGEMENTS: *The authors acknowledge the help and co-operation of the ICDS centers of Matigara Block for assistance during the study. The financial assistance of the University Grants Commission, Government of India, in the form of a Rajiv Gandhi National Fellowship (F1-17.1/17.1/2012-13/RGNF-2012-2013-ST-WES-24896) is also acknowledged.*

References

[1] Nandy S, Irvining M, Gorden D, Toseil S. Poverty, child undernutrition and morbidity: new evidence from India. Bull World Health Organ 2005; 83: 210-6.
[2] Rosati P, Triunfo S, and Scambia G. Child nutritional status: A representative survey in a metropolitan school. J Obesity 2013; 2013: 1-4.
[3] Ahmed T, Hossain M, Sanin KI. Global burden of maternal and child under-nutrition and micronutrient deficiencies. Ann Nutr Metab 2012; 61: 8-17.
[4] World Health Organization. Millennium Development Goals (MDGs). 2014 May. Available from: URL : hp://www.who.int/mediacentre/factsheets/fs290/en/index.html
[5] World Health Organization (WHO). Physical status: The use and interpretation of anthropometry. Technical Report series. Geneva 1995; 854: 1-452.
[6] Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: Global and regional exposures and health consequences. Lancet 2008; 371: 243-60.
[7] Save the Children. A Life free from hunger- Tackling child malnutrition. Save the Children, London. 2012-
[8] Bhutta ZA, Salam RA. Global nutrition epidemiology and trends. Ann Nutr Metab 2012; 61: 19-27-
[9] National Family Health Survey (NFHS-3). India (Vol.1) 2005-2006. International Institute for Population Sciences, Mumbai
[10] Ramachandran P. Poverty nutrition linkage. Ind J Med Res 2007; 126: 249-61.
[11] Antony GM, Laxmaiah A. Human development, poverty, health and nutrition situation in India. Ind J Med Res 2008; 128: 198-205
[12] Khor GL. Food-based approaches to combat the double burden among the poor: Challenges in the Asian context. Asia Pac J Clin Nutr 2008; 17: S111-5.
[13] Bose K, Biswas S, Bisai S, 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: 216-21.
[14] Mondal N, Sen J. Prevalence of undernutrition among children (5–12 years) belonging to three communities residing in a similar habitat in North Bengal, India. Ann Hum Biol 2010; 37: 198-216.
[15] Sen J, Mondal N. Socio-economic and demographic factors affecting the Composite Index of Anthropometric Failure (CIAF). Ann Hum Biol 2012; 39: 129-36.
[16] Sen J, Dey S, Mondal N. Conventional nutritional indices and Composite Index of Anthropometric Failure: which seems more appropriate for assessing under-nutrition among children? A cross-sectional study among school children of the Bengalee Muslim Population of North Bengal, India. Italian J Pub Health 2011; 8: 172-85.
[17] World Health Organizatio.WHO child growth standards: head circumference-for-age, arm circumference-for-age, triceps skin fold-for-age and sub-scapular skin fold-for-age methods and development. Geneva, available: http://www.who.int/childgrowth/standards/secondset/technical_report_2/en/.2007
[18] Som S, Pal M, Bhattacharya B, Bharati S, Bharati P. Socio-economic differentials in nutritional status of children in the states of West Bengal and Assam. J Biosoc Sci 2006; 38: 625-42.
[19] Cole TJ, Flegal KM , Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. British Medical J 2007; 335: 194-201
[20] Ramachandran P, Gopalan HS. Undernutrition and risk of infections in preschool children. Ind J Med Res 2009; 130: 579-83.
[21] Mandal G, Bose K, Bisai S. Thinness among rural children in Bengal. Ind J Pediatr 2009; 8: 817-19.
[22] Biswas S, Bose K, Bisai S, Chakraborty R. Prevalence of thinness among rural Bengalee pre-school children in Chapra, Nadia district, West Bengal, India. Malay J Nutr 2009; 15: 155-64.
[23] Bisai S, Manna I. Prevalence of thinness among urban poor pre-school children in West Bengal, India. Sudanese J Pub Health 2010; 4: 193-98.
[24] Bisai ST, Ghosh GK, De and K. Bose. Very high prevalence of thinness among Kora-Mudi tribal children Paschim Medinipur district of West Bengal, India. EJBS 2010; 3: 43-9.
[25] Das S, Bose K. Prevalence of thinness among Santal preschool children using new body mass index cut-off points. J Anthropol 2011; 2011: 1-4.

[26] Mandal G, Bose K. 2014. Thinness among primary school children of the migrated Santals of Arambag, West Bengal, India. Int J Food Saf Nutr Pub Health 2014; 5: 46-53.
[27] Chakraborty R, Bose K. Very high prevalence of thinness using new international body mass index cut o points among 5-10 year old school children of Nandigram, West Bengal, India. J Res Med Sci 2009; 14: 129-33.
[28] Mondal N, Sen J. Thinness is a major underlying problem among Indian children. J Trop Pediatr 2010; 56: 456-8.
[29] Choudhury KK, Hanifi MA, Rasheed S, Bhuiya A. Gender inequality and severe malnutrition among children in a remote rural area of Bangladesh. J Health Popul Nutr 2000; 18: 123-30.
[30] Mahgoub SEO, Nnyepi M, Bandeke T: Factors affecting prevalence of malnutrition among children under three years of age in Botswana. Afr J Food Agric Nutr Dev 2006, 6:1.
[31] Tigga PL, Sen J, Mondal N. Association of some socio-economic and socio-demographic variables on wasting among pre-school children of North Bengal, India. Ethiop J Health Sci 2015; 25:63-72.
[32] Sen J, Mondal N, Dey S. Assessment of the nutritional status of children aged 5-12 years using upper arm composition. Ann Hum Biol. 2011; 38:752-9.
[33] Bhadra RK, Chakraborty S. Cultural dimension of health of tea labourers in West Bengal. In. Bhadra RK, Bhadra M, editors. Plantation labours of north-east India. Dibrugarh: NL Publishers, 1997, pp. 199-212.
[34] Kapil U, Pradhan R. Integrated Child Development Services scheme (ICDS) and its impact on nutritional status of children in India and recent initiatives. Ind J Pub Health 1999; 43: 21-5.
[35] Touitou Y, Portaluppi F, Smolensky MH, Rensing L. Ethical principles and standards for the conduct of human and animal biological rhythm research. Chrono Biol Int 2004; 21: 161-70.
[36] Mishra D, Singh HP. Kuppaswami's socio-economic status scale – A revision. Indian J Pediatr 2003; 70: 273-74.
[37] Hall JG, Allanson JE, Gripp KW, Slavotinek AM. Handbook of Physical Measurements. New York: Oxford University Press, 2007.
[38] Ulijaszek SJ, Kerr DA. Anthropometric measurement error and the assessment of nutritional status. British J Nutr 1999; 2: 165-77.
[39] Kapil U, Sachdev HP. Urgent need to orient public health response to rapid nutrition transition. Ind J Community Med 2012; 37: 207-10.
[40] Ramachandran N. Persisting undernutrition in India: Causes, consequences and possible solutions. New Delhi: Springer, 2014.

*