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Determinants of Undernutrition among Rural School-going Adolescents of Nandigram, PurbaMedinipur, West Bengal, India

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ABSTRACT:

Undernutrition is a major underlying problem among the population of the low-middle income countries including India. The prevalence of undernutrition is increasing among adolescents. The present cross-sectional study will determine the prevalence of thinness among the adolescents (10-17 years) of Nandigram, PurbaMedinipur using the cut off given by Cole et al. (2007). This study will also find the association of different socio-economic and demographic variables on the same. Sample size for the present study was 958. The prevalence of overall thinness was 44.48% and 35.37% among the boys and girls respectively. The result of binary logistic regression analysis showed that gender, number of siblings, house type, physical exercise, midday meal consumption, parental education, parental occupation, family income and menarcheal status were significantly associated with thinness. Proper awareness related to nutritional requirement, eating habits and lifestyle would be helpful to reduce the prevalence of undernutrition among adolescents.

Keywords: *BMI, Thinness, socio-economic factors, Adolescents, PurbaMedinipur*

INTRODUCTION

Adolescents represent around 20% of the global world's population and around 84% of them are found in developing countries (WHO working group, 1986). Inadequate nutrition in adolescence can potentially retard growth and sexual maturation, which will lead to delay in the onset of puberty and poor work capacity and reproductive outcomes in adulthood (WHO 1995; Strickland 2002). Adequate supply of nutrition is the key to improve undernutrition (Bogin 1999; Maestreet al. 2017). Different studies significantly revealed higher prevalence of undernutrition (stunting and thinness) among Indian adolescents of different community.

According to The National Food Security Bill, 2010, it was a legal entitlement to subsidized food grains to be extended to at least 75% of the country's population (NFSB 2010). Though the per capita food production increased by 75% in the past two decades, It does not impact much in nutrition and food security, despite an increase in per capita food production, income, poverty and nutritional deprivation is not moving in the same direction (Chand & Jumrani 2013). Despite economic progress, undernutrition among adolescents still claims due to the illiteracy, Population size, socioeconomic disparities and inadequate health facilities in India. So, assessment of nutritional status among the adolescents plays an important role for developing strategies and programs in India.

Assessment of nutritional status of adolescents needed because they will be future parents. Undernutrition contributes to the poor performance at school, risk of frequent infections and risk of being underweight as a short term complications whereas, long term consequences were associated with poor health and less economic productivity. Previously the low-middle-income countries (LMICs) reported a higher prevalence of undernutrition but now-a-days have to contend with the added challenge of overweight and obesity (Balasubramanyaet al. 2024). This coexistence of under- as well as overnutrition within a population is generally called as double burden of malnutrition (DBM), an emerging public health problems caused due to nutritional transition (Ahmed et al. 2018). Previous researches reported 13.3-48% prevalence of thinness (Rawat et al. 2012; Sharma &Mondal 2014; Kumar et al. 2021; Balasubramanyaet al. 2024) among the Indian adolescents Likewise the prevalence of thinness was reported 3-58.30% (Ghosh &Bandhyopadhyay 2009; Maitiet al. 2011; Debnathet al. 2016; Khatunet al. 2017; Pal et al. 2017; Naskar& Roy 2020a; Roy et al. 2020; Naskar&Roy 2020b; Biswas et al. 2023; Gaziet al. 2024) among the adolescents of West Bengal. Several socio-economic, demographic and lifestyle factors were found to be associated with malnutrition among the adolescents as reported by the above said studies. There is a little information available on the nutritional assessment and associated factors among the adolescents of West Bengal along with there are little population based data available. The aim of the present study is to investigate the prevalence of undernutrition among school-going adolescents in Nandigram, PurbaMedinipur of West Bengal.

Objective of Present Study

(1) To explore the anthropometric characteristics of the boys and girls under study with special emphasis on the evaluation of nutritional status and (2) to check the association of different socio-demographic and economic variables with thinness among the studied population.

MATERIAL AND METHODS

Area and Population

PurbaMedinipur (English: *East Medinipur*, alternative spelling *Midnapore*) district is an administrative unit in the Indian state of West Bengal. It was formed on 1 January 2002 after the Partition of Medinipur into PurbaMedinipur and PaschimMedinipur which lies at the northern and western border of it. There are 4 sub-division, 5 Municipality and 25 numbers of Blocks under PurbaMedinipur district (source: https://purbamedinipur.gov.in). Present investigation was carried out by field survey among Bengalee adolescents (10-17 years) from three secondary schools, i.e. Nandigram B.M.T. Shikshaniketan, RajaramchachSikshaniketan (H.S.) and Manuchak Milan Vidyaniketan of Nandigram I block, Haldia subdivision, PurbaMedinipur, West Bengal.

Sample of the study

The total sample size of the study was 958 (517 boys and 441 girls). Data were collected using simple random sampling. Written consent was taken from the authorities of the schools prior data collection. Verbal consent was taken from each participant before commencing the study. Apparently healthy school students were selected from those schools.

Socio-economic, demographic and other data collection

Socio-demographic and economic data for each subject included age, sex, caste, parental education, parental occupation, monthly family income, family type, house type etc. All the variables were grouped into two or more categories as shown in table 1. For calculating and grouping the adolescents into various socio-economic classes BG Prased scale (Majhi& Bhatnagar 2021) was utilized.

Anthropometric data collection

Two anthropometric measurements such as height (HT) and weight (WT) have been taken following standard anthropometric techniques as recommended by Lohmanet al. (1988).Height was measured to the nearest 0.1 cm using Martin's anthropometer. Weight was takenin kilograms by a conventional weighing machine to nearest 0.5 kg on the weighing scale.Body mass index (BMI has been calculated following the formula of World Health Organization (1995). The nutritional status of studied participants were calculated by using the cut offs given by Cole et al.(2007) for determining different grades (grade I or mild, grade II or moderate and grade III or severe) of thinness among adolescents.

Statistical analysis

For conducting all the statistical analysis SPSS (version 26) was used. Frequencies, descriptive statistics (mean ± SD) were estimated. The age-sex variations in anthropometric measurements were estimated using t-test and ANOVA. The binary logistic regression (BLR) was performed to check the association of nutritional status with various socio-economic, demographic and other factors (physical exercise, midday meal consumption and menarcheal status). A p value set to <0.05, <0.01 and <0.001 for statistical significance.

RESULTS

Demographic and Socio-economic variables

Table 1 represents the frequency distribution (%) of the studied participants based on different socio-economic and demographic variables. Majority of the participants were Hindu and general caste. A minimum were belong to parity ≥3 and most have ≤2 number of siblings. Maximum boys and girls were from medium family size. The percentage was same for both boys and girls who belonged to nuclear family (56.7%). Most of them lived in bricked house. Most of the participant's fathers were either tailor or labourer. Very few adolescents reported that their mothers were working women. The frequency of academic level upto class X was the highest among both the parents of the studied adolescents. It is seen from table 1 that most of the boys belong to class IV (33.7%) and most of the girls were from class III (28.1%) according to their monthly family income. More boys (93.2%) reported that they were engaged in any kind of physical exercise in comparison to the girls (53.1%). Only 29.6% of boys and 29.6% of girls preferred to take midday meal at school on a regular basis. Most of the post-meanrcheal girls (54.42%) reported to experience late menarche (at the age of 12-15 years).

Table 1. Frequency distribution of various socio-economic, demographic and other factors of the studied participants

Variables		**Frequency (%)**	
		Boys (N=517)	Girls (N=441)
Age (years)	10-13	283 (54.74)	189 (42.86)
	14-17	234 (45.26)	252 (57.14)
Religion	Hindu	331 (64.0)	270 (61.2)
	Muslim	186 (36.0)	171 (38.8)
Caste	General	438 (84.7)	368 (83.4)
	OBC	38 (7.4)	45 (10.2)
	Others (SC & ST)	41 (7.9)	28 (6.3)
Birth order	≤2	483 (93.4)	382 (86.6)
	≥3	34 (6.6)	59 (13.4)

No of family members	≤4 (small)	238 (46.0)	144 (32.7)
	5-10 (medium)	261 (50.5)	275 (62.4)
	≥11 (large)	18 (3.5)	22 (5.0)
No of Siblings	≤2	417 (80.7)	273 (61.9)
	3-4	97 (18.8)	154 (34.9)
	≥5	3 (0.6)	14 (3.2)
Family type	Nuclear	293 (56.7)	250 (56.7)
	Joint	224 (43.3)	191 (43.3)
House type	Kutcha (non-bricked)	175 (33.8)	193 (31.5)
	Pucca (bricked)	342 (66.2)	302 (68.5)
Father's occupation	Service	79 (15.3)	76 (17.2)
	Business	107 (20.7)	112 (25.4)
	Labourer/Tailor	331 (64.0)	253 (57.4)
Mother's occupation	Service	18 (3.5)	29 (6.6)
	Business	0 (0)	11 (2.5)
	Labourer/Tailor	6 (1.2)	16 (3.6)
	Unemployed/Housewife	493 (95.4)	385 (87.3)
Father's education	Primary (I-IV)	91 (17.6)	88 (20.0)
	Secondary (V-X)	233 (45.1)	201 (45.6)
	Higher secondary (XI-XII)	114 (22.1)	78 (17.7)
	Graduation and above	79 (15.3)	74 (16.8)
Mother's education	Primary (I-IV)	80 (15.5)	73 (16.6)
	Secondary (V-X)	275 (53.2)	230 (52.2)
	Higher secondary (XI-XII)	108 (20.9)	77 (17.5)
	Graduation and above	54 (10.4)	61 (13.8)
Monthly per capita income (MPCI)	Class I (≥7863 Rupees)	42 (8.1)	66 (15.0)
	Class II (3931-7862 Rupees)	112 (21.5)	108 (24.5)
	Class III (2359-3930 Rupees)	152 (29.4)	124 (28.1)
	Class IV (1179-2358 Rupees)	174 (33.7)	97 (22.0)
	Class V (<1179 Rupees)	38 (7.4)	46 (10.4)
Physical exercise	Yes	482 (93.2)	221 (50.1)
	No	35 (6.8)	220 (49.9)
Midday meal consumed	Regular	153 (29.6)	82 (18.6)
	Never	254 (49.1)	288 (65.3)
	Sometimes	110 (21.3)	71 (16.1)
Menarcheal status	Not started	-	132 (29.93)
	Early (9-11 years)		69 (15.64)
	Late (12-15 years)		240 (54.42)

Anthropometric and Nutritional Status

Table 2 describes the descriptive statistics (mean and standard deviation) of height (HT), weight (WT) and BMI. Increment of height was observed in both boys and girls with the advancement of age. Age-wise increase for weight was observed only for boys. No significant overall sex difference was observed among the studied participants but age difference was found (boys $F=44.516$, girls $F=29.434$ at $p<0.001$). An overall significant sex difference was also seen for BMI among the studied participants.

Table 2. Descriptive statistics (mean±SD) of anthropometric variables (Height, Weight and BMI)

Variables	Gender	Age (years)								Overall	F-value
		10	11	12	13	14	15	16	17		
HT (cm)	Boys	135.43 ±5.84	139.42 ±7.01	143.45 ±7.88	149.59 ±8.82	157.45 ±9.32	160.63± 7.04	164.31 ±5.81	165.43± 7.11	150.81 ±12.91	146.851***
	Girls	136.10 ±6.23	138.86 ±7.79	143.50 ±7.09	149.77 ±6.90	151.67 ±6.37	152.59 ±5.15	153.20 ±5.25	153.48± 5.64	148.22 ±8.60	55.893***
	t-value	-0.522 (ns)	0.389 (ns)	-0.046 (ns)	-0.123 (ns)	4.064***	8.406***	9.786***	9.363***	3.587***	
WT (kg)	Boys	28.42 ±6.58	32.72 ±9.30	34.37 ±8.25	41.14 ±12.36	45.91 ±12.76	46.71 ±10.32	48.80 ±10.06	51.06 ±7.83	40.26 ±12.37	44.516***
	Girls	29.63 ±6.91	31.28 ±7.83	34.79 ±8.59	43.55 ±11.68	44.64 ±12.05	44.12 ±7.69	46.96 ±8.89	46.96 ±7.65	40.82 ±10.91	29.434***
	t-value	-0.839 (ns)	0.859 (ns)	-0.333 (ns)	-0.922 (ns)	0.570 (ns)	1.839 (ns)	0.945 (ns)	2.639*	-0.737 (ns)	
BMI (Kg/m^2)	Boys	15.43 ±3.09	16.61 ±3.53	16.58 ±3.14	18.09 ±3.99	18.28 ±3.88	18.04 ±3.42	18.06 ±3.62	18.66 ±2.76	17.36 ±3.57	6.629***
	Girls	15.83 ±2.57	16.05 ±2.97	16.75 ±3.28	19.28 ±4.31	19.30 ±4.66	18.94 ±3.12	20.02 ±3.72	19.93 ±2.96	18.36 ±3.81	11.783***
	t-value	0.858 (ns)	0.858 (ns)	-0.353 (ns)	-1.342 (ns)	-1.306 (ns)	-1.765 (ns)	-2.593*	-2.198*	-4.125***	

Figure 1 depicts the prevalence of different grades of thinness as well as the overall thinness among the boys and girls. The prevalence of thinness was 40.29% for the whole study population among which almost 44% boys and 35% girls were thin.

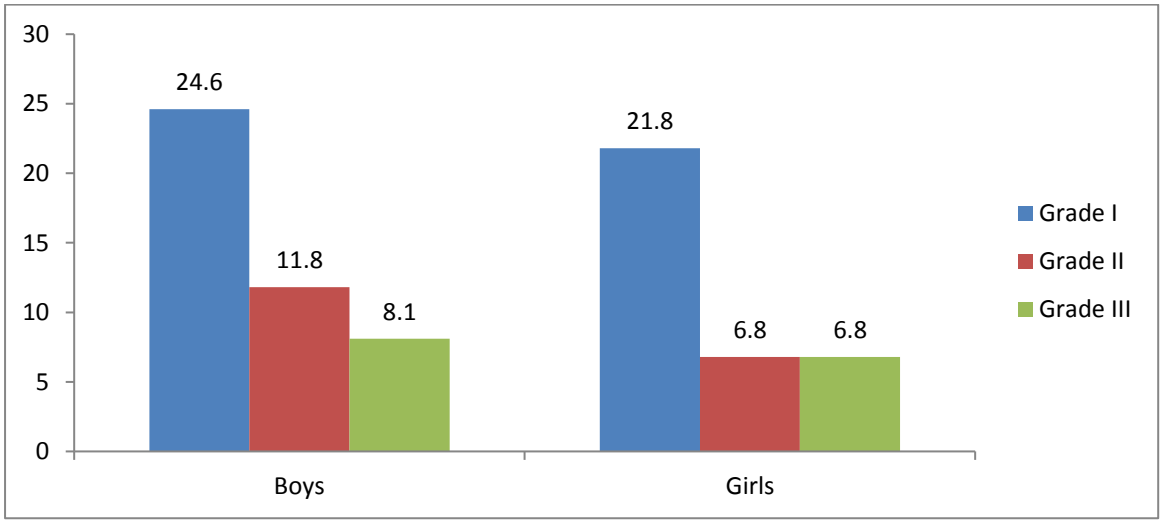

Figure 1. Prevalence of different grades of Thinness (%) among the adolescents

Binary Logistic Regression to show the association of nutritional status with various factors

The results of binary logistic regression analysis (BLR) fitted to estimate the crude odds of being thin with socio-economic, demographic and other parameters are represented in Table 3. It is seen that girls exhibit 0.683 times higher significant odds ratio (95% CI= 0.526-0.887) of being thin in comparison to boys. Religion, caste, birth order, no of family members and

no of siblings did not exhibit any significant association with thinness. But there was higher insignificant odds ratio for religion (OR=1.080; CI=0.827-1.410), caste (General and OBC, OR=1.151 & 1.067; CI= 0.722-1.835 & 0.645-1.766 respectively) and having more number of siblings (OR=1.164; CI=0.426-3.185). Those living in bricked house showed significantly higher odds ratio (OR= 1.327 & 2.205; CI= 1.010-1.745 & 1.327-3.663) for being thin.

Mid-day meal consumption and habit of physical exercise also showed to be significantly associated with thinness. Physical exercise also found to be significantly associated with thinness (OR=0.637; CI=0.471-0.861). Both father's (service and businessman) and mother's (service) occupation was found to be significant contributor for thinness Father's with higher education level (From secondary and above) found to be significantly associated with thinness. Mother's education also showed a higher odds ratio for all the three educational level (from secondary to above) for thinness. Interestingly upper economic class was found to be associated with thinness. Likewise, menarcheal status (both early and late) exhibits a higher odds ratio (OR= 2.510 & 1.911) with thinness.

Table 3. Binary logistic regression (BLR) to show the association of nutritional status (thinness and overweight/obesity) with different socio-demographic and economic variables

Variables		**Thinness**		
Different socio-demographic, economic & other factors		Frequency (N)	Odds Ratio	95% CI
Gender	Boys®	230	-	-
	Girls	156	**0.683****	0.526-0.887
Religion	Hindu	238	1.080	0.827-1.410
	Muslim®	148	-	-
Caste	Gen	328	1.151	0.722-1.835
	OBC	31	1.067	0.645-1.766
	SC & ST®	27	-	-
Birth Order/ Parity	≤2®	347	-	-
	≥3	39	0.928	0.601-1.431
No of Family Members	≤4®	153	-	-
	5-10	215	0.998	0.763-1.304
	≥11	18	0.817	0.424-1.573
No of Siblings	≤2®	268	-	-
	3-4	112	0.788	0.588-1.056
	≥5	6	1.164	0.426-3.185
Family Type	Nuclear®	224	-	-
	Joint	162	1.097	0.845-1.424
House Type	Non-bricked®	141	-	-

	Bricked	245	**1.327***	1.010-1.745
Mid-day meal	Yes®	117	-	-
	Never	206	**1.617****	1.187-2.203
	Sometimes	63	**1.857****	1.247-2.767
Physical Exercise	Yes	303	**0.637****	0.471-0.861
	No®	83	-	-
Father's Occupation	Service	46	**2.024*****	1.382-2.962
	Business	71	**1.780****	1.284-2.467
	Laborer/tailor®	269	-	-
Mother's Occupation	Service	7	**4.085****	1.810-9.220
	Business	3	1.906	0.502-7.234
	Labourer/tailor	10	0.858	0.367-2.007
	Unemployed®	366	-	-
Father's Education	Primary®	76	-	-
	Secondary	190	**0.464****	0.290-0.741
	Higher secondary	81	**0.439*****	0.292-0.662
	Graduate and above	39	**0.469****	0.295-0.745
Mother's Education	Primary®	70	-	-
	Secondary	216	**0.464****	0.290-0.741
	Higher secondary	77	**0.439*****	0.292-0.662
	Graduate and above	23	**0.469****	0.295-0.745
MPCI	Class V®	36	-	-
	Class IV	131	0.802	0.489-1.313
	Class III	116	1.034	0.631-1.695
	Class II	77	1.383	0.828-2.311
	Class I	26	**2.365****	1.276-4.383
Menarcheal Status	Not started yet®	62	-	-
	Early	18	**2.510****	1.327-4.744
	Late	76	**1.911****	1.235-2.958

*® indicates references *p<0.05; **p<0.01; ***p<0.001*

DISCUSSION

Several studies have been conducted in West Bengal to identify the extent and consequences with prevalence of undernutrition among the adolescents (Figure 2). Present study was conducted to assess not only the prevalence but the important determinants of thinness among the adolescents of Nandigram, West Bengal.

Prevalence and associated factors of Undernutrition (based on thinness)

High prevalence of thinness was observed among the present studied adolescent groups (40.29%). Similar observations were reported from studies conducted previously (Gaziet al.2024). Some studies also reported much higher prevalence of thinness than present study (Maiti et al. 2011; Khatunet al. 2017; Pal et al. 2017; Roy et al. 2020; Biswas et al. 2023), whereas, some showed low prevalence (Ghosh &Bandhopadhyay 2009; Debnath et al. 2016; Naskar& Roy 2020a,b). Though the prevalence of thinness was very high among both gender

of the studied population (boys 44.5%; girls 35.4%) but girls were in a better position in comparison to the boys, similar with the findings of Kumar et al (2021), Pandurangi et al. (2022). Different studies found various socio-economic and demographic factors as the important determinants of thinness among the Indian adolescents. A study conducted by Meshram&Khobragade (2018) among 6-12 years school children found that family size and socio-economic status were significantly associated with thinness. Another study conducted by Debnathet al. (2016) among rural adolescent girls reported a strong association between thinness and birth order, family size and father's occupation. Though present study did not find any association between family size, birth order and thinness but there was a significant association with socio-economic class. Present findings also reported both parental education and occupation as significant determinants for undernutrition but no significant association was found with religion or caste.

Another finding suggested the factors such as households' socio-economic status; sex and educational attainment of the household heads, and dietary diversity have a positive impact on reducing malnutrition among adolescent girls (Paul et al. 2023).Present study lacks the data regarding dietary habits of the studied adolescents. However, from Indian perspective as suggested by different studies, age, educational status, working status, wealth index (Kumar et al. 2021), type of family, junk food intake (Kumari et al. 2024), physical activity level (Choudhuri&Sutradhar 2020), age at menarche, student's literacy rate (BabuGeddam et al. 2019) were the most crucial factors for thinness. Frequency of midday meal consumption was found to be a significant associated factor for thinness. Both the groups such as who never consumed (OR=1.617) or occasionally consumed (OR=1.857) midday meal had a significant odds ratio. Patel et al. (2016) reported a high prevalence of malnutrition in terms of stunting and wasting among the adolescents who received midday meal regularly than those who never consumed midday meal. Kaur et al. (2024) also observed a greater prevalence of underweight (50%) among the upper primary school children covered under midday meal programme of rural Punjab. This study observed who were engaged with any kind of physical exercise showed a low significant odds ratio of being thin.

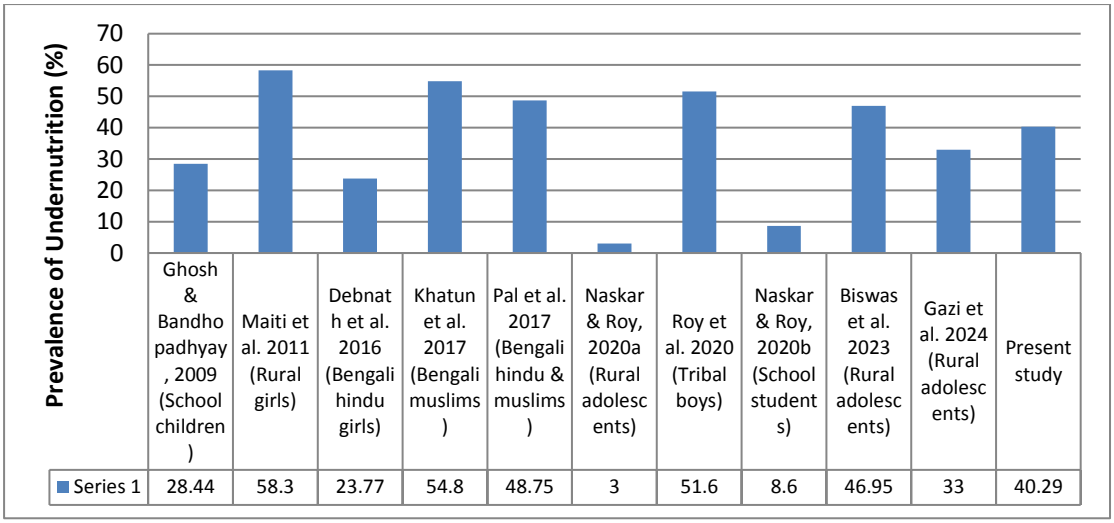

Figure 2: Comparison of the prevalence of undernutrition among adolescents of West Bengal with present population.

Conclusion

Various socio-economic, demographic and other factors such as physical exercise, menarcheal status and midday meal consumption were significantly influenced the overall prevalence of thinness. House type, parental occupation, parental education, family income and menarcheal status were identified as most important determinant for thinness. Proper awareness related to nutritional requirement, eating habits and lifestyle would be helpful to reduce the prevalence of malnutrition among adolescents.

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Conflict of Interest: The author declares no conflict of interest.

Data availability statement: As a research project funded by North Bengal University, I am not authorized to share the data publicly. Therefore, I am unable to upload the data to the website.

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