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Prevalence and Sex Specific Determinants of Stunting among Rural Primary School Children of Hooghly District, West Bengal, India

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Abstract

Present study was undertaken to assess the prevalence of stunting and identify the sex specific risk factors of stunting among rural primary school children of Hooghly district, West Bengal, India. Height (cm.) of 812 children (431 girls; 381 boys) was measured according to standard procedures. Date of birth of child was recorded from the school registers. Children were considered as stunted if HAZ (height for age Z score) was below minus two WHO Child Growth Standards 2007 (<-2SD). No sex difference was observed in mean height and HAZ. Age differences were significant in mean height for girls (F=117.597, $p<0.001$) as well as boys (F=104.184, $p<0.001$). Age differences in mean HAZ were not statistically significant for both sexes. The age combined prevalence of overall stunting among girls and boys were 20.2% and 19.4%, respectively. Age and sex combined prevalence of overall stunting was 19.8%. No significant sex differences in stunting were observed in each age group as well as age combined except at 6 years (χ^2=6.517; df=1; $p<0.05$). Results of univariate Binary Logistic Regression analysis revealed that 9-10 years age group, Scheduled Caste (SC)/Scheduled Tribe (ST), 2 sibs, non-bricked house, no access of source of drinking water at home, tubewell as source of drinking water, manual category father occupation and working mother, $\leq 10^{th}$ standards of father education had significantly high odds of stunting among studied girl pupils. Mid-Day-Meal consumption at school had significantly negative impact on stunting among girls. Stepwise multiple regression analysis revealed that household without access of drinking water source was important predictor for stunting among girls. The other risk factors of stunting among girls found were: working mother, older age (9-10 years), and $\leq 10^{th}$ standards of father education. In boys, predictors of stunting were manual category father occupation and $\leq 10^{th}$ standards of mother education remain in univariate binary logistic regression and stepwise multiple regression analysis. Prevalence of stunting was low as per public health perspectives. Household without access of drinking water source, working mother, older age group, low father education were found to be predictors of stunting for girls. Manual father occupation and low mother education were observed as determinant of stunting among studied boys.

Keywords: Stunting; West Bengal; Primary school children, Rural.

AMS Classification: 91B82, 92D50, 91D20.

1. Introduction

Stunting (low height-for-age) or linear growth retardation is considered as best indicator for child growth that indicates chronic undernutrition. Stunting is defined as height for age Z score (HAZ) below minus two standard deviation (-2SD) of a reference standard or population (WHO, 1995). WHO Child Growth Standards 2007 or National Centre for Health Statistics Reference population may often used as reference population for assessing child growth. Linear growth retardation often starts in utero and continues for at least first thousand days of postnatal life (first 2 years) as identified the most critical window for opportunity for interventions (www.thousanddays.org). Chronic undernutrion is associated with increased morbidity and mortality, reduced physical, nureo developmental and economic productivity and raised the risk of metabolic diseases in adult life (Prendergast and Humphrey, 2014). Despite some progress in reducing child stunting, in 2017, nearly 151 million or 22% children under five years are affected by stunting globally which indicates levels still remain unacceptably high (Global Nutrition Report, 2018). While 38.4% and 32.5% children under five years of India and West Bengal, respectively have stunted growth (NFHS-4).

In India, prevalence of stunting among school aged children ranges from 4.5% (study conducted by Yadav et al., 2016 among urban primary school children of Pune, Maharashtra) to 80.4% (study conducted by Khalil and Khan, 2004 among rural school going children of Aligarh, Uttar Pradesh). Similarly, this magnitude of stunting in West Bengal ranges from 17.2% of school children of Bankura (Bose et al., 2007) to 49.6% of Kora-Mudi tribal children of Paschim Medinipur (Bisai and Mallick, 2011). Several previous studies undertaken by Bose et al., 2008 (girls vs. boys: 48.4% vs. 51.7%), Bisai et al., 2009 (45.6%), Mondal and Sen, 2010 (girls vs. boys: 34.59% vs. 37.08%), Sen et al., 2011 (38.5%), Mondal et al., 2012 (37.2%), Ghosh and Sarkar, 2013 (47.8%), Banik et al., 2016 (44.6% among Limbu tribal girls and 43.5% among Limbu tribal boys) and Debnath et al., 2018 (31.8%) in West Bengal; Panigrahi and Das, 2014 (57.4%) in Odisha; Hasan et al., 2011 (40.4%) in Karnataka; Sultan, 2014 (68.0%) in Uttar Pradesh; Osei et al., 2010 (56.1%) in Uttarakhand have reported high to very high prevalence of stunting among school age children of India.

National Family Health Survey (NFHS) of India and most of the independent researchers (Som et al., 2007; Biswas and Bose, 2010; Biswas and Bose, 2011; Meshram et al., 2012; Deshmukh et al., 2012; Sarkar, 2016) were carried out their research among children of under five years. School aged children were sometimes less studied than young children. Nationwide, few studies (Mukherjee et al., 2008; Mondal and Sen, 2010; Mondal et al., 2012; Yadav et al., 2016 and Debnath et al., 2018) have been undertaken to find out the associated risk factors of stunting among school age children. There is paucity of data on the prevalence of stunting and associated risk factors among school age children of Hooghly district of West Bengal, India. Therefore, present study was undertaken to assess the prevalence of stunting and its sex specific predictors among rural primary school children of Hooghly district, West Bengal, India.

2. Materials and Methodology

2.1 Study area and study sample

Our cross-sectional investigation attempted to evaluate the prevalence of stunting and its determinants among primary school going children of Jangipara Block, Hooghly District, West Bengal, India. A total of 812 children (431 girls; 381 boys) were studied. Exact age of the children was ascertained from date of birth. Anthropometric measurement like height (cm.) of the children was measured as per standard procedures (Lohman et al. 1988). Relevant permissions were obtained prior to the commencement of the study. Nutritional status of the children was evaluated by WHO Child Growth References (2007). Height-for-age Z score (HAZ) was computed using WHO AnthroPlus Software. Children were classified as stunted (low height-for-age <-2 Z score of children) and normal (>-2 Z score of children). Children with HAZ -2 to -3 Z score was defined as moderately stunted and children with HAZ <-3 were defined as severely stunted.

2.2 Socioeconomic and demographic variables

Some socioeconomic and demographic characteristics of the studied children were classified in the following way for the purpose of Binary Logistic Regression (BLR) analysis. Age of the children was categorized into two groups i.e. 6-8 years (≤median value of age 8 years) and 9-10 years (>median value of age). Ethnicity was classified into three categories – general, Other Backward Class (OBC) and Scheduled Caste (SC)/Scheduled Tribe (ST). Number of sibling(s) was categorized into four groups – none, one sib, two sibs and three or more sibs. House type was classified into two grouped non-bricked [which includes kaccha (mud house) and semi-pakka (brick house without concrete roof)] and bricked (with concrete roof). Access of availability of drinking water source at home was classified into two categories: yes and no. Drinking water source was also categorized into two groups i.e. tube well and submersible (tapwater). Mid-Day Meal (MDM) consumption at school was categorized into two groups yes or no. Father occupation was classified into two groups i.e. manual category (which includes labourer, mason, agriculture, job card work etc. requires more physical stamina) and nonmanual category (which includes jewellery work, shop, business, service). Mother occupation was also classified into two groups – working mother (which includes low wage handcraft/nonmanual work, job card work, and service) and housewife (who only engaged in household works). Parents (father as well as mother) education status was classified into two categories – less than equal 10^{th} standards and above 10^{th} standards.

2.3 Statistical Analysis

All data were analyzed using Statistical Software for Social Sciences (SPSS, Version 16.0). Independent sample t-tests were performed to observe the age specific sex differences in mean height and HAZ. One-way ANOVA (F test) tests were done to see significant age variations in mean height and HAZ for both sexes. Chi-square (χ^2) analysis was done to assess the age specific and age combined sex differences in prevalence of stunting. Univariate binary logistic regression (BLR) analysis (enter method) was performed to estimate the crude odds ratios (OR) and 95% confidence intervals (CI) associated with stunting. Step-wise multiple logistic regression analysis (forward conditional method) was also used to determine the most effective risk factors amongst variables considered in BLR analysis. Statistical significance level was set at $p<0.05$.

3. Results and Discussions

Table 1: Descriptive Statistics (Mean and Standard Deviation), t test and F test value of height (cm) and HAZ of the participants

Age (Years)	n		Height (cm.)					HAZ				
			Girls		Boys		t	Girls		Boys		t
	♀	♂	Mean	S D	Mean	S D		Mean	S D	Mean	S D	
6	60	51	113.1	4.9	112.7	5.8	0.465	-1.05	0.86	-1.35	1.10	1.597
7	96	88	116.3	5.7	117.5	5.7	-1.412	-1.29	0.97	-1.23	1.01	-0.420
8	116	97	122.3	5.4	123.2	4.2	-1.412	-1.21	0.85	-1.15	0.72	-0.551
9	108	95	127.1	5.6	127.9	6.4	-0.870	-1.32	0.85	-1.14	1.02	-1.385
10	51	50	131.6	7.5	130.6	6.1	0.722	-1.41	1.15	-1.33	0.96	-0.373
Total	430	381	121.9	8.2	122.6	8.1	-1.075	-1.26	0.92	-1.22	0.95	-0.633
F = 117.597* (♀)**					**F = 104.184*** (♂)**			**F = 1.333 (♀)**		**F = 0.684 (♂)**		

♀ and ♂ indicates girls and boys, respectively. *** means p<0.001.

Table 1 indicates the descriptive statistics (mean and standard deviation), t test and One-Way ANOVA (F test) of height (cm.) and height-for-age Z score (HAZ) of the studied participants. Independent Sample t test results revealed that there were no significant sex differences in mean height and HAZ. Significant age differences were observed in mean height for girls (F=117.597, p<0.001) as well as boys (F=104.184, p<0.001).Age differences in mean HAZ were not statistically significant for both sexes.

Figure 1 shows the sex wise comparison of HAZ of the participants with WHO Reference 2007. Graph clearly indicated that HAZ of studied children of both sexes were behind the WHO Reference population.

Figure 2 represents age and sex wise stunting prevalence among studied children. The age combined prevalence of overall stunting among girls and boys were 20.2% and 19.4%, respectively. The age combined severe stunting among girls and boys were 3.7% and 2.9%, respectively. Results of chi-squared test (χ^2) revealed that no significant sex differences in stunting were observed in each age group as well as age combined except at 6 years (χ^2=6.517; df=1; p<0.05).

Binary Logistic Regression analysis was performed to identify the risk factors of stunting (dependent variable) among girls.

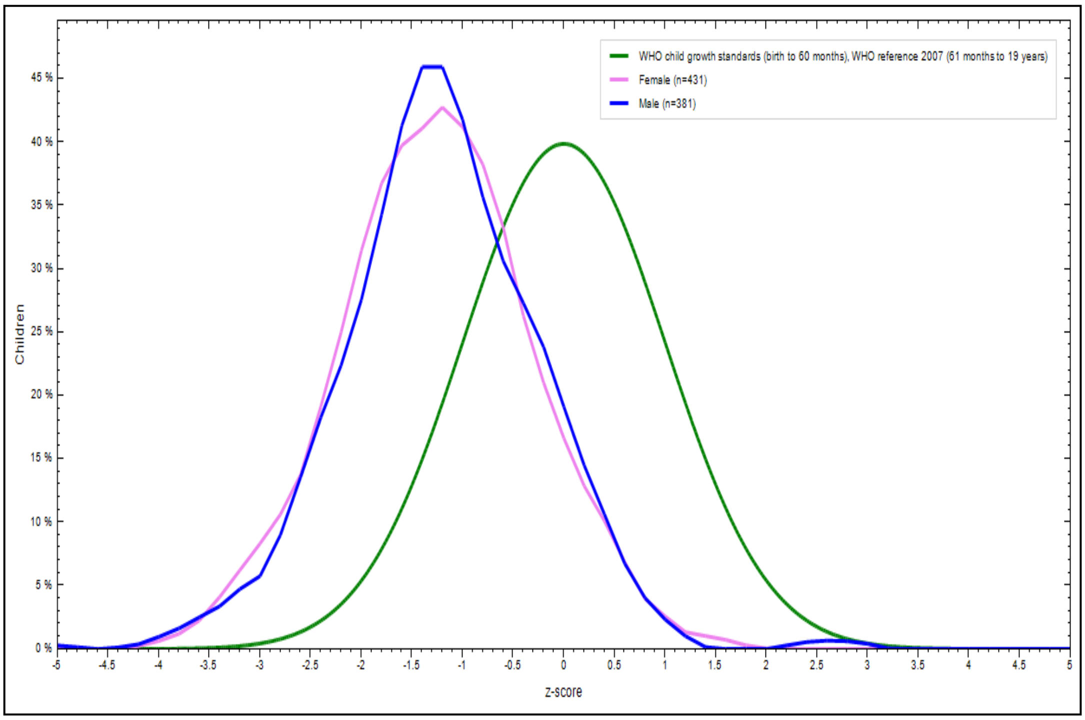

Figure 1: Comparison of Z-score of the participants with WHO Reference 2007

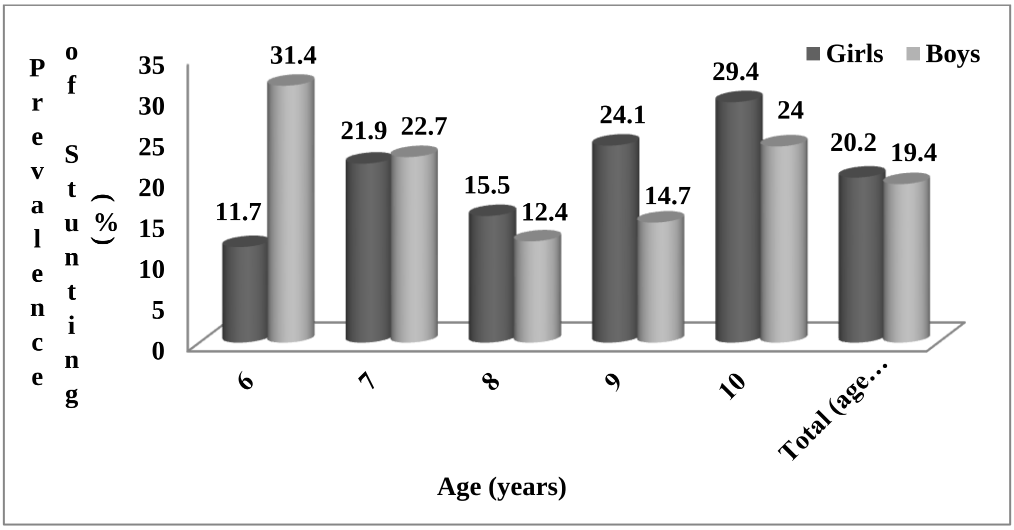

Figure 2: Age and sex wise stunting prevalence among study participants

Table 2: Association of socio-economic and demographic variables with stunting in girls

Predictor variable		Binary Logistic Regression analysis							
		B	**SE(B)**	**Wald (Sig)**	**df**	**Exp(B)**	**95% CI**	**Cox & Snell R^2**	**Nagel-kerke R^2**
Age groups	6-8 yrs®	-	-	-	-	1	-	0.011	0.017
	9-10 yrs	0.535	0.243	4.845*	1	1.707	1.060-2.748		
Ethnicity	General®	-	-	-	-	1	-	0.025	0.039
	OBC	1.872	1.029	3.307	1	6.500	0.865-48.868		
	SC/ST	2.337	1.037	5.075*	1	10.348	1.355-79.032		
No. of sibling(s)	None®	-	-	-	-	1	-	0.015	0.023
	1 sib	1.197	0.755	2.509	1	3.309	0.753-14.543		
	2 sibs	1.1498	0.758	3.908*	1	4.472	1.013-19.745		
	≥3 sibs	1.487	0.779	3.643	1	4.424	0.961-20.368		
House type	Non-bricked	0.535	0.243	4.845*	1	1.707	1.060-2.748	0.011	0.017
	Bricked ®	-	-	-	-	1	-		
Access of source of drinking water @home	Yes®	-	-	-	-	1	-	0.021	0.032
	No	0.732	0.244	9.025**	1	2.079	1.290-3.351		
Type of source of drinking water @home	Tubewell	1.028	0.447	5.295*	1	2.795	1.165-6.707	0.015	0.024
	Submersible (Tapwater)®	-	-	-	-	1	-		
Mid-day meal consumption @ school	Yes®	-	-	-	-	1	-	0.013	0.021
	No	-1.246	0.612	4.143*	1	0.288	0.087-0.955		
Father occupation	Manual category	0.488	0.242	4.076*	1	1.629	1.014-2.615	0.009	0.015
	Nonmanual category®	-	-	-	-	1	-		
Mother occupation	Working	0.704	0.243	8.396**	1	2.021	1.256-3.252	0.019	0.031
	Housewife®	-	-	-	-	1	-		
Father education	≤10th standards	1.004	0.358	7.868**	1	2.728	1.353-5.501	0.022	0.034
	Above 10th standards®	-	-	-	-	1	-		

*indicates p<0.05 and ** indicates p<0.01. ® indicates reference group.

Table 2 revealed that 9-10 years age group, Scheduled Caste (SC)/Scheduled Tribe (ST) children, 2sibs, non-bricked house, no access of source of drinking water at home, tubewell as source of drinking water at home, manual category father occupation and working mother, $\leq 10^{th}$ standards of father education had significantly high odds of stunting among studied girls pupils. It is noteworthy that MDM consumption had inverse significant association with stunting among girls. Girls who did not consume MDM at school were 71.2 % less likely affected by stunted compared to those girls who ate MDM at school.

Table 3: Multiple stepwise regression analysis and effects of demographic and socio-economic factors of stunting among girls

Risk factors		**Step 1 OR (95% CI)**	**Step 2 OR (95% CI)**	**Step 3 OR (95% CI)**	**Step 4 OR (95% CI)**
Age groups	6-8 years®	-	-	1	1
	9-10 years	-	-	1.740* (1.069-2.830)	1.806* (1.105-2.950)
Access of source of drinking water @home	Yes®	1	1	1	1
	No	2.079** (1.29-3.351)	1.969** (1.215-3.190)	1.987** (1.222-3.232)	1.767* (1.076-2.902)
Mother occupation	Working	-	1.913** (1.182-3.095)	1.918** (1.181-3.113)	1.776* (1.088-2.899)
	Housewife®	-	1	1	1
Father education	$\leq 10^{th}$ standards	-	-	-	2.253* (1.089-4.660)
	$>10^{th}$ standards®	-	-	-	1

*means p<0.05 and ** indicates p<0.01.

Stepwise multiple regression analysis (forward: conditional model) was performed to determine the important risk factors of stunting for girls. Table 3 indicated the results of stepwise multiple regression of stunting with demographic and socio-economic variables among girls. In the first step, no access of source of drinking water at home was found to be a prime determinant (OR: 2.079, 95% CI: 1.29-3.351 and p<0.01) of stunting. Girls of working mother were observed in the second step with 1.913 times higher risk (OR: 1.913, 95% CI: 1.182-3.095 and p<0.01) of being stunted. In case of step three, girls of 9-10 years old had significantly more risk (OR: 1.740, 95%: 1.069-2.830 and p<0.05) than younger (6-8 years) counterpart. Similarly, step four showed that $\leq 10^{th}$ standards of father education had 2.253 times increased the risk of being stunted.

Table 4: Association of socio-economic variables with stunting in boys

Predictor variable		B	SE(B)	Wald(Sig)	df	Exp(B)	95% CI	Cox & Snell R^2	Nagel kerke R^2
Father occupation	Manual category	0.677	0.261	6.704*	1	1.968	1.179-3.284	0.009	0.015
	Nonmanual category®	-	-	-	-	1	-		
Mother education	$\leq 10^{th}$ standards	1.454	0.610	5.671*	1	4.278	1.293-14.151	0.006	0.010
	Above 10^{th} standards®	-	-	-	-	1	-		

*indicates p<0.05.

Table 4 represents the results of Binary Logistic Regression analyses among boys. It revealed that manual category father occupation and $\leq 10^{th}$ standards of mother education were significantly increased risk of being stunted among rural studied boys.

Table 5: Multiple stepwise regression analysis and effects of demographic and socio-economic factors of stunting among boys

Risk factors		Step 1 Odd Ratio (95% CI)	Step 2 Odd Ratio (95% CI)
Father occupation	Manual category	1.968*(1.179-3.284)	1.796*(1.070-3.015)
	Non-manual category ®	1	1
Mother education	$\leq 10^{th}$ standards	-	3.763*(1.129-12.545)
	$>10^{th}$ standards®	-	1

*indicates p<0.05.

Results of Stepwise multiple regression analysis among studied boys are shown in table 5. Manual category of father occupation was observed as an important predictor (OR: 1.968, 95% CI: 1.179-3.284 and p<0.05) of stunting in step one among boys. In the second step, $\leq 10^{th}$ standards of mother education had significantly 3.763 times high odds (95% CI: 1.129-12.545) of being stunted boys.

Our study revealed that the prevalence of overall stunting among girls and boys were 20.2% and 19.4%, respectively. This difference was not statistically significant. Numerous previous studies carried out in India (Bose et al., 2006; Bose et al., 2007; Das et al., 2014; Sultan, 2014 and Debnath et al., 2018); Pakistan (Mushtaq et al., 2011); Iraq (Al-Saffar, 2009); Iran (Fatemi et al., 2018); Brazil (Ramires et al., 2014); Colombia (Dekker et al., 2010); Sudan (Mohamed and Hussein, 2015); Burkina-Faso (Daboné et al., 2011); Ethiopia (Zelellw et al., 2014) also observed no significant sex difference in the prevalence rate of stunting.

Our study found that age and sex combined prevalence of overall stunting was 19.8%. Similar kind of prevalence rate of stunting was found in previous studies conducted by Srivastava et al., 2012 (19.9%) and Talwar and Airi, 2015 (19.4%) in India; Degarege et al., 2015 (19.6%) in Ethiopia. In India, lower prevalence of stunting was found in studies conducted by Bose et al., 2007 in Bankura district (17.2%) and Chowdhury et al., 2008 (17.9%) in Puruliya district of West Bengal; Mukherjee et al., 2008 (13.81%) and Yadav et al., 2016 (4.5%) in Pune, Maharashtra; Fazili et al., 2012 in Jammu and Kashmir (9.25%); Kaushik et al., 2012 in Varanasi, Uttar Pradesh (9.2%); Kumawat et al., 2016 in Bikaner, Rajasthan (9.86%). Worldwide, several investigations have been also reported low prevalence of stunting undertaken by Esfarjani et al., 2013 (3.7%) in Iran; Al-Saffar, 2009 (18.7%) from Iraq; Khuwaja, Selwyn and Shah, 2005 (16.5%) and Mushtaq et al., 2011 (8.2%) in Pakistan; Naotunna et al., 2017 (12.6%) in Sri Lanka; Li et al., 2009 (13.8%) and Piernas et al., 2015 (2.4% in 2009 and 0.4% in 2011) in China; Dekker et al., 2010 (9.9%) in Colombia; Ramires et al., 2014 (9.1%) in Brazil; Saltzman et al., 2016 (15.4%) in Guinea-Bissau; Armstrong et al., 2017 (8.1%) in South Africa; Mohamed and Hussein, 2015 (7.1%) in Sudan; Daboné et al., 2011 (8.8%) in Burkina-Faso (West Africa); Fetuga et al., 2011 (14.2%) and Elusiyan et al., 2016 (6.3%) in Nigeria; Mesfin et al., 2015 (8.9%) and Menber et al., 2018 (11.4%) in Ethiopia.

Results showed that girls from those household lacking of access of drinking water source had significantly higher risk of stunting (OR: 2.079, 95% CI: 1.290-3.351 and $p<0.01$). Mother working status remained one of the strongest determinants of stunting in stepwise multiple regression analysis. Findings of several previous studies from India (Srivastava et al., 2012 and Debnath et al., 2018), Iran (Fatemi et al., 2018) and Ethiopia (Mesfin et al., 2015 and Degarege et al., 2015) were also similar to our finding that working mothers had significantly more risk of stunted children. However, Yadav et al., 2016 and Mukherjee et al., 2008 in India found that no significant association between maternal working status and stunting.

Our study revealed that older age group was significantly associated with stunting compared to younger age group among girls. Number of studies undertaken among school aged children of different regions of Ethiopia (Zelellw et al., 2013; Herrador et al., 2014; Wolde et al., 2015; Tariku et al., 2018; Bogale et al., 2018; Mazengia and Biks, 2018 and Getaneh et al., 2019), Burkina-Faso (Daboné et al., 2011), Egypt (Wahed et al., 2017), Lebanon (El-Kassas and Ziade, 2017), Iraq (Al-Saffar, 2009), Indonesia (Yasmin et al., 2014), Pakistan (Khuwaja et al., 2005 and Mushtaq et al., 2011) and India (Ghosh and Sarkar, 2013 and Debnath et al., 2018) also suggested that children of older age group had significantly high risk of being stunted than younger aged children. However, Mohamed and Hussein, 2015 found different findings among rural school aged children of Dolgo area of Northern Sudan. They showed that younger children (<10 years) were significantly more stunted than older children (>10 years).

One of the important findings of our study was that MDM consumption showed significantly negative association with stunting of girls. In other words, MDM scheme had significantly no effect among studied girls to reduce chronic undernutrition. However, Mandal et al., 2014 found otherwise. They observed that children receiving food implementation in MDM scheme had better nutritional condition compared to those children benefited by Integrated Child Development Service (ICDS) from Bali Gram Panchayat of Arambagh, Hooghly district, West Bengal, India.

Mwaniki and Makokha (2013) reported that risk of stunting was 3.3 times lower among children who had adequate energy intake compared to the children who took inadequate energy from a study undertaken among students aged 4-11 years in Dagoretti Division, Nairobi, Kenya. They also found that children who consumed four or more food groups had s lower risk of being stunting.

The present study showed that low father education ($\leq 10^{th}$ standards) was another risk factor of stunting among girls. Das et al., 2014 and Yadav et al., 2016 also found that father education was significantly associated with the stunting among rural and urban primary school children of West Bengal and Maharashtra, respectively. However, Shashank and Chetan (2016) observed no significant association between father education and stunting.

Our study also revealed that boys of manual category occupation of father were more likely to be stunted. Similar findings was found by Mondal et al., 2012 among rural Bengalee boys (OR: 1.84, Wald: 8.0 and $p<0.001$) of Nadia district, West Bengal, India. A community based cross-sectional study from North

Western Ethiopia (Mazengia and Biks, 2018) among 5 to 15 years old school children found that father's occupation as farmer had 5.23 times higher risk (AOR: 5.23, 95% CI: 1.55-17.64 and p<0.01) of having a stunted child. Our study indicated that $\leq 10^{th}$ standard of mother education was an important determinant of stunting of boys. Globally several studies undertaken by Dekker et al., 2010 in Colombia; Wolde et al., 2015 and Mazengia and Biks, 2018 in Ethiopia; Senbanjo et al., 2011 in Nigeria; Yasmin et al., 2014 in Indonesia; Shang et al., 2010 in China; Yadav et al., 2016 and Mukherjee et al., 2008 in India have showed that there existed a significant association between stunting and maternal education.

Lastly, it must be mentioned here that some of the major limitations of our study was a limited study area as well as small sample size.

4. Conclusion

Our study observed low prevalence of stunting among rural primary school children. Findings of the present study indicate immediate restructure of Mid-Day Meal Scheme. Funding in this scheme should be increased to combat the chronic undernutrition among school age children. Lack of access of drinking water source at home, older age group, n working mother and $\leq 10^{th}$ standards father education were found to be determinants of stunting among girls. Boys were significantly affected by manual category father occupation and $\leq 10^{th}$ standards mother education.

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