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Research article

Prevalence and determinants of malnutrition among primary school going children in the haor areas of Kishoreganj district of Bangladesh

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ABSTRACT

Objectives: The objectives of this study were to assess the prevalence of malnutrition (stunting, wasting, underweight) among primary school going children in *haor*[2] area of Bangladesh, to identify the determinants for which the rates of malnutrition differ among the study population and to analyse the relationship between socio-demographic characteristics and malnutrition among primary school going children.

Design: The study was conducted in the *haor* areas of Kishoreganj district in Bangladesh. A cross sectional study was conducted among randomly selected 400 children of aged 5–10 years using semi-structured questionnaire. The outcomes variables considered were stunting, wasting and underweight calculated following the World Health Organization anthropometric guidelines of 2006. Children and their parents' socio-demographic characteristics were considered as the exposure variables. Descriptive statistics were used to describe the characteristics of the respondents. Binary logistic regression model was used to determine the factors associated with the malnutrition.

Results: Around half (48%) of the total children analysed were wasted at the time of the survey following around 40.5% were underweight and 38% were stunted. The likelihoods of occurring stunting, wasting and underweight were found higher among female children than their male counterpart. The prevalence of stunting, wasting and underweight were 39%, 54% and 45% among girls whereas the prevalence was 36%, 42% and 36% among the boys, respectively. The likelihoods of becoming malnourished were found to be increased with the increase ages of the children, from the ages 5–6 years. Higher the number of children in the family and delay of giving complementary food after six months were also found associated with the higher odds of becoming malnourished. In contrary, increased meal frequency, solvency with land ownership were found associated with the reduced odds of becoming malnourished.

Conclusion: Prevalence of malnutrition among primary school going children in *haor* areas of Bangladesh is higher than its other geographical regions. The prevalence is even higher among the female children. Proper nutritional education of parents is important along with the supports for the parents who do not have the capacity to provide nutritional food for their children. Parents of the female children should be given priority.

1. Introduction

Malnutrition is a widespread public health problem all over the world. Globally, 149.2 million and 45.4 million children under five years old suffered from stunting and wasting, respectively in 2020 [1]. During this pandemic situation of COVID-19 the number of malnourished children may increase significantly, because of constraints in accessing nutritious balanced diet, necessary health and nutrition services. In Asia more than half and in Africa two out of five of all children under five years old suffered from stunting in 2020. On the other hand in 2020, it was found that more than two thirds of all children under five years were wasted in Asia and more than one quarter in Africa. Actually prevalence of wasting is the highest in South Asia among all other sub-regions in the world. Progress assessment shows that among the South Asian countries Bangladesh is still off track with high prevalence of malnutrition [1]. Malnutrition is common among children in Bangladesh, mainly because of the lower nutritional food intake. In low- and lower-middle income countries, one-third of the total under-five children are malnourished

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[2] Haor is a swampy wetland located at the north eastern part of Bangladesh.

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[2]. Among the South Asian countries, Bangladesh, India, and Pakistan, represent almost all incidences of malnutrition [3]. Malnutrition leads multiple health complications and infections [4], which are found responsible for around 64% of total 7.6 million under-five deaths occur each year as reported by the World Health Organization [5]. The United Nation for Children's Fund (UNICEF) in 2013, further claims malnutrition affects the physical and mental growth of the children and hampers their social skills and development [6]. Approximately the lives of 25% young children of developing world are touched by invisible malnutrition. Malnutrition is one of the most important associated causes of death among children [7, 8]. This is also the case of Bangladesh, where malnutrition and related complications and deaths are in the top of the list of adverse child health outcomes [9]. Importantly, this higher prevalence was reported following the successful implementation of the Millennium Development Goals (MDGs) where reducing malnutrition was a core target and Bangladesh achieved this target [10]. For instance, around 31% of children under age 5 was found as stunted following 8% was wasted and 22% was underweight in the most recent 2017/18 Bangladesh Demographic and Health Survey [11]. The rate of malnutrition was reported around five years back to this latest survey among under-five aged children, in the MDG period, stunted 36%, wasted 14% and underweighted 33% [12]. Though the prevalence rate is decreasing to maintain the improvement and to achieve one or more of the three Sustainable Development Goals (SDGs) targets on child malnutrition within 2030 [1] we have to be careful about several socio-demographic factors associated with higher burden of malnutrition in Bangladesh including children's age and sex, mother's education, number of children in the family, and household's income [13]. Moreover, one important reason of malnutrition is prevalence of extreme poverty that is mostly common in the disadvantaged areas such as *haor* areas of Bangladesh (a swampy wetland located at the north eastern part) [14, 15] Basically, due to poor economic condition even the least expensive balanced diet cannot be afforded by majority people [7]. Poverty, insufficient food production and food aid, less access to markets and natural disasters affect food security which are related to malnutrition [16, 17]. Due to poverty and indebtedness people of low lying lands intake simpler food which increases levels of diseases and malnutrition. Socio-economic and environmental conditions increase parental migration for work, increase sales of remaining wealth which leads to more rural landlessness. From a related study it was found that the average income of low lying land was decreasing over time and in every year about 98% of household experienced decrease in income which is really frustrating [18]. Actually prevalence of malnutrition among disadvantaged communities are mostly unknown. Moreover, malnutrition among under-five children may continue in the following years when children admitted to the school for their primary education, however, such estimates are mostly lacking and a few available estimates had limitations. For instance, a study in Bangladesh reported that 48%–56% school age slum children were stunted and 34%–62% were underweight in Dhaka city [19]. On the other hand, around 20% prevalence of stunting was reported among primary school going children in Mymensingh district of Bangladesh [20]. Importantly, both of these study settings were adjacent, therefore such differences were debateable and could be because of small sample size analysed, methods, lifestyle or environmental differences.

Considering the limitations, an initiative has been made in this study to assess the malnutrition among the primary school going children in *hoar* area of Bangladesh and its associated factors. The analysis may reflect the nutritional hardship of children to a great extent. Findings will help the policy makers to develop evidence-based policies to prevent malnutrition among primary school going children in Bangladesh.

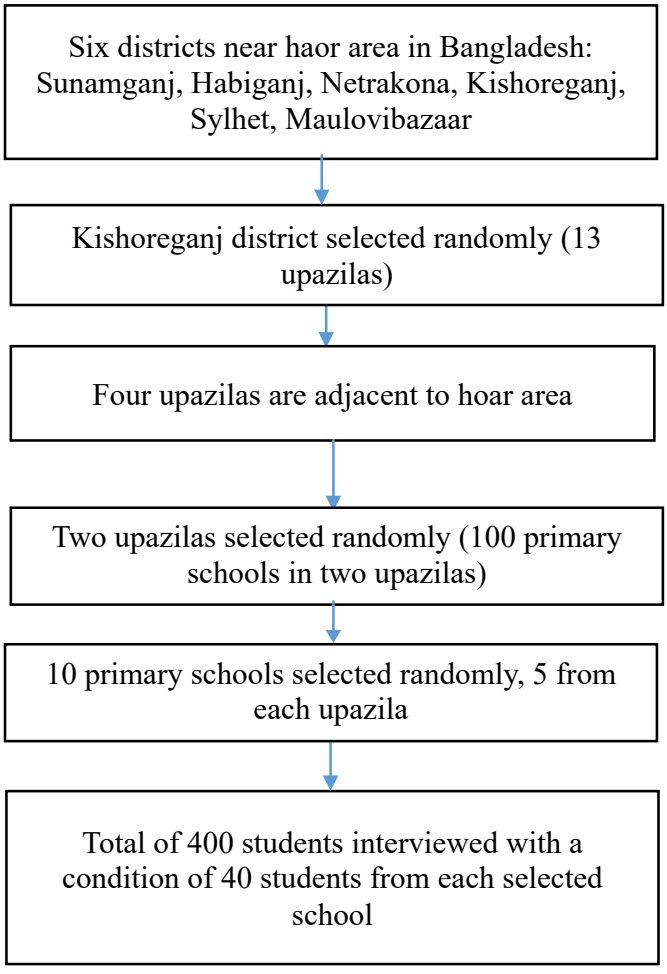

Figure 1. Sampling framework.

2. Methods

2.1. Survey

A cross-sectional study was conducted in randomly selected one (Kishoreganj district) of the six districts (Sunamganj, Habiganj, Netrakona, Kishoreganj, Sylhet, Maulovibazaar) which are characterized as *haor* area and located in the north-eastern part of Bangladesh. Four (Austagram, Mithamain, Itna and Bajitpur) out of 13 Upazilas of the districts are adjacent to *haor* and according to Sample Vital Registration System (SVRS) 2019 statistics, socio-economic as well as geographical characteristics of those Upazilas are almost similar [21]. At the second stage of sampling, two Upazilas (Austagram and Bajitpur) were selected randomly from the four. Out of a total 100 primary schools, ten primary schools[3] were selected randomly from two Upazilas. List of all the students were collected from the schools. Average student size of the schools was 200. Considering the objectives of the study and consultation with the statisticians and experts, it was decided to interview 40 students from each of the school (40 *10 = 400 students) (Figure 1). Data was collected through face-to-face interview using a semi-structured questionnaire. The questionnaire was developed based on the Demography and Health Survey's standard questionnaire, which is validated and recognized worldwide [11, 12]. Before finalizing the questionnaire, a validation survey was conducted with 15 respondents and disagreements reported were incorporated in the final version. Forty students were selected using

[3] 1. The names of the schools are Baroichor Primary School (BPS), 2. Haor Adarsha Govt. Primary School (HAGPS), 3. East Austagram Govt. Primary School (EAGPS), 4. Sabihanagar Govt. Primary School (SGPS), 5. Bhatshala Govt. Primary School (UGPS), 6. Usmanpur Govt. Primary School (BGPS), 7. Shovarampur Govt. Primary School (SGPS), 8. Shahid Helal Govt. Primary School (SHGPS), 9. Bindubasini Govt. Primary School, Basantapur (BGPSB), 10. Gosaipur Govt. Primary School (GGPS), Maturapur.

lottery methods bur if the selected student was sick or absent for a long then excluded the student and selected other student for survey. We excluded children who were seriously ill at the time of survey because of difficulty of height and weight measurements and significant effects of child illness on child malnutrition. Data was collected randomly from the children of the selected schools and their mothers or caregivers. In case when the mothers or caregivers were not available in schools, we visited the residences of the children to reach their mothers or caregivers.

2.2. Sample size determination and survey sample

To have a representative sample size for this study, standard formula, $n = \frac{z^2pq}{d^2}$ was used. Where, n = required sample size, z = 1.96, p = proportion of the targeted estimated population, q = (1-p) and d = degree of accuracy. The proportion of the targeted estimated population considered was 14%, which was the lowest rate reported in the 2014 BDHS among the three forms of malnutrition. The degree of accuracy considered was 0.03. According to the calculation of the formula, a sample size of 514 was determined. As the study was conducted in two Upazilas of one district, so statisticians and sampling experts opined to reduce the sample size between 384-415 to cope up with time, labour and cost of the study. Finally a total of 400 students were included in the survey.

2.3. Dependent variables

Stunting, wasting and underweight were considered as the dependent variables. The variables were measured using the World Health Organization (WHO) anthropometric calculator (version 1.48). The calculator is one of the modules of WHO AnthroPlus software. It is designed to calculate forms of malnutrition where the underlying data on weight and height of the children were used. The underlying algorithm to calculate these forms of malnutrition was designed in such a way that reflects the WHO's guidelines 2006 of childhood malnutrition calculation [22, 23]. According to this guideline, a child was classified as stunted when in terms of height for age z score he or she was lower than -2 SD below the mean on the WHO's Child Growth Standards. A child was considered as wasted if he or she was in terms of weight for height z score, lower than -2 SD below the mean on the WHO's Child Growth Standards. A child was underweight if his or her weight-for-age z score was lower than -2 SD below the mean on the WHO's Child Growth Standards [22, 23, 24]. Weight was measured using a standard weight machine where children were asked to be barefooted and removed heavy cloths. A Stadiometer was used to measure height where children were asked to look straight forward and stand barefooted on the platform of Stadiometer with head upright.

2.4. Explanatory variables

Explanatory variables for this study considered were children's and their parents' socio-demographic factors. Children related factors considered were their age and gender. Mother related factors considered were their age, educational status, and occupation. Father's education was also considered. Other factors considered were land ownership, total number of children ever born, age of taking complementary food (any food supplement given to children during 6–24 months) and meal frequency in a day. To meet the nutritional requirements of infants ensuring proper food diversification at critical period of growth is essential [25].

2.5. Data management and analysis

Descriptive statistics were used to explore the characteristics of the respondents. Pearson's Chi square test was used to determine the factors associated with malnutrition of the children. Finally, binary logistics regression models were used to determine factors associated with each form of malnutrition. The factors found associated in Pearson's Chi square at $p < 0.20$ were included in the binary logistic regression model. The results were reported as Odds Ratio (OR) with its 95% Confidence Interval (95% CI).

2.6. Limitations

This study was conducted in a remote and geographically different setting of Bangladesh so the findings of the study are very important for the policymakers and researchers to improve the nutritional situation of the children of the disadvantageous geographical region. But the findings may not be applicable for the plain land of the country. The study design is cross-sectional, therefore the findings reported were correlational, not causal. There was a strict timeline for this study with limited resources so the study had to limit interviews within a 400 sample. Moreover, rather than the factors considered in the model, there are many other factors (e.g., poorer breastfeeding practices, low total family income, unsafe drinking water and sanitation etc.) influence the child malnutrition. However, considering the volume of the study, it was not possible to include all those variables in this study. In addition, we collected data from the children attended in school, therefore, this study was not representative for the children who did not get chance to attend school. Besides, we have collected data relevant to dietary with 24 h recall period which could be subject to the recall bias. However, besides these limitations, this is the first study of its kind comprehensive study on nutrition of the children in the *haor* areas of Bangladesh.

2.7. Ethics approval and consent to participate

The Institute of Biological Science of the University of Rajshahi, Bangladesh reviewed and approved this study (approval number: 123/375/IAMEBBC/IBS). Informed verbal consent was taken from the school authority and guardians of the school children. Before collecting data from the respondents, we informed the respondents about their right to stop sharing information any time or not to response any question.

3. Results

3.1. Basic characteristics of the participants

The basic characteristics of the respondents were presented in Table 1. The share of the male and female children was equal. Around 44.0% of the total children were in the age group 5–6 years. Around two-third of the total mothers were in their ages 26–30 years at the time of the survey while around 18.0% were aged 25 years or less. Most of them (43.0%) had primary level education and around 16.0% of the total children's mothers were uneducated. A majority of the mothers (49.0%) were housewives. Regarding educational level of the fathers, 36.3% had primary level education. Around 52.0% of the children's family had only dwelling place. Around 58.0% of the total children included started their complementary food at 6 months and 73.0% children reported they took meal three times in a day.

3.2. Prevalence of stunting, wasting and underweight

Around 48.0% of the total children analysed in this study were wasted at the time of the survey following 40.5% were underweight and 38.0% were stunted.

3.3. Stunting, wasting and underweight across socio-demographic factors

The differences in the prevalence of stunting, wasting and underweight were determined across socio-demographic characteristics of the children and their parents. Findings show that, variables like gender, age of child, age of mother, educational qualification of parents, occupation of mother, total number of children, age of taking complementary food,

Table 1. Distribution of respondents by basic characteristics (n = 400).

Variables	Frequency(n)	Percent (%)
Gender		
Boy	200	50
Girl	200	50
Age of children		
5–6	178	44.5
7–8	126	31.5
9–10	96	24.0
Age of mother (in years)		
≤25	72	18
26–30	244	61
≥31	84	21
Educational qualification of mother		
No education	63	15.8
Primary	171	42.8
Secondary	129	32.3
Higher secondary or more	37	9.3
Occupation of mother		
Housewife	196	49.0
Agriculture	42	10.5
Business	78	19.5
Job	78	19.5
Other	6	1.5
Educational qualification of father		
No education	75	19.2
Primary	142	36.3
Secondary	97	24.8
Higher secondary or above	77	19.7
Total number of children		
1	36	9.0
2	178	44.5
≥3	186	46.5
Age of taking complementary food (in months)		
≤6	232	58.0
>6	168	42.0
Meal Frequency (in times per day)		
>3	6	1.5
3	292	73.0
2	102	25.5
Land ownership of family		
Only dwelling place	208	52.0
Only agricultural land	23	5.8
Both	141	35.3
Landless	28	7.0

meal frequency in a day and land ownership were significantly associated to occurrence of stunting or wasting or underweight (Table 2).

3.4. Determinants factors of stunting, wasting and underweight

Three different binary logistic regression models were produced to explore the determinants of stunting, wasting and underweight, respectively (Table 3). Results show that, children aged 9–10 years were more likely to be stunted (OR, 2.620, 95% CI, 1.204–5.699) than their counterparts of age 5–6 years. However, in case of wasting and underweight, the likelihoods were significantly higher in both the age group 7–8 years and 9–10 years than age group 5–6 years. Higher level of father's education was found negatively associated with the occurrence of stunting and wasting while only an exception was reported for the children whose parents had secondary level education with significantly higher odds of to be stunted (OR, 5.303, 95% CI, 1.927–14.591). However, mother educational level was found associated with underweight with the declining likelihoods. Likelihoods of being stunted and wasted were found 8.505 times (95% CI, 2.311–31.306) and 6.330 times (95% CI, 1.604–24.973) higher among children whose mothers had at least two children and three or more children, respectively, at the time of survey as compared to the children whose mothers had only one child at the time of the survey. Lower odds of stunting, wasting and underweight were found among the children who were given complementary food at 6 months than the children who were given complementary food at more than 6 months. The children whose families had only agricultural land were more likely to be stunted (OR, 8.034, 95% CI, 1.726–37.429) and less likely to be under-weighted (OR, 0.105, 95% CI, 0.025–0.444). Around 75.0% lower likelihood of stunting was reported among the children whose family had both dwelling places and agricultural lands than the children whose families were landless at the time of the survey. We also ran sensitivity analysis by adjusting a categorical variable that covered all schools to examine whether any difference on the likelihoods of stunting, wasting, and under-weight existed. No significant differences on the likelihoods were found *(results not shown in the table)*.

4. Discussion

This study was conducted to assess the prevalence of malnutrition (stunting, wasting and underweight) in low lying haor areas of Bangladesh and their associated factors. Around 48.0% of the total children were found as wasted following 40.5% were underweight and 38.0% were stunted. Age of the children and their mother, educational status of parents were found as significant determinants of to be stunted, wasted, and underweight. Other factors found associated with malnutrition were number of children ever born, age of taking complementary foods, and land ownership categories, either in positive or negative direction. These findings were reported when the Bangladesh had been celebrating their achievements in the Millennium Development Goals related to the child nutrition, health, and survival status. This suggests an urgent need for policies and programs targeting to disadvantaged communities' (such as hoar area) children for further improvement.

The haor areas of Bangladesh are disadvantaged in several characteristics, including transportation, means of living, and other living arrangements. People living there are also disadvantaged groups in response to their education and socio-economic status. These could have the impacts of higher prevalence of malnutrition, as reported in this study, than the national estimates of 36.0% stunted, 14.0% wasted, and 33.0% underweight [12]. However, this study findings were consistent with a previous study of similar setting [26], though there was another study reported about significantly higher prevalence of malnutrition among the rural primary school going children of Mymensingh district of Bangladesh, a neighbouring district of the area where this research was conducted [20].

Along with the disadvantaged area related characteristics, there are numerous factors responsible for malnutrition among hoar area children. For instance, the study found a higher prevalence of stunting, wasting and underweight among girls than boys. There is a norm in Bangladesh of giving higher importance to boys than girl children, consequently they receive proper care and nutritional intake [9]. Such differences can be linked to differences of malnutrition among girls and boys. Actually the gender discrimination against the female may have cultural determinants to be addressed using public policies and education because it has been observed even in rich families as well as deeply rooted in poor families [27]. It was mentioned earlier that poverty contributes to increase the rate of malnutrition but in case of girls the risk of being malnourished is almost double. Women are at twofold deprivation of equality because of being poor and then women within the context of overall poverty, low food intake and nutritional status, deficiency disorders and social pressures. Girls suffer from malnutrition more adversely than boys during crisis. It was found from the studies conducted in West Bengal during economic crisis due to flood that about 20.0% of the boys and 50.0% of

Table 2. Factors associated with the childhood nutritional disorder in Haor area of Bangladesh.

Variables	Stunting		Wasting		Underweight	
	Normal n (%)	Stunted n (%)	Normal n (%)	Wasted n (%)	Normal n (%)	Under-weighted n (%)
Total ****	**250 (62)**	**150 (38)**	**208 (52)**	**192 (48)**	**238 (59.5)**	**162 (40.5)**
Gender (W*)						
Boy	128 (64.0)	72 (36.0)	116 (58)	84 (42)	128 (64)	72 (36.0)
Girl	122 (61)	78 (39.0)	92 (46)	108 (54)	110 (55.0)	90 (45.0)
Age of child in years (S*,W***,U***)**						
5–6	100 (56.2)	78 (43.8)	112 (62.9)	66 (37.1)	136 (76.4)	42 (23.6)
7–8	96 (76.2)	30 (23.8)	48 (38.1)	78 (61.9)	42 (33.3)	84 (66.7)
9–10	54 (56.3)	42 (43.8)	48 (50.0)	48 (50.0)	60 (62.5)	36 (37.5)
Age of mothers (in years) (W*, U***)**						
25 or less	42 (58.3)	30 (41.7)	6 (8.3)	66 (91.7)	12 (16.7)	60 (83.3)
26–30	148 (60.7)	96 (39.3)	154 (63.1)	90 (36.9)	166 (68.0)	78 (32.0)
31 or above	60 (71.4)	24 (28.6)	48 (57.1)	36 (42.9)	60 (71.4)	24 (28.6)
Educational qualification of mother (W*,U***)**						
No education	41 (65.1)	22 (34.9)	6 (9.5)	57 (90.5)	22 (34.9)	41 (65.1)
Primary	112 (65.5)	59 (34.5)	66 (38.6)	105 (61.4)	66 (38.6)	105 (61.4)
Secondary	70 (54.3)	59 (45.7)	106 (82.2)	23 (17.8)	117 (90.7)	12 (9.3)
Higher Secondary or more	27 (73.0)	10 (27.0)	30 (81.1)	7 (18.9)	33 (89.2)	4 (10.8)
Occupation of mother (S*,W*,U***)**						
Housewife	166 (84.7)	30 (15.3)	118 (60.2)	78 (39.8)	124 (63.3)	72 (36.7)
Agriculture	24 (57.1)	18 (42.9)	12 (28.6)	30 (71.4)	6 (14.3)	36 (85.7)
Business	36 (46.2)	42 (53.8)	12 (15.4)	66 (84.6)	36 (46.2)	42 (53.8)
Job	18 (23.1)	60 (76.9)	66 (84.6)	12 (15.4)	72 (92.3)	6 (7.7)
Other	6 (100)	0.0 (0)	0 (0.0)	6 (100)	0 (0.0)	6 (100)
Educational qualification of father (S*,W*,U***)**						
No education	35 (46.7)	40 (53.3)	22 (29.3)	53 (70.7)	12 (16)	63 (84)
Primary	101 (71.1)	41 (28.9)	60 (42.3)	82 (57.7)	54 (38.0)	88 (62.0)
Secondary	47 (48.5)	50 (51.5)	80 (82.5)	17 (17.5)	69 (71.1)	28 (28.9)
Higher Secondary or more	67 (87.0)	10 (13.0)	67 (87.0)	10 (13.0)	64 (83.1)	13 (16.9)
Land ownership (S*, W*,U*)**						
Only dwelling place	132 (63.5)	76 (36.5)	84 (40.4)	124 (59.6)	82 (39.4)	126 (60.6)
Only agricultural land	6 (26.1)	17 (73.9)	6 (26.1)	17 (73.9)	18 (78.3)	5 (21.7)
Both	101 (71.6)	40 (28.4)	118 (83.7)	23 (16.3)	127 (90.1)	14 (9.9)
Landless	11 (39.3)	17 (60.7)	0 (0.0)	28 (100)	11 (39.3)	17 (60.7)
Total number of children (S*,W*,U*)**						
One children	30 (83.3)	6 (16.7)	24 (66.7)	12 (33.3)	24 (66.7)	12 (33.3)
Two children	100 (56.2)	78 (43.8)	118 (66.3)	60 (33.7)	148 (83.1)	30 (16.9)
Three children or above	120 (64.5)	66 (35.5)	66 (35.5)	120 (64.5)	66 (35.5)	120 (64.5)
Age of taking complementary food (S*, W***,U***)**						
6 months	190 (81.9)	42 (18.1)	166 (71.6)	66 (28.4)	148 (63.8)	84 (36.2)
More than 6 months	60 (35.7)	108 (64.3)	42 (25)	126 (75)	90 (53.6)	78 (46.4)
Meal Frequency (number of times in a day) (W*,U***)**						
More than three times	6 (100)	0 (0.0)	6 (100)	0 (0.0)	6 (100)	0 (0.0)
Three times	184 (63.0)	108 (37.0)	190 (65.1)	102 (34.9)	214 (73.3)	78 (26.7)
Two times	60 (58.8)	42 (41.2)	12 (11.8)	90 (88.2)	18 (17.6)	84 (82.4)

****Row percentage, remaining estimates in the table are column percentages.
*indicates $P < 0.05$. ***indicates $P < 0.001$.
'S' indicates P value of stunting and independent variables, 'W' indicates P value of wasting and independent variables and 'U' indicates P value of underweight and independent variables.

girls under five years were at risk due to malnutrition [28]. From a study conducted in different agro climatic zones of Punjab it was found that about 92 percent of the primary school girls from Undulating Plain region of Punjab were suffering from mild to severe malnutrition [29]. Here it is important to be mentioned that there is evidence in other parts of the world in which the gaps operate against boys, that is, in the opposite direction. Prevalence and severity of wasting and stunting is higher among boys than girls which indicates nutritional and health risk of boys. Perhaps girls get more priority than boys for health seeking behaviours from the households[30, 31].

Age difference of the prevalence of malnutrition was also reported with the evidence of higher malnutrition among higher aged children than the children aged 5–6 years. Demand for the adequate nutrition increases with the increase of age, however, parents usually become less

Table 3. Determinant factors of childhood nutritional disorders in Haor area of Bangladesh.

Variables	Stunted Odds Ratio (95% Confidence interval)	Wasted Odds Ratio (95% Confidence interval)	Underweight Odds Ratio (95% Confidence interval)
Age of children			
5–6	[Ref]	[Ref]	[Ref]
7–8	0.793 (0.402–1.565)	3.304 (1.578–6.920)***	2.818 (1.447–5.487)***
9–10	2.620 (1.204–5.699)*	3.181 (1.526–6.631)***	1.991 (0.940–4.219)
Education of father			
No education	[Ref]	[Ref]	
Primary	0.273 (0.109–0.680)***	0.132 (0.050–0.350)***	
Secondary	5.303 (1.927–14.591)***	0.021 (0.007–0.063)***	
Higher secondary or above	0.855 (0.237–3.080)	0.028 (0.008–0.101)***	
Education of mother			
No education			[Ref]
Primary			1.701 (0.804–3.597)***
Secondary			0.196 (0.072–0.536)***
Higher secondary or above			0.264 (0.064–1.091)
Number of children			
One children	[Ref]		[Ref]
Two children	8.505 (2.311–31.306)***		0.198 (0.070–0.564)***
Three children or above	6.330 (1.604–24.973)***		1.106 (0.390–3.133)
Age of taking complementary food			
More than 6 months	[Ref]	[Ref]	[Ref]
6 months	0.096 (0.050–0.185)***	0.071 (0.037–0.136)***	0.527 (0.276–1.006)*
Land ownership of family			
Landless	[Ref]		[Ref]
Only dwelling place	1.559 (0.534–4.554)		2.15 (0.75–6.16)
Only agricultural land	8.038 (1.726–37.429)***		0.105 (0.025–0.444)***
Both	0.258 (0.074–0.892)***		0.555 (0.159–1.938)

*indicates $P < 0.05$; ***indicates $P < 0.01$.

careful with their child getting older [32, 33]. This is particularly true if the parents have higher parity, therefore they have another young child who get higher priority than the aged one. This is evident in this study finding with negative impact of increasing parity on child malnutrition. Together these lead to the higher likelihoods of malnutrition among children of increasing ages. Parental characteristics, including mother's age, mother's and father's educational status also played a significant role of becoming their children as either stunted, wasted or underweighted. For instance, as reported in this study, children in the higher educated and aged mothers were less likely to report any of these forms of malnutrition. These findings represent importance of parental knowledge, that they may have achieved through education and experience, to reduce prevalence of malnutrition in hoar area of Bangladesh. However, there is an alternative direction of such associations as reported in this study higher likelihoods of malnutrition among children of increased birth order, meaning their parents were aged and already had the experience of handling their siblings. This reflects prenatal negligence for higher ordered birth which can be linked to various reasons. One of the main reason is higher birth order is common among parents who are less educated and poor-a common characteristics of the people resided in the hoar areas of Bangladesh.

The study found a higher prevalence of malnutrition among the children of parents who depend on agricultural land. In Bangladesh, people who depend fully on agricultural land are usually marginalized, uneducated and have lower socio-economic status [34]. These can reduce parental ability to buy nutritional food for their children which affect their nutritional status [35]. Even if they had this capacity, their knowledge about the nutritional foods may not be sufficient and they may not know the importance to provide nutritional foods or frequency of providing foods to their children [36]. Moreover, in traditional agricultural society children aged 10 years or less are usually engaged in the agricultural work as a helping hand for their parents. Together these contributes to the higher prevalence of malnutrition among the children of families depended on agricultural land only.

For the consideration of higher number of confounding factors and appropriate statistical analysis, this study findings were more reliable and valuable. Firstly, it put in evidence the serious nutritional problems that children face. Moreover, the potential exclusion of non-attending children allows us to hypothesize that the underlying malnutrition's prevalence is even worse than those reported in this study. However, the issue of gender gap is really striking and important also, so further research can be conducted to find out more relevant factors behind this. Besides, parents' education, their care, socio-economic condition of family also influence nutritional status of children. So, social awareness among disadvantaged group of people can play a vital role in reducing social stigma and nutritional hardship of a substantially higher number of children in the country. Therefore, the findings will help the policy makers to make evidence based policies.

5. Conclusion

The findings of the study reported a very higher prevalence of malnutrition in hoar area children in Bangladesh. Different socio-demographic factors of the children and their parents are found associated with the occurrence of malnutrition. These include higher age of children, female sex, lower parental education and parental dependency on agricultural land only. So increasing parental knowledge regarding the child malnutrition and supports to the poor parents who do not have the capacity to provide nutritional food for their children are important to reduce malnutrition among the vulnerable children. Policy makers should pay urgent attention to redesign the nutritional programs to address the malnutrition situation of the children of the socio-economic and geographically disadvantaged regions of the country. The findings would be very helpful for the researchers and academicians to re-

examine their ongoing and upcoming researches. The findings will be applicable for the countries where similar social-economic and geographical settings exist.

Declarations

Author contribution statement

Shimlin Jahan Khanam: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Aminul Haque: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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