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Original article

Socio-demographic factors influencing nutritional status of under-five children in Rajshahi district, Bangladesh

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ABSTRACT

Adequate nutrition and care are the crucial factor for developing brain, maintaining growth and health in children. The objective of this study was to measure the nutritional status among children aged 6-59 months with in-depth investigation of the effect of socio-economic and behavioral factors.

A cross-sectional study was conducted from April to June 2019 among 453 children in Rajshahi district. The socio-economic and behavioral data were collected from each mother. Three indices were used to measure the nutritional status of children: (i) stunting, height–for– age, (ii) wasting¸ weight–for–height and (iii) under-weight¸ weight–for–age. These values were converted into z-scores for categorizing the nutritional status of children. Chi-square (χ^2) test and multiple logistic regression model was used to determine associated factors of children nutritional status.

This study found that the prevalence of stunting, under-weight and wasting among under-five children in Rajshahi district, Bangladesh were 25.6%, 35.5% and 22.7% respectively. The Chi-square test demonstrated that socio-demographic, socio-economic and behavioral factors were the significant determinants of all three indices of child nutritional status. These significant factors were: type of residence, age of mothers, age of fathers, mothers' education, father's education, age of children, wealth index, type of house, child birth weight, and gestational age of children, initial breastfeeding, and exclusive breastfeeding.

Key words: Nutritional status, Logistic regression, Stunting, Under nourished, Wasting

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INTRODUCTION

Globally, about 33% children are not growing well, about 50% may have vitamin and other nutrient deficiencies as hidden hunger. The greater burden of malnutrition bears mainly by poor and marginalized countries in Africa and Asia (UNICEF, 2019). About 20 million children are suffering from severe malnutrition and more than 70% of the world's children with wasting live in Asia (Hoq et al., 2019). As part of Asian countries considered as low-middle income country, Bangladesh is facing a variety of malnutrition related burden. As malnutrition is causing ill-health, interrupting growth and impairing functional development with long term consequences, it is a significant anxiety for policy makers in Bangladesh. According to NIPORT 2014, about 5.5 million children under-five years (36%) are suffering from chronic malnutrition (stunting), 14% are acutely malnourished (wasting) and 33% under-weight. Many of the causal and confounding factors are linked to malnutrition. According to UNICEF casual framework, insufficient dietary intake and diseases are the immediate causes; household food insecurity, insufficient care and poor sanitation and hygiene practice are underlying causes and socio-economic characteristics are categorized as basic causes of malnutrition in developing countries (Hoq et al., 2019). However, the most serious form of malnutrition is severe acute malnutrition (SAM) that includes severe wasting with or without nutritional oedema which have twelve times higher risks of deaths than others (UNICEF, 2019; Guesdon et al., 2020).

Bangladesh is the most densely populated country in the world with about 163 million people living in a landmass of 147,570 square kilometers, and around one-third of the population is less than 15 years (UNICEF, 2017; NIPORT, 2014). Though about 78% people use sanitary latrine, 73% adults are literate and childhood immunization coverage is 86%, infant and young child feeding practice is not at optimum level (only 34%), early initiation of breastfeeding practice is also low (46.6%) indicates caring behavior of mother and caregiver (NIPORT, 2017-2018). Poor maternal nutrition thus causing intra-uterine growth retardation (IUGR), illiteracy and adolescents' pregnancy thus also causing IUGR, are the main reason for low-birth-weight baby in Bangladesh who have the chance of frequently facing wasting, under-weight and stunting with higher risk of death (Rahman et al. 2016). Considering the current situation and findings from different sources, we analyzed some additional information (socio-demographic, socio-economic and behavioral factors) associated with

nutritional status of under-five children to recommend action points for policy makers and program managers for the benefits of the nation. Hence, the objective of this study was to determine the prevalence and associated factors of malnutrition measured by different anthropometric measures of under-five years children.

The key research questions of the study were to:

(i) How many under-five years children were suffering from stunting, underweight and wasting in Rajshahi region, Bangladesh?

(ii) What type of factors associated with malnutrition of under-five children? and

(iii) What are the influencing factors of malnutrition among under-five children?

We hoped and believed that the answer of these questions would help to government and non-government health departments of Bangladesh to improve their health policy for reducing malnutrition from the population of the country.

MATERIALS AND METHODS

Study area: Initially we selected two *upazilla* of the Rajshahi district covering both urban and rural areas. The district has nine *upazilla*, total area is 2425.37 square kilometer and total population is 2699688 (BBS census 2011).

Study population: For this cross-sectional study, the children aged 6-59 months were selected for this study who were living in Rajshahi district, Bangladesh.

Study period: Along with anthropometric measurement of under-five children, the socio-economic, socio-demographic and behavior related data collection was conducted from the field survey between April to June months, 2019 from the respondents who had at least one child aged 6-59 months living with mothers in Rajshahi district, Bangladesh. All selected mothers were interviewed by an expert research group.

Data collection: The primary data was used in this study. All selected children aged 6-59 months were suitable for height and weight measurement. Weight was measured using lightweight SECA scales with digital screens, designed and manufactured under the authority of the UNICEF. Similarly, height board was used for height measurement.

Sample size determination: An appropriate mathematical formula was used for calculating sample size. In this formula, 80% power of study and 5% level of significance were considered.

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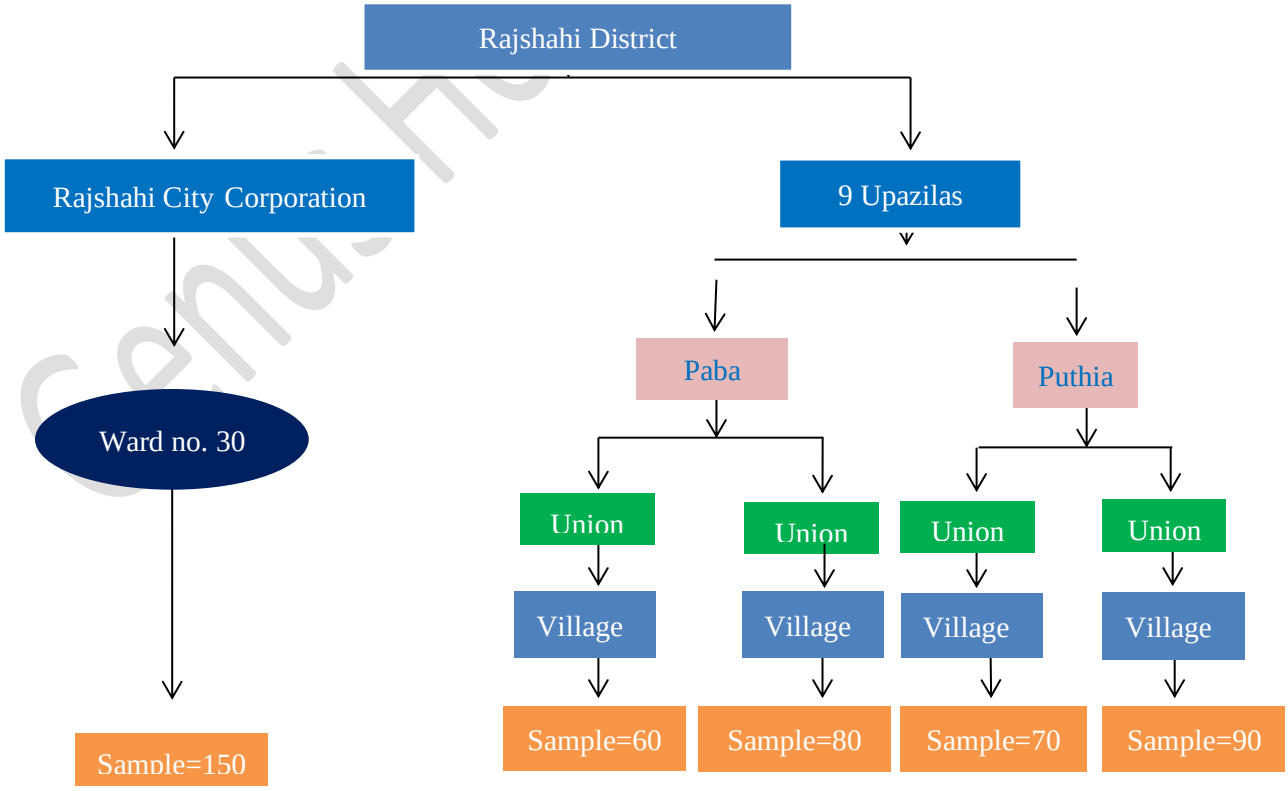
The formula was**,** n= z^2 p (1-p) / d^2; where, Z=1.96 in 95% Confidence Interval (CI); p = prevalence =33%=0.33 (NIPORT, 2014); 1-p = 1-0.33 = 0.67 and d = 0.05 (d is considered 0.05 to produce good precision and smaller error of estimate). The formula provided that 340 children would be the aquacade sample size for the present study. However, extra 110 children (32% extra) were considered for the study for allowing some failure cases.

Sampling procedure: Multistage stratified random sampling technique was used for selecting sample. In the first stage, we selected 2 Upazilas randomly from 9 Upazilas in Rajshahi district, and 1 Ward was selected from the Rajshahi City Corporation. In the second stage, 4 unions were selected randomly from 2 selected Upazilas and 2 Mohalla were selected randomly from the selected Ward of Rajshahi City Corporation. In the third stage, 4 villages were selected randomly from designated union. In the final stage, total 300 children were selected from selected village and 150 children were selected from 2 Mohalla of Rajshahi City Corporation by stratified random sampling with proportional allocation. The household information was gathered from respective selected *Union Parished* and councilor office. Data were collected from mothers of selected children using a standard pre tested questionnaire.

Fig-2: Sampling technique



Selection criteria: In this study, we considered only children aged 6-59 months in Rajshahi district, Bangladesh who were living with their mothers. We only considered children aged 6-59 months who had no serious disease, and their mothers were well in mental and physical healthy. Similarly, after sharing the purpose of study, those mothers were not willing to participate, they were excluded for this study.

Outcome variables: Nutritional status among children aged 6-59 months was the outcome variable for this study. The following anthropometric measurement was used for calculating nutritional status of children aged 6-59 months:

i. Height-for-age (stunting) Z-score
ii. Weight-for-height (wasting) Z-score
iii. Weight-for-age (under-weight) Z-score

Nutritional status was classified into three classes on the basis of z-scores such as (i) under nutrition, (ii) healthy (normal), and (iii) over nutrition (WHO, 2006). Finally, it was classified into two classes such as (i) under nutrition (code, 1) and (ii) not under nutrition (Code. 0) for binary logistic regression model to find the effect of socio-economic, demographic, anthropometric and behavioral factors on under nutrition of children.

Independent variables: The socioeconomic, demographic, and anthropometric factors were considered as independent variables in our study. However, most of the selected variables were treated on the basis of previous studies (Kahssay et al., 2020, Eshete et al., 2017 and Talukder *et al.*, 2017). Socio-economic and demographic factors: Parents occupation, education, monthly family income, residence, religion, toilet facilities, source of water, type of house, mother's age, child birth weight, gestational age of children, initial breastfeeding, exclusive breastfeeding, and child has given breast milk only for 2 years, mothers received antenatal (ANC) services.

Data collection tools and consent taken: A semi-structured questionnaire was used to collect all relevant data. However, before collection of data, the purpose of study was properly shared with mothers and received verbal consent.

Data coding: Most of the independent data were coded for analysis. The type of residence were coded as urban=1, and rural=2, mother's age as adolescent mother=1, young adult=2 and adult

mother=3; father's age as young father=1, adult father=2 and aged father=3; mother's education as primary or below=1 and secondary or higher=2; similarly father's education as primary or below=1 and secondary or higher=2; mother's occupation as housewife=1 and others=2; father's occupation as farmer=1, day labor=2, worker=3, business=4 and others=5; age of children as 6-11 months=0, 12-23 months=1, 24-35 months=2, 36-47 months=3 and 48-59 months=4; gender of the children as male=1 and female=2; family members as less than equal four=1, five to six=2, more than equal seven=3; religion as Muslim=1 and Non-Muslim=0; type of house as terraced=1, semi-tilled=2 and raw=3; wealth index (tk.) as poor (≤14000.00 tk)=1, middle income (15000-29000 tk.)=2 and rich (≥29000tk)=3; child birth weight as <2.5 kg=1 and ≥2.5kg=2; gestational age of children as <37 weeks=1 and ≥37 weeks=2; source of water as Tube-well=1 and others=2; toilet facility as unhygienic=0 and hygienic=1. The other relevant data were coded as yes and no. The mother received ANC as No=0 and Yes=1; breastfeeding within one hour as No=0 and Yes=1; Exclusive breastfeeding as No=0 and Yes=1 and breastfeeding continued up to two years as No=0 and Yes=1.

Statistical analysis: Chi-square test was utilized to find the significant association between two categorical variables. Binary logistic regression model was selected to find the effect of socio-economic, demographic and behavioural factors on nutritional status of under-five children. All statistical analysis was carried out using statistical package for social science (SPSS) IBM version 20.0. A value of $p<0.05$ was considered as statistically significant in this study.

RESULTS

In our study, 74.4% from rural and 25.6% from urban children were actively participated. The total stunting, under-weight and wasting rate was 25.6%, 35.5% and 22.7% respectively. Of them, higher stunting rate was observed among urban (31.8%) children than rural (22.5%). Chi-square test demonstrated that the association between stunting status of children and their type of residence was statistically significant ($p<0.05$) (Table 1). Most of the mothers were young adults (aged between 20-34 years). However, more than 4% was adolescents and 6% was above 35 years of age (adult mother). Of them, a significant portion (22.7%) of children were stunted who belongs to young adult mothers. The association between age of mother and stunting was significant ($p<0.05$). In our study, 21.8% stunted children who belongs to young

fathers followed by adult father (33.3%) and aged father (35.3%) respectively. This association was also significant ($p<0.05$). . We got that 97.6% mothers were housewife (97.6%) and 25.8% stunted children belongs to them which was not significant ($p>0.05$). Primary or below level educated parents had higher stunting children (30.6%, 27.6%) than secondary or higher (19.9%, 23.3%) educated parents. The association between the parent's education and stunting was statistically significant ($p<0.05$). The children aged between 12-35 months was more stunted (34.9%) than other age group and χ2-test demonstrated that the association between child age and stunting status was statistically significant ($p<0.05$). This study explored that 30.2% father was day labour. More stunting (34.6%) children belongs to father doing business than farmer (16.2), labour (26.3%), service holder (27.9%) and others (28.6%). From our data we found that 28.9% children's family was living under poor conditions. Surprisingly the highest number of stunting children was found in rich family (31.6 %) followed by poor (30.5%) and middle-income family (20.1%). The association between the wealth index and stunting was statistically significant ($p<0.05$). In this study found that the children who had low birth weight (< 2.5 kg) and pre-term baby (gestational age is less than 37 weeks) were more stunted than the others children. Subsequently, the mothers who did not breastfeed within one hour of birth, did not follow exclusive breastfeeding and did not continue breastfeeding up to two years of age had higher stunted than their counterparts. The χ^2-test demonstrated that the association between delayed initiation breastfeeding, non-exclusive breastfeeding and not continued breastfeeding up to two years of age and stunting was statistically significant ($p<0.05$) (Table1).

Table 1: Association between stunting and socio-economic and demographic factors

Variables	Group, N (%)	Stunting		χ^2 value	P-value
		Not stunted N (%)	Stunted N (%)		
Residence	Urban, 151 (25.6%)	103 (68.2)	48 (31.8)	4.54	0.04
	Rural, 302 (74.4%)	234 (77.5)	68 (22.5)		
Mother's age	Adolescent, 20 (4.4%)	9 (45.0)	11 (55.0)	17.01	0.000
	Young, 405 (89.4%)	313 (77.3)	92 (22.7)		
	Adult, 28 (6.2%)	15 (53.6)	13 (46.4)		

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Father's age	Young, 307 (67.8%)	240 (78.2)	67 (21.8)	7.19	0.028
	Adult, 129 (28.5%)	86 (66.7)	43 (33.3)		
	Aged, 17 (3.8%)	11 (64.7)	6 (35.3)		
Mother's occupation	Housewife, 442 (97.6)	328 (74.2)	114 (25.8)	0.326	0.568
	Others, 11 (2.4)	9 (81.8)	2 (18.2)		
Father's occupation	Farmer, 111 (24.5%)	93 (83.8)	18 (16.2)	9.103	0.105
	Day labor, 137, (30.2%)	101 (73.7)	36 (26.3)		
	Worker, 61 (13.5%)	44 7(2.1)	17 (27.9)		
	Business, 81 (17.9%)	53 (65.4)	28 (34.6)		
	Service, 49 (10.8%)	35 (71.4)	14 (28.6)		
Mother's education	Primary or below, 211(46.6%)	169 (80.1)	42 (19.9)	6.741	0.009
	Second. or Higher, 24 (53.4%)	168 (69.4)	74 (30.6)		
Father's education	Primary or below, 210(46.4%)	161 (76.7)	49 (23.3)	1.062	0.033
	Second. or Higher, 24 (53.6%)	176 (72.4)	67 (27.6)		
Age of children	6-11 month, 89 (19.6%)	66 (74.2)	23 (25.8)	15.905	0.003
	12-23 month, 126 (27.8%)	82 (65.1)	44 (34.9)		
	24-35month, 126 (27.8%)	93 (73.8)	33 (26.2)		
	36-47 month, 51 (11.3%)	40 (78.4)	11 (21.6)		
	48-59 month, 61 (13.5%)	56 (91.8)	5 (8.2)		
Gender	Female, 226 (49.9)	171 (75.7)	55 (24.3)	0.382	0.536
	Male, 227 (50.1%)	166 (73.1)	61 (26.9)		
Religious	Non-Muslim, 10 (2.2%)	10 (100)	(0,0)	3.520	0.061
	Muslim, 443 (97.8%)	327 (73.8)	116 (26.2)		
Family member	=>4 member, 244 (53.9)	174 (71.3)	70 (28.7)	3.751	0.154
	5-6 member, 150 (33.1)	114 (76.0)	36 (24.0)		
	7 and above, 59 (13.0)	49 (83.1)	10 (16.9)		
Wealth index	Poor, 131 (28.9%)	91 (69.5)	40 (30.5)	7.117	0.028
	Middle, 224 (49.4%)	179 (79.9)	45 (20.1)		
	Rich, 98 (21.6%)	67 (68.4)	31 (31.6)		

Toilet facilities	Unhygienic, 8 (1.8%)	7 (87.5)	1 (12.5)		
	Hygienic, 445 (98.2%)	330 (74.2)	115 (25.8)	0.734	0.391
Type of house	Terraced, 133 (29.4%)	95 (71.4)	38 (28.6)	12.319	0.006
	Semi-tilled, 152 (33.6%)	104 (68.4)	48 (31.6)		
	Raw, 168 (37.0%)	138 (82.6)	29 (17.4)		
Child birth weight	<2.5 kg (11, 2.5%)	7 (56.7)	4 (43.3)	5.259	0.022
	≥2.5 kg, 442 (97.5%)	319 (75.6)	103 (24.4)		
Gestational age	<37 weeks, 38 (8.4%)	23 (60.5)	15 (39.5)	4.187	0.041
	≥ 37 weeks, 415 (91.6%)	314 (75.7)	101 (24.3)		
Received ANC	Yes, 438 (96.6%)	325 (74.2)	113 (25.8)	0.256	0.613
	No, 15 (3.4%)	12 (80.0)	3 (20.0)		
Source of water	Tube-well, 425 (93.8)	313 (73.6)	112 (26.4)	2.008	0.156
	Others, 28 (6.2)	24 (85.7)	4 (14.3)		
Early initiation BF	Yes, 433 (95.5%)	327 (75.5)	106 (24.5)	7.561	0.006
	No, 20 (4.5%)	9 (47.4)	11 (52.6)		
Exclusive breastfeeding	Yes, 396 (87.4%)	301 (76.0)	95 (24.0)	4.321	0.038
	No, 57 (12.6%)	36 (63.2)	21 (36.8)		
Continued BF up to 2 yr	Yes, 440 (97.1%)	331 (75.2)	109 (24.8)	5.603	0.018
	No, 13 (2.9%)	6 (46.2)	7 (53.8)		

N.B: BF=breastfeeding, yr=year

The binary logistic regressions model demonstrated the predictors of stunting associated with some selected socio-economic and demographic variables. We considered only significant associated factors of stunting status obtain from Chi-square test. Since the standard error (SE) of each independent variable was laid between the values of 0.001 and 0.05, there was no evidence of multicollinearity problems among independent variables. After controlling the effect of others variables, the model demonstrated that adolescent mothers had more likely to have stunting children [AOR= 0.330, 95% CI: 0.117-0.930; p<0.036] than young and adult mothers. Subsequently, the young fathers had more chance to have stunting children than adult and aged fathers [AOR= 2.062, 95% CI: 1.15-3.6767; p<0.014] and [AOR= 0.549, 95% CI:

0.94-3.197; p<0.017] respectively. The children aged between 48-59 months were more likely to have stunting [AOR= 0.158, 95% CI: 0.047-0.533; p<0.003], than other age group. The Nagelkerke R^2 values showed that the binary logistic regression models can be explained 21.6% of the variation in the outcome variable. Hosmer and Lemeshow test (χ^2 value=9.159, p=0.329) demonstrated that our selected model was good model for explaining the variation of dependent variable (Table 2).

Table 2: Binary logistic regression estimates for the effects of socio-demographic factors on stunting status of children

Variables	β	S.E.	Wald	P-Value	AOR	95% CI for AOR	
						Lower	Upper
Mother's age							
Young Vs Adolescent	-1.107	0.528	4.396	0.036	0.330	0.117	0.930
Adult Vs Adolescent	0.770	0.872	0.780	0.377	2.160	0.391	11.935
Father's age			8.611	0.013			
Adult Vs Young	0.724	0.295	6.024	0.014	2.062	1.157	3.676
Aged Vs Young	-0.599	0.899	0.445	0.017	0.549	0.94	3.197
Father's education							
Second. or Higher Vs Primary or below	-0.295	0.329	0.802	0.370	0.744	0.390	1.420
Mother's education							
Second. or Higher Vs Primary or below	0.503	0.319	2.481	0.115	1.654	0.884	3.092
Age of children in months			18.625	0.001			
12-23 months Vs 6-11 months	0.442	0.355	1.552	0.213	1.556	0.776	3.119
24-35 months Vs 6-11 months	0.018	0.370	0.002	0.962	1.018	0.493	2.102
36-47 months Vs 6-11 months	-0.673	0.506	1.769	0.183	0.510	0.189	1.375
48-59 months Vs 6-11 months	-1.845	0.620	8.856	0.003	0.158	0.047	0.533

Wealth Index			3.833	0.280			
Middle Vs Poor	-0.548	0.335	2.683	0.101	0.578	0.300	1.114
Rich Vs Poor	0.178	0.581	0.094	0.760	1.195	0.382	3.734
Type of House			9.930	0.007			
Semi-tilled Vs Terraced	1.430	0.552	6.705	0.010	4.180	1.416	12.339
Raw Vs Terraced	0.683	0.566	1.457	0.227	1.979	0.653	5.998
Child birth weight							
≥2.5 kg Vs <2.5 kg	-0.700	0.588	1.418	0.234	0.497	0.157	1.571
Gestational age of children							
≥37 weeks Vs <37 weeks	-0.158	0.530	0.088	0.766	0.854	0.302	2.416
Continued breastfeeding up to two years							
Yes Vs No	-1.165	0.691	2.840	0.092	0.312	0.080	1.209
Exclusive breastfeeding							
No Vs Yes	-0.116	0.416	0.077	0.781	0.891	0.394	2.012
Early initiation of breastfeeding							
No Vs Yes	0.809	0.574	1.991	0.158	2.247	0.730	6.915
Constant	0.478	1.097	0.190	0.663	1.613		
Goodness of fit	Hosmer and Lemeshow test			χ^2=9.159		p-value=0.329	
Nigelkarke R-square=0.216							

It was found that, the prevalence of underweight (weight for age z score) children was more in rural areas (38.7%) than urban areas (29.1%). The χ^2-test demonstrated that the association between type of residence and under-weight was statistically significant ($p<0.05$) (Table 3). Surprisingly, the mother's age was not significantly associated with underweight ($p>0.05$). But the father's occupation had significant association with child underweight. The children who belong to farmer family had higher underweight (47.7%) than labor (32.1%), business (34.4%), service holder (28.4%) and others (31.7%). In this study, the lower educated mother had higher underweight (40.3%) than secondary or higher educated (31.4%) which was significant ($p<0.05$). According to age group, children aged between 6-11 months was more under-weight

(44.9%) than other age group and χ2-test demonstrated that the association between child age and stunting status was statistically significant ($p<0.05$). In this study, male children (50.7%) were more underweight than female (20.4%) ($p<0.05$). Those who had raw house (30.8%) were more under-nourished than others type of house (27%).

Table 3: Association between underweight and socio-economic and demographic factors

Variables	Group, N (%)	Under-weight		χ^2-value	P-value
		Not under-weight N (%)	Under-weight N (%)		
Residence	Urban, 151 (25.6%)	107 (70.9)	44 (29.1)	4.052	0.044
	Rural, 302 (74.4%)	185 (61.3)	117 (38.7)		
Mother's age	Adolescent, 20 (4.4%)	14 (70.0)	6 (30.0)	2.978	0.226
	Young, 405 (89.4%)	256 (63.2)	149 (36.8)		
	Adult, 28 (6.2%)	22 (78.6)	6 (21.4)		
Father's age	Young, 307 6(7.8%)	188 (61.2)	119 (38.8)	5.353	0.069
	Adult, 129 (28.5%)	90 (69.8)	39 (30.2)		
	Aged, 17 (3.8%)	14 (82.4)	3 (17.6)		
Mother's occupation	Housewife, 442 (97.6)	283 (64.0)	159 (36.0)	1.483	0.223
	Others, 11 (2.4)	9 (81.8)	2 (18.2)		
Father's occupation	Farmer, 111 (24.5%)	58 (52.3)	53 (47.7)	10.155	0.038
	Day labor, 137 (30.2%)	93 (67.9)	44 (32.1)		
	Worker, 61 (13.5%)	40 (65.6)	21 (34.4)		
	Business, 81 (17.9%)	58 (71.6)	23 (28.4)		
	Others, 63 (13.9%)	43 (68.3)	20 (31.7)		
Mother's education	P. or below, 211 (46.6%)	126 (59.7)	85 (40.3)	3.879	0.049
	S. or Higher, 242 (53.4%)	166 (68.6)	76 (31.4)		
Father's education	P. or below, 210 (46.4%)	126 (60.0)	84 (40.0)	3.398	0.065
	S. or Higher, 243 (53.6%)	166 (68.3)	77 (31.7)		
Age of children	6-11 month, 89 (19.6%)	49 (55.1)	40 (44.9)	16.795	0.002
	12-23 month, 126 (27.8%)	98 (77.8)	28 (22.2)		

	24-35month, 126 (27.8%)	74 (58.7)	52 (41.3)		
	36-47 month, 51 (11.3%)	29 (56.9)	22 (43.1)		
	48-59 month, 61 (13.5%)	42, 68.9)	19 (31.1)		
Gender	Female, 226 (49.9)	180 (79.6)	46 (20.4)	45.405	0.000
	Male, 227 (50.1%)	112 (49.3)	115 (50.7)		
Religious	Non-Muslim, 10 (2.2%)	9 (90.0)	1 (10.0)	2.912	0.088
	Muslim, 443 (97.8%)	283 (63.9)	160 (36.1)		
Family member	≤4 member, 244 (53.9)	162 (66.4)	82 (33.6)	3.139	0. 208
	5-6 member, 150 (33.1)	98 (65.3)	52 (34.7)		
	7 and above, 59 (13.0)	32 (54.2)	27 (45.8)		
Wealth index	Poor, 131 (28.9%)	89 (67.9)	42 (32.1)	2.717	0.257
	Middle, 224 (49.4%)	136 (60.7)	88 (39.3)		
	Rich, 98 (21.6%)	67 (68.4)	31 (31.6)		
Toilet facilities	Unhygienic, 8 (1.8%)	5 (62.5)	3 (37.5)	0.014	0.907
	Hygienic, 445 (98.2%)	287 (64.5)	158 (35.5)		
Type of house	Terraced, 133 (29.4%)	92 (69.2)	41 (30.8)	15.829	0.000
	Semi-tilled, 152 (33.6%)	111 (73.0)	41 (27.0)		
	Raw, 168 (37%)	89 (53.0)	79 (47.0)		
Child birth weight	<2.5 kg, 30 (6.9 %)	24 (80.0)	6 (20.0)	3.332	0.068
	≥2.5 kg, 423 (93.1%)	268,(63.5)	155 (36.5)		
Gestational age	<37 weeks, 38 (8.4%)	27 (71.1)	11 (28.9)	0.787	0.375
	≥37 weeks, 415 (91.6%)	265 (63.9)	150 (36.1)		
Received ANC	Yes, 438 (96.6%)	279 (63.7)	159 (36.3)	3.340	0.068
	No, 15 (3.4%)	13 (86.7)	2 (13.3)		
Source of water	Tube-well, 425 (93.8)	268 (63.1)	157 (36.9)	5.885	0.015
	Others, 28 (6.2)	24 (85.7)	4 (14.3)		
EIBF	Yes, 433 (95.5%)	277 (64.0)	156 (36.0)	0.749	0.387
	No, 20 (4.5%)	14 (73.7)	6 (26.3)		

EBF	Yes, 396 (87.4%)	244 (61.6)	152 (38.4)	11.103	0.001
	No, 57 (12.6%)	48 (84.2)	9 (15.8)		
Continued BF up to 2 years	Yes, 440 (97.1%)	285 (64.8)	155 (35.2)	0.658	0.417
	No, 13 (2.9%)	7 (53.8)	6 (46.2)		

N.B: P=primary, S=Secondary, EIBF=Early initiation of breastfeeding, EBF=Exclusive breastfeeding.

Binary logistic regression model demonstrated that the children aged between 12-23 months were more likely to under-weight than 6-11 months [AOR=0.378; 95% CI: 0.194-0.738; p<0.05]. After controlling effect of others variables, it was observed that, gender of children had significant effect on under-weight. The odds ratio of gender was [AOR=0.201, CI: 0.127-0.318; p<0.05]. This study showed that who did not exclusively breastfeed for 6 months [AOR= 0.363, CI: 0.143-0.926; p<0.05] were more likely to get under-weight than exclusive breastfeed children (Table 4).

Table 4: Binary logistic regression estimates for the effects of socio-demographic factors on underweight status of children

Variables	β	S.E.	Wald	P-Value	AOR	95% CI for AOR	
						Lower	Upper
Residence							
Rural Vs Urban	-0.206	0.515	0.160	0.689	0.814	0.297	2.233
Father's occupation							
Day laborer Vs Farmer	-0.274	0.372	0.544	0.461	0.760	0.366	1.576
Worker Vs Farmer	0.067	0.418	0.026	0.872	1.069	0.472	2.424
Business Vs Farmer	-0.437	0.459	0.907	0.341	0.646	0.262	1.588
Service Vs Farmer	0.008	0.539	0.000	0.988	1.008	0.351	2.899
Mother's education							
S. or Higher Vs P. or below	-0.218	0.279	0.612	0.434	0.804	0.465	1.389

Age of children							
12-23 Vs 6-11 months	-0.972	0.341	8.138	0.004	0.378	0.194	0.738
24-35 Vs 6-11 months	-0.041	0.325	0.016	0.900	0.960	0.508	1.816
36-47 Vs 6-11 months	0.496	0.420	1.393	0.238	1.642	0.720	3.745
48-59 Vs 6-11 months	-0.266	0.415	0.412	0.521	0.766	0.340	1.727
Gender of Children							
Female Vs male	-1.604	0.234	46.876	0.000	0.201	0.127	0.318
Type of House							
Semi-tilled Vs Terraced	-0.576	0.504	1.308	0.253	0.562	0.209	1.509
Raw Vs Terraced	0.164	0.538	0.093	0.761	1.178	0.410	3.384
Source of water							
Others Vs Tube-well	-1.440	0.620	5.391	0.020	0.237	0.070	0.799
Exclusive breastfeeding							
No Vs Yes	-1.013	0.477	4.502	0.034	0.363	0.143	0.926
Constant	1.043	0.525	3.951	0.047	2.838		

N. B: P=Primary, S=Secondary, Vs=Versus,

Out of 453 children, 22.7% children were wasted (according to weight for height z score). The father's occupation, age of children, gender and religion were significantly associated with wasting ($p<0.05$). The most wasted children belong to day labor family (30.2%) followed by farmer (24.5%) and 17.9% business. The most wasted children were aged between 48-59 months (36.1%) and Muslim and female children were more wasted 22.1% and 34.1% respectively. The χ^2-test demonstrated that the association between age, religion and gender with wasting was statistically significant ($p<0.05$) (Table 5.). The other factors did not significantly associated with wasting.

Table 5: Association between wasting and socio-economic and demographic factors

Variables	Group, N (%)	Wasting		χ^2-value	P-value
		Not-wasting N (%)	Wasting N (%)		
Residence	Urban, 151 (25.6%)	116 (76.8)	35 (23.2)	0.025	0.874
	Rural, 302 (74.4%)	234 (77.5)	68 (22.5)		
Mother's age	Adolescent, 20 (4.4%)	16 (80.0)	4 (20.0)	1.313	0.511
	Young, 405 (89.4%)	310 (76.5)	95 (23.5)		
	Adult, 28 (6.2%)	24 (85.7)	4 (14.3)		
Father's age	Young, 307 (67.8%)	240,78.2)	67 (21.8)	0.990	0.609
	Adult, 129 (28.5%)	96 (74.4)	33 (25.6)		
	Aged, 17 (3.8%)	14 (82.4)	3 (17.6)		
Mother's occupation	Housewife, 442 (97.6)	341 (77.1)	101(22.9)	0.113	0.715
	Others, 11 (2.4)	9 (81.8)	2 (18.2)		
Father's occupation	Farmer, 111 (24.5%)	84 (75.7)	27 (24.3)	12.079	0.017
	Day labor, 137 (30.2%)	112 (81.8)	25 (18.2)		
	Worker, 61 (13.5%)	42 (68.9)	19 (31.1)		
	Business, 81 (17.9%)	70 (76.4)	11 (23.6)		
	Others, 63 (13.9%)	42 (66.7)	21 (33.3)		
Mother's education	P. or below, 211 (46.6%)	156 (73.9)	55 (26.1)	2.492	0.114
	S. or Higher, 242 (53.4%)	194 (80.2)	48 (19.8)		
Father's education	P. or below, 210 (46.4%)	163 (77.6)	47 (22.4)	0.028	0.866
	S. or Higher, 243 (53.6%)	187 (77.0)	56 (23.0)		
Age of children	6-11 month, 89 (19.6%)	81 (91.0)	8 (9.0)	19.890	0.001
	12-23 month, 126 (27.8%)	89 (70.6)	37 (29.4)		
	24-35month, 126 (27.8%)	102 (81.0)	24 (19.0)		
	36-47 month, 51 (11.3%)	39 (76.5)	12 (23.5)		
	48-59 month, 61 (13.5%)	39 (63.9)	22 (36.1)		
Gender	Female, 226 (49.9)	149 (65.9)	77 (34.1)	32.976	0.000
	Male, 227 (50.1%)	201 (88.5)	26 (11.5)		

Religious	Non-Muslim, 10 (2.2%)	5 (50.0)	5 (50.0)	4.326	0.038
	Muslim, 443 (97.8%)	345 (77.9)	98 (22.1)		
Family member	≤4 member, 244 (53.9)	191 (78.3)	53 (21.7)	0.912	0.634
	5-6 member, 150 (33.1)	112 (74.7)	38 (25.3)		
	7 and above, 59 (13.0)	47 (79.7)	12 (20.3)		
Wealth index	Poor, 131 (28.9%)	101 (77.1)	30 (22.9)	0.007	0.997
	Middle, 224 (49.4%)	173 (77.2)	51 (22.8)		
	Rich, 98 (21.6%)	76 (77.6)	22 (22.4)		
Toilet facilities	Unhygienic, 8 (1.8%)	5 (62.5)	3 (37.5)	1.010	0.315
	Hygienic, 445 (98.2%)	345 (77.5)	100 (22.5)		
Type of house	Terraced, 133 (29.4%)	101 (75.9)	32 (24.1)	2.901	0.407
	Semi-tilled, 152 (33.6%)	124 (81.6)	28 (18.4)		
	Raw, 168 (37.0%)	124 (74.3)	44 (25.7)		
Child birth weight	<2.5 kg, 11 (2.5%)	22 (73.3)	8 (26.7)	0.275	0.600
	≥2.5 kg, 442 (97.5%)	327 (77.5)	95 (22.5)		
Gestational age	<37 weeks, 38 (8.4%)	30 (78.9)	8 (21.1)	0.067	0.796
	≥37 weeks, 415 (91.6%)	320 (77.1)	95 (22.9)		
Received ANC	Yes, 438 (96.6%)	338 (77.2)	100 (22.8)	0.066	0.797
	No, 15 (3.4%)	12 (80.0)	3 (20.0)		
Source of water	Tube-well, 425 (93.8)	329 (77.4)	96 (22.6)	0.087	0.768
	Others, 28 (6.2)	21 (75.0)	7 (25.0)		
EIBF	Yes, 433 (95.5%)	333 (76.9)	100 (23.1)	0.552	0.457
	No, 20 (4.5%)	16 (84.2)	4 (15.8)		
EBF	Yes, 396 (87.4%)	306 (77.3)	90 (22.7)	0.000	0.989
	No, 57 (12.6%)	44 (77.2)	13 (22.8)		
Continued BF up to 2 years	Yes, 440 (97.1%)	340 (77.3)	100 (22.7)	0.001	0.976
	No, 13 (2.9%)	10 (76.9)	3 (23.1)		

N. B: EIBF=Early initiation of breastfeeding, EBF=Exclusive breastfeeding

The binary logistic regression model demonstrated that the children were more likely to have wasted among day labor family [AOR=0.378; 95% CI: 0.194-0.738; $p<0.05$] than the farmer

family. The children aged between 48-59 months were more likely to wasting than the children aged between 6-11 months [AOR=5.613; CI: 2.347-13.423; p<0.05]. After controlling the effect of others variables, it was observed that, gender of children had significant effect on wasting. The female children had more chance to get wasted [AOR=4.250, CI: 2.521-7.164; p<0.05] than male children.

Table 6: Binary logistic regression estimates for the effects of socio-demographic factors on wasting status of children

Variables	β	S.E.	Wald	P-value	AOR	95% CI for AOR	
						Lower	Upper
Father's occupation							
Day labor Vs Farmer	-0.878	0.361	5.934	0.015	0.415	0.205	0.842
Worker Vs Farmer	-0.175	0.401	0.190	0.663	0.839	0.382	1.842
Business Vs Farmer	-1.193	0.429	7.729	0.005	0.303	0.131	0.703
Service Vs Farmer	-0.116	0.404	0.083	0.773	0.890	0.403	1.966
Age of children							
12-23 months Vs 6-11 months	1.725	0.445	15.037	0.000	5.613	2.347	13.423
24-35 months Vs 6-11 months	1.232	0.459	7.193	0.007	3.428	1.393	8.434
36-47 months Vs 6-11 months	1.464	0.541	7.323	0.007	4.325	1.498	12.492
48-59 months Vs 6-11 months	2.292	0.509	20.253	0.000	9.900	3.648	26.867
Gender of children							
Female Vs male	1.447	0.266	29.495	0.000	4.250	2.521	7.164
Religion							
Muslim Vs Non-Muslim	-1.041	0.742	1.968	0.161	0.353	0.083	1.512
Constant	-1.994	0.850	5.504	0.019	0.136		

DISCUSSION

In our study, the socio-economic, demographic and behavioral factors were closely linked to child nutritional status. Several studies also found almost similar results (Sultana et al.2019,

Islam et al., 2016, Talukder et al., 2017 and Hoq et al., 2019). Surprisingly, the stunting rate was higher in urban area than rural. This may indicate the comparative scarcity of nutritional counseling and services for urban slum. A study in Bangladesh demonstrated the similar findings (Fakir and Khan, 2015). The more attention is required for urban children who are facing the effect of chronic malnutrition thus causing stunting. However, most of the stunted children were belongs to young mother. This may depict those young mothers were not adequately participated in child nutrition information and service-related sessions. In addition, in spite of young age, stunted mother usually gives stunted children (UNICEF, 2019). However, the reverse findings were observed in respect of father's age. In our study, aged fathers had higher stunting children than adult and young father. The maximum stunted (25.8%) children were found among mothers who were housewife. Subsequently, the primary or below level parents had higher stunting children (30.6%, 27.6%) than secondary or higher level educated parents (19.9%, 23.3%). Different studies found even higher stunting rate (41% and 36.8%) in Bangladesh (NIPORT, 2014 and Ali et al. 2018). However, our findings were consistent with other studies in different countries (Eshete, et al., 2017, Khamis et al., 2019 and Galgamuwa et al., 2017). Surprisingly, rich income group had higher stunted than middle- and poor-income group. This may indicate that the rich family usually has more access to breast milk substitutes (BMS) thus interrupting exclusive breastfeeding (EBF) and ultimately the children might fall in stunting.

In our study, we found 35.5% underweight children which are almost similar to other study in Bangladesh (Ali et al. 2018). The findings are also consistent with other Asian countries like Sri Lanka, Pakistan and Vietnam (Galgamuwa et al., 2017, Khan *et al.* 2019 and Huynh et al., 2019). According to residence, the prevalence of underweight children was more in rural areas than urban areas. This may indicate that the rural children might face seasonal food insecurity, inadequate dietary diversity and improper care thus impacts on underweight. The magnitude of underweight was more among housewife, young mother and farmer father. The parents' education was also negatively impacts on underweight. However, the most underweight children were 6-11 months of age. This may indicate that the appropriate infant and young child feeding (IYCF) practice was on in place particularly during this time period. The Bangladesh Demographic and Health Survey (BDHS), also showing only 34% of IYCF

practice in Bangladesh (NIPORT, 2017-18). Along with birth spacing, waster sanitation and hygiene and continued breastfeeding up to two years of age, it is suggested to increase IYCF practice in both urban and rural areas of Bangladesh to reduce underweight among under-five children in Rajshahi, Bangladesh.

In our study, we found comparative higher wasting (22.7%) in Rajshahi district than national average (8%) (NIPORT, 2017-2018). This may due to specific region with small sample size. However, the wasting was almost homogenous in both urban and rural areas. The young as well as housewife mothers had comparatively higher wasting children than their counterparts. The worker fathers had more wasted children indicates their low pay for improper feeding of their children. Subsequently, the low educated mothers had higher wasted children indicates the association between education and feeding with care practice. Surprisingly, the female children had almost four times higher wasted than male children. It may give us an important clue to study the gender difference during child care. As the wasted children with nutritional edema have higher chance of deaths and more severe ill health condition, policy makers should give special attention towards wasted children to reduce malnutrition related mortality and morbidity.

CONCLUSION

In this study, we found the associated factors that influence on childhood nutritional status. The socio-economic, demographic and behavioral or educational factors were closely associated with stunting, under-weight and wasting. Along with other factors, the residential influence, family size, food insecurity in rural areas, certain occupation, age specific feeding including appropriate IYCF practice with continuation of breastfeeding up to two years of age significantly impacts on child nutritional status.

Conflict of interest: All authors declare that there is no conflict of interest with respect to research, authorship or publication.

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Ethics statement: We obtained the ethical clearance from the Ethical Review Committee, Institute of Biological Sciences (IBSc), University of Rajshahi. After sharing the study purpose, the data collection permission was obtained from the head of the selected household. We

provided participant's information sheet and agreement to the mothers. Most of the important information was included in the participant's information sheet. However, we kept all information confidential as all questionnaires were coded without names or addresses of respondents. The participants were free to opt-out if they were not comfortable with the information in the questionnaire. Then we obtained signed consent forms from the mothers.

Availability of data and materials: The study was based on the primary data. All required data are in hand for sharing, when necessary.

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Authors' contributions: MDH, MAS and MGH developed the concepts and designed the study. MDK collected the relevant data and performed the statistical analysis. ASMAL, MAS and MGH reviewed the manuscript and improved accordingly for publication. DAK, MAH, PB, MRH and MNI revised and edited the manuscript.

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