A household study on under-nutrition among mother-child pairs in Bangladesh

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ABSTRACT

Background: Bangladesh is undergoing a nutrition transition associated with rapid social and economic transitions giving rise to the double burden of malnutrition phenomenon. Some studies have been done on the double burden of malnutrition with Bangladeshi women, children, and mother-children pairs. It is essential to investigate under-nutrition among mother-under-five children pairs of the same household in Bangladesh. The objective of this study was to determine the prevalence and associated factors of under-nutrition among mother-under-five children pairs at the same household in Bangladesh.

Methods: We extracted data from the last data set of Bangladesh Health and Demographic Survey, 2014 (BDHS, 2014). BDHS, 2014 collected data from married women of reproductive age from different levels of Bangladesh. The sample of this study consisted of 7,368 married, currently non-pregnant Bangladeshi women with their under-five children. Two-level binary logistic regression model was used in this study for getting the risk factors of under-nutrition among mother-child pairs in Bangladesh.

Results: We observed that the prevalence of under-nourished mother-child pairs in Bangladesh was 22.0%. The two-level binary logistic model determined five risk factors of under-nutrition among mother-under-five child pairs: (i) living location (division), (ii) type of residence, (iii) parental education, (iv) household wealth quintile, (v) children birth weight.

Conclusions: Our selected model determined the risk factors of under-nutrition among mother-under-five child pairs in Bangladesh. The government and non-government authorities can consider our findings for reducing the number of under-nutrition among mother-children pairs at the same households in Bangladesh for achieving health-related goals under SDGs by 2030.

Keywords: Under-nutrition, Mother-child pairs, Chi-square test, Two-level logistic regression, Bangladesh

INTRODUCTION

Some developing countries like Bangladesh are undergoing through a nutritional transition associated with rapid social and economic changes giving rise to the double burden of malnutrition phenomenon. Child and maternal malnutrition within the same household often termed as the 'dual burden of malnutrition', is a relatively new phenomenon that has been described in studies from low and middle-income countries including Benin (Barquera et al. 2007), sub-Saharan Africa (Wojcicki, 2014), Brazil (Gubert et al. 2017), Malaysia (Wong et al. 2015), Gaza Strip-Palestine (El Kishawi et al. 2016) and Sri Lanka (Shinsugi et al. 2020).

The household wealth quintile in Bangladesh has been increasing during the last two decades with undergoing a nutritional transition. The change in the composition of the diet, usually accompanied by changes in the level of physical activity is referred to as nutritional transition, which has been analyzed by Popkin (2003). It is characterized as taking a westernized diet high in meat, saturated fats, sugar, and energy with sedentary physical activities and increasing mental pressure instead of a traditional, homemade food, low fat, high-fiber, plant-based diet combined with physical labor. Populations in many developing countries like Bangladesh are consuming processed foods in increasing amounts including more refined grains and foods with a higher content of saturated fat, sugar, and salt with increasing economic development and urbanization (Doak et al. 2000). The nutritional transition usually occurs in parallel with economic, epidemiological, and demographic transitions in a country with a sedentary occupation and habituated with daily household labor-saving technologies.

The number of overweight and obese women has been unrelentingly increasing in the world including low-income countries (WHO, 2011). On the other hand, under-nutrition is associated with one-third to one-half of the deaths of children under 5 years of age globally (Black et al. 2008). In sub-Saharan Africa, 28% of children under 5 years of age are moderately or severely underweight (UNICEF, 2007) with 38% of children under-five stunted (UNICEF, 2008). Global obesity prevalence has doubled since 1980 (WHO, 2011). Study in several African countries (Burkina Faso, Ghana, Kenya, Malawi, Niger, Senegal, and Tanzania), the prevalence of urban adult overweight and obesity increased to around 35% from 1992 to 2005 (Ziraba et al. 2009). In a more recent study using Demographic Health Survey data from the early 2000s from North Africa, sub-Saharan Africa, Asia, and Latin America, it was found that low levels of maternal education, working in agriculture, living in urban areas, increased siblings in the household and

relative poverty were associated with increased risk of dual burden households (Jehn & Brewis, 2009).

More recently, a comparative study was done on the double burden of malnutrition with populations of Bangladesh, Nepal, Pakistan, and Myanmar (Anik et al. 2019). Another comparative study was done on the maternal and child double burden of malnutrition in rural Indonesia and Bangladesh (Oddo et al. 2012). The double burden of malnutrition with the Bangladeshi population was also investigated. (Mamun & Mascie-Taylor, 2019; Das et al. 2019). In these studies, the authors considered over nourished mothers and under-nourished children pairs for determining the prevalence and associated factors of this issue. The prevalence of overnourished mothers and under-five children has been increasing while the rate of under-nourished mothers and under-five children decreased during the last two decades in Bangladesh (NIPORT, 2014). But, still, the prevalence of under-nourished mothers and under-nourished children is high in low-income and middle-income countries. As a result, in substantial increase in mortality and overall disease burden in low and middle-income countries (Black et al. 2008). To the best of our knowledge, under-nourished mother and nourished under-five children pairs in the same household were not investigated yet in Bangladesh. Mother plays a vital role to maintain a family and taking care of her family members specially children. An unhealthy mother cannot take proper care of her children. Under-nourished mother is vulnerable to getting some diseases such as anemia, tuberculosis, acute respiratory infections, and increased risk of morbidity and death and of having under-nourished babies (NIPORT, 2014). On the other hand, under-nourished children suffer from growth retardation, anemia, eye problems, and increased and lengthened common childhood infections (Thompson et al. 2012). If the mother and her under-five children are under-nourished, this family faces unbound sufferings in terms of diseases and treatment costs, and eventually creates a major health concern for the country. It is essential to determine the prevalence of under-nutrition and investigate its risk factors among mother-under-five children pairs in the same household in Bangladesh for reducing malnutrition. The aim of this study was to determine the prevalence and associated factors of under-nutrition among mother-child pairs in Bangladesh.

Research questions

There are two research questions of our present study; (i) what is the prevalence of under-nutrition among mothers and their five child pairs in the same household of Bangladesh? (ii) what are the risk factors of under-nutrition among mother-child pairs in Bangladesh? We hope our

study will able to provide the answer of these questions, and the answers can help to reduce the number of under-nourished mother-child pairs in Bangladesh. This study can also help the government of Bangladesh to achieve SDGs by 2030, good maternal and child health being one of its important components.

MATERIAL AND METHODS

This was a cross-sectional study, and data were extracted from the latest data set of Bangladesh Demographic and Health Survey (BDHS-2014), the seventh of its kind in Bangladesh. BDHS-2014 collected data from Bangladeshi married women of reproductive age from all over Bangladesh. Socio-demographic, health, and lifestyle information from each selected woman were collected by the survey from June 28 to November 9, 2014. BDHS-2014 also measured the height and weight of the selected mothers and their under-five children if available. The sampling technique, survey design, survey instruments, measuring system, questionnaires, data processing, quality control, etc. were clearly described in the BDHS-2014 report (NIPORT, 2014).

Sampling

BDHS-2014 used **a** two-stage stratified cluster sampling of households for selecting samples from the population. It was a nationally representative sample that covered the entire population. BDSH-2014 followed the system of the Bangladesh Bureau of Statistics (BBS) as a sampling frame. BBS divided Bangladesh into some units terming these as enumeration areas (EAs) for the housing census in 2011 in such a way that every EA should be comprised of an average number of 120 households. In the first stage of BDHS-2014 sampling, 600 EAs were selected with probability proportional to the EA size, 207 EAs from urban and 393 EAs from rural areas, covering all the seven administrative divisions in Bangladesh. In the second stage, they used systematic sampling to select 30 households on average from each selected EA. Thus, they selected 18,000 households (6,210 urban and 11,790 rural) for collecting information from about 18,000 ever-married women. However, finally, a total of 19,989 households were selected, out of which 17,565 were found occupied. Interviews were successfully completed in 17,389 households (99%). A total number of 18,245 ever-married women of reproductive age were identified in the selected households but 17880 were interviewed (98% response rate). The details of sample design,

sampling procedure, sampling weight, and sampling errors were described elsewhere (NIPORT, 2014). The procedure for selecting the sample for the present study was shown in Figure 1.
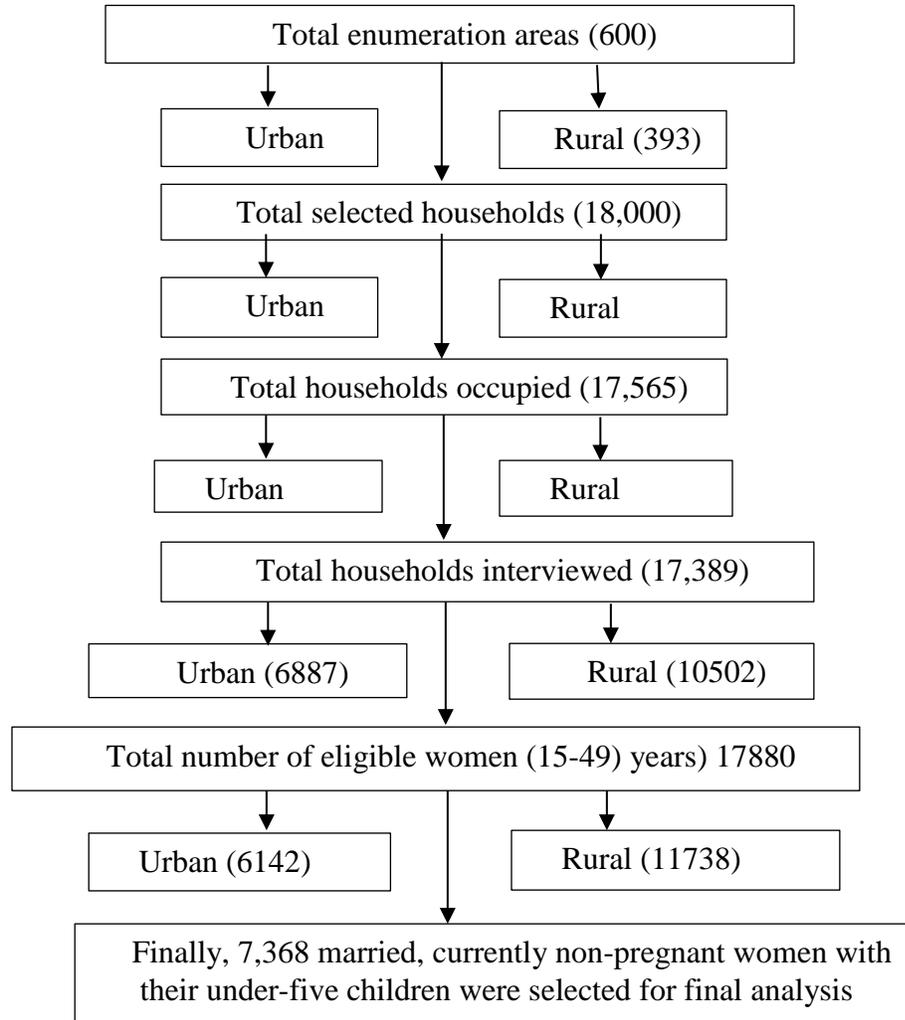
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            ┌────────────────────────────────────┐
            │   Total enumeration areas (600)     │
            └────────────────────────────────────┘
       ┌──────────────┐           ┌──────────────┐
       │    Urban     │           │  Rural (393)  │
       └──────────────┘           └──────────────┘
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          │  Total selected households (18,000) │
          └────────────────────────────────────┘
       ┌──────────────┐           ┌──────────────┐
       │    Urban     │           │    Rural     │
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          │ Total households occupied (17,565)  │
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       │    Urban     │           │    Rural     │
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          │ Total households interviewed (17,389)│
          └────────────────────────────────────┘
       ┌──────────────┐           ┌──────────────┐
       │ Urban (6887) │           │ Rural (10502)│
       └──────────────┘           └──────────────┘
       ┌──────────────────────────────────────────┐
       │ Total number of eligible women (15-49)    │
       │ years) 17880                              │
       └──────────────────────────────────────────┘
       ┌──────────────┐           ┌──────────────┐
       │ Urban (6142) │           │ Rural (11738)│
       └──────────────┘           └──────────────┘
       ┌──────────────────────────────────────────┐
       │ Finally, 7,368 married, currently non-     │
       │ pregnant women with their under-five       │
       │ children were selected for final analysis  │
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Figure 1: Sample selection procedure

Outcome variable

The nutritional status of mothers and their under-5 children was the outcome variable in this study. The nutritional status of mothers was measured by their body mass index (BMI) that was calculated using the formula: BMI= weight (kg)/{(height (m))^2. BMI was classified into three classes according to cut-off points: under-nutrition (BMI<18.5 kg/m^2), (ii) normal weight or

healthy (18.5≤BMI<25 kg/m^2), and over-nutrition (BMI≥25 kg/m^2) (Oddo et al. 2012). The nutritional status of under-five children was calculated using weight-for-age (underweight) (z-score). Z-scores were calculated according to the WHO child growth standards for children. Firstly, BDHS-2014 classified girls and boys separately, but finally, into three classes: (i) under-nutrition (under-weight) (z-score ≤-1), (ii) normal weight or healthy (--1<z-score<2) and (iii) over-nutrition (z-score≥2) (NIPORT, 2014; WHO, 2006). Initially, we calculated three groups of mother-child pairs in the same household according to their nutritional status such as (i) under-nourished mother-child pairs, (ii) over nourished mother-child pairs, and (iii) normal weight or healthy mother-child pairs. In addition, we also studied the prevalence of over-nourished mothers and under-nourished children pairs. The frequency of over-nourished mother and over nourished children was very small (0.2%). Finally, we considered only under-nourished mother-child pairs compared to normal weight or healthy mother-child pairs. There were classified as: (i) under-nutrition mother-child pairs (code, 1) (ii) healthy mother-child pairs (code, 0).

Independent variables

Socioeconomic, demographic, and household information were considered as independent variables in our study that came from the relevant record of BDHS-2014. We also followed published papers on the dual burden of mother-child pairs for selecting our independent variables (Wojcicki, 2014; Gubert et al. 2017; Wong et al. 2015; El Kishawi et al. 2016; Shinsugi et al. 2020; Mamun & Mascie-Taylor, 2019).

Statistical analysis

Descriptive statistics (frequency distribution) was used to determine the prevalence of the nutritional status of mothers and their under-five child pairs. We used the Chi-square (χ^2) test for establishing the association between socio-economic and demographic variables with the outcome variable. The median odds ratio (MOR) was used to check the existence of clustering effect of outcome variable. The MOR is defined as $\text{MOR} = \exp\left\{0.6745\sqrt{2}\ \sqrt{\sigma_u^2}\right\} = \exp(0.95\sqrt{\sigma_u^2})$, where σ_u^2 is the cluster variance. The value of MOR is always greater than or equal to 1. If MOR=1, it means there is no cluster variation, but if MOR>1, there is a cluster variation of the outcome variable, and it needs to remove the effect (Islam et al. 2019). We found that the value of MOR was 1.978 which was greater than 1. Two-level multiple logistic regression model was used to remove the clustering effect of dependent variable and find the effect of socio-economic and

demographic factors on under-nutrition among mother-child pairs in Bangladesh. Statistical significance was accepted at p<0.05. All statistical analyses were performed using SPSS (IBM version 20.0) Software.

RESULTS

A total of 7,368 married, currently, non-pregnant Bangladeshi women and their under-five children were selected for investigating their nutritional status and risk factors of under-nutrition. The age range of mothers was from 15 to 49 years with an average age of 31.52 ± 9.17 years. It was noted that more than one fifth (22.0%) mother-child pairs were under-nourished while the prevalence of over-nourished mothers and under-nourished children pairs was near to 10%. The over nourished mother-child pairs were very low, only 0.2%. It was found that 19.6% mother-child pairs were normal weight or healthy (Table 1).

Table 1: Distribution of nutritional status among mother-child pairs in Bangladesh

Nutritional status of mother-child pairs	N (%)
Under-nourished mother-child pairs	1621 (22.0%)
Over nourished mothers and under-nourished children pairs	710 (9.6%)
Normal weight or healthy mother-child pairs	1441 (19.6%)
Over nourished mother-child pairs	15 (0.2%)

In order to select the independent variables for logistic regression analysis, Chi-square test was considered in this study. This test demonstrated that children birth weight (p<0.01), type of residence (p<0.01), fathers' educational level (p<0.01), living location (division) (p<0.01), mothers' educational level(p<0.01), household wealth quintile (p<0.01), mothers' occupation(p<0.01), mothers' age (p<0.015), place of delivery (p<0.01) and mothers' amenia (p<0.01) were significantly associated factors of under-nutrition among mother-child pairs in Bangladesh (Table 2). These factors were considered as independent variables in the two-level binary logistic regression model.

Table 2: Stratification of under-nourished mother-child pairs by their socio-demographic characteristics

Variables (N, %)	Nutritional status of mother-child pairs		χ²-value
	Normal weight mother-child pairs N (%)	Under-nourished mother-child pairs N (%)	
Child's birth weight			
Normal (2548, 83.2%)	1280(50.2%)	1268(49.8%)	61.41**
Low (514, 16.8%)	161(31.3%)	353(68.7%)	
Type of residence			
Urban (847, 27.7%)	501(59.1%)	346(40.9%)	68.69**
Rural (2215, 72.3%)	940(42.4%)	1275(57.6%)	
Fathers' educational level			
No education (946, 30.9%)	305(32.2%)	641(67.8%)	246.89**
Primary (923, 30.1%)	394(42.7%)	529(57.3%)	
Secondary (839, 27.4%)	468(55.8%)	371(44.2%)	
Higher (354, 11.6%)	274(77.4%)	80(22.6%)	
Division (living location)			
Barisal (318, 10.4%)	143(45%)	175(55%)	68.25**
Chittagong (602, 19.7%)	302(50.2%)	300(49.8%)	
Dhaka (520, 16.9%)	250(48.1%)	270(51.9%)	
Khulna (354, 11.6%)	213(60.2%)	141(39.8%)	
Rajshahi (351, 11.5%)	175(49.9%)	176(50.1%)	
Rangpur (430, 14.0%)	198(46.0%)	232(54.0%)	
Sylhet (487, 15.9%)	160(32.9%)	327(67.1%)	
Mothers' educational level			
No education (618, 20.2%)	195(31.6%)	423(68.4%)	229.40**
Primary (989, 32.3%)	374(37.8%)	615(62.2%)	
Secondary (1246, 40.7%)	705(56.6%)	541(43.4%)	

Higher (209, 6.8%)	167(79.9%)	42(20.1%)	
Household wealth quintile			
Poor (1447, 47.3%)	470(32.5)	977(67.5)	
Middle (576, 18.8%)	265(46.0)	311(54.0)	305.69**
Rich (1039, 33.9%)	706(67.9)	333(32.1)	
Mothers' occupation			
Housewife (2739, 89.5%)	1280(46.7%)	1459(53.3%)	1.14**
Non housewife (323, 19.5%)	161(49.8%)	162(50.2%)	
Mothers' age (year)			
Age (15-20) (697, 22.8%)	304(43.6%)	393(56.4%)	
Age (21-29) (1704, 55.6%)	842(49.4%)	862(50.6%)	8.67*
Age ≥30 (661, 21.6%)	295(44.6%)	366(55.4%)	
Place of delivery			
Home (2334, 76.2%)	943(40.4%)	1391(59.6%)	174.67**
Clinic/Others (728, 23.8%)	498(68.4%)	230(31.6%)	
Mothers amenia status			
Anemic (477, 47.65%)	207(43.4%)	270(56.6%)	2.78**
Non anemic (524, 52.34%)	255(48.7%)	269(51.3%)	

** 1% level of significance and * 5% level of significance

It was observed that the magnitude values of standard error (SE) of each independent variable were ≤0.5; there was no evidence of a multicollinearity problem. Adjusted odds ratio (AOR) with 95% confidence interval (CI) of AOR and p-value were used to interpret the results of two-level logistic regression model. After removing the clustering effect of outcome variable and controlling the effect of other variables, the model demonstrated that, the mothers and their children living in Sylhet division were more likely to be under-nourished by 36%, 40.1%, 52%, 52.5%, 55.1% and 68.8% higher than those living in Rangpur [AOR=0.640, 95% CI: 0.417-0.983; $p<0.01$], Barisal [AOR=0.599, 95% CI: 0.380-0.944; $p<0.01$], Rajshahi [AOR=0.480, 95% CI: 0.308-0.746; $p<0.01$], Dhaka [AOR=0.475, 95% CI: 0.315-0.717; $p<0.01$], Chittagong [AOR=0.449, 95% CI: 0.298-0.676; $p<0.01$] and Khulna [AOR=0.312, 95% CI: 0.201-0.485; $p<0.01$] divisions respectively. It was found that rural mothers and their under-five children pairs

had a 1.97-fold greater risk to get under-nutrition than urban mothers and their under-five children pairs [AOR= 1.97, CI: 1.268-3.076; p<0.01]. It was observed that uneducated [AOR= 3.14, CI: 1.91-5.15; p<0.01], primary [AOR=2.85, CI: 1.799-4.54; p<0.05] and secondary [AOR= 1.71, CI: 1.109-2.64; p<0.05] educated mothers had 3.14, 2.85 and 1.7 times respectively higher risk with their under-five children for getting under-nutrition than higher educated mothers with their children. This study showed that uneducated [AOR= 3.96, CI: 2.70-5.78; p<0.01], primary [AOR= 3.11, CI: 2.17-4.47; p<0.01] and secondary educated [AOR= 2.19, CI: 1.55-3.10; p<0.01] husbands' wives and their under-five children had a 3.96, 3.11 2.19-folds higher chance to get under-nutrition respectively than higher educated husbands' wives and their under-five children. Low birth weight children with their mothers had 2.55 times greater risk [AOR=2.55, 95% CI: 1.57, 4.13; p<0.05] to become under-nourished than average birth weight children with their mothers. The AOR revealed that mother-child pairs living in the poor family were more likely to have under-nutrition by 38% and 61.2% than mother-child pairs living in middle [AOR=0.62, 95% CI: 0.39-0.98; p<0.01] and rich [AOR=0.38, 95% CI: 0.23- 0.63; p<0.01] families respectively. We did not find the significant effect of other selected factors on mother-child pairs' nutritional status, and those factors were not shown in Table 3. The Nagelkerke R^2 value showed that the two-level multiple binary logistic regression model explained 49.2% of the variation in the outcome variable by our selected independent variables. Hosmer and Lemeshow test demonstrated that our selected model was good fitted to the data (Table 3).

Table 3: Two-level logistic regression estimates for the effects of demographic and socioeconomic factors on under-nutrition of mother-child pairs

Variables	Coefficients	SE	Wald	AOR	95% CI for AOR	
					Lower	Upper
Division						
Chittagong	- 0. 79**	0.21	9.65	0.44	0.29	0.67
Dhaka	-0.74**	0.21	18.01	0.47	0.31	0.71
Khulna	-1.16**	0.22	15.86	0.31	0.20	0.48
Rajshahi	-0.73**	0.23	28.71	0.48	0.30	0.74
Rangpur	-0.45**	0.22	14.90	0.64	0.41	0.98
Barisal	-0.52**	0.23	15.61	0.59	0.38	0.94
Sylhet[R]						
Type of residence						
Rural	0.68**	0.23	3.01	1.97	1.26	3.07
Urban[R]						
Mothers' education level						

No education	1.14**	0.25	4.54	3.14	1.91	5.15
Primary	1.05*	0.24	4.45	2.85	1.79	4.54
Secondary	0.58*	0.22	2.43	1.71	1.10	2.64
Higher[R]						
Husbands' education level						
No education	1.36**	0.19	7.10	3.96	2.70	5.78
Primary	1.17**	0.18	6.18	3.11	2.17	4.47
Secondary	0.77**	0.17	4.45	2.19	1.55	3.10
Higher[R]						
Child birth weight						
Low	0.94*	0.25	3.82	2.55	1.57	4. 13
Average[R]						
Household wealth quintile						
Middle	-0.47**	0.24	-2.03	0.62	0.39	0.98
Rich	-0.95**	0.25	-3.78	0.38	0.23	0.63
Poor[R]						
Nagelkerke R^2-value = 0.49						
Goodness of fit	Hosmer and Lemeshow Test		Chi-Square Value=10.88		p-value=0.44	

N.B: B=Co-efficient, SE=Standard error, AOR=Adjusted odds ratio, CI=Confidence interval, ** 1% level of significance and * 5% level of significance.

DISCUSSION

Prevalence of under-nutrition

In our study, it was found that the prevalence of under-nutrition among mothers and their under-five children pairs in Bangladesh was 22.0%. As far as we knew, there were two studies were done with the double burden of malnutrition of Bangladeshi population and compared with other population (Anik et al. 2019; Oddo et al. 2012), same studies also had been found with other than Bangladeshi populations (Wong et al. 2015; Doak et al. 2000; Shinsugi et al. 2019; Unuwar et al. 2020). Our findings could not possible to compare with other studies.

Effect of socio-economic and demographic factors on under-nutrition

It was observed that the prevalence of under-nourished mothers and their under-nourished children in the divisions varied due to differences in culture and socio-economic factors. The result of this study showed that the prevalence of underweight mothers and underweight children was higher among rural mothers and children. The socioeconomic facilities of Bangladesh are not equally distributed among rural and urban areas. There are some obvious deficiencies of many

socioeconomic conveniences such as nutritional, medical, educational facilities in rural areas (Srinivasan et al. 2013). Mothers and children living in rural areas of Bangladesh do not have the same socioeconomic facilities as urban mothers and children get. This might be responsible for the higher percentage of under-nourished mother and child pairs in rural areas compared to those in urban areas. This study also showed comparatively lower educated mothers were more likely to become under-nourished and also she had under-nourished children in Bangladesh. It was found that the highest number of underweight mother and child pairs were found among illiterate mothers (67.8%) and the lowest number of underweight mother and underweight child pair was found among higher educated mothers (22.6%). Education plays a pivotal role in maintaining good health. With no education, mothers do not have adequate knowledge of nutrition and health. Consequently, they remain unaware of the nutritional status of themselves and their children as well. Getting higher education empowers women to acquire knowledge about good health and nutrition. More numbers of uneducated and primary educated mothers are living in the rural environments than the urban areas, and the number of comparatively lower educated mothers is living in poor families. These factors might be the possible causes of under-nutrition among lower educated mothers and their under-five children. In this study, we found that low birth weight children and their mothers were more likely to have under-nourished than average birth weight children and their mothers. One of the Bangladeshi studies reported that the prevalence of malnutrition was higher in children with low birth weight than those with normal birth-weights (Rahman et al. 2016), on the other hand, under-nourished mother was more likely to get low birth weight children (Hosegood et al. 2003). Low birth weight of children is correlated with under-nutrition of children and their mothers. Mother-child pairs living in the poor families had a higher chance to become under-nourished than mother-child living in middle and rich families. Household quintile can play a good role to improve the nutritional status of their members. Poor families cannot spend sufficient money for proving adequate nutrient food for their family members consequently they become under-nourished. The prevalence of under-nutrition among women of reproductive age and under-five children has been decreasing with increasing household wealth quintile in Bangladesh during the last two decades (NIPORT, 2014).

Strength and limitation of the study

Perhaps this was the first time we attempted to study on under-nutrition among mother-child pairs

in the same households of Bangladesh. In this study, we used two-level binary logistic regressions for removing the cluster effect of outcome variable for getting the accurate effect of socio-economic and demographic factors on under-nutrition among mother-child pairs. However, we had some limitations; secondary data used in this study, and it was bounded by the limitation of those data. Since it was a cross-sectional study, it was difficult to set up a causal relationship between the socio-economic, demographic, and anthropometric factors and mother-child pairs' nutritional status in Bangladesh. In this study, we measured the child's nutritional status by using only weight-for-age z-score, other indices such as height-for-age (stunting) and weight-for-height (wasting) were not used. More research is required regarding the other paradoxical forms of mother-child pairs' malnutrition in Bangladesh.

CONCLUSIONS

A total of 7,368 mother-child pairs were considered as the sample in the present study. We found that a remarkable number of mother-child pairs in Bangladesh were suffering from under-nutrition. Two-level binary logistic regression model provided that some modifiable factors such as living location (division), parental education, household wealth quintile, type of residence, and birth weight of children were more important predictors under-nutrition of mother-child pairs in Bangladesh. These factors should be addressed for reducing malnutrition among mothers and their under-five children in Bangladesh.

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