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Co-occurrence of anemia among mother (15-49 years) and child (6-59 months) pairs: a cross-sectional study based on Bangladesh Health and Demographic Survey 2011

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ABSTRACT

Background: *The co-occurrence of anemia in mothers and their children can be a larger public health issue. The aim of this study was to determine the prevalence and associated factors of anemia among Bangladeshi mothers (currently living in Bangladesh) and their under-five children pair.*

Methods: *This was a household cross-sectional study. We used only secondary data, and that was extracted from the Bangladesh Demographic and Health Survey 2011. The presence of anemia among mothers and their under-five children was considered as the co-occurrence of anemia. A total of 1,281 of mother-child pairs were considered as samples. Frequency distribution, chi-square test and logistic regression model were used in this study.*

Results: *The prevalence of anemia among the defined mother-children pairs was found to be 45.8%, out of which 54.0%, 44.3%, and 1.7% had mild, moderate, and severe anemia respectively. The multivariable logistic model demonstrated that living in Barisal division, non-Muslims, poor household index, under-nutrition, children of less than 2 years and currently breastfeeding were the most influential factors of anemia among mothers and their under-five children in Bangladesh.*

Conclusion: *The co-occurrence of anemia among mother-child pairs was alarming in Bangladesh. Six modifiable risk factors were found, and these should be addressed for reducing the prevalence of anemia among mother-child pairs.*

Keywords: *Anemia, Co-occurrence, Mothers, Children, Bangladesh*

INTRODUCTION

Anemia is one of the leading public health concerns in the world (WHO, 2008, 2015), especially in low- and middle-income countries (Stevens, 2013; Borges, 2016) like Bangladesh. Globally, 43% of children (6-59 months), 38% of pregnant women, 29% of non-pregnant women and 29% of all women of reproductive age suffer from anemia (WHO, 2015). It causes many adverse effects on health and its negative impacts on social and economic development is significant (WHO, 2015). Anemia attacks people of all ages and sexes, but women, especially mothers and under-five children are the main victims of it. Poor nutrition is an important and predominant cause of anemia (UNICEF et al., 2015). It results from a complex interaction of several factors, but iron deficiency is the most significant contributor (UNACC/SCN, 1997). It is considered as an indicator of both poor nutrition and poor health resulting in an increased risk of maternal and child mortality and morbidity (Northrop-Clewes and Thurnham, 2013). A recent study claimed that infections, especially of malaria and diarrhea, were important causes of anemia in younger populations, and measures of controlling and preventing malaria and other infections might improve the burden of anemia independently of iron interventions, and if combined with iron, might make iron interventions safer and more effective (Pasricha S-R et al., 2018). Another study revealed that heme-iron and vitamin C consumption reduced the effect of groundwater iron on anemia among women but not among children in Bangladesh, which might be due to higher levels of iron deficiency and lower levels of iron intake among children (Wendt et al., 2019). Anemic women have been associated with numerous morbidities including miscarriage (Szerafin L and Jakó, 2010), preterm delivery (Scholl et al., 1992), placental abruption (Arnold et al., 2009), low birth weight (Rasmussen, 2001), prenatal and maternal mortality (Lee et al., 2006; Mulayim, 2008; Brabin et al., 2001), infectious diseases (Ndyomugyenyi et al., 2008), generalized weakness, a lower capacity to perform physical work (Scholz et al., 1997), and psychiatric problems including unipolar depressive disorder, bipolar disorder, anxiety disorder, etc. (Chen et al., 2013). Anemia causes many serious health problems in children also, such as growth retardation, impaired motor and cognitive development, increased morbidity and mortality (Ramakrishnan, 2008), intelligence and developmental delay (Grantham-McGregor et al., 2001; Lozoff et al., 1991), attention deficit hyperactivity disorder (Cortese et al., 2012), and autism spectrum disorder (Herguner et al., 2012).

According to World Health Organization (WHO), 56% of children (6-59 months), 48% of pregnant women, 43% of non-pregnant women and 43% of all women of reproductive age are anemic in Bangladesh (WHO, 2008). However, according to the National Micronutrients Status Survey 2011-12 of Bangladesh, the prevalence of anemia was 26.0% in non-pregnant non-lactating mothers and 33.1% in pre-school children (CNFS, icddr,b and UNICEF,2013) .

Some studies have already been carried out on anemia in Bangladesh with different population groups, such as rural children (Faruque et al., 2006), pre-school children in Dhaka city (Ahmed et al., 2006) and adolescent girls in Tangail district (Miah et al., 2014). Bangladesh Demographic and Health Survey 2011 (BDHS-2011) tested anemia among ever-married women of reproductive age and their under-five children; it was the first nationally representative survey on anemia in Bangladesh (NIPORT, 2013). Almost at the same time, Bangladesh National Micronutrients Status Survey 2011-12 also estimated anemia status with nationally representative data (CNFS, icddr,b and UNICEF,2013). Several studies were conducted using BDHS-2011 data on anemia, such as among non-pregnant women (Kamruzzaman et al., 2015) and under-five children (Khan et al., 2016). Also, a coexistence study on overweight mothers with undernourished and anemic children is available with Bangladeshi population (Mamun et al., 2009). To the best of our knowledge, no study has yet been carried out on the simultaneous presence of anemia among Bangladeshi mothers and their under-five children in the same households.

Usually, mothers play the major role in doing household chores and rearing children in Bangladesh. The anemic mothers can neither perform their daily household chores well nor take proper and satisfactory care of their anemic children who need more nursing than the normal ones that ultimately creates a major public health concern for the country.

To address the issues, we aimed to study on co-occurrence of anemia and its associated factors among mothers of reproductive age (15-49 years) and their under-five (6-59 months) children pairs in Bangladesh.

METHODS

Study design and data collection

We used only secondary data for the present study, and data were extracted from the BDHS-2011 (NIPORT, 2013). The sampling technique, survey design, survey instruments, measuring systems, quality control, ethical approval and subjects' consent for the BDHS-

2011 were described in detail in its published report (NIPORT, 2013). The survey was conducted from July 8 to December 27, 2011 among mothers in reproductive age (15-49 years) and their under-five children from all over Bangladesh. The objectives of BDHS-2011 survey were to collect data on demographic rates, factors affecting fertility and mortality, contraceptive use, STDs, nutritional status, maternal and child health, accessibility and availability of health services, food security and so on. They also collected blood samples from some mothers and the children for measuring their Hb levels. This was the first time BDHS-2011 collected blood sample from mothers and their under five children across the country for measuring anemia, and BDHS-2014 did not blood sample (NIPORT, 2014). It was mentioned that perhaps BDHS-2011 dataset only the nationally representative sample for measuring Hb levels of mothers and their children in Bangladesh. The BDHS-2011 used a two-stage stratified cluster sampling method based on enumeration areas (EAs) and household samples. In the first stage, 600 EAs (210 urban and 390 rural) were selected on a probability proportional basis for all the seven administrative divisions of the country. In the second stage, an average of 30 households was selected by systematic sampling from each one of the EAs, thereby selecting a total of 18,000 residential households. However, 17,141 households could be interviewed. Besides, the BDHS-2011 selected a sub-sample of one-third of the selected households for collecting biomarker components of the survey including Hb levels from all legally married women (5,902) and their under-five (6-59 months) children (2,558). Blood samples were taken from each of them for the measurement of Hb level as the indicator of anemia. Excluding the pregnant women and outliers, the number of married non-pregnant women totaled 5,293; and similarly, excluding outliers and children below 6 months, the number of children of 6-59 months was counted at 2,263. For this present study, the married non-pregnant mothers with at least one child represented a sample (one pair of mother-child). In the case of more than one child of a selected mother, her last child was considered. Thus, the final sample size of the study became at 1,281 pairs of mothers and children [Fig. 1].

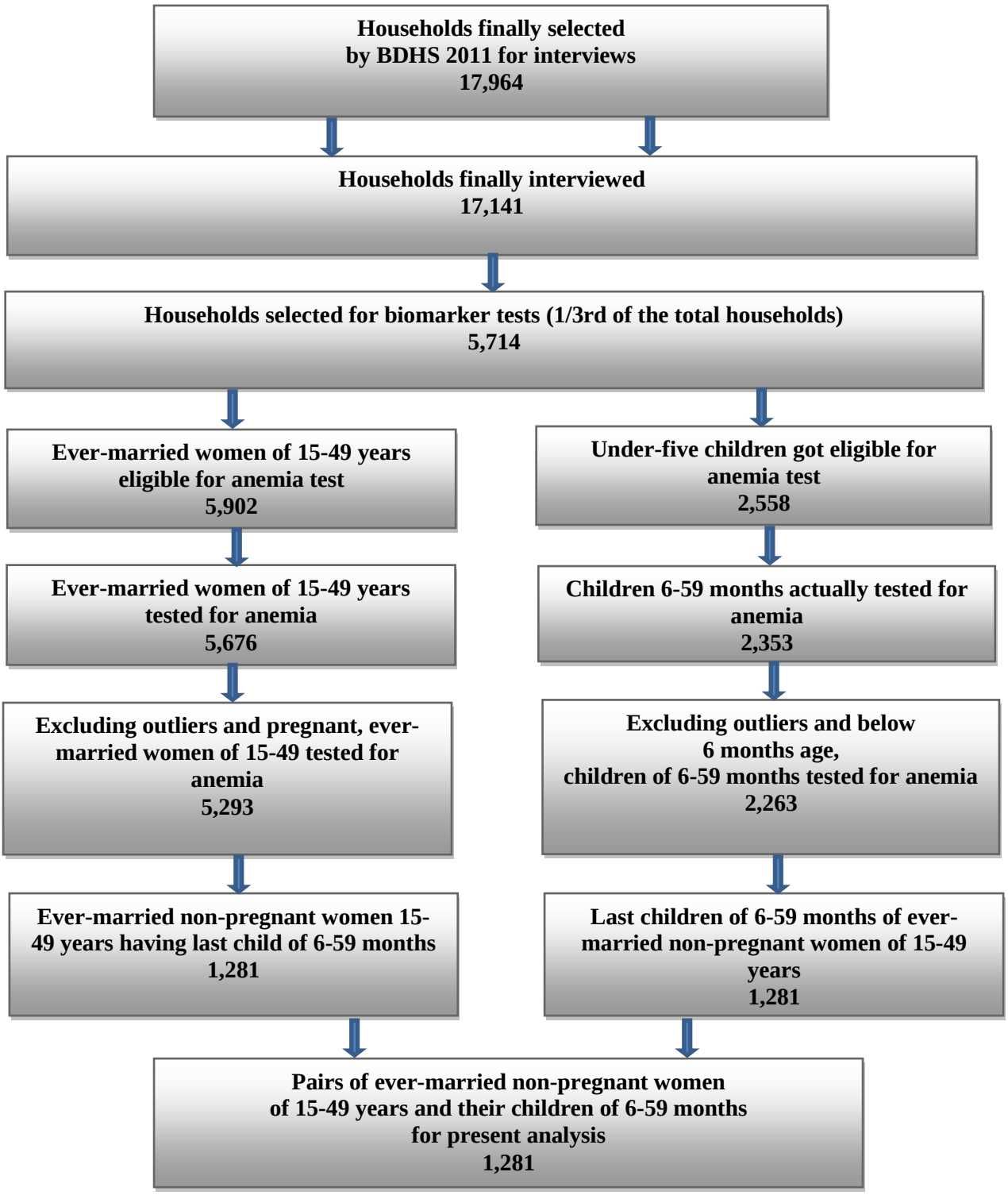
Households finally selected by BDHS 2011 for interviews 17,964
Households finally interviewed 17,141
Households selected for biomarker tests (1/3rd of the total households) 5,714
Ever-married women of 15-49 years eligible for anemia test 5,902
Under-five children got eligible for anemia test 2,558
Ever-married women of 15-49 years tested for anemia 5,676
Children 6-59 months actually tested for anemia 2,353
Excluding outliers and pregnant, ever-married women of 15-49 tested for anemia 5,293
Excluding outliers and below 6 months age, children of 6-59 months tested for anemia 2,263
Ever-married non-pregnant women 15-49 years having last child of 6-59 months 1,281
Last children of 6-59 months of ever-married non-pregnant women of 15-49 years 1,281
Pairs of ever-married non-pregnant women of 15-49 years and their children of 6-59 months for present analysis 1,281

Fig.1: Sample selection procedure

Outcome variable

Co-occurrence of anemia among mothers and their under-five children pairs (mother-child pairs) was the outcome variable for this study. At first, the samples were classified into two groups: pairs of anemic mothers (Hb level <12.0 g/dl) and anemic children (Hb level <11.0 g/dl) (code, 1) and pairs of non-anemic mothers (Hb level ≥12.0 g/dl) and non-anemic children (Hb level ≥11.0 g/dl) (code, 0). The anemic pairs were then divided into three subgroups; (i) mild: both mothers and children were mild, (ii) moderate: both mothers and children were moderate, and (iii) severe: both mothers and children were severe. Dissimilar categories were not considered for this classification, and the classification was not considered for further statistical analysis. In non-pregnant mothers (women), Hb level of 10.0-11.9 g/dl was considered as mild, 7.0 -9.9 g/dl as moderate and <7.0 g/dl as severe; and in under-five children, Hb level of 10.0-10.9 g/dl was considered as mild, 7.0 -9.9 g/dl as moderate, and <7.0 g/dl as severe anemia (Kamruzzaman et al., 2015). The definition and grading of anemia and the process of blood testing in the BDHS-2011 were described in detail in report (NIPORT, 2013).

Independent variables

The independent variables used in this study were type of residence (urban/rural), living location (division), religion (Muslim/non-Muslim), mother's education level (no education, primary, secondary, higher), husband's education level (no education, primary, secondary, higher), household wealth index (poor, middle, rich), mother's age (≤20, 21–29, 30–39, ≥40 years), mother's age at first marriage (≤18, >18 years), total ever-born children (1–2, 3–5, 6 and more), number of family members (≥4, 5–10, ≥11), children's age (<2, 2–<3, 3–4, 4–5 years), current breastfeeding status (no/yes), children's birth weight (normal weight, low birth weight), mother's nutritional status (undernourished- body mass index (BMI) <18.5), healthy (normal BMI 18.5–24.9), and over-nourished (BMI≥25) (WHO, 2003)), currently parents living together (yes/no), household toilet facilities (hygienic/ unhygienic). The variables were extracted from the BDHS-2011 data set and selected based on previous studies (Kamruzzaman et al., 2015; Khan et al., 2016).

Statistical analysis

Frequency distribution was used to determine the co-occurrence (prevalence) of anemia among mother-child pairs in this study. The chi-squire test was utilized to investigate the association of socio-economic and demographic factors and anemia. The factors found statistically significant in the chi-square test were considered as independent variables and anemia status of mother-child pairs was considered as dependent variable in further statistical analysis. As the data used in this study were collected using multistage stratified cluster sampling, the dependence among observations came from several levels of hierarchy. This type of data might show a cluster effect. A multilevel regression model is appropriate in this case (Khan and Shaw, 2011), but we did not get a significant variation (cluster effect) of the outcome variable among clusters (EAs). The multivariable binary logistic regression model was applied to examine the effects of independent variables on anemia. In this study, the multicollinearity problem was detected using by the magnitude of the standard error (SE); there was no evidence of multicollinearity if the magnitude of the SE lies between 0.001 and 0.5 (Kamruzzaman et al., 2015). Statistical analyses were carried out using SPSS software (version IBM 22). Statistical significance was accepted at $p < 0.05$.

RESULTS

The prevalence (co-occurrence) of anemia among the mother-child pairs was found to be 45.8%. Out of the total anemic pairs, 54.0%, 44.3%, and 1.7% had a mild, moderate and severe type of anemia respectively (Fig. 2).

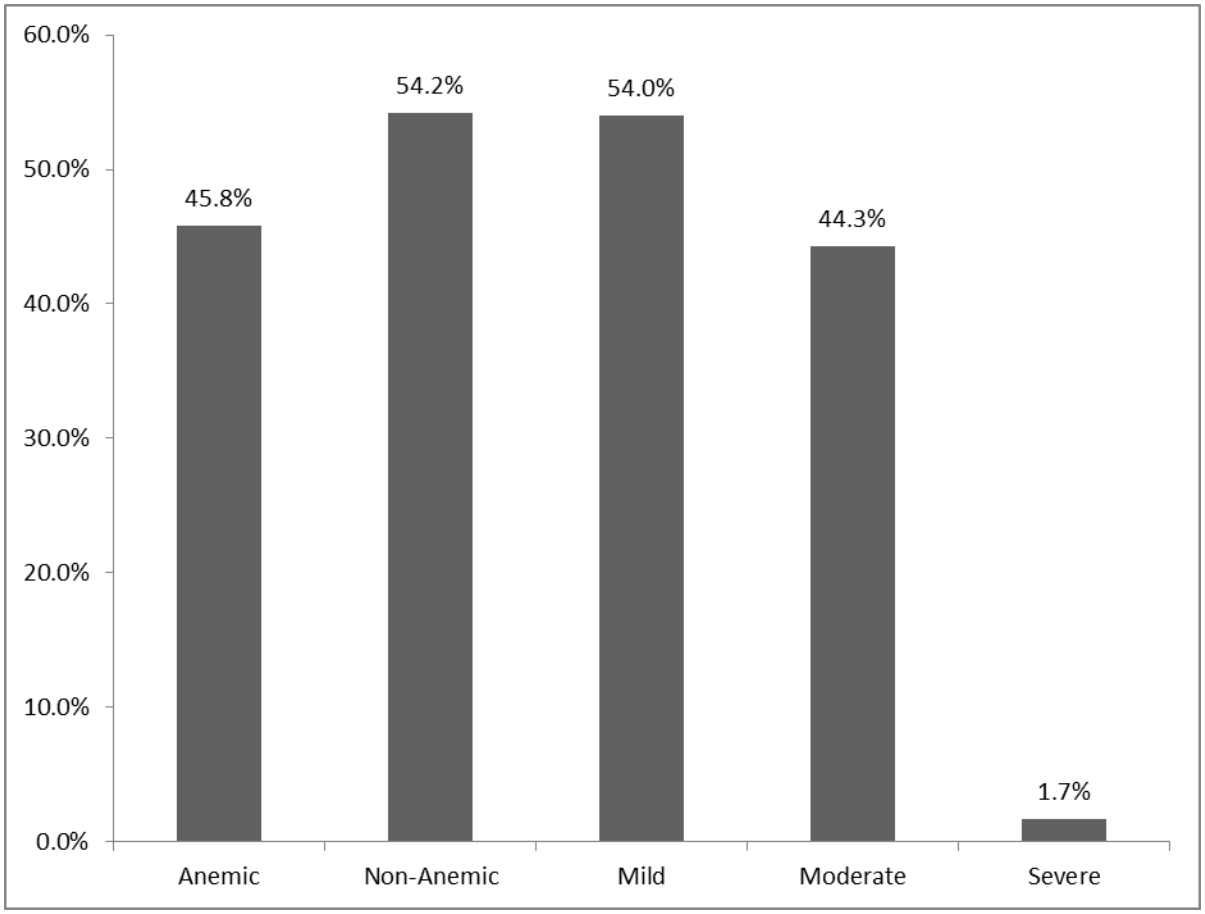

Fig 2: Prevalence of anemia among mothers and their under-five children pairs in Bangladesh

The chi-square ($\chi 2$) test demonstrated that the significant associated factors of anemia were type of residence, living location (division), religion, mothers' education level, household wealth index, mothers' age, mothers' age at first marriage, total ever born children, number of family members, children's age, current breastfeeding status, mothers' nutritional status, and household toilet facilities (Table 1).

Table 1: Association between socio-demographic factors and anemia of mothers of reproductive age and their under-five children in Bangladesh

Variables with category, N (%)	**Anemic mothers and their under five children,** Yes, N (%)	**χ^2-value**	**p-value**
Type of residence		11.361	p<0.001
Urban, 399 (31.15)	155 (38.8)		
Rural, 882 (68.85)	432 (49.0)		
Living location (division)		18.674	p<0.001
Barisal, 146 (11.40)	82 (56.2)		
Chittagong, 226 (17.64)	93 (41.2)		

Dhaka, 233 (18.19)	108 (46.4)		
Khulna, 132 (10.30)	53 (40.2)		
Rajshahi, 154 (12.02)	67 (43.5)		
Rangpur, 172 (13.43)	95 (55.2)		
Sylhet, 218 (17.02)	89 (40.8)		
Religion		12.159	p<0.001
Muslim, 1165 (90.94)	516 (44.3)		
Non-Muslim, 116 (9.06)	71 (61.2)		
Mother's education level		22.161	p<0.001
No education, 242 (18.89)	125 (51.7)		
Primary, 420 (32.79)	214 (51.0)		
Secondary, 524 (40.90)	221 (42.2)		
Higher, 95 (7.42)	27 (28.4)		
Household wealth index		58.373	p<0.001
Poor, 549 (42.86)	312 (56.8)		
Middle, 221 (17.25)	104 (47.1)		
Rich, 511 (39.89)	171 (33.6)		
Mother's age (year)		12.245	0.007
≤20, 217 (16.94)	121 (55.8)		
21-29, 722 (56.36)	306 (42.4)		
30-39, 309 (24.12)	144 (46.6)		
≥40, 33 (2.58)	16 (48.5)		
Mothers' age at first marriage (year)		14.664	p<0.001
≤18, 1093 (85.32)	525 (48.0)		
>18, 188 (14.68)	62 (33.0)		
Total ever-born children		8.710	0.013
1-2 children, 730 (56.99)	318 (43.6)		
3-5 children, 470 (36.69)	220 (46.8)		
6+ children, 81 (6.32)	49 (60.5)		
Number of family members		6.125	p<0.001
≤4, 371 (28.96)	161 (43.4)		
5-10, 811 (63.31)	390 (48.1)		
≥11, 99 (7.73)	36 (36.4)		
Children's age (year)		95.137	p<0.001
<2, 404 (31.54)	265 (65.6)		
2-3, 256 (19.98)	104 (40.6)		
3-4, 327 (25.53)	115 (35.2)		
4-5, 294 (22.95)	103 (35.0)		

Current breastfeeding status		60.151	p<0.001
No, 466 (36.38)	147 (31.5)		
Yes, 815 (63.62)	440 (54.0)		
Mothers' nutritional status		49.208	p<0.001
Under-nourished, 393 (30.68)	218 (55.5)		
Healthy, 726 (56.67)	332 (45.7)		
Over- nourished, 162 (12.65)	37 (22.8)		
Household toilet facilities		15.856	p<0.001
Hygienic, 684 (53.40)	278 (40.6)		
Unhygienic, 597 (46.60)	309 (51.8)		

It was observed that the magnitude of SE for each independent variable lies between 0.001 and 0.5, there was no multicollinearity problems among independent variables. The multivariable binary logistic model demonstrated that the risk for getting anemia was reduced by 51.5%, 44.4% and 40.4% among mother-child pairs who were living in Sylhet (AOR = 0.485; p<0.01), Khulna (AOR= 0.556; p<0.01) and Chittagong division (AOR= 0.596; p<0.05) respectively compared to mother-child pairs in Barisal division. Muslim mother-child pair was lower risk for getting anemia (AOR = 0.484; p<0.01) than Non-Muslim pairs. It was found that mother-child pairs were lower risk for getting anemia who were living in middle (AOR= 0.672; p<0.05) and rich families (AOR = 0.475; p<0.01) than poor mother-child pairs. The risk for getting anemia was decreased by 62.8%, 69% and 66% of mother-child (age, 2-3 years) among (AOR = 0.372; p<0.01), mother-child (age, 3-4 years) (AOR=0.31; p<0.01) and mother-child (age, 4-5 years) pairs (AOR=0.340; p<0.01) respectively than mother-child (age<2years) pairs. The over nourished mothers and their children pairs were lower risk to develop anemia than under nourished mothers and their children (AOR = 0.431; p<0.01). Also, currently breastfeeding mothers and their breastfed children were at 1.451 times higher risk to get anemia than their counterparts (AOR = 1.451; p<0.05) (Table 2).

Table 2: Effects of demographic and socioeconomic factors on anemia among mothers of reproductive age and their under-five children pairs in Bangladesh

Variable	**SE**	**p-value**	**AOR**	**95% Cl of AOR**	
				Lower	**Upper**
Type of residence					
Urban vs Rural[R]	0.152	0.610	1.081	0.802	1.455
Living location (division)					

Chittagong vs Barisal[R]	0.241	0.031	0.596	0.371	0.954
Dhaka vs Barisal	0.236	0.180	0.729	0.459	1.157
Khulna vs Barisal	0.267	0.028	0.556	0.329	0.938
Rajshahi vs Barisal	0.258	0.073	0.631	0.381	1.045
Rangpur vs Barisal	0.254	0.378	0.799	0.485	1.315
Sylhet vs Barisal	0.250	0.001	0.485	0.297	0.791
Religion					
Muslim vs Non-Muslim[R]	0.224	0.001	0.484	0.312	0.750
Mother's education level					
Primary vs No Education[R]	0.192	0.947	0.987	0.678	1.439
Secondary vs No Education	0.221	0.404	0.832	0.540	1.282
Higher vs No Education	0.382	0.207	0.618	0.292	1.306
Household wealth index					
Middle vs Poor[R]	0.184	0.030	0.672	0.469	0.963
Rich vs Poor	0.194	0.001	0.475	0.325	0.694
Mother's age (year)					
21-29 vs ≤20[R]	0.188	0.417	0.858	0.593	1.241
30-39 vs ≤20	0.256	0.896	1.034	0.626	1.709
≥40 vs ≤20	0.477	0.802	0.887	0.349	2.258
Mothers' age at first marriage (year)					
≤18 vs >18[R]	0.208	0.504	1.149	0.764	1.728
Total ever-born children					
1-2 vs 6+[R]	0.339	0.084	0.556	0.286	1.081
3-5 vs 6+	0.295	0.106	0.621	0.348	1.106
Number of family members					
≤4 vs ≥11[R]	0.274	0.773	0.924	0.540	1.580
5-10 vs ≥11	0.246	0.572	1.149	0.710	1.861
Children's age (year)					
2-3 vs <2[R]	0.178	0.001	0.372	0.263	0.528
3-4 vs <2	0.183	0.001	0.310	0.217	0.444
4- 5 vs <2	0.199	0.001	0.340	0.230	0.501
Current breastfeeding status					
Yes vs No[R]	0.155	0.016	1.451	1.070	1.968
Mother's nutritional status					
Healthy vs Under-nourished [R]	0.140	0.260	0.854	0.649	1.124

Over- nourished vs Under-nourished	0.243	0.001	0.431	0.268	0.694
Household toilet facilities					
Hygienic vs Unhygienic[R]	0.139	0.791	0.964	0.734	1.265

N.B.: B-Coefficients, SE-Standard error, CI-Confidence interval, AOR-Adjusted odd ratio, R-Reference variable

DISCUSSION

The study revealed that about 46 percent of the mother-child pairs were anemic, and living in Barisal division, non-Muslims, poor household index, under-nutrition, children of less than 2 years and currently breastfeeding status contributed most to cause anemia. These significant factors are inter-related and influence one another to further increase the risk of anemia.

The pairs of mothers and their children in Barisal division were found to be more anemic than those in other divisions. Poverty might be a cause behind it. In 2010, the poverty rate based on the upper poverty line was highest in Rangpur (46.2%) followed by Barisal (39.4%) divisions (GED et al., 2018). The sample design of this study might also be a factor. In this study design, rural household allocation by division was highest in Rangpur (87.2%) followed by Barisal (84.7%) compared to other divisions (NIPORT, 2013). Our chi-square test showed that Barisal division had the largest number of anemic pairs, and the rural women and children pairs had a higher rate of anemia. These two factors might influence each other in causing anemia. The poverty rate was 35.2% in rural areas in Bangladesh against the national level of 31.5% in 2010 (GED et al., 2018). People living in the rural environment are poorer and less educated; they are not sufficiently conscious like urban people about the need for a balanced and nutritious diet. This might explain the higher prevalence of anemia in rural areas. More in-depth and multi-disciplinary research is needed for establishing the inter-relations of living location (Barisal division), study design (larger rural allocation of samples) and poverty. The reason behind the higher prevalence of anemia among currently breastfeeding mothers might be that these mothers took in an inadequate amount of nutrition due to poverty, familial customs and lack of knowledge. The occurrence of anemia at a higher rate among breastfed children might be for low iron content of breast milk (Yalçin et al., 2009; Dror and Allen, 2018). About 50% children aged 6-23 months received iron-rich foods, and 2.27% of children got iron supplements during last seven days of BDHS-2011 survey

(NIPORT, 2013). On the other hand, 15% mothers did not take full meals every time and 4% had never or rarely had a full meal during last year of BDHS-2011 survey due to poverty (NIPORT, 2013). An estimated 18% women had skipped meals and 22% did not have adequate amount of meal during last year of BDHS-2011 survey (NIPORT, 2013). About 85% of women had never replaced their staple food, and 32% of women lacked food security in Bangladesh (NIPORT, 2013). The BDHS-2011 did not include information on whether the mothers were provided iron/folic acid supplementation coverage during most recent pregnancies (NIPORT, 2013).

The mothers and children coming from poor and middle-income households were found to be more anemic because they could not get proper and adequate nutrition and healthcare facilities. The BDHS-2011 reported that 15% of women (15-49 years) did not have full meals every time and 4% had never or rarely had a full meal in the last one year due to poverty. The report further revealed that 18% of women had to skip meals and 22% had less than an adequate amount of meal during the last 12 months (NIPORT, 2013). The composition of their meals was also important and needs to be noted. About 85% of women had never replaced their staple food, i.e., rice, which is not iron-rich, with alternative food sources and that about 32% of women lacked food security (NIPORT, 2013). Non-Muslims, mostly Hindus, were found to be more anemic perhaps due to poverty. Poor food habits might be another cause (Islam, 2012). They usually avoid animal protein, especially meat. Younger children (<2 years) were found to be more anemic than the older ones probably because they were breastfed and, notable that iron content of breast milk is low (Yalçin et al., 2009; Dror and Allen, 2018). Another cause might be that perhaps, nutrition of the children was not cared as much as required by their ill (anemic) mothers.

We could not compare our findings with other studies because anemia was usually studied separately among women, children and various other groups of population. The co-occurrence of anemia was not studied so far among specific population of mother–child pairs in the same household, neither globally nor in any region. Anemia among mothers and under five children in the same household at such a higher rate indicates that the overall situation of maternal and child health status in Bangladesh is depressing, the associated factors behind it and inter-relations of these factors should be thoroughly investigated.

Strength and Limitations of the study

Perhaps this was the first time we attempted to study on anemia among mother-child pairs in same households. Furthermore, this study was done with nationally representative

data of married non-pregnant mothers of reproductive age and their under-five children in Bangladesh. The data were collected on a household basis that gave a more reliable and clearer picture of the prevailing situation. However, this study had some limitations. The data used in in the present study was old collected in 2011, new nationally representative data was not available. The secondary data was used in our study; we did not consider some necessary health indicator variables such as nutritional attitude, dietary culture and so on. Some important factors such as iron status, intake of groundwater iron, comorbidities like thalassemia and diabetes, infection-burden like malaria, kala-azar and worm infestations, children's nutritional status, immunization, etc. were not considered. Also, it was not possible to look effect of some other possible important socioeconomic issues such as environmental factors, sedentary lifestyle, familial customs, effect of drugs, etc. on anemia. Recall bias might also be a problem. These limitations should be addressed in further in-depth studies with more elaborate research strategies.

CONCLUSIONS

In the present study, we determined the prevalence and associated factors of the co-occurrence of anemia among mother-child pairs in Bangladesh. Nationally representative sample was used, and it was found that 45.8% Bangladeshi mothers and their under five children were suffering from anemia. Our selected multivariable logistic model provided that living location (division), religion, household wealth index, children's age, current breastfeeding status and mothers' nutritional status were the risk factors of anemia among mother-child pairs in Bangladesh. The co-occurrence of anemia among mothers and their children was alarming in Bangladesh. Necessary steps should be taken to reduce poverty and improve nutritional status especially in underprivileged regions such as Barisal division and population groups like poor and non-Muslims. Breastfeeding mothers, breast-fed children and the children of less than 2 years should be given special care including supplementation of iron-rich foods. Bangladesh is trying hard to achieve the SDGs by 2030 that include maternal and child health care challenges. The findings of our study would hopefully help the government and other stakeholders take proper, adequate and timely interventional measures for decreasing anemia prevalence among mothers and their under five children and thereby reduce maternal and child morbidity and mortality in the country.

ABBREVIATIONS

AOR- Adjusted Odds Ratio; BDHS- Bangladesh Demographic and Health Survey; BMI- Body Mass Index; CI- Confidence Interval; EAs- Enumeration Areas; Hb- Hemoglobin; HKI- Helen Keller International; IBM- International Business Machines; NIPORT- National Institute of Population Research and Training; SDGs- Sustainable Developments Goals; SPSS- Statistical Package for the Social Sciences; WHO- World Health Organization.

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COMPETING INTERESTS

The authors have no conflict of interest.

AUTHORS CONTRIBUTIONS

MAW and MGH conceptualized and designed the research and analyzed the data; MAW drafted the original manuscript; MGH, MRK, and ASMAM critically reviewed and edited the manuscript. All the authors read, discussed and approved the final version of the manuscript for publication.

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AVAILABILITY OF DATA AND MATERIAL

Data and materials of the BDHS-2011 are freely available at http://dhsprogram.com/data/dataset/Bangladesh_Standard-DHS_2011.cfm?flag=0.

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