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Key Predictors of Anemia in Under Five Children in Rural Setting of Bangladesh: A Cross Sectional Study

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Abstract Introduction: Anemia is a substantial public health problem that happens worldwide with higher prevalence noted in children less than 5 years and rural children. The studywas aimed to explore the keypredictors of anemia of study population in rural setting of Bangladesh. Methodology & Materials: This cross-sectional study was conducted in the rural Bangladesh from 1 July 2018 to December 2019. Under-five children aged six months to below sixty months were enrolled in the study. Data were collected through face-to-face interview from attending primary caregiver and from the results of laboratory tests of blood sample from target children. Data were analyzed through SPSS 23 software. Initially univariate analysis was done to identify predictors of anaemia followed by multivariate analysis to explore the key predictors through logistic regression. Results: A total data of258 under-five children aged 6-59 month were included in this study from the rural areas of Bangladesh. Among the studied children overall prevalence of anaemia was found 61.8%. The significant predictors ($p < 0.05$) of anaemia through univariate analysis are age, maternal education level, monthly family income, exclusive breast feeding, proper complementary feeding practice as well as regular consumption of animal protein, fruits and vegetables. In addition, children who were under-weight stunted and wasted. Through multivariate analysis the key factors were explored as age group 6-24 month (AOR=0.02; p=0.006), family income less than 10000 BDT group-i.e 5000BDT or below (AOR=0.27;p=0.01) and 5001- 10000 BDT (AOR=8.84; 0.02), early and late weaning practiced children (AOR=0.23;p=0.002), low consumption of animal protein (AOR=0.05; p=0.001), and vegetables (AOR=0.18; p<0.001), stunting (AOR=0.18;p<0.001), wasting (AOR=0.14; p=0.03) and children who have chronic or recent infection (AOR=0.33; p=0.008). Conclusion: The keypredictors of anaemia are explored in this study are age below 2 year, family income less than 10000 BDT (in 2018 AD) or below, early and late weaning practice, low consumption of animal protein and vegetables, chronic malnutrition, acute malnutrition and chronic or recent infection. Rising mass awareness among the caregiver group on child care, nutrition and special focus to the children below age of two years will be the key strategies to prevent and control this extensive public health problem in Bangladesh.

Keywords: *anemia, rural area, Childhood Aanaemia, Anaemia Predictors, under-five children. (stunting, wasting, and infestation), under- nutrition*

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1. Introduction

Worldwide, anaemia still remains as one of the major causes of morbidity and mortality particularly for young and preschool children. Approximately half of the world's under-five population are suffering from anaemia prevailed mainly in the developing countries including Bangladesh [1]. Evidentially, anaemia has adverse effect on physical growth and development, childhood cognitive disorders, school performance and low immunity and that in adult is reduced productivity. Because of these negative consequences, an anaemia prevalence ≥ 40% in any

population is considered as a serious public health problem [2]. Anemia is one of the leading nutritional causes of disability and has adverse impact on productivity [3]. According to recent information from the South Asian region, the prevalence of anemia among children 6–35 months aged was nearly 79% in India [4], and anaemia was predominant in rural Indian children [5]. Different studies indicated that anemia is significantly associated with age, sex, rural residence, low birth weight child, Infant & Young

Child Feeding (IYCF) practice, duration of lactation, infectious disease (e.g. malaria, intestinal parasitic children [14]. Iron deficiency anemia also increases risk of morbidity and mortality from infectious disease [5,6,15]. To eliminate childhood underweight), poor socioeconomic status, household food insecurity, and poor dietary iron intake, poor maternal educational status and maternal anemia [6,7,8]. In Bangladesh, several studies in the past have indicated that among under-five children anemia is a severe public health problem. The national overall prevalence of anemia in Bangladesh was 51% in 2011 (BDHS 2011) [9]. The Nutritional Surveillance Project (NSP) indicated that prevalence of anemia was 68% in 2004 among the under-five aged children [10,11]. National Micronutrient Status Survey in 2011-12 showed that anemia prevalence was 33.1% in pre-school aged children and it was 37.0% in the rural and 22.8% in the urban area [12]. The prevalence of anemia was higher among younger children below 3 years and anaemia reduced as age progressed [13]. In Bangladesh, 62% of children start complementary feeding delayed at 6 to 8 months of age [9]. The suboptimal Infant and Young child feeding (IYCF) practices and delayed or early weaning beginning after or before six months of age were leading to high level of nutritional anaemia in early childhood [13]. Iron deficiency is the most common cause of nutritional anemia. Nutritional anemia particularly iron deficiency is a public- health priority and believed to be the most common cause of preventable anaemia among children in Bangladesh [16]. However, there are very few studies were conducted to explore key predictors of anaemia in young children in rural Bangladesh. So, the researchers designed this study with the aim to trace out the main predictors of anemia using socio- demographic, health, and nutritional variables in under-five population in rural setting of Bangladesh.

2. Objectives

2.1. General Objective

To determine the key predictors of anaemia in under-five children in rural setting of Bangladesh.

2.2. Specific Objectives

To explore the key predictors of anaemia in under- five children in rural Bangladesh

To determine the food, nutrition and health related factors associated with anaemia.

3. Methods

This cross-sectional study was conducted in the rural eleven upazilla(s) or sub districts under five districts in northern Bangladesh. A sample size of 325 was calculated using formula (where N = Sample size, z = 1.96 (95% confidence), p = a 33% estimated prevalence of anemia in under-five population based on available information, and e = 0.05 at 5% margin of error). Rural children of aged 6-59 months whose guardians provided written consent were included in the study. And children from municipalities, child who need of emergency care and hospitalization, and /or having history of blood transfusion within last three months, were excluded from the study. A predesigned and pretested questionnaire was developed bytheresearchers for data collection. Children were selected purposefully through convenient technique at the EPI outreach centers at community level after approval of the attending guardian. Then parents with eligible child were sent to the assigned laboratory for interview, anthropometry and blood collection. Principal Investigator conducted face-to- face interview of the attending guardian and nutritional anthropometry of target child. After that 5 millilitre (ml) venous blood was drawn for lab tests. The blood was analyzed on the same day with an 'Automated Hematology Analyzer' (Nihon Kohden, Tokyo, Japan) for a Complete Hemogram (haemoglobin%, hematocrit, red cell indices. The degree of anaemia was classified into three categories on the basis of hemoglobin level as defined by the WHO (2001)17. Accordingly, mild anaemia was considered witha Hb% of 10.90 gm/dl, which for moderate and severe anaemia were 7.00- 9.90 gm. /dl and <7.00 gm. /dl respectively. Ethical approval was taken from the Institutional Animal, Medical Ethics, Bio-safety and Bio- security Committee (IAMEBBC) of Institute of Biological Sciences, Rajshahi University. Informed written consents were taken from attending guardian of the selected children. Data were analyzed using SPSS (version 23.0). Continuous data were presented with frequency, means, standard deviation and percentage. For categorical data, initially univariate analysis and chai-squared tests were done to see the association of variables with anaemia. Then only significant independent variables having $p<0.05$ were put together into a logistic regression model to explore the key predictors of anaemia. Association between dependent and independent variables was assessed using odds ratios (OR) at 95% confidence interval (CI). A p-value <0.05 was considered as significant. Time limitation and resource constrain made us possible to collect 258 data of target children during July 2018 to July 2019 from eleven sample upazilla(s) under five districts included 133 (51.6%) children from Joypurhat district; 49 (19.0%) from Dinajpur district; 32(12.4%) from Naugaon district; 25 (9.7%) from Gaibandha district and 19 (7.4%) from Bogura district.

4. Results

Study population was featured with median age 24 months, mean heamoglobin 10.36±1.68 gram/deciliter.

Mother was found as main primary caregiver 241(93.4%) among study population. The ratios of male to female participants were 6:4. Overall prevalence of anaemia was 61.23% (N=258). Of the total male children (n=154), nearly 65% were anaemic and that was 56% in female children (n=104). In our study, the gender has no significant association statistically with the occurrence of anaemia (p = 0.088) (Table 1). Age group 6-24 months occupied the majority (50%) of study children, which was followed by>36–60 months (34%) and >24-36 months (16%) age group with statistically significant association with anaemia (p=<0.001). Family size with ≤2 children (91.1%) and >2 children (8.9%)) was not associated significantly with anaemia (p = 0.23). The family heads' occupation-small business and service had almost equal distribution e.g. 35.5% and 34.5% respectively and that the rest 24.4% and 5.8% had farmer and day labour. Anaemia and family occupations had no significant association (p = 0.11). In regard to monthly family income, among four income group, distributions of study population were nearly equal in the middle two-family income groups (i.e., 33.8% and 31% in (5,001-10,000) Taka (Bangladesh currency) and (10,001- 20,000) Taka groups respectively and rest 11% covered (5,000 taka or below) groups and 24% belonged to (10,001- 20,000) Taka group (Table 1). Monthly family income had was significantly associated with anaemia (p =<0.001) (Table 1). The majority, 58.5% (n = 151) of the total mothers' education level was below primary level and rest 25% & 16% were secondary level and higher level respectively. Maternal education status was significantly associated with children's anaemia (p = 0.001) (Table 2). Children of consanguineous (53.65%) and non-consanguineous (62.56%) parents status had no significant difference (p = 0.30) in anemia occurrence. Anaemia prevalence was nearly 18% higher in non-exclusive breast-feeding group than exclusive breast-feeding children (Table 2) which was statistically significant (p=0.02). Delayed or early weaning practiced children had nearly 25% higher prevalence of anaemia with a statistically significant difference (p < 0.001) than their properly weaning counterpart. Groups belong to regular consumption of animal protein, fruits and vegetable consumption were found lower anaemia prevalence than non-consumption group which were statistically significant respectively (p = 0.001, p=0.001, p=0.001). Plant protein (pulses) intake group had no significant influence on anaemia development (p = 0.064). Underweight, stunted and wasted children all had higher prevalence of anaemia than their normal counterpart which were statistically significant respectively (p=0.022; p=0.006, p = 0.001) (Table 2). Chronic and recent illness of under-five children were found as significant contributor to develop anaemia (p < 0.001). In this study through multivariate logistic analysis, the following predictors of anaemia were prevailed as independent risk factors of anemia. These were 6-24 month aged children {AOR: 0.29 (0.12-0.71); CI: 95%; p = .006}, monthly family income 10000 BDT or below {AOR: 0.27 (0.08-0.74); CI: 95%; p=.01},early or late weaning practiced Children {AOR: 0.23(.09-0.59); CI: 95%; p = .002}, low Consumption of animal protein {AOR: 0.05(.01-0.32); CI: 95%; p = .001}, and vegetable {AOR: 0.18 (0.08-0.45); CI: 95%; p < .001}, stunting (chronic malnutrition) {AOR: 0.36 (0.14-0.96); CI: 95%; p = .04}, wasting (acute Malnutrition) {AOR: 0.14 (0.03-0.82); CI: 95%; p = .03} And children who had chronic or recent infection {AOR: 0.33 (0.14-0.75); CI: 95%; p = .008}.

Table 1. Socio-demographic characteristics in relation with anaemia by univariate analysis (N=258)

Variables	Study population distribution (%) (N = 258)	Anaemia in sub- category (N=158)	Prevalence of anaemia (%)	Chi squire & p-value
Gender:				
Male	154 (59.7%)	100	64.93	χ^2 =22.197, df=1, p=0.088
Female	104 (40.3%)	58	55.77	
Age(months):				
6-24	129 (50%)	93	72.09	χ^2 =17.09, df=2, p=0.000
>24-36	41 (15.9%)	26	63.41	
>36-60	88 (34.1%)	39	44.31	
Educational level of mother:				
Primary enrollment or below	151 (58.5%)	104	68.87	χ^2=13.387, df=2, p=0.001
Secondary enrollment	65 (25.2%)	38	58.46	
Above secondary or higher	42 (16.3%)	16	38.10	
Number of children:				
<2	235 (91.1%)	146	92.40	χ^2=0.874, df=1, p=0.237
>2	23 (8.9%)	12	7.59	
Occupation of household head:				
Service(Public or Private)	89 (34.5%)	54	34.17	χ^2=6.008, df=3, p=0.111
Agriculture	63 (24.4%)	41	25.94	
Small Business	91 (35.3%)	50	31.64	
Day Labor	15 (5.8%)	13	8.22	
Monthly(family) income:				
5000 BDT or below	29 (11.2%)	21	72.41	χ^2 =26.118, df=3, p=0.000
5001-10000 BDT	87 (33.8%)	68	78.16	
10001- 20,000 BDT	80 (31.0%)	45	56.25	
More than 20,000BDT	62 (24.0%)	24	38.71	
Consanguinity of parents:				
Yes	39 (15.1%)	21	53.65%	χ^2 =1.058, df=1, p=0.30
No	219 (84.9%)	137	62.56%	

Table 2. Nutrition and health related factors associated with anemia (N=258)

Variables	Study population (%) (N = 258)	Anaemia in sub- category (n=158)	Percentage prevalence of anemia	Chi squire & p value
Exclusive Breast feeding:				$\chi2$=5.074, df 1 p=0.024
Yes	186 (72.1%)	106	56.99%	
No	72 (27.9%)	52	72.22%	
Timely weaning:				$\chi2$=18.186, df 1 p=0.000
Yes	169 (65.5%)	89	52.66%	
No	89 (34.5%)	69	77.52%	
Animal protein intake :				$\chi2$=26.257, df 1 p=0.000
Yes	210 (81.4%)	113	53.80%	
No	48 (18.6%)	45	93.75%	
Plant protein intake:				$\chi2$=3.425, df 1 p=0.064
Yes	93 (36%)	50	53.76%	
No	165 (64%)	108	65.45%	
Fruits intake:				$\chi2$=17.610 df 1 p=0.000
Yes	141 (54.7%)	70	49.65%	
No	117 (45.3%)	88	75.21%	
Green leafy vegetable:				$\chi2$=14.817 df 1 p=0.000
Yes	150 (58.1%)	77	51.33	
No	108 (41.9%)	81	75	
Underweight:				$\chi2$=5.273, df 1 p=0.022
Yes	40 (15.5%)	31	77.5	
No	218 (84.5%)	127	58.26	
Stunted:				$\chi2$=7.483, df 1 p=0.006
Yes	74 (28.7%)	55	74.32	
No	184 (31.3%)	103	55.98	
Wasted:				$\chi2$=11.114, df 1 p=0.001
Yes	29 (11.2%)	26	89.66	
No	229 (88.8%)	132	57.64	
Chronic illness or recent illness:				$\chi2$=12.867 df 1 p =0.000
Yes	97 (37.6%)	73	75.25	
No	161 (62.4%)	85	52.80	

Table 3. Summarize predictors of anaemia by multivariate logistic regression analysis (N=258)

Variable s	Anaemi a in sub-category (N=158)	Prevalence of Anaemia (%)	AOR (95% CI)	p- value
Age (in month):				
>36-60	39	44.31%	1	
>24-36	26	63.41%	1.12 (0.37-3.44)	0.842
6-24	93	72.09%	0.29 (0.12-0.71)	0.006
Monthly (family) income in BDT:				
More than 20,000BDT	24	38.71	1	
5000 BDT or below	21	72.41	0.27 (0.08-.74)	0.01
5001-10000 BDT	68	78.16	8.84 (1.39-57.66)	0.02
10001- 20,000 BDT	45	56.25	2.27 (0.80-6.43)	0.12
Exclusive Breast feeding:				
Yes	106	56.99%	1	
No	52	72.22%	0.88 (0.32-2.2)	0.08
Timely starting weaning:				
Yes	89	52.66%	1	
No	69	77.52%	0.23 (.09-0.59)	0.002
Animal protein intake at least 4 days/week:				
Yes	113	53.80%	1	
No	45	93.75%	0.05 (0.01-0.32)	0.001
Green leafy vegetable intake :				
Yes	77	51.33%	1	
No	81	75.00%	0.18 (.08-0.45)	0.000
Stunted:				
No	103	55.98%	1	
Yes	55	74.32%	0.36 (0.14-0.96)	0.04
Wasted:				
No	132	57.64%	1	
Yes	26	89.66%	0.14 (0.03-0.82)	0.03
Chronic illness or recent illness:				
No	85	52.80%	1	
Yes	73	75.25%	0.33 (0.14-0.75)	0.008

5. Discussion

This cross-sectional study was conducted to explore the current key predictors of anemia in under five children in the rural areas of Bangladesh. In our study, the overall prevalence of anaemia was observed 61.8% with prevalence in male 64.93% and 55.77% in female children which was higher than the global prevalence of anemia, 24.8% [18]. WHO considers childhood anemia as one of the severe public health problems with a prevalence of more than 40% in Bangladesh [17,18]. Therefore, the prevalence rate (61.8%) of anaemia in under-five children in rural Bangladeshi was in a severe state. However, higher prevalence rate of child anemia has also been observed in some other countries of the world such as Indonesia (58.7%) [19], Benin (82%), Mali (83%) [20] and Ghana (78.4%) [21] whereas, the prevalence rate (61.8%) in Bangladesh is comparably higher than those of neighboring countries Pakistan (33.2%) [22] and India (31.4%) [23] located in the South Asia region. In ourstudy, on the basis of univariate analysis, we observed age, mother's educational level and family's monthly income were significant predictors ($p<0.05$), associated with the high prevalence of anaemia in under five rural children in Bangladesh. Singh S et al, conducted a study in Govt. Medical College, Srinagar, Jammu and Kashmir also observed gender, age, mother's educational level and socio-economic status of the studied patients [24]. According to multivariate analysis, our study revealed, children age group (6-24) months, (AOR=0.29) was highly associated with anaemia in comparison to other age groups. This concurred with prior findings showing that the younger age group demands more nutrients to support the rapid body growth of children [25]. Children above 2 years are able to eat more variety of foods, which put them at less risk of being anemic [26]. Monthly family income 10000 BDT (in 2018AD) or below was found highly associated (AOR: 0.27) with the prevalence of anaemia in rural Bangladesh than >10000 Tk monthly income groups. Probably low earned parents (poverty) could not fulfill nutritional demand of their family adequately. Similar observation was found in the result of a study of Pakistan showed that patients with a monthly income of less than Rs 5,000 (in 2018AD) had a haemoglobin value which was 1 g/dL lower than those with a monthly income of greater than Rs 5,000 [27]. Delayed or early weaning practice was significantly associated (AOR=0.23) with anaemia among the under-five rural children. Complementary foods are started when the children reach 6 months [28]. In our study, nearly 27.9% of children were not exclusively breastfed and 34.5% infant had found as either delayed or early weaning practiced. The early or delayed introductions of complementary foods to the under-five rural children are often of low quality and insufficient quantity in rural Bangladesh due to poverty or superstations or some other reasons and these practices may lead to high level of anaemia in infancy. On the other hand, the complementary foods which the anaemic children usually eat, includes thin plain rice porridge and cow's milk, which are poor sources of iron [29]. In our study, non-consumption of animal protein and green leafy vegetables were also observed significantly associated predictors with anaemia respectively (AOR=0.05) and (AOR: 0.18) among rural children of Bangladesh. These results contain similarity with a study conducted in Brazil, on the title, "Prevalence and Risk Factors of Anaemia in Children," by Zuffo CR et al. (2016) [30]. In this present study, stunted or chronic malnourished (AOR=0.36) and wasted or acute malnourished (AOR=0.14) were observed more susceptible to develop anaemia among the rural children. The similar observation was found in some other studies conducted in Bangladesh and China. In a study in Bangladesh in 2019, by Rahman MS et al. found stunted significantly associated with anaemia (AOR=1.76) ($p=0.01$). Another study, conducted in rural china in 2012, by Yang et al, also found stunted (AOR=1.65) and wasted (AOR=2.89) highly associated predictors. anaemia in under five children in rural China [31,32]. Inthis current study, chronic illness or recent illness were found linked with occurring of anaemia among under five rural children of Bangladesh (AOR=0.33). AJ Madu et al. (2017), also found chronic illness responsible for the prevalence of anaemia [33].

6. Limitations of the Study

Because of resource constrain, this cross-sectional study was confined in northern region of Bangladesh with comparatively small sample size. Therefore, the studyresult may not reflect the exact scenarios of the whole country.

7. Conclusion

In this study following key predictors of anaemia are identified as independent risk factors of anemia among the under-five population in rural Bangladesh. These are 6-24-month aged children, monthly family income is 10,000 BDT or below, early or late weaning practice, low consumption of animal protein and vegetables, stunting (chronic malnutrition), wasting (acute malnutrition) and children who have chronic or recent infection. Mass awareness on those risk factors will be help primary caregiver to prevent anaemia among young children. Further study with extended sample size is needed to find out etiological and morphological pattern anaemia to treat, control and prevent this pediatric public health challenge in Bangladesh.

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