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Key Clinical and Morphological Patterns of Anaemia in Preschool Children in Rural Setting of Bangladesh: A Fact Finding Study

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Abstract **Original Research Article**

Background: Anaemia and its association with low physical and cognitive development in under-five children remain as a common public health burden in developing countries including Bangladesh. Diagnosing anemia with its clinical and morphological pattern is important since it help in directing further investigation, identifying the etiology and most importantly helps in treatment. ***Aim of the study:*** The aim of the study was to find out key clinical and morphological pattern of anaemia among the under-five children in rural community of Bangladesh. ***Methods and Materials:*** A cross-sectional study were conducted at five remote northern districts of Bangladesh involving rural children aged 6 - <60 months. Five millilitre (ml) venous blood was drawn using a sterile syringe and was analyzed with an 'Automated Hematology Analyzer' for complete hemogram. The degree of anaemia was classified into three categories on the basis of hemoglobin level. Chi-squared test and independent sample t test were the main statistical model to identify significant variables. A p-value <0.05 was considered as significant. ***Results:*** Overall prevalence of anaemia (N = 258) was 61.23% with mild, moderate and severe anaemia of 28.29%, 28.68% and 4.26% respectively. Of all anaemic children nearly 7% has been suffering from severe anaemia. The prevalence of anaemia was the highest (72%) in age group 6-24 months, which was followed by 63% in >24-36 months and 44.3% in >36-60 months categories. Morphologically, the most common type of anemia is *microcytic anemia* (80%) followed by normocytic anaemia (19%) in rural settings. Majority of microcytic anaemic children (63%) belongs to 6-24 month age group and normocytic anemia are commonly prevailed (50%) in >36-60 month and (43%) in 6-24 month aged group. Sex has no statistically significant influence on morphological pattern of anaemia (χ^2= .075). ***Conclusion:*** Clinically moderate anemia or mild anaemia is very common in preschool children particularly under 2 year age in rural community. Morphologically the most common type of anemia is *microcytic anemia* in 6-24 month age category. Therefore 6-24 month young children deserve special care in terms of nutrition and micronutrient supplementation.

Keywords: Clinical anaemia, Morphology of anaemia, Microcytic anaemia, MCV, Under-five children

INTRODUCTION

Globally, anaemia is one of the common public health challenges particularly for under-five children. Nearly half of world's under-five population are suffering from anaemia [1] in the present year, anaemia remains as a major cause of mortality and morbidity in developing countries like Bangladesh where resources to determine the underlying etiology remain poor [1]. Anaemia in infant and young children is associated with impairment of cognitive development, low school performance, insufficient physical growth and behavioral development as well as reduces immunity among others. Because of these adverse health and socio-economic consequences, WHO declared anaemia prevalence more than 40% in any population is considered as a major public health problem [2]. Anemia is the second leading nutritional cause of disability with adverse effects on socioeconomic development and productivity [3]. Anemia is significantly associated with fetal low birth weight (LBW), age, sex, rural residence, infant and young child feeding (IYCF) practices, infectious disease (e.g., malaria, tuberculosis, intestinal parasitic infestation), poor socioeconomic status, under-nutrition (e.g., stunting, wasting, and underweight), household

food insecurity, duration of lactation, poor dietary iron intake, maternal illiteracy and maternal anemia are reported as predictors of anaemia [4-7]. Several studies indicated that the prevalence of anemia was higher among younger children below 3 years and anaemia reduces as age progressed [4, 8, 9]. The etiology of anemia among children is multi-factorial [8, 10]. Diagnosing anemia and knowing its pattern is important since it help in directing further investigation, identifying the etiology and most importantly helps in treatment. On the basis of red cell morphology, classification of anaemia is provided etiologic clues such as red cell size (normocytic, microcytic, or macrocytic), degree of hemoglobinization (mild, moderate and severe); reflected in the color of red cells (normochromic or hypochromic); and shape. In general, microcytic hypochromic anaemias are mainly caused by iron deficiency and thalassemia. Macrocytic anaemias are due to impair the maturation of erythroid precursors in the bone marrow mainly caused by vitamin B [11] deficiency and Folic acid deficiency. Normochromic normocytic anaemias have very diverse etiologies including some have specific abnormalities of red cell shape (e.g. hemoglobinopathy) provide important clues about cause [11, 12]. Introducing newer technology of automated cell counters has initiated prompt approach to classify anaemia easily on the basis of MCV and MCH, and MCHC. Bangladesh had very few nationwide studies on children's anaemia assessed through the indicators like total Red Blood Cell (RBC) count, MCV, MCH, MCHC, RWD-CV, vitamin B [11] and folate assay. Especially RBC counts, RWD-CV and RWDi index were found to be relatively newer RBC indices for multiple etiological diagnosis of anaemia through cell-count technique. Very few studies have noticed the relative contribution of these important factors to anemia in rural under-five children of Bangladesh [1, 8]. To control and prevent this problem effectively, health care providers should have a comprehensive understanding of the key morphological and clinical pattern of anemia. Therefore, this study was designed to know the key patterns of anaemia by using these RBC indices among the under-five aged rural children in Bangladesh [13, 14].

OBJECTIVES

To find out clinical degree of anaemia (mild, moderate and severe anaemia) in this target population and to determine the key morphological pattern prevailed among the under-five children in rural community of Bangladesh.

MATERIALS AND METHODOLOGY

Study design, settings, and population

This cross-sectional study was conducted in the rural areas of northern Bangladesh. Eleven Upazillas (sub-district) of five districts were selected purposively as the study settings Under-five children aged 6 - <60 months were the target population. A sample size of 325 was calculated using Cockranch's formula (where N = Sample size, z = 1.96 (95% confidence level), p = 33% estimated prevalence of anemia in under-five population basing on available information, and e = 0.05 at 5% margin of error).

Table 1: Sample districts with corresponding sample upazillas

District	Corresponding upazilla*
Joypurhat	Panchbibi, Jopurhat Sador, Ketlal, Kalai, Akkelpur
Dinajpur	Hakimpur, Ghoraghat
Naugaon	Dhamuirhat, Bodolgachi
Gaibandha	Gobindogong
Bogura	Sibgong

Note: several upazillas form a district.

Rural children of aged 6 - <60 months whose guardians provided written consent were included in the study. Children who were living in urban, municipality area, in need of emergency care and hospitalization, and/or having history of blood transfusion within last three months from the date of data collection were not included.

Data collection tools and techniques

A questionnaire was prepared by principal researcher and tested then questionnaire was finalized with minimum changes. Data was collected consecutively from purposively selected from the study Upazilas. Following an initial face-to-face interview for collecting qualitative data, parents with eligible child were sent to the assigned laboratory. Five millilitre (ml) venous blood was drawn using a sterile syringe (3ml blood were preserved into ethylene ediamine tetra acetic acid (EDTA) vial). The EDTA blood was analyzed on the same day with an 'Automated Hematology Analyzer' (Nihon Kohden,Tokyo, Japan) for a Complete Blood Count (CBC; i.e., haemoglobin percentage, hematocrit), Red cell indices (i.e., MCV, MCH, MCHC, RWD), total count of white blood cell (WBC), differential count of WBC and total platelet count. The degree of anaemia was classified into three categories on the basis of hemoglobin level as defined by the World Health Organization [3]. Accordingly, mild anaemia was considered with a Hb% of 10.00 - 10.90 gm/dl, which for moderate and severe anaemia were 7.00 - 9.90 gm/dl and <7.00gm/dl respectively. Basing on mean corpuscular volume (MCV), anemia were further classified as normocytic (MCV 80–96 fl), microcytic (MCV <80 fl), and macrocytic (MCV >96 fl.

Ethical Clearance

Ethical clearance was obtained from the Institutional Animal, Medical Ethics, Bio-safety and Bio-security Committee (IAMEBBC) of the Institute of Biological Sciences, Rajshahi University (memo no: 83/320/IAMEBBC/IBSC, date: 27 August 2017). Informed written consents were taken from parents of the sample children.

Statistical Analysis

Data were computed and analyzed using SPSS (version 23.0). Univariate analysis, chai-squared tests, students t test were the main models to identify the prevalence of anaemia and signify variables. A p-value <0.05 was considered as significant.

RESULTS

A total 258 under-five children aged 6-59 month were enrolled in this study from July 2018 to July 2019. Data were collected from eleven rural upazilla(s) of five districts included 133 (51.6%) children from Joypurhat district (Panchbibi, Jopurhat Sador, Ketlal, Kalai and Akkelpur Upazilla); 49 (19.0%) from Dinajpur district (Hakimpur and Ghoraghat Upazilla); 32(12.4%) from Naugaon district (Dhamuirha and Bodolgachi Upazila); 25(9.7%) from Gaibandha (Gobindogong Upazila) and 19 (7.4%), from Bogura (Sibgong Upazila). Among study children 158(61.8%) had anaemia and 100(38.2%) had normal heamoglobin level. Study population were featured with median age 24 month, mean hemoglobin 10.36±1.68 gm/dl and mean corpuscular volume (MCV) 75.93±9.7fL. Mother was found as main primary caregiver (93.4%) for (N=258) study children.

Table 1: Socio-demographic characteristics of study population in relation with anaemia (n=258)

Variables	Study population (%) (N = 258)	Anaemia in sub-category (n=158)	Percentage prevalence of anaemia	*Chi squire & p* value
Gender				χ^2=22.197, df 1
Male	154 (59.7%)	100	64.93%	*p*= 0.088
Female	104 (40.3%)	58	55.77%	
Age (in month)				χ^2=17.09, df 2
6-24	129 (50%)	93	72.09%	
>24-36	41 (15.9%)	26	63.41%	*p*=0.000
>36-60	88 (34.1%)	39	44.31%	
Religion or ethnicity				χ^2=4.297, df 2
Islam	229 (88.8%)	145	63.32%	
Hinduism	22 (8.5%)	9	40.90%	p=0.117
Indigenous	7 (2.7%)	4	57.14%	
Educational level of mother				χ^2=13.387, df 2
Primary enrollment or below	151 (58.5%)	104	68.87	
Secondary enrollment	65 (25.2%)	38	58.46	p=0.001
Above secondary or higher	42 (16.3%)	16	38.10	
Number of children				χ^2=0.874, df 1
≤2	235 (91.1%)	146	62.13	p=0.237
>2	23 (8.9%)	12	52.17	
Occupation of household head:				χ^2=6.008, df 3
Service (Public or Private)	89 (34.5%)	54	60.67	
Agriculture	63 (24.4%)	41	65.07	p=0.111
Small Business	91 (35.3%)	50	54.95	
Day Labor	15 (5.8%)	13	86.66	
Monthly (family) income				χ^2=26.118, df 3
5000 BDT or below	29 (11.2%)	21	72.41	
5001-10000 BDT	87 (33.8%)	68	78.16	p=0.000
10001- 20,000 BDT	80 (31.0%)	45	56.25	
More than 20,000BDT	62 (24.0%)	24	38.71	

Among the study population 59.7% were male children and 40.3% were female children (N=258). 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. Study children mostly 88.8% belongs to Muslim family followed by 8.5% Hindu family and 7(2.7%) from Indigenous Community. Family size with ≤2 children were (91.1%) and rest were >2 children (8.9%). 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. 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. The majority, 58.5%

(151) of the total mothers' education level was below primary level and rest 25% & 16% were secondary level and higher level respectively. On the issue of consanguinity, 84.9% children were from consanguineous parents whereas 15.1% children from non-consanguineous parents (Table-1).

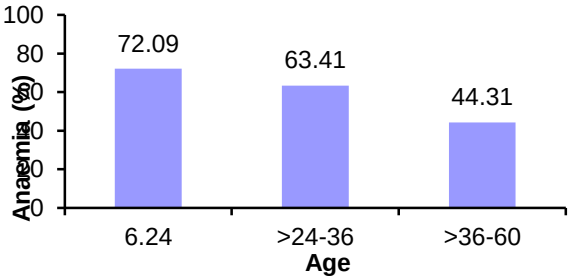

Fig 1: Shows percent prevalence of anaemia with Age (N = 258)

Table 2: Laboratory parameters and RBC indices of study children (N = 258)

Laboratory parameters	Mean (95% CI) with SD			*Independent sample t test (2 tailed) & p value*
	Study Population (N=258)	With anaemia (n=158)	No anaemia n=100	
Heamoglobin level g/dl	10.36±1.68	9.44±1.43	11.82±0.74	t= -15.83, p = 0.000
Hematocrit (HCT) %	32.82 ±4.52	30.64±4.06	36.27±2.69	t= -12.26, p = 0.000
RBC count m/cumm	4.34±0.52	4.28±0.56	4.43±.46	t= -2.24, p = 0.026
MCV fL	75.93±9.87	72.26±8.88	81.71±8.51	t= -8.46, p = 0.000
MCH pg	24.11±3.61	22.57±3.26	26.53±2.70	t= -15.83, p = 0.000
MCHC g/dl	31.50±1.48	30.98±1.47	32.33±1.03	t= -10.40, p = 0.000
RWD-CV %	17.13±3.80	17.99±4.47	15.76±1.62	t= 4.79, p = 0.000

Laboratory parameters (RBC indices-) with mean value and standard deviation of Hemoglobin, Hematocrit, RBC count, MCV, MCH, MCHC and RWD CV presented as anaemic and non anaemic group with their t test. All parameter were compared and found significant statistically (Table-2).

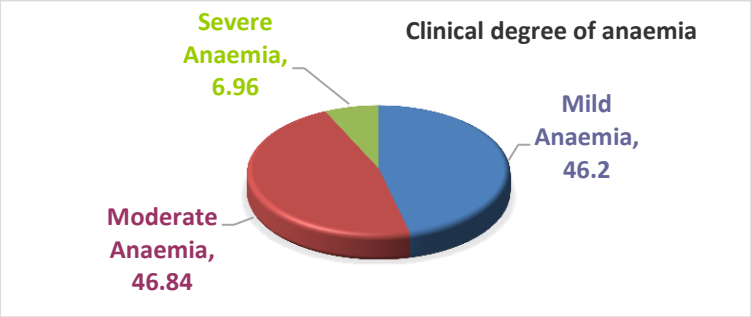

Fig 2: Pie chart shows clinical type of anaemia (n=158)

Among the anaemic children (*n* = 158), mild (Hb% 10-<11 gm/dl) and moderate (Hb% 7-<10 gm/dl) degree of anaemia were nearly equally distributed 46.2% and 47% respectively, whereas severe anaemia (Hb% <7 gm/dl) was only 7 % (*n* = 158) (Fig 2). Mild and moderate anaemia were found with nearly same prevalence 46.2% and 46.84% respectively and severe anaemia was nearly 7% (Fig 3).

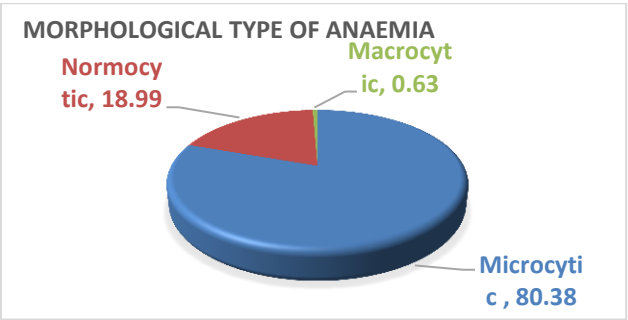

Fig 3: Pie chart shows morphological type anaemia on the basis of MCV (N=158)

Morphologically *microcytic anaemia* is found as the main (80.38%) contributor followed by *normocytic anaemia* with 19% and *macrocytic anaemia* less than 1% (Fig-3).

Table 3: Age and morphological pattern of anaema (N=158)

Morphological type	Microcytic Anaemia (n=127)	Normocytic Anaemia (n=30)	Macrocytic Anaemia (n=1)	Chi-square
6-24 month	80(63.0%)	13(43%)	0	
>24-36 month	24(18.90%)	02(07%)	0	χ^2= .002
>36-60 month	23(18.10%)	15(50%)	1(100%)	

Age has significant relation (χ^2= .002) with morphological pattern of anaemia in our study (Table 3). Majority (63%) of microcytic anaemia belongs to the age 6-24 month followed by two other age groups equally (18%) . Normocytic anemia most commonly (50%) prevailed in >36-60 month age group followed by 43% in 6-24 month age category. Only 1(100%) macrocytic anaemia has belongs to the age group of >36-60 month. In our study sex and morphological pattern have no statistically significant relation (χ^2= .075).

DISCUSSION

This study was undertaken to find out key clinical and morphological pattern of anaemia among the under-five children in rural community of Bangladesh. In our study the overall prevalence of anaemia (N = 258) was 61.23%. So, it is clear high prevalence of anaemia is a major public health issue of children in northern Bangladesh. In some other studies in India, Kenya, Tanzania and South Africa, the prevalence of anaemia in under-five children ranging 69%-79% was observed in under-five population [14-17]. In our study, there was a higher prevalence of anaemia (72%) among children under the age of two and it decreased (44%) as the age of the children progressed (upto 60 month). In our study males were suffered (nearly 65%) anaemia more than female (55%) with no statistical significance. This result is similar to a study conducted by Roosy et al, where she found 70% of male and 30% of girls [18] had anaemic. In this present study prevalence of anaemia had a significant relation with family income and mother's level of education. Similar findings were observed by Allen L *et al*., & Ali D *et al*., in their studies [19, 20]. Among under-five population, the prevalence of mild, moderate and severe anaemia were observed as 28.29%, 28.68% and 4.26% respectively. Mild and moderate anaemia accounted nearly equally, 30% each, may be due to nutritional deficiencies and socio-demographic related factors in rural Bangladesh. Lack of education and lack of proper dietary routine plays a significant role for having such degrees of anaemia. In a study in India, the prevalence of mild, moderate and severe anaemia were 26.2%, 40.4%, 2.9% respectively [21], which is similar to our findings. Simbauranga *et al*., noted nearly similar trend of moderate anaemia in Tanzania was33% [22]. In present study the percentage proportion of mild, moderate and severe anaemia among anaemic children were 46.86%, 46.20% and 7% respectively. Thus the study findings show an overall dominance of either moderate anemia or mild anaemia in preschool children in all studies including our present study. Muoneke *et al*., [23] reported a 9.7% prevalence of severe anaemia in similar settings in Nigerian under-five children which is higher than our findings (4.26%). The difference might be due to the role of socioeconomic factors, regional differences and other demographic factors in different studies. For the evaluation and management of anemia, morphological types provide a clue to the underlying cause. In the present study, the most common types of morphological anemia are identified as microcytic anemia (80%) followed by normocytic anemia (19%) and macrocytic anemia (1%). In our study, we have also found, age has statistically (χ^2= .002) significant relation with morphological pattern of anaema. Majority (63%) of microcytic anaemia belongs to 6-24 month age group. Normocytic anemia are commonly prevailed in >36-60 month and 6-24 month age categories. In our study sex has no statistically significant influence on morphological pattern of anaemia. Similar observation was noted in some other studies [24-26].

Limitations of the study

Because of resource and time limits, this study followed convenient purposive sampling technique with relatively smaller sample size. So, study may not reflect the total scenario of whole Bangladesh. Furthermore, the study was conducted through automated cell count technology. Therefore, dimorphic category of anaemia was not detected.

CONCLUSION

In our study childhood anaemia prevalence is high with common occurrence of moderate anemia or mild anaemia in rural community particularly in young children below the age 2. Nearly 7% anaemic children have been suffering from severe anaemia, which is alarming. Morphologically *microcytic anemia* (80%) (assume nutritional) is the most common type of anemia in rural settings. In our study, age categories have significant (χ^2= .002) impact on morphological pattern of anaema. Majority of microcytic anaemic children (63%) belongs to 6-24 month age group. Normocytic anemia are commonly prevailed in >36-60 month and 6-24 month age group. Therefore 6-24 month aged young children are most susceptible to develop microcytic as well as clinically mild to moderate anaemia.

RECOMMENDATIONS

Young children, below the age of 2 year, deserve special care in terms of nutrition and micronutrient supplementation. Further large scale study is needed to explore etiological diagnosis from microcytic, normocytic and macrocytic anemia by using newer determinants like serum ferritin, Hb electrophoresis, reticulocyte count, serum B12 and serum folate assay.

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