

# Prevalence and Risk Factors of Iron Deficiency Anaemia in Children admitted in a Tertiary Care Hospital of Bangladesh

Hoque MM<sup>1</sup>, Ahmed ASMNU<sup>2</sup>, Quaderi H<sup>3</sup>

## Abstract

**Introduction:** Anaemia is a common problem in childhood. In Bangladesh, overall 68% of children aged 6-59 months are anaemic. Anaemia impairs normal growth and development, decreases physical exercise tolerance and intellectual performance in children. The objective of this study was to find out the prevalence and risk factors for iron deficiency anaemia in hospitalized children aged 6 to 36 months. **Materials and Methods:** Eligible children admitted in Dhaka Shishu (Children's) Hospital due to any acute illness, were enrolled from 1<sup>st</sup> June 2010 to 30<sup>th</sup> August 2010. Anaemia (Hb <11gm/dl) was classified as microcytic, normocytic or macrocytic. Peripheral blood film, serum ferritin, haemoglobin electrophoresis, serum C-reactive protein and stool microscopy were done. Risk factors were looked for in cases of iron deficiency anaemia. **Results:** Among 331 enrolled children, 201 (61%) had anaemia, among them 63 (31%) had iron deficiency anaemia. Lower the socioeconomic status, higher was the rate of anaemia. Prematurity and low birth weight was significantly associated with anaemia. Poor feeding practices including colostrum rejection, non-exclusive breastfeeding, early/late weaning and inappropriate weaning diet were important risk factors. Gender was not found as a risk factor. **Conclusion:** A large proportion of hospitalized children under three years of age were found anaemic, among them iron deficiency anaemia was most common. The study result emphasizes the importance of identifying the risk factors of anaemia in this age group. Raising awareness of the problem and providing health and nutrition education will be the key interventions to prevent and control this huge public health problem in Bangladesh.

**Key words:** Anaemia, Infants, Iron deficiency, Prevalence, Risk factors

## Introduction

Anaemia is a common problem in childhood especially affecting children aged 6-24 months. It has been estimated that among children below four years of age, 12% are anaemic in developed countries while 51% in the developing world<sup>1</sup>. In Bangladesh, 64% of children aged 6-23 months and 42% of children aged 24-59 months are anemic<sup>2</sup>. Anaemia is primarily associated with nutritional

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deficiencies such as iron deficiency, the main factor responsible for microcytic anaemia; while folate or vitamin B<sub>12</sub> deficiencies are responsible for macrocytic anemia<sup>3,4</sup>.

Aetiology of anaemia in tropical countries is multifactorial. It has been noted that infants breastfed for more than 6

months without receiving iron fortified complementary foods or iron supplementation are at risk of developing iron deficiency anaemia (IDA)<sup>5,6</sup>. Other risk factors for anaemia include low birth weight, unusual perinatal haemorrhage, prolonged consumption of large amounts of cow's milk, and intestinal infection, such as hookworms and diarrhoea<sup>7</sup>.

Iron deficiency is the most profound form of nutritional deficiency in developing and developed countries<sup>3,8</sup>. According to the World Health Organization (WHO), IDA affects 43% of the world's children,<sup>1</sup> while UNICEF reported that around two billion people globally suffer from anaemia with the highest proportion suffering from IDA, especially in developing countries, where 40-50% of children under age 5 are iron deficient<sup>9</sup>.

Anaemia impairs normal development in children and it constitutes a major public health problem in young children in the developing world with wide social & economic implications. Even mild anaemia can decrease physical exercise tolerance and intellectual performance of children. Anaemia may also cause growth retardation in children<sup>3</sup>. Furthermore, iron deficiency, leading to anaemia, is found to be associated with abnormalities in cell-mediated immunity and the ability of neutrophils to kill several types of bacteria<sup>10</sup>, along with poorer psychomotor development and behaviour changes of young children<sup>11,12</sup>. Iron is necessary for maintaining normal structure and function of virtually all mammalian cells and is also involved in the immune and non-immune host defence.<sup>13</sup> Data suggests that infants with IDA are at higher risk for long-lasting developmental disturbance, when compared to their healthy peers<sup>14,15</sup>.

Thus it has been suggested that infants and toddlers should be screened for anaemia, especially IDA. This study was to assess the contribution of several presumed risk factors for the occurrence of iron deficiency anaemia in six months to thirty six months old hospitalized children who were admitted due to other acute illnesses.

## Materials and Methods

**Study site:** This cross-sectional study was conducted in Dhaka Shishu (Children's) Hospital (DSH) over a period of three months from 1<sup>st</sup> June 2010 to 30<sup>th</sup> August 2010. DSH is the largest tertiary care paediatric teaching hospital in Bangladesh that provides care to the children from all over the country. It has a large Out-patient Department (OPD) and an In-patient Department with 550 beds that includes different subspecialties.

**Study Population:** Children aged six months to thirty six months, who were admitted during this period due to any acute illness like acute respiratory tract infection, acute gastroenteritis, etc., and whose parent or guardian provided informed consent, were eligible for enrolment. Children who have been suffering from chronic illness such as haematological and renal disorders, severe malnutrition, persistent diarrhoea etc. were excluded from the study, also children who received blood transfusion before admission due to any cause were excluded.

At enrolment a detailed case history was taken and thorough physical examination was performed and recorded on standard case record forms. Historical information included socioeconomic status (parents' education and monthly income), birth history (prematurity, low birth weight) and detailed feeding practice since birth was recorded. Based on monthly income, socioeconomic status was defined as: low income Bangladesh Taka (Tk.) <5,000, lower-middle Tk. 5,000 to 20,000, and upper class Tk. >20,000.

**Laboratory investigations:** Complete blood count (CBC) including peripheral blood film was done in all cases on enrolment. A blood sample (2 ml) was collected by venepuncture into an ethylenediaminetetraacetic acid (EDTA) coated tube. The coulter counter machine was used for haemoglobin (Hb) measurement, erythrocyte count and mean red cell volume. The mean corpuscular volume (MCV) was derived from these values.

Anaemia was defined when Hb level was below <11 g/dL according to World Health Organization (WHO)<sup>16,17</sup>. Children were categorized as children with anaemia (Hb <11gm/dl) and children without anaemia (Hb ≥11gm/dl). Anaemia was labelled as mild (Hb 10-10.9gm/dl), moderate (Hb 7-9.9gm/dl), and severe (Hb <7 gm/dl)<sup>18</sup>. Furthermore, on the basis of RBC morphology from peripheral blood film, anaemia was classified as microcytic (MCV < 80 fl), normocytic (MCV 80–100 fl), and macrocytic (MCV >100 fl)<sup>19</sup>.

In addition, if peripheral blood film showed microcytic hypochromic RBC, further investigations for serum ferritin (2 ml blood, collected in a plain test tube for the measurement of serum ferritin by immunoenzymometric examination), stool routine and microscopic examination, haemoglobin electrophoresis and C-reactive protein (CRP) were performed. Iron deficiency anaemia was defined when concentration of serum ferritin were less than 12 microgram/L<sup>18</sup>. Serum Iron and TIBC could not be performed due to financial reason.

**Ethical issues:** Ethical permission was taken from Ethical Review Committee of Bangladesh Institute of Child Health. Informed written consent was obtained from parents or primary caregivers of the children before enrolment. Results of laboratory tests were communicated to the parents. Advice for prevention of anaemia was given and correction was done when needed.

**Statistical analysis:** The data were entered and analyzed using SPSS version 12.0 for Windows (SPSS Inc, Chicago, IL, USA) software. Standard test for significance using Chi-square ( $\chi^2$ ) test and multivariate predictor analysis were performed. A p-value of <0.05 was considered as statistically significant.

**Sample size:**

Using the anaemia prevalence of 68% in a similar age group as reported in a previous survey, we estimated a sample size of 335 children based upon the following formula:

$$N = \frac{t^2 \times p(1-p)}{m^2}$$

where N = sample size, t = confidence level of 95% (= 1.96), p = estimated prevalence of the variable, and m = margin of error at 5-10% (5% = 0.05).

**Results**

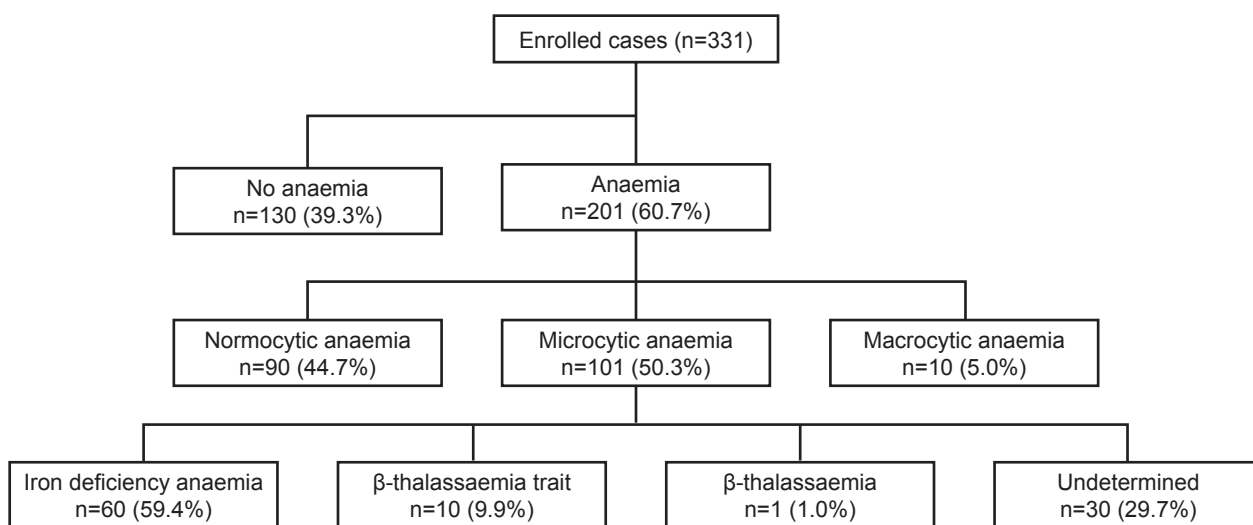
A total of 384 children were screened during the study period, among them 331 cases were enrolled. Fifty-three (13.8%) cases could not be enrolled because of not giving consent for venepuncture (n=46) or insufficient collection of blood for estimation of serum ferritin (n=7). Out of the 331 enrolled children, 201 (60.7%) had anaemia (Hb <11gm/dl) while 130 (39.3%)

had normal haemoglobin concentration (Hb  $\geq$ 11gm/dl). Among the anaemic children, 63 (31.3%) had mild anaemia, 130 (64.7%) were moderately anaemic and 8 (4%) were severely anaemic. Microcytic anaemia was observed in 101 (50.2%) cases, macrocytic anaemia in 10 (5%) cases and normocytic anaemia in 90 (44.8%) cases. Among 101 patients with microcytic hypochromic anaemia, IDA was identified in 60 (59.4%) cases,  $\beta$ -thalassaemia trait in 10 (9.9%) cases and  $\beta$ -thalassaemia in one (1%) case. However 30 (29.7%) cases were left undetermined. Prevalence of IDA among the total anaemic children was 30% (60 out of 201). The undetermined cases were those who had serum ferritin level >12 microgram/ L, a normal Hb electrophoresis pattern, and a high CRP level.

Among 205 male children, 123 (60%) were anaemic and among 126 female children, 78 (62%) were anaemic; the difference between gender was not statistically significant. Anaemia had direct relationship with socioeconomic status, lower the socioeconomic status, higher the rate of anaemia (Table 1).

Premature birth and low birth weight were found to be significantly associated with occurrence of anaemia (Table 2).

Poor feeding practices like colostrum rejection, non-exclusive breastfeeding, early/late weaning and inappropriate weaning diet are important risk factors for childhood anaemia (Table 3). These factors are significant contributors to the occurrence of anaemia as confirmed by multivariate analysis for the risk factors (Table 4).  $\beta$ -thalassaemia and  $\beta$ -thalassaemia trait were excluded during analysis of risk factors for iron deficiency anaemia.



**Fig 1:** Study Profile

**Table 1:** Distribution of the Study Patients according to Socioeconomic Status (n=320)

	Socioeconomic status					
	Poor (n=121)		Lower middle (n=74)		Upper middle (n=125)	
	n	%	n	%	n	%
Anaemia (190)	90	74.4	39	52.5	61	48.8
No anaemia (130)	31	25.6	35	47.5	64	51.2

**Table 2:** Distribution of the Study Patients according to Birth History (n=320)

Birth history	Children with anaemia (n=190)		Children without anaemia (n=130)		p value
	n	%	n	%	
Premature birth:					<0.001 <sup>a</sup>
Present	26	10.4	3	2.3	
Absent	164	89.6	127	97.7	
Low Birth Weight:					<0.001 <sup>b</sup>
Present	29	10.6	3	2.3	
Absent	161	89.4	127	97.7	

$\chi^2=11.15$ ,  $df=1$ ,  $p$  value <0.001<sup>a</sup>

$\chi^2=13.23$ ,  $df=1$ ,  $p$  value <0.001<sup>b</sup>

**Table 3:** Distribution of the Study Patients according to Feeding History (n=320)

Feeding history	Group A (n=190)		Group B (n=130)		p value
	n	%	n	%	
Colostrum given	146	76.8	120	92.3	0.001*
Exclusive breast feeding	75	39.5	78	60	0.001*
Mixed feeding	97	51.1	43	32.3	0.001*
Prolonged breast feeding (after 6 month without weaning)	42	22.1	10	7.7	0.001*
Early weaning	72	37.9	25	19.2	0.001*
Late weaning	48	25.3	16	12.3	0.002*
Received anthelmintic	35	18.4	33	25.4	0.134

\*Statistically significant

**Table 4:** Multivariate analysis of risk factors of anaemia among hospitalized children (n=320)

Risk Factors	Adjusted OR	95% CI		P Value
		Lower	Upper	
Low birth weight/prematurity	5.28	1.44	19.44	0.012*
Prolonged breast feeding (after 6 month without weaning)	3.47	1.56	7.72	0.002*
Early weaning	2.44	1.18	5.04	0.001*
Socioeconomic status (poor)	1.74	1.08	2.81	0.032*
Colostrum feeding	0.45	0.19	1.08	0.073
Exclusive breast feeding	1.48	0.54	4.09	0.451
Late weaning	1.42	0.53	3.79	0.486

\*Statistically significant

## Discussion

Anaemia adversely affects immunity, growth, and cognitive development, which affects school performance and social development<sup>20</sup>. The prevalence of anaemia varies widely between the countries.

Different surveys in the past have shown that anaemia is a severe problem in Bangladesh among all ages, population and geographic groups<sup>21,22</sup>. In this study, 60.7% (n=201) children had anaemia, which is similar to the findings of the National Surveillance Project (NSP) of Helen Keller International (HKI) in collaboration with

the Institute of Public Health Nutrition (IPHN) which revealed that overall 68% of Bangladeshi children aged 6-59 months had anaemia<sup>23</sup>. The prevalence of anaemia in the neighbouring country of India was 74.3% for 6-35 months age group, Nepal had 78% for 6-59 months age group and in Kazakhstan anaemia prevalence was found to be at 73.7% for 0-23 months age group<sup>24</sup>. This study did not find any gender disparity in the occurrence of anaemia which is in contrast to a similar study done in Bangladesh that found boys to be more anaemic than girls<sup>25</sup>.

In this study, among the anaemic cases, the undetermined cases were 30 (29.7%). With regard to the undetermined cases, it could be argued that as ferritin is an acute phase reactant, it increases by two to four folds in infections, which reduces its diagnostic value. So a majority of undetermined cases of anaemia might be a case of IDA which could be detected if subsequent follow up was done.

The occurrence of microcytic anaemia was high in this study. The prevalence of IDA among the anaemic babies has been shown to be higher in other developing countries, such as South Benin, Africa (62%)<sup>26</sup> Argentina (46%)<sup>5</sup> and Pakistan (67%)<sup>27</sup>. The high prevalence of iron deficiency could be attributed to the high prevalence of nutritional inadequacy, intestinal parasite infestation, and the high consumption of pasteurized unfortified cow's milk in these regions. The prevalence of iron deficiency, however, is much lower in developed countries, e.g. United States (9%)<sup>28</sup>, and European countries (7%)<sup>29</sup>. The lower prevalence of ID in these developed countries is attributed to several factors: improved socio-economic status, avoidance of cow's milk feeding during the first year of life, and improvement in the childhood iron nutrition after implementation of special supplemental food programmes for women, infants and children (e.g. the WIC programme in USA)<sup>30</sup>. This study also confirms anaemia to be more common in the low socio-economic class, among whom the adverse consequences of anaemia on health, nutrition and livelihoods are most serious. In this study majority of the anaemic children (66.2%) came from poor and lower middle class family while 35.8% came from upper middle class family (Table 1).

Prematurity, low birth weight and poor complementary feeding practices were responsible for anaemia in this age group in Bangladesh. In this study, anaemia was found to be significantly associated with low birth weight and prematurity. Healthy normal weight newborns usually have adequate iron stores

up to six months of life, provided they are exclusively breastfed. However, 36% of infants in Bangladesh are born with low birth weight<sup>31</sup>, and with low body iron stores that are quickly exhausted in the first few months of life. Furthermore, only 42% of Bangladeshi infants are exclusively breastfed for six months<sup>32</sup>, and the quality, quantity and frequency of complementary feeding is inadequate to meet their requirements from six months of age.

## Conclusion

A large proportion of hospitalized children under three years were found anaemic. Among all anaemic children IDA, was most common. This study emphasizes the importance of identifying the risk factors of anaemia in this age group, namely prematurity, low birth weight and poor complementary feeding practices.

## Recommendation

Raising awareness of the problem and providing effective health and nutrition education in general will be the key interventions to prevent and control this huge public health problem in Bangladesh.

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**Conflict of Interest:** None.

**Permission from IRB:** Yes, Bangladesh Institute of Child Health

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