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Factors causing anemia among children living around Darbhanga attending Pediatric department of Darbhanga Medical College & Hospital, Bihar, India

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Abstract
Anemia is one of the important health problems in India and also in many other parts of the world. Anemia in children is an important social health problem. Nearly half of the school going children in the developing countries are anemic. Anemia in infants is associated with growth retardation, delayed motor development, poor cognitive abilities, reduced social performance and impaired immune system. Anemia is also associated with increased mortality and morbidity. Most of the children with anemis are asymptomatic and infrequently manifest with pallor, weakness, jaundice, tachypnoea, tachycardia and cardiac failure which results from severe anemia regardless of its cause. Since the clinicopathological patterns of anemia in children are reflected by their underlying etiopathogenetic factors, it is important to study the clinicopathological patterns of anemia to establish their causes. This study is intended to be carried out with an aim to determine the prevalence, patterns and various hematological types of anemia in children. Hence based on these findings the present study was planned for socio clinical study of prevalence and relationship of anemia among pediatric cases referred to Darbhanga Medical College & Hospital.
The present study was planned in the Department of Paediatrics, Darbhanga Medical College & Hospital, Laheraisarai, Bihar. Total 760 cases of the childrens referred to the department were evaluated in the present study. Out of 760 cases only 64 cases were found positive for the anemia were evaluated and discussed with the already reported literature.
The data generated from the present study concludes that anemia is a major health problem among well-nourished school children belonging to better socio-economic classes. Routine iron supplementation for all groups of children would be of benefit in decreasing the wide prevalence of this problem. There is a need for urgent community participation strategies in the form of counseling the parents for child feeding practices, immunization and sickness recognition from the first year of life. Preventive measures for anemia control in children must be accompanied by measures to prevent underweight and stunting by focusing on integrated child feeding, health and environmental core measures.

Keywords: Anemia, childrens, Hemoglobin levels, etc

Introduction
Pediatric anemia refers to a hemoglobin or hematocrit level lower than the age-adjusted reference range for healthy children. Physiologically, anemia is a condition in which reduced hematocrit or hemoglobin levels lead to diminished oxygen-carrying capacity that does not optimally meet the metabolic demands of the body.
Anemia is not a specific disease entity but is a condition caused by various underlying pathologic processes. It may be acute or chronic. This article provides a general overview of anemia, with an emphasis on the acute form. In addition, conditions are emphasized in which anemia is the only hematologic abnormality. The combination of anemia with leukopenia, neutropenia, or thrombocytopenia may suggest a more global failure of hematopoiesis, caused by conditions such as aplastic anemia, Fanconi anemia, myelofibrosis, or leukemia, or may suggest a rapid destruction or trapping of all blood elements, such as hypersplenism, localized coagulopathy in a large hemangioma, or hemophagoctic lymphohistiocytosis (HLH) or macrophage activation syndrome (MAS).
The main physiologic role of red blood cells (RBCs) is to deliver oxygen to the tissues. Certain physiologic adjustments can occur in an individual with anemia to compensate for the lack of oxygen delivery. These include (1) increased cardiac output; (2) shunting of blood to vital organs; (3) increased 2,3-diphosphoglycerate (DPG) in the RBCs, which causes reduced oxygen affinity, shifting the oxygen dissociation curve to the right and thereby enhancing oxygen release to the tissues; and (4) increased erythropoietin to stimulate RBC production.
The clinical effects of anemia depend on its duration and severity. When anemia is acute, the body does not have enough time to make the necessary physiologic adjustments, and the symptoms are more likely to be pronounced and dramatic. In contrast, when anemia develops gradually, the body is able to adjust, using all 4 mechanisms mentioned above (1, 3, and 4 in most cases), ameliorating the symptoms relative to the degree of the anemia.
Many studies have shown the deleterious effects of iron deficiency anemia or iron deficiency without anemia on the neurocognitive and behavioral development in children. Other complications can include congestive heart failure, hypoxia, hypovolemia, shock, seizure, and acute silent cerebral ischemic event (ASCIE; see Magnetic resonance imaging in research settings in Workup) [1].
To evaluate anemia, obtain initial laboratory tests, including the complete blood count (CBC), reticulocyte count, and

review of the peripheral smear. Chest radiography is performed in patients who may have congestive heart failure (CHF) and to rule out mediastinal mass (associated with acute leukemia). Abdominal ultrasonography is used to assess for gallstones or splenomegaly in hemolytic anemia, while computed tomography (CT) scanning is used to evaluate occult bleeding in blunt trauma (eg, splenic rupture, subcapsular hemorrhage of the liver) or a bleeding disorder. Abdominal Doppler study is used to detect portal vein thrombosis.

Transfusion with packed red blood cells (PRBCs) is the universal treatment for most individuals with severe acute anemia. The indication to transfuse should not be based solely on the hemoglobin or hematocrit levels; more importantly, one must consider the clinical effects or the signs and symptoms of the individual with anemia [2].

Girls with heavy and/or prolonged menstrual periods should seek medical attention (should tell parents to obtain CBC count). One of the most common reasons for fainting spell or syncope in adolescent girls is rapidly developing anemia due to menstrual blood loss. Toddlers who drink more than 24 oz of milk a day most likely have iron deficiency. Primary care physicians should inquire about the amount of milk intake [3].

Children diagnosed with anemia should be taught to look at their stool color and to report to their parents if it is tarry or bloody. Educate the patient and/or the family about the specific disease that causes the anemia. For example, provide a list of drugs, food, and other agents to avoid because of their effect of triggering acute hemolysis in glucose-6-phosphate dehydrogenase (G-6-PD) deficiency. In pediatrics beyond the immediate neonatal period, acute anemia is rare in otherwise healthy children. In most instances, it is due to blood loss, usually through the GI tract or via a heavy menstrual period. The most common reason for hospitalization because of acute anemia is so-called aplastic crisis in children with chronic hemolytic anemia who otherwise had been stable. The most common varieties are hereditary spherocytosis and sickle cell disease. Therefore, it would be prudent to educate parents regarding this complication, at the time when the diagnosis is established.

Among all races, ages, and socioeconomic groups studied, an overall steady decline (from 7.8% in 1975 to 2.9% in 1985) in prevalence of anemia in the US pediatric population (aged 6 mo to 6 y) has been observed. Data showed continued decline in the prevalence of anemia from the mid-1980s to the mid-1990s [4]. Iron deficiency was the most common etiology.

A prevalence study of anemia on selected groups using the National Health and Nutrition Examination Surveys covering 1988-1994 and 1999-2002 showed a decrease in the prevalence of anemia from 8% to 3.6% in children aged 12-59 months and from 10.8% to 6.9% in women aged 20-49 years. However, no significant change in the prevalence of iron deficiency anemia was seen in either group [5].

In developing nations, the prevalence of anemia is extremely high. This is particularly true in preschool-aged children, in whom the prevalence reached as high as 90% of the sample population studied. Although iron deficiency is identified as the major factor, the etiology is often multifactorial, including recurrent or chronic infections (bacteria, parasites), malnutrition, and reduced immunity.

In addition, the prevalence of certain hereditary forms of anemia (eg, thalassemia, sickle cell disease) varies with ethnicity and, thus, with geography. For instance, α thalassemia, which may be the most common single gene disorder in the world, has a frequency of as much as 68% in the southwest Pacific, 20-30% in western Africa, and 5-10% in the Mediterranean region. Beta thalassemia mutations have high frequencies in the Mediterranean, northern Africa, Southeast Asia, and India, but they have low frequencies in Great Britain, Iceland, and Japan.

A study by Mujica-Coopman *et al* of anemia rates in children under age 6 years in Latin America and the Caribbean found the lowest rates in Chile (4.0%), Costa Rica (4.0%), Argentina (7.6%), and Mexico (19.9%). Anemia was found to pose a severe public health threat in Guatemala, Haiti, and Bolivia [6].

A study by Aladjidi *et al* estimated that in the Aquitaine region of France, the incidence of the rare disease autoimmune hemolytic anemia in persons under age 18 years is 0.81 per 100,000 per year [7]. Acute anemia is universal, but the likely underlying etiologies are influenced by race. Inherited red cell disorders are predominant in certain racial populations, such as sickle cell disease in black persons, β thalassemia in persons of Mediterranean ethnicity, and α thalassemia in Asians, African Americans, and others [8].

Sex predisposition to anemia varies according to the underlying etiology. For instance, certain hereditary X-linked red cell disorders (eg, G-6-PD deficiency) are observed in males. Anemia caused by blood loss can be observed in males with an X-linked bleeding disorder (eg, hemophilia). Females with the autosomally inherited von Willebrand disease may be anemic because of heavy blood loss during menstruation. Even without this disorder, they have a high risk of developing iron deficiency and iron deficiency anemia, quite often worsened by acute blood loss. Acquired hemolytic anemia related to autoimmune disorders such as systemic lupus erythematosus is more common in females because of their relative predisposition to autoimmune disease.

Acute anemia most commonly occurs among newborns. Significant blood loss can occur from birth trauma or blood exchange from the baby's mother (feto-maternal transfusion) or the placenta. Isoimmune anemia can result from maternal antibodies crossing the placenta. Neonates have a shorter red cell life span and limited erythropoiesis that can aggravate any hemolytic process. Abnormalities of fetal hemoglobin may cause anemia that resolves with the normal shift to adult-type hemoglobins. Deletion of α globin gene, unlike β globin gene mutation, causes anemia in neonates. Hemoglobin H disease is a good example (in neonates Hb Barts is the abnormal hemoglobin rather than Hb H).

Nutritional anemia is common in infancy because of the associated rapid growth (necessitating an increase in red blood cell mass) and dietary adjustments. With exposure to new infections in early childhood, the anemia of acute infection is common. Rarely, severe autoimmune hemolytic anemia can be triggered by certain infections. Adolescence is characterized by rapid growth and vulnerability to nutritional anemia. In addition, blood loss with heavy menstruation can be observed in adolescent girls.

The prognosis depends on the severity and acuteness with which the anemia develops and the underlying cause of the anemia. Mortality and morbidity rates vary according to the underlying pathologic process causing the anemia, the

degree of severity, and the acuteness of the process. When a precipitous drop in the hemoglobin or hematocrit level occurs (eg, due to massive bleeding or acute hemolysis), the clinical presentation is typically dramatic and can be fatal if the person is not immediately treated. In addition to the signs and symptoms of anemia, patients can present with congestive heart failure (CHF) or hypovolemia. Cerebral injury has been reported in perioperative patients with anemia [9].

Anemia is one of the important health problems in India and also in many other parts of the world. Anemia in children is an important social health problem. Nearly half of the school going children in the developing countries are anemic. Anemia in infants is associated with growth retardation, delayed motor development, poor cognitive abilities, reduced social performance and impaired immune system. Anemia is also associated with increased mortality and morbidity. Most of the children with anemis are asymptomatic and infrequently manifest with pallor, weakness, jaundice, tachypnoea, tachycardia and cardiac failure which results from severe anemia regardless of its cause. Since the clinicopathological patterns of anemia in children are reflected by their underlying etiopathogenetic factors, it is important to study the clinicopathological patterns of anemia to establish their causes. This study is intended to be carried out with an aim to determine the prevalence, patterns and various hematological types of anemia in children. Hence based on these findings the present study was planned for socio clinical study of prevalence and relationship of anemia among pediatric cases referred to Darbhanga Medical College & Hospital.

Methodology

The present study was planned in the Department of Paediatrics, Darbhanga Medical College & Hospital, Laheraisarai, Bihar. Total 760 cases of the childrens referred to the department were evaluated in the present study. Out of 760 cases only 64 cases were found positive for the anemia were evaluated and discussed with the already reported literature.

The children were examined for pallor as seen from palpebral conjunctiva, lips, tongue, skin and nail beds. In addition a complete clinical examination was also done. Blood was drawn by venepuncture in EDT A vials. Hemoglobin (Hb) estimation was done using cynmethemoglobin method [10]. Twenty micro litre of anticoagulated blood was added to 5 ml of freshly made stan- dardized Drabkin's solution in a vial. This was inverted several times to mix the solution. It was allowed to stand for 10 minutes. The solution was read in spectro-photometer at 540 nm and values were compared with a standard table. All observations were made by a single person to prevent inter-observer bias

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion criteria: Cases of anaemia

Exclusion Criteria: Patients with other causes of anemia such as chronic infection and systemic disorders. Patients having mild to moderate anemia, severe anemia due to hemolysis, malaria, aplastic anemia and patients collapsed due to congestive cardiac failure within 12 hours of admission were excluded.

Results and Discussion

Anemia is clinically defined on the basis of Hb level in the blood. According to WHO grading of anemia, severe anemia is hemoglobin level less than or equal to 7g/dl. Anemia is not a specific entity but it results from many underlying pathologic processes. Pallor is the most prominent and characteristic sign of anemia. It is best appreciated in skin, nailbeds, mucous membranes and conjunctiva.

The prevalence of anemia was much higher in the present report ranging from 25-100%, among children aged 5-15 years. Previously a high prevalence has been noted by others in studies among children of rural and free urban schools, i.e., mainly belonging to economically weaker sections [10, 11]. The present study included only a small percentage of children from lower strata of society and still a large proportion were found to be anaemic.

Table 1: Age group and No of Cases

Age	Number of Cases	Anaemic Cases
6 month to 2 year	76	8
2 to 3 years	94	16
3 to 6 years	150	22
6 to 9 years	186	14
9 to 12 years	254	4
Total	760	64

Table 2: Different Variables responsible for Haemoglobin

Variables	No. of Cases
Sex	
Males	
Females	
Diet	
Non vegetarian	28
Only milk diet	20
Vegetarian	16
PICA	
No	24
Yes	40
Worm Infection	
Yes	54
No	10
Class of Family	
Upper	8
Middle	22
Lower	34
Parent Literacy	
Illiterate	24
Literate	40

Table 3: Distribution of Anemia based in Hemoglobin Levels

Age	Number of Anaemic Cases
Below 6 years	
10.0 – 10.9 g/dl (mild)	6
9.0 – 9.9 g/dl (moderate)	12
< 9.0 g/dl (severe)	28
Above 6 years	
11.0 – 11.9 g/dl (mild)	8
10.0 – 10.9 g/dl (moderate)	6
< 10.0 g/dl (severe)	4
Total Cases	64

Thavraj and Reddy had also noted iron deficiency among 20% of healthy, non-anemic, high income group children [12]. In view of these findings it is evident that a significant proportion of the apparently healthy children belonging to the higher socio-economic classes suffer from overt anemia and may have latent iron deficiency even if not anemic. The possible reason for this could be the poor bio- availability of iron in the Indian diets [13]. The rising trend of consuming snacks and junk foods which supply empty calories is also responsible for so called 'healthy' but anemic children. This fad is fast spreading to the lower socio-economic status as well. The higher prevalence of anemia among vegetarian children in the present study further adds to the already existing evidence indicating that vegetarian diets are a poor source of iron [14, 15].

Margaret F. Gutelius in 1969 [16] published a research on the problem of iron deficiency anaemia in preschool Negro children. Among 460 preschool Negro children from low income families, 29 per cent were found to have low haemoglobin levels. Although these children had received well-child care, none had a haemoglobin determination. The need for iron provided in dietary milk as a public health measure was emphasized.

Gomber S *et al* in 1998 [17] conducted a study on Prevalence & etiology of nutritional anaemia's in early childhood in an urban slum. Randomly selected 300 children aged 3 months-3 yr were analysed over a period of one year for estimating prevalence of nutritional anaemia. Pure iron deficiency anaemia (IDA) was detected in 41.4% of anaemic children. Vitamin B12 deficiency alone or in combination with iron was diagnosed in 14.4 and 22.2 per cent anaemic children respectively. Similarly folate deficiency, IDA with infection and anaemia of chronic diseases (ACD) was diagnosed in 2.2, 3.3 and 12.2 per cent cases respectively.

Manuel Olivares *et al* in 1999 [18] in their article on Anaemia and iron deficiency disease in children reported that iron deficiency is the single most common nutritional disorder world-wide and the main cause of anaemia in infancy, childhood and pregnancy. It is prevalent in most of the developing world and it is probably the only nutritional deficiency of consideration in industrialized countries. In the developing world the prevalence of iron deficiency is high, and is due mainly to a low intake of bioavailable iron.

Jain S *et al* in 2000 [19] conducted a study on Anemia in children: Early iron supplementation. This study was conducted to find out the prevalence of anemia in children and its contributory factors with reference to early iron supplementation. It was a cross sectional study done on 137 children of age 1–2 years in urban slums of Meerut. Prevalence of anemia in the study group was 59.9%.

Abdulrahman O Musaiger in 2002 [20] published a series on Iron Deficiency Anaemia among Children and Pregnant Women in the Arab Gulf Countries: The Need for Action. This paper explores the magnitude of the problem and factors that contribute to the high prevalence of anaemia in these countries. The prevalence of iron deficiency anaemia among preschool children ranged from 20% to 67%, while that among school children ranged from 12.6% to 50%.

Sinha N *et al* in 2008 [21] conducted a study on epidemiological correlates of nutritional anemia among children in Wardha, Central India. Seven hundred seventy-two children between 6 months and 35 months of age were studied for anemia by cluster-sampling method. Data was analyzed by SPSS 12.0.1. They reported a mean hemoglobin level was 98.5 ± 12.9 gm/L. Prevalence of anemia was 80.3%. Only 1.3% children had severe anemia (hemoglobin <70 gm/L).

In infants and young children, severe chronic anemia may lead to delayed growth and long term effects on neurodevelopment and behavior, mediated by changes in neurotransmitter myelination, monoamine metabolism in striatum, functioning of the hippocampus and energy metabolism. Growth and pubertal delay are common complications of thalassemia major [22, 23].

Iron is essential for all tissues in a young child's developing body. Iron is reversibly stored within the liver as ferritin and hemosiderin and is transported between different compartments in the body by transferrin. Ferritin is the stored form of iron used by the cells, and a better measure of available iron levels than serum iron. Fe performs vital functions including carrying of oxygen from lung to tissues, transport of electrons within cells, acting as co-factor for essential enzymatic reactions, including synthesis of steroid hormones and neurotransmission. Mitochondria supply cells with adenosine triphosphate, heme, and iron-sulfur clusters (ISC), and mitochondrial energy metabolism involves both heme-and ISC-dependent enzymes. Mitochondrial iron supply and function require iron regulatory proteins that control messenger RNA translation and stability and iron is positively correlated with mitochondrial oxidative capacity. [24],

Conclusion

The data generated from the present study concludes that anemia is a major health problem among well-nourished school children belonging to better socio-economic classes. Routine iron supplementation for all groups of children would be of benefit in decreasing the wide prevalence of this problem. There is a need for urgent community participation strategies in the form of counseling the parents for child feeding practices, immunization and sickness recognition from the first year of life. Preventive measures for anemia control in children must be accompanied by measures to prevent underweight and stunting by focusing on integrated child feeding, health and environmental core measures.

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