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Original Scientific Paper

Prevalence of iron deficiency anemia among children in the municipality of Dibër, North Macedonia

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Abstract

Today, anemia is considered one of the most common blood disorders. It continuing to represent a global health problem, affecting about a third of the worldwide population, especially infants and children. Some of the leading causes of anemia among children include malnutrition and lack of iron in the bloodstream. In technical terms, anemia consists of low hemoglobin or hematocrit. This study inquires some epidemiological features of children treated due to anemia of varying degrees in the municipality of Debar, in North Macedonia. The population of this study consists of a sample of 234 children from the municipality of Diber regularly checked at the local clinical practice "Alba Med." The parameters for the evaluation of anemia comprise the level of hemoglobin, iron, MCV, and MCVC.Of 234 children involved in this study, 23 or 9.82 % resulted in anemia. Seventeen children registered low levels of MCH, while 18 of them registered low levels of MCHC. Moreover, in this study, 27 children resulted in low ferritin levels, a slightly higher number than those with anemia.

Keywords: anemia, iron deficiency anemia, children.

1. Introduction

Anemia caused by iron deficiency is a common problem in infants and children. Anemia is a disorder that manifests itself in the reduction of hemoglobin concentration, hematocrit, and the number of RBC. Anemia represents a worrying condition in infants and children due to various complications it can trigger, some of which can be quite serious, such as disorders of immune function, stagnation in neurological development, and the weakening of cognitive functions.

Lack of iron in the bloodstream resulting from malnutrition has been recognized as one of the leading causes of anemia. Usually, iron deficiency anemia is most common in underdeveloped countries. Other causes of anemia in children may include; megaloblastic anemia (vitamin B-12 or folate deficiency anemia), pyridoxine deficiency anemia (deficiency of vitamin B6), hypoplastic and aplastic anemia (stem cells are damaged), parasitic intestinal infections, or anemia as a result of chronic or malignant diseases. Anemia may develop in some infants even due to increased destruction of erythrocytes because of erythrocyte membrane defects.

One of the characteristics of anemias is erythrocyte deficiency, a condition of a low level of hemoglobin, and a low concentration of iron. It is essential that, through anamnestic data, the pediatrician must obtain sufficient information on how the child's symptoms began and how long they lasted. In this respect, to determine the type and severity of anemia, laboratory data are critical.

Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) are significant indicators for determining the degree and type of anemia (Centers for Disease Control and Prevention, 1998).

On the other hand, an examination known as peripheral blood film (PBF) enables us to ascertain the morphology of RBC. It also supports to determine the various forms of anemia, some of which are very serious, including nutritional anemia, hemolytic anemia, acute leukemia, chronic lymphocytic leukemia, chronic myelocytic leukemia, etc.
However, sometimes for a more accurate assertion of the causes of anemia, we need to involve some other parameters: iron and ferritin concentration, the blood level of vitamin B12, folates, Hb electrophoresis, and sometimes gastroscopy and colonoscopy examination.
The most common clinical signs of children with mild to moderate anemia are pale or sometimes yellow skin, pale cheeks, and lips, irritability, mild weakness, etc. Those with more severe forms of anemia may manifest more severe complaints such as shortness of breath, tachycardia, dizziness, headaches, restless leg syndrome, etc.
Nonetheless, low levels of ferritin in the blood due to malnutrition continue to remain the most common cause of anemia in children. Fortunately, this form of anemia is easily preventable by administering a well-balanced diet.
It's recommended that children older than 12 months should not consume more than two glasses of cow's milk, which contains low iron levels. On the other hand, milk consumption stimulates the feeling of satiety, which may reduce the appetite for iron-rich foods. Preferably children over one-year-old should be served and encouraged to consume foods that are rich in iron and vitamin C; Thereby, proper absorption of iron could be facilitated, especially from green vegetables. Since most anemias are associated with malnutrition and iron deficiency, effective treatment may consist of improving the quality and type of nutrition intake.
In food, iron can be found in two forms: heme and nonheme. The heme form usually is found in meat products, whereas the nonheme form is found mostly in plant products. Hem form is better absorbed; however, it is estimated that only 10% of the iron in foods is hem-iron.
Oral iron preparations are usually prescript to children with anemia as a more affordable solution with fewer side effects. In these preparations, iron may be in the ferrous (+2) form, or ferric (+3) forms, with that said, the ferrous form is much better absorbed in the gastrointestinal tract.
For the treatment of iron deficiency anemia, the most commonly used preparation is ferrous sulfate. Usually, administering a dose of 3- 5 mg/kg is recommended.
The purpose of the study is to evaluate the rate of anemia in children regularly checked in local clinical practice in the municipality Debar, specifically those that have been confirmed with anemia of various degrees during medical examinations. The study investigates the correlation of anemia with nutritional characteristics resulting in iron deficiency anemia as the primary cause.

2. Materials and methods

This study population includes a sample of 234 children from the municipality of Debar regularly checked at the local clinical practice "Alba Med." The parameters for the evaluation of anemia comprise the level of hemoglobin, iron, MCV, and MCVC.
The age of children investigated is between two and twelve years, while the period of the study extends from June 2018 - 2019. For our study's purpose, several ml of blood was taken from each child for blood counts, hemoglobin, blood iron levels, MCV, and MCVC. Some important parameters for the diagnosis of anemia were determined through blood tests, such as RBC count, iron (ferritin) levels, mean corpuscular hemoglobin concentration (MCHC), and Mean Corpuscular Volume (MCV).
The criteria used to classify children as anemic included: hemoglobin values below 11.5 gm/dl and ferritin levels below12 µg/L. Even low MCH and MCVC values are also crucial for diagnosing anemia since low values of these parameters indicate low levels of iron in the blood.

Data required for this study were taken from the children's medical records in the local clinical practice "Alba Med". This data consists of regular blood tests analysis before the start of the school year, or during a certain period of the year. Furthermore, this study classified children based on their socio-economic status and age. Based on age, children were grouped into three categories; 2 - 5 years, 6-9 years, and 10-12 years. Whereas referring to their socio-economic status, children were classified into three categories as well, children coming from families with low, medium, or high socio-economic status.

3. Results

From a total of 234 children included in this study, 108 were boys, and the rest (126) were girls, as presented in the graph below. For analysis purposes, we classified children into three groups; in the first group, we allotted children from 2 to 5 years, in the second group children between 6 to 9 years, and the third group children from 10 to 12 years old (Figure 1).

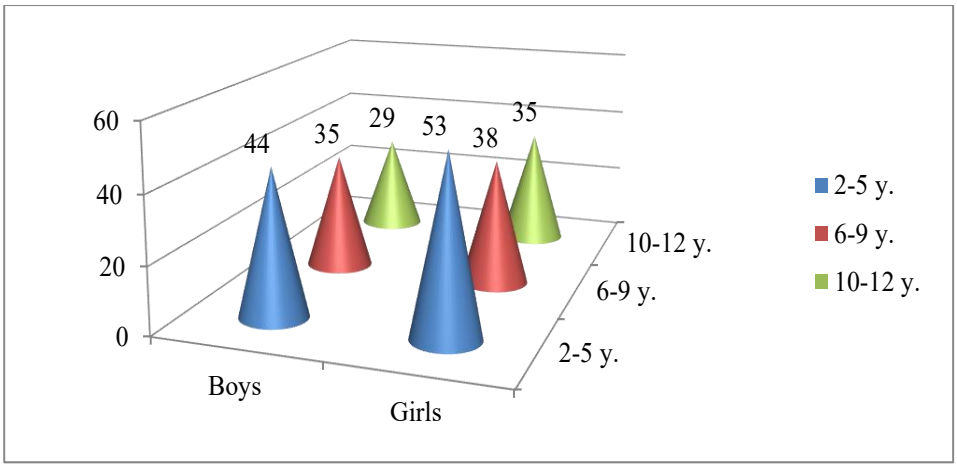

Figure 1: Distribution of children by age

According to our data, we observed that 48 children came from families with low status and poor economic conditions in terms of socio-economic level. In contrast, 49 came from families with a good statute, and 137 from families with a very good financial situation as presented in the diagram below (Figure 2).

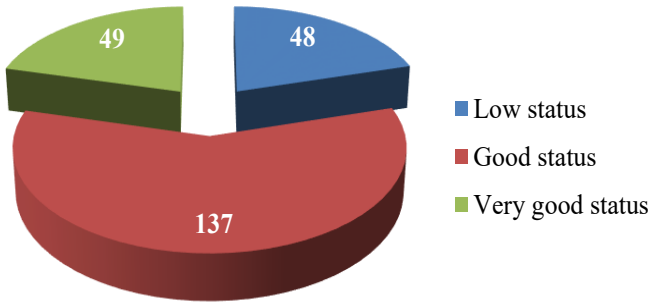

Figure 2: Distribution of children according their socio-economic status

The diagnosis of iron deficiency anemia is based on laboratory data such as RBC count, hemoglobin, hematocrit levels, MCV and MCVC levels, and ferritin concentration in the blood.

The hemoglobin level below normal values was recorded in 23 children or 9.82 % (Figure 3).

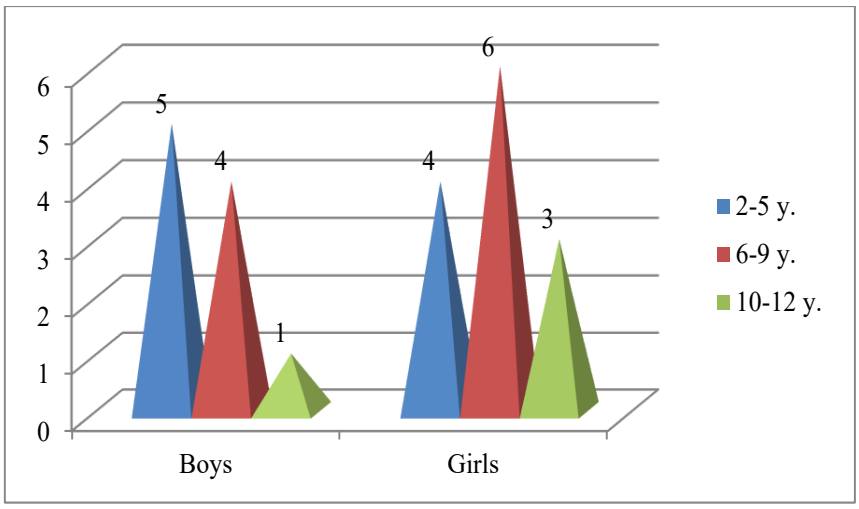

Figure 3: Distribution of hypoglobinemia among children in our study

In this study, low MCH values were registered in 17 children, whereas the low MCHC values were found in 18 out of 234 children (Table 1).

Table 1. Data for anemic children in our study

	Boys	**Girls**	**2-5 years**		**6-8 years**		**9-12 years**	
			M	**F**	**M**	**F**	**M**	**F**
Hemoglobin level								
Mild anemia (10 to <11.5 g/dl)	8	8	4	3	3	4	1	1
Moderate anemia (7 to <10 g/dl)	2	4	1	1	1	2	0	1
Severe anemia (<7 g/dl) anemia	0	1	0	0	0	0	0	1
Ferritin levels below 12 ng/ml	12	15	6	5	6	4	2	4
MCV < 73 fL	7	10	5	6	2	1	0	3
MCHC level ≤32 g/dL	8	10	6	6	2	2	0	2
Hematocrit < 34 %	8	11	6	6	2	3	0	2

Simultaneously, low levels of iron were diagnosed in 27 children, resulting in a slightly higher value than that of children with anemia. The distribution of iron deficiency by gender and age is presented in Figure 4.

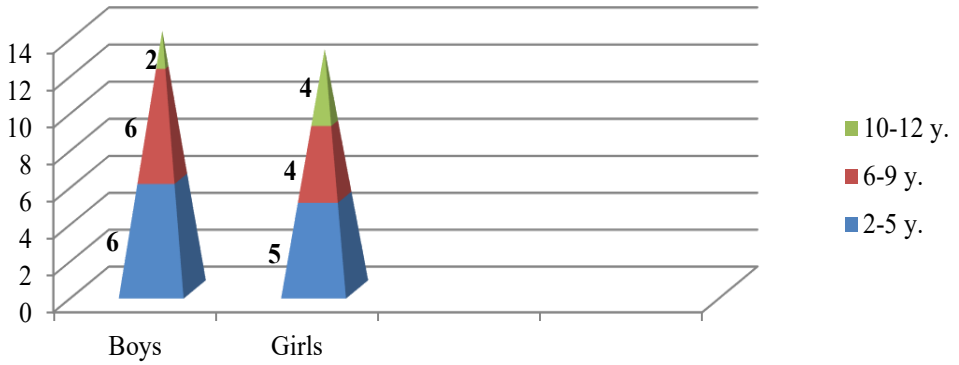

Figure 4: Distribution of iron deficiency by gender and age

As referred earlier, iron deficiency anemia depends on nutritional factors. Through the anamnestic data, we gathered information from parents about the amount of food such as red and white meat, and fruits and vegetables consisting of their children's diets. In most children diagnosed with anemia and the low level of iron, the consumption of red and white meat was more than two times a week, while most of them consumed large quantities of milk every day (Figure 5).

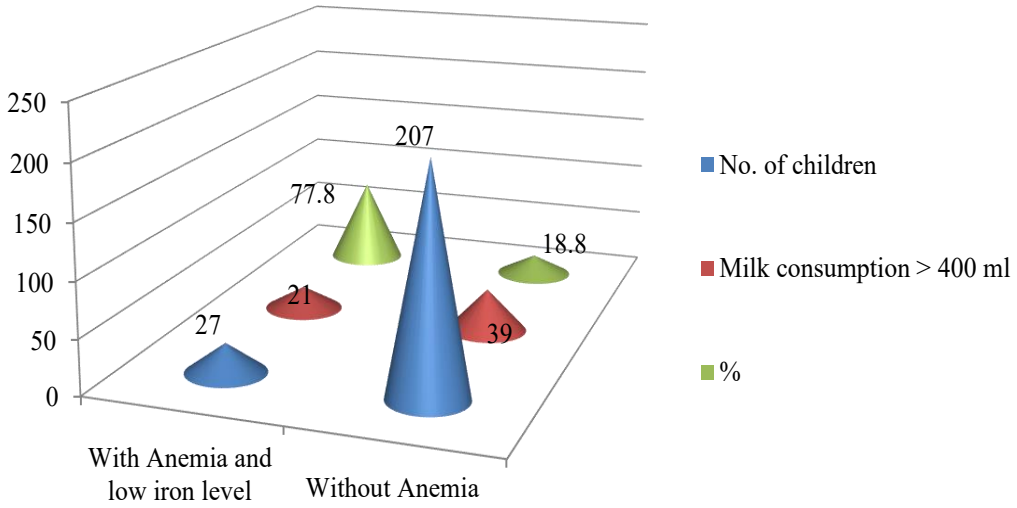

Figure 5: Milk consumption in children with and without anemia

In many studies, excessive milk consumption is a possible cause of iron deficiency anemia because milk usually reduces appetite for other foods and impedes the proper absorption of iron from the gastrointestinal tract.

In terms of socio-economic status and anemia, a higher incidence of anemic children resulted in low-status families, respectively, from 23 children with anemia 14 of them came from families with low status, while seven from families with medium status and two from families with high socio-economic status (Figure 6).

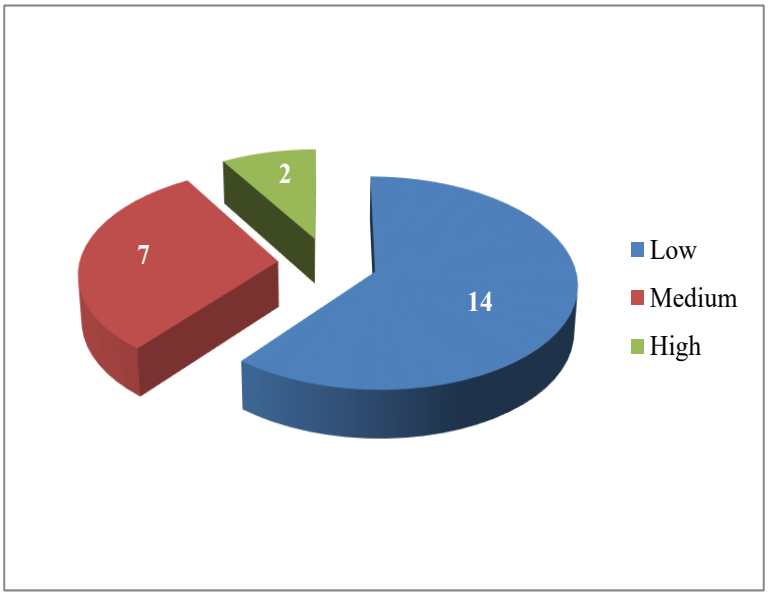

Figure 6: Distribution of anemic children according to their socio-economic status

4. Discussion

Anemia is defined as a condition in which the number of erythrocytes and hemoglobin concentration is below the normal value. This condition continues to be a serious problem among children worldwide, but mostly in countries with lower economic standards (Centers for Disease Control and Prevention, 1998; Centers for Disease Control and Prevention, 2005) .

It is estimated that in the US, the prevalence of iron deficiency anemia is about 8% (Centers for Disease Control and Prevention,1998; U.S. Preventive Services Task Force, 2006).

Although the causes of anemia can be different while many other factors and diseases might trigger its development, one of the most common causes remains malnutrition, low concentration of iron in the blood, or iron deficiency anemia (World Health Organization, 2001, Centers for Disease Control and Prevention, 1998).

Recently the American Association of Pediatricians recommended conducting screening tests to diagnose iron-deficiency anemia in children by determining hemoglobin and hematocrit values. However, The Centers for Disease Control and Prevention does not endorse any universal screening test for the diagnosis of IDA (U.S. Preventive Services Task Force, 2006).

Hemoglobin concentrations below 11 mg are considered an anemia sign in children, an assessment supported by the WHO as well (Miller V *et al*, 1985). In this study, hemoglobin levels, besides the MCV and MCVC values, were considered an indicator of anemia's presence.

WHO estimates that approximately 42% of children up to the age of five and 40% of pregnant women are anemic on a global level (World Health Organization, 2001).

Based on our data, the prevalence of anemia in our sample (9.82 %) is different from other reported studies. However, some studies are showing a prevalence of anemia in children, as described in our paper.

Our study shows that from the total number of children with anemia, 16 children resulted in mild anemia. They had hemoglobin values of 10 to <11.5 g/dl, whereas, in other six, the anemia was moderate, respectively, with hemoglobin values between 7 to <10 g/dl, while one of them exhibited severe forms of anemia, whose hemoglobin values was less than 7 g/dl.

A study carried out by Djokic D. found that the prevalence of anemia among Serbian school-age children was 18 %[11]. In a similar study in a district of Lezha (Republic of Albania) among children aged between 5 - 60 months, the prevalence of anemia results in about 47 % (Ersilia Buonomo *et al*, 2005).
It is estimated that around 2–3% of children in the US have iron deficiency anemia (Brotanek JM *et al*, 2008). In developing countries, red meat consumption is deficient; therefore, iron deficiency anemia is more frequent than in developed countries. In Nepal and Sudan, for example, approximately 2/3 of children suffered from IDA, whereas in Egypt, about 1/2 of children are anemic (Eltayeb MS *et al*, 2016; El-Zanaty F *et al*, 2006).
As in many other studies, this study included MCV and MCVC values as parameters for evaluating anemia. According to our data in our population of 234 children with anemia, low values of MCV were registered in 17 children, whereas low MCVC level at 18. Malnutrition causes a decrease in ferritin levels in the blood, usually due to iron deficiency in the food. Low ferritin levels are not regularly associated with anemia, despite iron deficiency anemia having low iron levels. During inflammatory processes, ferritin levels are usually high; that's why we have excluded in this study children with acute inflammatory processes.
We recorded low levels of ferritin in 27 (11.5 %) children. At the same time, 23 of them had low hemoglobin levels associated with MCV and MCVC levels.

5. Conclusion

Anemia continues to represent a serious health problem among children worldwide, especially in developing countries. Based on our observation, the Balkan region makes no exception. Therefore, similarly to developed countries, Balkan countries like North Macedonia should commit both on screening children for anemia and, at the same time, raising awareness among parents on how to effectively prevent this disorder in their children. Our experience also shows that one of the leading causes of anemia, especially in children under the age of five, is high milk consumption.

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