International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Iron Deficiency and Iron Deficiency Anemia Prevalence in School Children (6-10 Years) in Tirana, Albania

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Abstract: ***Iron deficiency (ID) is a systematic condition that harms physical stability, work capacity, psychomotor development of children and decreases their immunity. Our study aimed at assessing the prevalence of iron deficiency (ID) and iron deficiency anemia (IDA) among 6-10 years school children from Tirana and its relation to demographic, socio-economic and lifestyle factors in order to design fair policies for control and prevention of anemia in children in our country. Paying attention to the iron deficiency anemia control will help these children be treated in time and not suffer from the long-term consequences of iron deficiency.***

Keywords: iron, deficiency, anemia

1. Introduction

Anemia is a condition characterized by the reduction of hemoglobin concentration in the blood under reference ranges for age and gender. Under these conditions the capacity of red blood cells is insufficient to meet the physiological requirements of the body for oxygen, which vary according to age, gender, smoking, pregnancy, height [1].

Erythropoiesis is the process of continuous regeneration of erythrocytes that have reached the end of their physiological life, or are destroyed before time. The anatomical functional that performs this function is called erythron [2]. Erythrocyte's production is a well-regulated process. During hematopoiesis, about 10^{10}red blood cells per hour are produced in the bone marrow to maintain hemoglobin levels within the norms limits. This product can be added very quickly in the case of blood loss and hemolysis.

The immature erythroid cell is the place where hemoglobin synthesis occurs. This process requires the cell to have an adequate source of iron as well as normal intra-cellular production of porphyrin and polypeptide chains of the globin. Iron moves from plasma through transferin, is captured by the iron-transferin complex receptors in the erythrocyte membrane. This complex iron-transferin-receptor creates an aggregate on the cell surface, causing a membrane deepening and forming a vacuola within the cytoplasm. Then the iron is released and the receptor-transfer complex returns to the cell membrane, while the transferin molecule returns to the plasma for re-inclusion in the transport of the iron. Then the cellular iron enters the mitochondria for heme synthesis, if it is more, it accumulates in the ferritin molecule [3].

In adults and children over six months, hemoglobin, which accounts for about 96% of total hemoglobin, is hemoglobin A (HB A), which is composed of two alpha chain and two beta chain.

Fetal Hemoglobin (HB F) containing two alpha chain and two gamma chain is the main hemoglobin during fetal life. The concentration of HB F in the newborn is about 60-80% decreasing to less than 1% in adults.

Hemoglobin A2 (HB A2) consisting of two alpha chain and two delta chain is a hemoglobin found in small amounts both in fetal life and in adults. Its concentration in normal adults is about 2-3%.

HbA1c differs from HbA only in the addition of glucose molecules. It accounts for about 3% of total hemoglobin in red blood cells and increases in individuals with diabetes mellitus, especially in patients with poorly controlled diabetes [4].

2. Biology and the Physiology of Iron

The newborn contains 0.5 g of iron while adults about 5g. To compensate for this inconsistency, the body should absorb about 0.8 mg each day for the first 15 years of life [5].

The iron content in the body is in the following forms:

- Hemoglobin (contains iron) in circulating erythrocytes and in all developing elements of the red blood cells during the erythropoietic process (about 2.5g) or about 75% of the amount of iron found in the organism.
- Iron-containing proteins (myoglobin, cytochrome, catalase-about 400 mg) or about 10% of the amount of iron in the body.
- Linked to the transfer (about 3-7 mg) or about 1-2% of the amount of iron in the body.
- Ferritin and Hemosiderin (the remainder in the form of deposits) about 10-20% of the amount of iron in the body.
- The regulation of iron metabolism involves the interaction of some specific proteins involved in the absorption, recycling and loss of iron [6].
- Iron is an essential microelement that serves to maintain the functions and structure of body cells. It is a component of many proteins (and hemoglobin) so it is very important

for oxygen transport throughout the body. Oxygen is little soluble in plasma, iron atoms in the hemoglobin heme group may reversibly bound with oxygen molecules, making transport of 98.5% of total oxygen to body tissues. The physiological balance of iron in the body depends on dietary uptake and loss. A balanced diet should contain enough iron for the body's requirements. About 10% of 10-20 mg iron taken from the diet is absorbed daily and this is sufficient to balance daily loss of sweats, epithelial decubitus, urine and gastrointestinal losses [7].

The composition of iron in the diet can also affect its absorption. The iron is found in two forms: hemic iron and non-hemic iron.

Food sources of hemic iron (fish, poultry and meat) have a higher bioaffinity than the nutrient sources of non-hemic iron (of plant origin). Hemic iron is normally absorbed about 30%, while non-hemic iron is about 10%. It is also important to associate iron with other foods. Ascorbic acid found mainly in fruits and citrus fruits can form complexes with iron that increases its absorption, while the tannates found mainly in tea, phosphate-rich foods can reduce iron absorption [8]-[11].

3. Clinical manifestation of Iron deficiency anemia (IDA)

Symptoms of anemia are related to its severity and speed of installation. Iron deficiency anemia (IDA) is a microcytic, hypochromic and hypoprolipherative condition. During the lack of iron the iron stores begin to diminish but have enough iron in circulation (from red blood cells turnover) for normal hemoglobin synthesis, unless its continuous loss occurs. Anemia develops only at the final stage of iron deficiency. Vice versa, when iron therapy begins, anemia is first corrected and then normalization of iron stores is done, which requires time to fully correct. The most common clinical presentation of iron deficiency anemia is an asymptomatic, well-fed baby or child who has a mild or moderate microcytic, hypochromic anemia. Rarely are children with severe anemia, appearing drowsy, pale, nervous, with cardiomegaly, malnourished, and with tachypnea. The main cause of iron deficiency anemia (IDA) is iron deficiency with diet. In some cases it may be due to a medical problem that leads to gastrointestinal bleeding, malabsorption syndrome, chronic inflammatory disease etc. [12]-[15].

In children, iron deficiency anemia (IDA) is associated with neurological disorder, including slower visual and auditory processing [16]-[23].

Iron deficiency (ID) is a systematic condition that harms physical stability, work capacity, psychomotor development of children and decreases their immunity. Morbidity against infectious diseases is increased in populations that suffer from iron deficiency. Depletion of iron stores into the brain may damage the activity of iron-dependent enzymes that are required for the synthesis, function and degradation of neurotransmitters such as dopamine, serotonin and noradrenaline, causing changes in behavior and reduction in test results of cognitive test in children [24]-[26].

4. Methodology

Our study aimed at assessing the prevalence of iron deficiency anemia among 6-10-years-school children from Tirana and its relation to demographic, socio-economic and lifestyle factors in order to design fair policies for control and prevention of anemia in children in our country. Type of study: transverse (cross-sectional). This study included a sample of 140 children (6-10 years-old) from the city of Tirana. Iron deficiency anemia (IDA) protocol: hemoglobin level was <11.5 gr / dl; ferritin <15 μg / L; / or sideremia <50μg / dL. Iron deficiency (ID) protocol: ferritin <15 μg / L. The erythrocyte sedimentation rate (ESR) and c-reactive protein (CRP) measurement are used to exclude inflammatory anemia. Are excluded from the study the hemoglobinopathies through the hemoglobin gel electrophoresis.

In total, 140 children participated in the study, out of which 93 (66.4%) were boys and 47 (33.6%) were girls.59 children (42.1%) belonged to the age group 6-7 years and 81 (57.9%) were 8-10 years old. Most mothers had completed secondary education (65%), while most fathers had completed higher education (55.7%).45% of children had a good performance against 53% who had a very good performance. Only 2.1% of the children were with developmental problems.

All over the world are different studies for iron deficiency (ID) and iron deficiency anemia (IDA). The most represented in these studies are pre-school children and pregnant women. Representation for the age group I have chosen is also small in internationally-conducted studies, but in the years that we are living where life has become very intense and the attention we devote to the lifestyle and way of nutrition is very small I think it deserves special attention.

The prevalence of iron deficiency anemia (IDA) for the age group 6-10 years in this study is 14.3%. The table below is a proposed classification of public health significance of anemia in populations on the basis of prevalence estimated from blood levels of hemoglobin or hematocrit.

Table 1. Proposed classification of public health significance of anemia in populations on the basis of prevalence estimated from blood levels of hemoglobin or hematocrit.

Category of public health significance	Prevalence of anemia (%)
Severe	> or = 40
Moderate	20.0 - 39.9
Mild	5.0 - 19.9
Normal	< or = 4.9

Source; Iron Deficiency Anemia Assessment, Prevention, and Control A guide for programme managers WHO 2001 pg 17

According to this categorization, the prevalence of iron deficiency anemia (IDA) in this study is a mild public health problem.

In this study it is noticed that there are no significant changes in iron deficiency anemia (IDA) related to gender for this age group (respectively 15.1% in males and 12.8% in women, P=0.715), but it was shown that anemia was statistically the most frequent among the age group 6-7 years old compared to the age group 8-10 years (22% and 8.6% respectively, P=0.025). A very strong, statistically significant relationship was reported between the presence of anemia and the fathers education level of children who were part of the study (P=0.003). This may be related to the level of income in the family. A very strong statistical link between parasitosis and anemia was reported in the children studied. Children who were infected with parasitosis (lamblia) in a very significant way (P <0.001) were most affected by anemia compared with healthy children. Data suggests that the mechanism by which lamblia infection causes IDA is a result of malabsorption or other mechanisms leading to chronic inflammation. This significant link has been found and in many other studies, and this suggests the importance of anemia investigation in infants infected with lamblia and also screening of children attending collective environments.

5. Conclusion

In this study, the prevalence of iron deficiency anemia (IDA) for the age group 6-10 years in the city of Tirana is 14.3% which, according to WHO categorization, is a mild public health problem. While the prevalence of iron deficiency (ID) in the age group 6-10 years in the city of Tirana is 30.7%.

6. Recommendation

Paying attention to the iron deficiency anemia (IDA) control will help these children be treated in time and not suffer from the long-term consequences of iron deficiency (ID). Breast-feeding should be encouraged for at least 4-6 months; breast milk has low levels of iron but with high bioavailability. If the baby is to be fed with formula milk, make sure that it should be iron-fortified. Between four and six months, in addition to breast milk, must introduce iron-rich complementary foods. Cow milk should not be used until the age of one year. Multidisciplinary attention is required to reduce the number of children affected by iron deficiency. This attention has to be in several directions, including the information we have to distribute to the school children about the way of nutrition and personal hygiene. An important intervention is also the drafting of policies by the Ministry of Health for introducing into the base control program the main laboratory test to diagnose iron deficiency anemia starting from infancy to pick up and treat anemia from iron deficiency (ID) and contributing factors in time.

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