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REVIEW ARTICLE

Risk factors for iron deficiency anemia in the pediatric patient

Factores de riesgo de la anemia por déficit de hierro en el paciente pediátrico

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ABSTRACT

Introduction: iron deficiency and consequent anemia constitute a universal health problem due to its implications on individuals. It occurs at all ages, but its prevalence is higher in young children and women of childbearing age.
Objective: to describe the incidence of iron deficiency anemia in pediatric ages and its risk factors.
Methods: a search for information was carried out in the databases PubMed, Medline, SciELO and Google Scholar, where 48 scientific articles on the subject were obtained, and 29 were selected for the development of the present study.
Development: anemia in children is one of the clinical situations that cause most attention and concern, both in national and international organizations as well as in health professionals, to the extent that it frequently affects one of the most vulnerable groups in society and that if it is not treated from the early years it can cause consequences with lifelong impact, so its diagnosis, identification and action on its risk factors during childhood is essential due to its potential repercussions in later ages.
Conclusion: the presence of anemia in children can be linked to maternal risk factors as well as to the infant's own risk factors that should be addressed from the child care consultation and throughout the pediatric age with health promotion and prevention activities.

Keywords: Anemia, Iron-Deficiency; Iron Deficiencies; Risk Factors; Child.

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RESUMEN

Introducción: la deficiencia de hierro y la anemia consecuente constituye un problema de salud universal por sus implicaciones sobre los individuos. Ocurre a todas las edades, pero su prevalencia es mayor en niños pequeños y mujeres en edad fértil.
Objetivo: es describir la incidencia de la anemia por déficit de hierro en las edades pediátricas y sus factores de riesgo.
Métodos: se realizó una búsqueda de información en las bases de datos PubMed, Medline, SciELO y Google Académico, donde se obtuvieron 48 artículos científicos sobre el tema, seleccionándose 29 para el desarrollo de la presente.
Desarrollo: la anemia en los niños es una de las situaciones clínicas que más atención y preocupación causan, tanto en organizaciones nacionales, internacionales así como en los profesionales de la salud, en la medida que afecta con frecuencia a uno de los grupos más vulnerables de la sociedad y que de no atenderse desde los primeros años puede originar consecuencias con impacto durante toda la vida, por lo que su diagnóstico, la identificación y actuación sobre de sus factores de riesgo durante la infancia es fundamental por su potencial repercusión en edades posteriores.
Conclusión: la presencia de anemia en los niños puede estar vinculada tanto a factores de riesgo materno como propios del infante que deben ser atendidos desde la consulta de puericultura y durante toda la edad pediátrica con actividades de promoción y prevención de salud.

Palabras clave: Anemia; Deficiencias de Hierro; Factores de Riesgo; Niño.

INTRODUCTION

Iron is the most abundant metal on the planet, and it is also the nutrient that most living beings use. In humans it is found in two compartments, a functional one (hemoglobin, myoglobin, transferrin and enzymes), and a depot one (ferritin and hemosiderin). Iron deficiency manifests itself in all stages of life; however, the most vulnerable groups are children, adolescents and women of reproductive age. It can be evidenced in an absolute or functional form; the former is due to a partial or total decrease in reserves and the latter occurs when these are normal or high, but the supply to the bone marrow is inadequate.

The physiological mechanisms of body iron ensure a closed-loop metabolism and most of it is retained within the body. The requirements of the metal to compensate for daily organic losses are low (0,88 to 0,98 mg/day). In patients with iron deficiency, these losses may decrease to 0,5 mg/day and increase to 2 mg/day when the reserves are high.[1]

Anemia is a reduction in the concentration of hemoglobin in the blood and in the number of red blood cells, thus affecting the capacity to transport oxygen to the tissues. Iron is essential for the production of hemoglobin, because it is the component that captures oxygen, as well as its participation in other metabolic processes in the body. Children under two years of age are particularly susceptible to anemia because of their accelerated growth and high needs for the metal.

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Anemia is a global health problem in both developed and developing countries, contributing significantly to morbidity and mortality in children under five years of age. About 43 % of children under five years of age are anemic. According to data from the World Health Organization (WHO), 1620 million people suffer from anemia, which represents 24,8 % of the world population, mostly preschool children. [2] The areas most affected by anemia are Africa (67,6 %) and Southeast Asia (65,5 %), while in the Eastern Mediterranean it is 46 % and 20 % in other regions such as the Americas, Europe and the Western Pacific.

In the case of Latin America and the Caribbean, it is estimated that there are 22,5 million children suffering from anemia, with the most critical age being from six months to 24 months of age.[3]

The prevalence of anemia is an indicator of the health status of the population. Anemia prevalence of less than 5 % is indicative of good health system performance, while 5 to 19,9 % is indicative of a mild problem, 20 to 39 % is a moderate problem, and 40 % or higher is a serious health problem.[1]

Iron deficiency and anemia are universal public health problems due to their consequences on individuals, social and/or economic aspects, which affect all countries to different degrees. It occurs at all ages, but its prevalence is highest in young children and women of childbearing age. According to data from the World Health Organization, more than two billion people are iron deficient, which represents almost 25 % of the world's population. Anemia is present in 800 million people, 273 million of whom are children. It is estimated that approximately 50 % of children under five years of age and 25 % of children six-12 years of age in the world population suffer from anemia. The most common cause of anemia in the world is iron deficiency, and its incidence in developing countries is 2,5 times higher than in developed countries.[2]

The normal term newborn has adequate iron stores sufficient to cover the requirements up to four-six months of age. These come, fundamentally, from maternal iron intake during intrauterine life and, to a lesser extent, from that originated by the destruction of erythrocytes during the first three months of life. From four-six months of age, the child depends primarily on dietary intake to maintain an adequate iron balance, so iron deficiency and iron deficiency anemia in infants and in early childhood are generally determined by an insufficient or poorly balanced diet.[4]

In the group of deficiency anemias, iron deficiency anemia is the most frequent. Although estimates of the prevalence of this type of anemia vary widely, there are often no exact data, although it is assumed that, in resource-poor regions, a considerable proportion of children under five years of age, pregnant women and women of childbearing age suffer from it. [5,6]

Iron deficiency anemia is a condition resulting from a decrease in hemoglobin levels for age and physiological state secondary to iron deficiency in the body.[5,7] The causes of this condition can be multifactorial and often coincidental, among them are gestational diabetes, maternal smoking, twins, low birth weight, prematurity, maternal fetus and fetal fetus transfusion, non-use of breastfeeding, low intake of food with adequate sources of iron in quantity and quality, and repeated chronic infections (gastrointestinal tract), among others.

It is currently estimated that more than two billion people suffer from iron deficiency, both in poor and developed countries. In Latin America and the Caribbean, this anemia is considered a serious health problem, especially in infants, pre-school children, pregnant women and women of childbearing age, who are the most vulnerable groups.[8,9,10]

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According to reports from the World Health Organization and the Food and Agriculture Organization of the United Nations, 40 % of Latin American pregnant women are anemic during pregnancy, of which 75 % are iron deficient, a figure that varies according to the region.[2]

In Cuba, anemia during pregnancy is the second cause of low birth weight, due to the fact that between 35 and 40 % of pregnant women suffer from anemia in the third trimester.[10]

Iron deficiency anemia continues to be a health problem in children from six to 11 months, as well as in pregnant women. National statistics reveal a prevalence in pregnant women between 20 and 25 %,[8] and in children over 40 %, figures that show a health problem of great dimensions.[11] Although the National Health System has permanent strategies for its prevention (iron supplementation in vulnerable groups and fortification of foods widely consumed by the population),[5,12] it increases in risk groups.[13]

The present research was developed with the objective of describing the incidence of iron deficiency anemia in pediatric ages and its risk factors.

METHODS

A search for information on iron deficiency anemia in the pediatric population was performed in PubMed, Medline, SciELO and Google Scholar databases.

To obtain the information, a search formula was structured according to the structure and syntax of each database. The terms Anemia, Iron Deficiency Anemia, Iron Deficiency, Pediatric Patient, Child, Infancy were used, as well as their English translations. Boolean operators AND and OR were used to structure the search formulas.

Records were retrieved regardless of language or typology. Forty-eight articles were obtained, of which 29 were selected for the development of the present research.

DEVELOPMENT

Anemia in children is one of the clinical entities that originates more attention and concern in health organizations, both national and international, as well as in professionals, to the extent that it affects one of the most vulnerable groups of society, and that, if this problem is not addressed from the first years of life, the individual and society itself as a whole will be seriously affected.

In Cuba, iron deficiency is the most common nutritional disorder and the main cause of anemia. In preschool children, the prevalence in 2016 was 29,34 %, with an increasing trend. It is currently known that anemia during pregnancy is a risk factor for the development of anemia in infants under six months of age, especially if during pregnancy it is associated with smoking or diabetes mellitus. Several authors agree in affirming that the products of pregnancies with anemia in the second and third trimester have a high probability of suffering from this blood disorder at birth and increase it during postnatal life, especially those who are not supplemented in a timely manner or come from mothers with uncorrected malnutrition. It is scientifically proposed that anemia during the second and third trimester of gestation, even with treatment with ferrous salts and diet, will hardly have a solution, therefore, the product will have the condition and will require supplements.[5]

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The abandonment of exclusive breastfeeding in the first semester of life is another risk factor for the development of anemia. At present it has been demonstrated that feeding with quality human milk during the first six months and supplemented up to two years of age with foods containing iron of good availability, is a factor of immunological protection for the growth of children and the prevention of diseases.

For breastfeeding to be effective during the first six months, it is necessary to empower the mother with knowledge about the nutritional, stimulating and protective advantages of human milk, prevent anemia before delivery with the use of iron and vitamin supplements, psychological and nutritional support is also very important, the use of this practice is highly positive and the family should also be provided with information about the growth and development of the child at this time of life, thus avoiding the unnecessary introduction of foods other than breast milk at the slightest problem. The increase in breastfeeding and the availability of iron-fortified milk formulas have decreased the incidence of iron deficiency anemia in infants; however, iron deficiency, with or without anemia, continues to be a common problem.[14]

Breastfeeding has been shown to protect neonates from experiencing iron deficiency because breast milk has between 0,3-1 mg of iron per liter, but has a high bioavailability of about 50 %. In contrast, formulas enriched with this mineral include 12 mg/L, but only 5 % reaches the general circulation, and the protection they provide lasts until approximately six months of age, for which reason additional iron must be provided later.[10]

In clinical practice, to obtain the diagnosis of anemia, hemoglobin figures and other parameters in the hemogram are obtained, according to age, sex, as well as the altitude where they reside above sea level, among them are:

- Hemoglobin: total hemoglobin in grams per liter of whole blood (g/L).
- Erythrocyte count: represents the number of red blood cells in a given volume of whole blood.
- Hematocrit: space occupied by red blood cells represented as a percentage of the volume of whole blood.[15]

The other quantifications and the hemoglobin figure are not stable values, since they depend on other variables such as sex, age and other circumstances. Anemia may exist with a normal hemoglobin value; this occurs in particular cases with high baseline hemoglobin and mild anemia, as well as in various physiological contexts such as pregnancy or clinical entities such as hyperviscosity, cirrhosis, hypersplenism, nephrosis, or hyperhydration, which are usually associated with increased plasma volume. It should be emphasized that a possible relative decrease in hemoglobin concentration such as the hematocrit value due to hemodilution is not always anemia, and does not necessarily imply an impairment of tissue oxygen supply. Also, falsely normal values may occur in patients with hemoconcentration, such as in those with severe burns or dehydration.[16]

When the body produces small amounts of red blood cells, their destruction is increased or their production is decreased, anemia may result.

Hemoglobin is contained within erythrocytes and is responsible for transporting oxygen throughout the body. When there is a low amount of hemoglobin in the blood or not enough red blood cells, the body does not receive the oxygen it needs, resulting in fatigue or other symptoms. In the case of aplastic anemia, the bone marrow, in addition to erythrocytes, does not provide a sufficient number of other cell types such as platelets and leukocytes, so infections,

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which are fought by the immune system thanks to the help of leukocytes, and hemorrhagic tendency due to thrombocytopenia are accompanying manifestations.

On the other hand, it should be emphasized that many clinical entities in the child and other factors can cause anemia. Certain autoimmune disorders are accompanied by the production of proteins that destroy red blood cells and this can lead to anemia. Another example is the presence of a sufficiently abundant bleeding, internal or external by some wound, since the body loses red blood cells in great quantity and the medullary response is not immediate. Therefore, it can be pointed out that the causes of anemia can be hereditary or acquired.[17]

The motor development of children is the sum of many factors, both their own and those of their context. Therefore, anemia represents a very important danger and, even worse, if the infant is in the first years or months of life, because in this motor area, fine and gross motor skills are developed. As a consequence, it could produce decay represented by limitations and low performance in these skills.[18,19]

The diagnosis of anemia is based on the clinical history of the patient, the identification of risk factors that predispose to the onset of anemia from the infant or preschool stage is a fundamental element, the physical examination and some basic tests (hemogram, peripheral blood smear examination and biochemical parameters of iron metabolism).[15]

The hemogram helps to know the amount of several different types of blood cells. For this purpose, the number of red blood cells, hematocrit, corpuscular indices (mean corpuscular hemoglobin, mean corpuscular volume and mean corpuscular hemoglobin concentration) as well as the hemoglobin figure are taken into account, all of which are automatically provided by electronic meters.[17]

The causes of iron deficiency states and iron deficiency anemia are various and can overlap in their influence. Intestinal parasitism and toxi-inflammatory processes often affect the absorption and subsequent distribution and peripheral utilization of the mineral. Chronic diseases often disrupt iron homeostasis as well. However, the imbalance between the increased iron requirements at each vital stage of growth and development, on the one hand, and the subject's ability to meet them appropriately, on the other, is the main determinant of iron deficiency states and iron deficiency anemia. That is why children between 0 and 5 years of age, women of childbearing age and those who are pregnant and breastfeeding are particularly vulnerable to develop iron deficiency conditions that can culminate in anemia.[20,21]

Fernandez-Gonzales, [14] when evaluating cultural risk factors, observed a prevalence of inadequate breastfeeding and non-consumption of nutritional supplementation. It is important to highlight that exclusive breastfeeding up to six months was present in most of the children included in her study, which is similar in another research conducted in Cuba, in which 100 % of the mothers had orientation on exclusive breastfeeding.[22]

In a study conducted in Peru[18] it was found that exclusive breastfeeding was in higher percentage, with 87,8 % and the non-consumption of nutritional supplements was identified as a frequent risk factor associated with the onset of anemia, although in each of the studies the role of inadequate feeding varied in its frequency.

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Iron deficiency and iron deficiency anemia should be conceptualized within the context of the human lifespan, since the alterations present during infancy may be fundamental in explaining variations in later life. There is insufficient evidence that, in the absence of any disease, a single variable, for example, cow's milk consumption during the first year of life, is determinant in causing iron deficiency, but undoubtedly, some of them may contribute, even if they do not represent the causal variable by themselves.

Generally, both hematologists and the rest of the medical professionals who take care of children with iron deficiency consider that it is caused by a particular biological mechanism, simplifying their vision by not considering its social determinants. Hence, there is a tendency to discard these conditions understood as those that exert their influence through the different components that determine a better or worse state of health of the population, such as the social, economic and cultural environment, lifestyles, as well as the organization and functioning of health services.

Several physiological and pathological conditions favor iron deficiency anemia, for example, when the absorption of the metal in the diet is less than the losses and the basal requirements in periods of rapid growth, as happens in children under five years of age and during adolescence, during pregnancy, a physiological condition in which there is an increase in iron requirements, but not in the child during lactation, if the mother receives iron supplementation, due to the high absorption of iron from breast milk.

Iron deficiency anemia and iron deficiency states are a widely recognized health problem. According to data from the Pan American Health Organization, 70 % of Ecuadorian children suffer from anemia (50 % due to iron deficiency). [23] On the African continent, statistics in Ghana show that the prevalence of anemia in the pediatric age group is 78,4 %, with a predominance in children under two years of age (85,1 %)[24] with the risk being higher in those with nutrient deficiency.[25,26]

However, there are reports in which no relationship has been found between the presence of anemia and vitamin deficiency.[27] Another of the elements indicated for the development of iron deficiency anemia during childhood is the inhibition of the absorption of non-heme iron due to the ingestion of foods rich in phytates, as is the case in Mexico.

In Cuba, a 70 % prevalence of anemia has been reported in children of mothers who had anemia before delivery and 55 % of those who were artificially breastfed. Similarly, the need to maintain iron supplementation during lactation has been pointed out, especially in situations of vulnerability such as infections and low birth weight.[8] In relation to preschool children, anemia has been reported in 23,3 %, with a higher prevalence in children between 12 and 24 months of age, while in school-age children it is 10,1 %, with no gender predominance. No significant differences were found when comparing children from urban and rural areas.[1]

The presence of anemia in children is linked to maternal and infant risk factors, which should be identified and treated in the child care consultation with health promotion and prevention activities. Similarly, metal deficiency is also accompanied by alterations in the immune response and efficiency among other aspects that identify the child's quality of life. To effectively combat this deficiency, it is necessary to promote exclusive breastfeeding up to six months of age and complementary breastfeeding up to two years of age, to increase the fortification of foods aimed at these age groups, nutritional education activities, as well as to improve the intake patterns of iron-rich foods.

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Conflict of Interest
The authors declare that there is no conflict of interest.

Authorship Contribution
LCM: participated in the conceptualization, bibliographic search, writing, revision and editing of the article.
DVV: contributed in the methodology of the study, the formal analysis and the writing of the original draft of the research.
CVS: Participated in the supervision and validation of the manuscript.

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