

# Reflections on iron supplementation in children

## *Reflexões sobre a suplementação de ferro na população infantil*

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### ABSTRACT

This study aims to improve the knowledge and daily practice in child health care. We attempted to use references starting in 1987, achieved in virtual libraries and personal collections in Pediatrics. The texts were submitted to an exploratory, interpretive, and selective reading. This study aims to reflect on the consciousness and behavior of parents and caregivers, trying to understand the problems resulting from no supplementation or inadequate iron supplementation in order to advise on the importance of iron supplementation in early childhood. In addition, it warns about the need for more studies on the benefits and harms arising from iron supplementation in the childhood diet, which are little discussed and disseminated.

**Key words:** Child Health; Iron Deficiency; Anemia, Iron-Deficiency; Iron/deficiency; Iron/metabolism; Iron, Dietary.

### RESUMO

*Este estudo tem como objetivo aprimorar conhecimentos e melhorar a prática diária na assistência à saúde da criança. Buscou-se utilizar referências a partir do ano de 1987, conseguidas em bibliotecas virtuais e acervo pessoal de Pediatria. Os textos foram submetidos à leitura exploratória, interpretativa e seletiva. Este estudo busca reflexão sobre a consciência e o comportamento de pais e cuidadores, tentando compreender os problemas advindos da não suplementação ou da suplementação inadequada de ferro, com o intuito de orientar sobre a importância da suplementação de ferro na primeira infância. Também adverte sobre a necessidade de mais estudos sobre os benefícios e malefícios pouco discutidos e difundidos advindos da suplementação de ferro na dieta na infância.*

**Palavras-chave:** Saúde da Criança; Deficiência de Ferro; Anemia Ferropriva; Anemia; Ferro/deficiência; Ferro/metabolismo; Ferro na Dieta.

### INTRODUCTION

Iron deficiency is characterized by a reduction in the total amount of iron in the body and insufficient supply to meet the needs of tissues and formation of hemoglobin by erythrocytes. Iron deficiency anemia (ADF) results from poor supply of iron to the bone marrow with consequent reduction in blood hemoglobin concentrations.<sup>1</sup>

Silva et al.<sup>2</sup> stress that iron deficiency anemia is a nutritional deficiency of high prevalence in various populations of the world and its major harm in childhood are deficits in mental and psychomotor development, behavioral alterations, decreased resistance to infections, and a slowdown in growth processes.

Pereira et al.<sup>3</sup> describe numerous bodily functions committed to the installation of anemia that result in deficiencies in relation to oxygen transport to tissues, oxi-

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dation and reduction reactions, humoral and cellular immunity, synthesis of deoxyribonucleic acid (DNA), and synthesis of myelin neurotransmitters among other vital activities, which alter physical and mental child development.

There are several definitions of iron deficiency anemia or ADF. The consensus considers it<sup>4</sup> as a pathological process in which the hemoglobin contained in red blood cells is low, arising from nutritional deficiency, with significant implications for child development, especially due to the magnitude of its prevalence, which determines the need for public policies for its prevention and control in Brazil.

Pereira et al.<sup>3</sup> make references to socioeconomic conditions as responsible for the development of anemia and nutritional deficiencies, mainly related to iron deficiency and vitamin A. These are key determinants of ADF: low maternal education level; lack of sanitation, sewerage, and water treatment; short duration of exclusive breastfeeding; diarrhea, and poor nutritional status.

Iron deficiency anemia in children, according to Monteiro et al.<sup>5</sup>, is one of the major nutritional problems faced in public health in need of implementation of actions to prevent its effects in developing countries.

The World Health Organization<sup>4</sup> estimates that anemia affects about 30% of the world population, and half of that prevalence can be attributed to iron deficiency. In children between six months and two years of age, the prevalence of anemia exceeds 50%.

Public health has grounded its intervention proposals in relation to anemia as a health-disease process, which limits the possibilities of action to solve the problem because of its predominantly curative and not preventive vision.<sup>6</sup> The authors warn about the need to consider processes and social and economic conditions, qualitative and quantitative dietary deficiencies, and inadequate environmental sanitation, reinforcing the importance of public health focused not only on the individual but on the community to improve the different social and biological processes.

International health advocacy organizations address this social vision suggesting three strategies for the prevention of ADF: nutritional education, food fortification, and iron supplementation. According to these strategies, Brazil made the fortification of wheat and maize flour with iron and folic acid mandatory since 2004 and implemented preventive supplemen-

tation with iron sulfate for vulnerable groups from 2005 onward.

Cardoso et al.<sup>7</sup> believe that interventions to control the prevalence of ADF are necessary because of the magnitude of nutritional deficiency and the knowledge of its effects on the quality of life, morbidity, and mortality.

Despite the various strategies adopted in several countries, there is an international consensus that programs for prevention and control of ADF have not been effective. The centralization of interventions in dietary supplementation with iron begun to consider it not only for the efficacy but also the effectiveness, i.e., the ability to produce the desired effect under the expected conditions of use.<sup>8</sup>

The supplementation of iron through medications is an essential prevention strategy for ADF on the understanding of Silva et al.<sup>2</sup>. There are several proposals for prophylactic iron doses for preventing anemia in the first years of life modeled on the World Health Organization (WHO) and based on the specific Pediatrics committees and proposals from official departments of many countries, such as the Ministry of Health (MS) in Brazil.<sup>9</sup>

Despite the relevance of this topic, the knowledge about benefits and possible harms related to the necessary amount of iron for supplementing the childhood diet remains controversial.

## MATERIAL AND METHOD

This study sought to identify publications related to the benefits and harms of the use of different prophylactic iron doses by offering support to the work of health teams in the pursuit of improving the quality of care provided.

Articles were found in the LILACS, SciELO, and MEDLINE databases in the period from June to December 2009 using the keywords: anemia, benefits, and iron. Subsequently, these articles underwent exploratory, interpretive, and selective reading.

## LITERATURE REVIEW

Iron is an essential nutrient for the functioning of many biochemical processes such as electron transfer reaction, regulation of growth and cell differentiation, and other oxygen transport. It is also a potent

cellular pro-oxidant, and its excess can be harmful to the various cellular processes.<sup>10</sup>

Iron deficiency anemia determines the reduction in the concentration of hemoglobin in the blood, which impairs the tissue oxygen transport, reduces the ability to work, and physical performance.<sup>11</sup> Delayed in psychomotor development and behavior alterations may occur when the iron deficiency occurs in the first two years of life.<sup>12-14</sup>

Silva et al.<sup>2</sup> report that the possible effect of iron supplementation on growth can be associated with changes caused to the immune system that impact the risk of morbidity.

Treatment with iron supplements should be used in all children with clinical and laboratory diagnosis of anemia because only dietary corrections do not correct anemia.<sup>11</sup> The route of iron administration should preferably be oral, reserving the parenteral way in cases in which that path is intolerable. Ferrous sulfate is the preferred formulation for its low cost and high bioavailability. The correction of anemia identified as low hemoglobin is usually fixed in six weeks. However, the replenishment of iron reserves requires four to six additional months due to decreased iron absorption as anemia is being controlled.

The Operational Manual of the National Program of Iron Supplementation of the Ministry of Health recommends daily supplementation with iron salts, in the classic form of administration in programs for the prevention of anemia at the dose of 1 mg/kg body weight/day or 5 ml weekly syrup in the presentation of 125 mg/5 mL up to 24 months of age. Moreover, for treatment, the dosage of 3 mg/kg/day. Premature children should receive 2 mg/kg/day up to 12 months and then continue with the prescription for children born at term.<sup>9</sup>

Alves and Moulin<sup>15</sup> advise on the administration of iron absorption facilitators such as meats and vitamin C, concomitant with therapeutic iron. Moreover, warn on inhibitors such as soft drinks and teas.

The equivalence effectiveness of the daily and weekly supplementation is discussed by Monteiro et al.<sup>5</sup> and Pereira et al.<sup>3</sup>. However, these data are little known.

Gillespie et al.<sup>16</sup> states that iron supplementation as a preventive measure has a great chance of success when directed to specific groups such as pregnant women, infants, and preschool children. For supplementation in school children, it is advisable to be carried out through tracking and not by covering the entire population, as this is usually unnecessary, impossible, and expensive.

## DISAGREEMENT ABOUT THE SUPPLEMENTATION WITH IRON IN CHILDREN POPULATION

Several studies have been conducted since 1993 with the purpose of acknowledging the harms and benefits of iron supplementation in non-anemic children. However, the harms are not disclosed or were omitted considering that only benefits have been presented in this strategy.

## BENEFITS

In 1993, Angeles et al.<sup>17</sup> initiated discussions on the benefits of iron supplementation in non-anemic children, but without discussing them. Subsequently, Soemantri et al.<sup>18</sup> and Thu et al.<sup>19</sup> found no differences in the effects of supplementation with iron on the nutritional status of non-anemic children.

The consequences arising from iron deficiency early in life were mentioned by Monteiro et al.<sup>5</sup> as relevant to child growth and development, focusing on impaired cognitive development and poor school performance. The same authors emphasize food fortification with iron and distribution of medicated supplements with iron salts through public health networks as two interventions more likely to control iron deficiency anemia in children. However, in developing countries, foods fortified with iron are expensive and therefore seldom used by most people. The need of iron supplementation via medication has become the government's responsibility.

In the research of Iannotti et al.<sup>10</sup>, the variations between benefits and harms of iron supplementation depended on the initial levels of hemoglobin and indicators used for iron nutritional status. The beneficial effects of iron supplementation have mainly been proven in anemic children, although supplementation with prophylactic iron doses can reach large numbers of non-anemic children.

In accordance with Monteiro et al.<sup>5</sup>, Pereira et al.<sup>3</sup> point out retardation in growth and motor and mental development, decreased physical activity, sense of insecurity, fatigue, and inattention in addition to cognitive impairments.

The content and frequency in offering prophylactic iron doses did not influence the growth of non-anemic children in the survey conducted by Silva et al.<sup>2</sup>. However, the infants presented, in general, improvement

in weight/age and weight/length indexes. The authors emphasized that the benefits of iron supplementation on growth could be grounded by improved appetite and food intake, thus strengthening the immune system and resulting in decreased morbidity.

## POSSIBLE HARMS

Some of the first works to present the possible harmful effects of iron supplementation in the diet of non-anemic children were Yip et al.<sup>20</sup> and Gillespie et al.<sup>16</sup>, which detected a need for an appropriate treatment avoiding overload supplementation with iron due to its influence on the absorption of other minerals (e.g. zinc). Moreover, the chronic iron overload (hemochromatosis or thalassemia) could influence carcinogenesis. They also considered the accidental intake of iron in children causing poisoning.

Dijkhuizen et al.<sup>21</sup> and Sachdev et al.<sup>22</sup> discussed the lack of expected effects with iron supplementation, not considering benefits or harms.

The strategy for iron supplementation in different countries, according to Dewey et al.<sup>23</sup>, show harmful common issues such as in Indonesia and Sweden where non-iron deficient infants showed less weight gain and smaller head circumference. In Honduras, where children presented the worse iron nutritional status, supplementation had a negative effect on the gain in length only in non-anemic infants. They warned about the risk of health damage caused by daily iron supplementation in children less than six months old due to the immaturity of their iron metabolism regulation.

Some probable harm caused by iron supplementation was cited by Fischer et al.<sup>24</sup> such as competitive inhibition with respect to Zinc absorption needed for the growth process. They referred to the lack of evidence regarding the supplementation of dietary iron and a decrease in serum zinc levels.

Leão et al.<sup>25</sup> recommend the indiscriminate use of iron in doses higher than those referred that should only be used for treating deficiency anemia, and it is not without risks.

Due to its chemical properties, Iannotti et al.<sup>10</sup> warn that iron is not readily eliminated from the body, has high oxidative power, and can cause damage to the absorption and/or metabolism of other nutrients and suppression of enzyme activity. They observed that supplementation was associated with improvement in hemoglobin concentration and reduction in cognitive defi-

cits and motor development among children with iron deficiency. However, the harm to weight gain and effects on height were inconclusive in non-anemic children.

## CONCLUSIONS

There are controversies about the relationship between benefits and harms of iron supplementation among children.

This review aimed to reflect on the knowledge and practice of health professionals in relation to dietary iron supplementation in children, aiming to guide how to proceed considering not only its benefits but also its harms. It aimed to minimize the harms resulting from non-supplementation and unnecessary supplementation, and how to execute it properly.

This theme is of great relevance because it deals with the administration of dosages to children in the early stages of life, not only considering its benefit but also an association with imponderable risks and irreversible harm. There are few studies on the possible harmful effects of iron supplementation concluding that prophylactic iron should be used in those situations recommended by the Ministry of Health and the Brazilian Society of Pediatrics, even with the consideration of possible harm, and until new recommendations are published.

Further studies on the subject and the dissemination of their results are needed in order to guide practitioners on how to provide the best care on an individual basis.

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