

Iron deficiency anemia in children: prevalence and prevention studies in Ribeirão Preto, Brazil

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SUMMARY. Iron deficiency anemia in children: prevalence and prevention studies in Ribeirão Preto, Brazil. Iron deficiency and ferropenic anemia are, certainly, the most prevalent and specific nutritional problems in Brazil. The Ribeirão Preto region is no exception to it. A large prevalence of iron deficiency/anemia is found, mainly in the age group 6-24 months. In spite of the fact that several aspects of its physiopathology are known it is a very difficult problem to be solved. Many approaches and alternatives for their prevention have been tried but we are far from controlling the situation. Several studies carried out at the Medical School of Ribeirão Preto, University of São Paulo, Brazil have shown this high incidence of iron deficiency and iron anemia among infants and preschool children. The importance of iron supplementation to preterm, premature and normal infants was pointed out. The possibility of use of iron complexes to prevent iron deficiency, besides the usual ferrous sulfate, was shown. Several community studies proved the feasibility of distribution and intake of iron as supplements or fortification of carriers as alternatives to prevent iron deficiency.

INTRODUCTION

As in many other parts of the world iron deficiency anemia is still quite common in Brazil. Surveys carried out in different regions of the country show its presence all over, both in urban and rural areas, affecting mainly pregnant/lactating mothers, 6 months infants and preschool children of poor socioeconomic groups. It is undoubtedly linked to low food iron intake, although parasitic infestation may play an important role in specific areas of Brazil. The prevalence of iron deficiency among infants from 6 to 24 months of age is so high in rich areas of the South, where it reaches more than 50% of their unprivileged population, as in the poorer Northeastern regions of the country, where energy-protein children undernutrition is also quite widespread. That age group along with prematures, low birth weight infants and pre-school children are, certainly, the highest target group to be protected against iron deficiency. On the other hand anemia among low socio-economic pregnant/lactating women seems to be less prevalent than in young children, reaching 20-30% of them and being apparently less common than in other developing countries.

The problem of iron deficiency and anemia although prevalent in the country has not brought the needed attention of the public health community, less to say of government personnel. Physicians know little about iron deficiency and iron anemia is only taken care of when values of hemoglobin reach very low values. Few nutritional investigators exist in the country and not many of them are regularly studying and dealing with the problem.

Theoretically, iron supplementation of pregnant/lactating mothers is accepted as a need in the country, but implementation and adherence of this practice is poorly controlled and low along the needed population.

Food fortification with iron and other nutrients is present in several industrial products but is only used by privileged medium and high classes groups. Low classes families have little knowledge and access to it.

Nutrition and dietary orientation/education is practically

absent in the country. Ignorance, at all levels concerning food and nutrition problems and solutions, is the rule. A lot is said in the country about hunger, mainly as political tool, but very little of practical and well planned projects and programs are implemented. Nutritional personnel, with poor knowledge and lack of interest in public health nutrition problems is doing too little to solve the iron deficiency/anemia situation.

WHAT HAS BEEN DONE AND WHAT TO DO?

It is not an easy task to deal with iron deficiency and anemia. If it would be, the solution being available, an answer could be found. The problem is still present everywhere in the planet, even in some population groups of the rich world. There is not only one solution to this serious iron nutrition problem. Its consequences are dreadful to the individual and specially detrimental to the mental and physical development of our children, to the working capacity of adults and to the quality of life of communities and nations.

This report will concentrate on data from Ribeirão Preto, Brazil. It is noteworthy to say that Ribeirão Preto is one of the richest regions of Brazil. The area has a good health infrastructure, a high economic development and very good educational system. On this situation it is a surprise to find there a high prevalence of iron deficiency and iron anemia among children. This deficiency picture certainly has a different physiopathology in our area than that of iron anemia from the Northeast Brazil, which is linked also to a high protein energy malnutrition plus poor iron intake and a greater parasitic infestation. Our situation is most dependent on low iron intake, high cow's milk intake and adequate energy-protein diet.

Several studies carried out all over different areas of the State of São Paulo, on normal infants as well as preschoolers, have showed several times the presence of anemia above 50%, affecting mainly children of low socio-economic level.

At the Medical School of Ribeirão Preto, University of São Paulo, Brazil, a group of the Department of Pediatrics and the Division

of Nutrition of the Department of Medicine, carried out several studies on the subject. These were carried out in rats, infants and children.

Data on the prevalence of iron deficiency and anemia in Ribeirão Preto of preterm and term infants followed during 6, 9 and 12 months are available (1,2) and show that the highest frequencies of anemia occurred at 6 months after birth in the preterm infants (80%) and at 9 months for term infants (31%). The type of feeding, mother's milk or cow's milk combined or not with beef and egg yolk, given to infants from 6 to 12 months of age presented a poor relationship with prevalence of anemia, which increased after 6 months (1). The effect of preventive iron supplements starting either at 15 or 60 days after birth has also been evaluated (3) and showed that prevalence of anemia at 12 months was 27.3% and 35.7 %, respectively. Bioavailability of iron from infant food cooked on iron pots was demonstrated (4). The effect of different iron supplements on the hematological picture of 6 to 60 months children attending a day care center (5) and experiments with rats (6) showed that FeEDTA and Fe aminocheilate gave similar results as ferrous sulfate for hematological iron indices and other parameters.

At our Clinical Nutrition Division the iron work includes a series of experimental and community studies. Our aim is to implement a national program to guarantee the intake of iron by the pregnant women through the once a week iron tablet, to fortify with iron salts the Brazilian Government cow's milk distribution already available and offered free to a very large number of infants, and to fortify with iron the drinking water available to pre-school children attending day-care community institutions.

During the last 5-6 years our iron work has, mostly, concentrated on this possibility of using drinking water as an alternative carrier for iron. This would guarantee an adequate daily intake of this mineral by preschool children (7). Certainly drinking water suits the known requisites for an effective fortification vehicle such as: it has a daily intake by everyone; delivery systems can be directed to the global population or to target groups; high bioavailable iron salts exist and may be easily added to water with small or no change of taste/appearance, and iron salts are quite cheap. A similar approach has been used for years, with the addition of fluoride to global drinking water systems, but these modus operandi are not always available. It was then decided to prove its feasibility to a target group, such as the preschoolers who attend urban day-care institutions all over the country. This was hypothesized as an easy and practical approach to supply iron.

From this theoretical reasoning we started to do physical-chemical studies of fortified water with different iron salts followed by experiments with rats and humans. The latter included studies with small groups of children under very close observation in a community day-care institution and later on large scale implementation programs, including nutritional and logistic aspects.

Physical-chemical studies of ferrous sulfate and NaFeEDTA fortified water were the subject of a MSc Thesis (8) and showed that greater solubility and less physical changes occurred when EDTA salts were used. The addition of ascorbic acid or citric acid to the ferrous sulfate solution increased the iron solubility and kept it more stable. This can also be important for maintaining iron as ferrous and not ferric ion. The EDTAFe solution is kept clear for a period of at least 7 days and has a better taste than the ferrous salt, which keeps a residual iron flavor. When the drinking water is chloride treated it is necessary to control the iron content to maintain the chloride activity. The FeEDTA, on the other hand does not react with the water chloride.

Studies with preschool children were carried out in a day-care Ribeirão Preto institution including 31 children, 2-6 years old. They attended the institution, Monday to Friday, from 7.00 a.m. to 5.00 p.m., while their mothers were at work. There, they received food and were submitted to a complete clinical-nutritional examination. Blood samples

were collected 4 times during the experimental period of 12 months, for hematological and chemical analysis. No clinical malnutrition was found in these children, their food intake was adequate and low parasitic infestation was found, on routine examination. Fifty eight percent of the children were anemic with hemoglobin below 11 g/dL and 45% had ferritin below 12 mg/L, at the beginning of the experiment. Ferrous sulfate was added daily to their water pot to reach a concentration of 20 mg Fe/L. After an eight months follow up the percent of hemoglobin below 11 was 3 % and of ferritin below 12 was 7 %. It was demonstrated that ferrous sulfate added to the drinking water was accepted by the children and reduced drastically the anemia of these low-socio-economic children. Fe-enriched water was shown to be a practical alternative to supply Fe to children attending day-care institutions (9).

The same experimental approach, now adding ferrous sulfate solution to home drinking water pot was tested in 21 families living at their community homes. The Fe was added to their drinking pot to give a final solution of 10 mg Fe/L. This water was drunk by all family members. Its effect was measured by changes in the hemoglobin level and compared to another group of families who received a placebo, instead of the iron. The mean hemoglobin levels of the children and adults who received iron fortified drinking water for 4 months increased significantly ($P < 0.01$) as compared to levels before fortification. The placebo did not change their hemoglobin levels (10).

Several other larger community studies, including city day-care institutions, with preschool children were carried out in the last 3-4 years. Their objective was to call the attention to iron deficiency, to test the intake and the delivery system of the concentrated iron solutions. These were diluted locally by a trained person in charge, at the day care institutions. At these places, all the local working personnel, the children and their mothers received classes about the importance and the need of iron for the better development of the children. Earth pots were furnished to the day-care institutions and the dilution was controlled by measuring the amount of concentrated iron solution to be added to the drinking water. The water was well accepted by the children and persons in charge expressed the fact that children improved their appetite and physical activities.

In one of these day-care institution trials, located in a small city nearby Ribeirão Preto, the program included blood sampling for hematological examination. After one year of ferrous solution added to the drinking water pot hemoglobin levels were higher and anemia prevalence decreased from 41% to 22% (11).

CONCLUSIONS

Drinking water was shown to be a suitable vehicle to carry Fe to supply iron needs of preschool children kept at community day-care institutions. These institutions exist everywhere in Brazil and local pharmacies can prepare the iron solution to be added to the drinking water pot. The children staying at these centers all day could have an adequate supply/intake of Fe, sufficient to prevent iron deficiency/anemia. A strong educational input on the importance of iron to the nutritional well-being has to be offered to all participants of the program. These include children and their mothers as well as professionals, local workers, community representatives and local government. This educational input is very important for the success of the program.

ACKNOWLEDGMENT

This paper is published as a tribute to the young professional Valéria Vasconcellos who started to work with us on iron research and prematurely died, a few years after finishing her BS degree at UNESP, Araraquara, Brazil, 1994

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