Weekly iron supplementation reduces anemia prevalence by 1/3 in preschool children

Suplementação semanal com sulfato ferroso reduz em 1/3 a prevalência de anemia em pré-escolares

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Funding: Mato-Grosso Foundation for Research Support – FAPEMAT (Process nº 352 85/07-1999.E)
Support: Municipal Health Secretariat of Várzea Grande – MT: donation of ferrous sulfate.
Presentations at Scientific Events:
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Abstract

A weekly medication scheme, followed by nutritional guidance on diets in child-care centers, was evaluated in order to make it feasible for routine use. The study was conducted in six child-care centers in the town of Cuiabá - Brazil. The supplement (6 mg/kg) was provided on a weekly basis to all children (n=178) less than three years old during four months at the institution by the classroom staff. After this initial phase, nutritional guidance was provided regarding the child-care center's normal diet as a way to control hemoglobin levels. This is an intervention study whose individuals were examined at three different periods: at the beginning of treatment (T0); after four months of iron supplementation (T1) and after five months of nutritional guidance (T2). Hemoglobin measurements were obtained using a portable hemoglobinometer - HemoCue. A significant improvement was observed in the hemoglobin levels of anemic children after controlling for age and initial hemoglobin. The hemoglobin concentration of these children improved an average of 0.1 g/l after each dose of iron sulfate. At the end of four months there was an average gain of 1.6 g/l, and prevalence of anemia reduced by 1/3, sufficient to meet the United Nations target adopted by Brazil. At the end of nine months (four months of weekly drug intervention followed by 5 months of nutritional guidance) the prevalence of anemia dropped by 1/4 in the child-care centers. The intervention proved to be feasible for child-care centers and pre-school population.

Key Words: Iron-deficiency anemia/PC. Dietary supplements. Infant. Preschool child. Child daycare centers.

Resumo

Um esquema terapêutico semanal, seguido de orientação alimentar aos cardápios, foi avaliado com o intuito de verificar viabilidade como rotina em creches. O estudo foi realizado em seis creches no município de Cuiabá. O suplemento (6 mg/kg) foi oferecido semanalmente a todas as crianças (n=178) menores de 3 anos durante 4 meses, na própria Instituição, pelas funcionárias. Após essa primeira etapa seguiram-se orientações alimentares ao cardápio da creche, como forma de controle desses níveis de hemoglobina. Este é um estudo de intervenção, onde os indivíduos foram avaliados em três momentos: no início do tratamento (T0), após a primeira etapa (T1) e após a segunda etapa (T2). Para avaliação da hemoglobina foi utilizado hemoglobinômetro portátil – HemoCue. Houve um acréscimo significativo na hemoglobina, após controle para idade e hemoglobina inicial. A concentração de hemoglobina aumentou em média 0,1 g/l após cada dose de sulfato ferroso. Ao final de quatro meses de suplementação houve um acréscimo médio de 1,6 g/l, e a prevalência de anemia reduziu para 1/3, suficiente para atingir a meta das Nações Unidas adotada pelo Brasil. Ao final de nove meses (quatro meses de suplementação medicamentosa semanal, seguida de cinco meses de orientação alimentar), a prevalência de anemia reduziu para 1/4. A intervenção mostrou-se viável para utilização em diferentes creches e em pré-escolares.

Palavras-chave: Aanemia ferropriva/PC. Suplementos dietéticos. Lactente. Pré-escolar. Creches.

Introduction

Iron Deficiency Anemia (also called IDA) is currently the most frequent nutritional deficiency found in less developed areas. It is the last stage of a relatively long process of deterioration of body iron levels and influences motor development and immune systems of pre-school children, perhaps even in the sub-clinical phase, causing irreversible damage[1]. In Brazil, the prevalence can be extremely high[2-4], even in more developed areas, by far exceeding malnutrition from caloric deprivation.

The extent of the problem motivated a multicenter study with Brazilian pre-school children in daycare centers conducted in the late 1990's in several state capitals, including Cuiabá. Between July and August 1997, the survey observed a high prevalence (63%) of hemoglobin concentrations below 110.0 g/l in the universe of children between 0 and 36 months who went to municipal daycare centers. One-third of these children had concentrations below 95.0 g/l[5]. This situation stimulated the search for a feasible intervention in daycare centers that could be adopted by all state-controlled health services.

International reports suggested that, in populations with a high prevalence of anemia (>40%), direct supplementation was likely to be the preferred initial approach to control existing anemia, to then be complemented, and perhaps replaced, by supplementation or nutritional guidance for the prevention of anemia[6,7].

Unfortunately, supplementation using medication, although efficient for the control of iron deficiency, presents several practical problems, because the obligation of ingesting the medication every day leads to saturation of the intestinal mucosa[8] which, in turn, causes gastrointestinal problems and non-compliance before hemoglobin levels are normal. In addition, as anemia generally does not present apparent clinical symptoms, patients forget to continue treatment for a prolonged period.

An attempt to solve this deficiency resulted in the proposal of an intermittent medical treatment (weekly or twice weekly), that achieved positive results in China[8], Indonesia[9] and Vietnam[10], reducing anemia prevalence without provoking side effects. Other studies prevented but did not control the deficiency[11]. Even so, there was greater commitment of individuals to continue taking medication (about 4 mg Fe/kg/week) for a long period (six months). Repeating the experiment with a higher dose would be worthwhile.

In 1999, Brazil signed a social commitment to reduce iron deficiency anemia. The target was to reduce the prevalence of iron deficiency in pre-school children by one-third until 2003[12]. Therefore, all strategies to eliminate this type of anemia should be adopted in a widespread national mobilization.

This paper intends to evaluate four months of a weekly medication program with ferrous sulfate, followed by another five months of nutritional guidance regarding diets, aiming to reduce iron deficiency anemia in children.

Material and Methods

The municipality of Cuiabá had 483 thousand inhabitants, of which 43,200 were between 0 and 5 years old[13]. Although officially there were 165 pre-school institutions, including 21 municipal daycare centers, few of these centers had nurseries for children below 2 years, the age group with the highest risk of iron deficiency.

The project coordinator visited probably all non-municipal daycare centers for less developed individuals, with nurseries for children below 2 years of age, and whose children stayed full time in the institution. Only six institutions met these criteria, and the individuals responsible for them agreed to participate in the research. Two were charity institutions; three institutions were supported by the State and a company employee association supported another one. It was decided not to have a control group due to ethical reasons. The Ethics Committee of the Federal University of Mato-Grosso approved the project.

After the coordinator of the project explained the risks and objectives of the study in each daycare center, he invited the parents of the children below 3 to participate in the survey signing the consent term. Of the 178 children enrolled at baseline, complete datasets were available for 173 children for age and for 147 children for social status and weight at birth. Reasons for exclusion were the absence of the child's vaccination card – with birth weight information – in the daycare center (n=5) and failure to interview the mother (n=31).

Regardless of blood results, children received the same amount of ferrous sulfate for controlling or preventing the deficiency. Those who remained anemic after 4 months of weekly supplementation were encouraged to continue treatment and, also, to seek medical care.

The cut-off point used to define anemia was a hemoglobin concentration of < 110.0 g/l[6,7]. The instrument used for evaluation was HemoCue, an accurate and precise portable hemoglobin analyzer. Blood withdrawal occurred in the morning, with a finger prick, and it followed the simple steps of operating manuals. The photometer calibration was checked everyday with the equipment's control cuvette.

The response to iron supplementation is the most reliable operational way of classifying an individual as having iron deficiency anemia (IDA). Thus, as the photometer tolerates a maximum deviation of 3.0 g/l, when the variation of hemoglobin concentration in the blood, from now on called *delta*, was more than or equal to 3.0 g/l, it was translated as a "raise" in *delta*. When hemoglobin variation remained between -3.0 and less than 3.0 g/l, it was considered "maintenance"; and when less than -3.0 g/l, *delta* was classified as "decreasing".

Treatment compliance was measured by the amount of ferrous sulfate and the number of doses ingested. Analyses were stratified by age and initial hemoglobin.

Iron administration was conducted by the staff that could either be: child development assistants, assistant nurses or other employees designated for this purpose. The calculation of the volume solution used the mean weight for age of a previous study with children at Cuiabá's daycare centers [5], as described in Table 1. As the research aim was to, in the future, incorporate the iron supplement protocol to all children below 3 years of age at child daycare centers, individuals received a dose (2 or 3 mL) based only on their age, intending to prevent or control the deficiency.

In general, the study protocol tried to resemble near operational program conditions, even though there was a researcher that visited the institutions once a week. He asked the individuals responsible for delivering the drug if the children were taking their liquid formulation, measured by the number of doses offered to each child, volume (mL), occurrence of undesirable effects and description of such effects. The visit generally corresponded to the weekday chosen to deliver the supplement to children and in order to study the feasibility of the institution adopting drug supplementation as a routine measure *in loco*. The researcher also observed how the drug delivery to the children altered the daycare center's routine.

After the end of the supplementation treatment, the director and the nutritionist of the daycare center – or whichever person was responsible for preparing the diet – were instructed about how to improve iron bioavailability in the center's everyday meals by: (a) inclusion of sources of vitamin C (oranges, acerola, lemons, raw vegetables like cabbage and tomatoes) at main meals – lunch and dinner; (b) elimination, as much as possible, of tea and guaraná syrup during meals, or only offering them between meals – tea and guaraná syrup are given very often to infants and young children in the region –; (c) availability of vegetables and meat at lunch and dinner, encouraging their ingestion.

This intervention was studied throughout 2000: the first evaluation in March-April (T0), the second – after weekly iron supplementation – in August (T1) and the last evaluation – after food guidance – in December (T2). Anthropometric and biochemical studies were conducted at the daycare centers on all three occasions.

Statistical analyses used EpiInfo 6 software and STATA release 6.0. Statistical tests were used for comparing differences of proportions and means (X^2, exact test, paired t-test, ANOVA, Kruskal-Wallis). Multiple regression analysis was used to investigate dependence of *delta* on possible explanatory variables.

Results

The greatest difficulty in carrying out this intervention study was following up the children investigated. Despite the best efforts, some of them were lost. Of the 178 children that began the study, 145 (81%) were re-evaluated after 4 months and 118 (67%) after 9 months. Causes of non-compliance were the child's removal from the daycare center or no-show at the institution during the examination period. The successfully traced group was then compared to the "lost" one with respect to several known characteristics. Table 2 shows that the children evaluated did not differ from children "lost" in T1

Table 1 – Weekly dose of iron sulfate and elemental quantity per dose, offered weekly to children less than three years old in kindergartens in Cuiabá-Brazil, 2000.

Age (years)	Average Weight[a] (kg)	Q Fe / week[b] (mg)	Q solution[c] / week (ml)
0 |— 1	7.3	44	2
1 |— 2	9.6	58	2
2 |— 3	12.0	72	3

[a] Average weight of the children at the 9 municipal daycare centers analyzed in 1997 [5]; [b] 6 mg Fe / kg / week;
[c] CEME Solution: ~25 mg elementary Fe / mL – donation from the Municipal Health Secretariat of Várzea Grande.

and T2 in regard to several biological, anthropometric, biochemical and social parameters. Thus, it increased one's confidence that the lost group did not introduce any bias into the findings.

There was a clear and significant reduction in the prevalence of anemia (% Hb < 110.0 g/l) by 1/3, since the beginning of the weekly treatment (from 41% to 17%), which continued even when the supplement was no longer provided and only food guidance was observed (final prevalence: 10% or reduction by 1/4 in relation to baseline). On the other hand, anthropometrical z-scores indicators (weight-for-age, height-for-age and weight-for-height) did not differ for the three periods investigated.

Table 3 presents average hemoglobin concentrations for the 3 moments of the study. A comparison of hemoglobin mean from the beginning of the study (Hb0) and after a nine-month intervention (Hb2) showed a significant increase (p < 0.0001) of 12.0 g Hb / l, regardless of the child initial age and hemoglobin.

Children less than two years old had lower hemoglobin values – approximately 6.5 g/l less – than the ones 2 years old or older. Comparing hemoglobin means, after a 4-month intervention with medication, there was a significant increase by 10.0 g Hb/l (p < 0.001). After 5 months of nutritional guidance on the daycare centers' diets, hemoglobin continued to rise by approximately 2.0 g/l, but it was non-significant (p = 0.178).

This variation was threefold in children who were anemic to begin with (19.6 g Hb/l), compared to non-anemic children (6.6 g Hb/l). Those with Hb < 110.0 g/l at baseline achieved a mean increase of 15.7 g Hb/l during the weekly treatment with medication, and after 5 months acquired further 3.9 g/l. Severely anemic children (Hb < 95 g/l) achieved a gain of 19. g Hb/l during treatment with medication, and after a 5-month guidance on diet, they gained a further 5.5 g/l (Table 3). By

Table 2 – Comparison of biological, anthropometric and social attributes at baseline, follow-up and "lost" children on the first, second and third visits. Cuiabá-Brazil, 2000.

Attributes	T0	T1	Lost T0 - T1	p	T2	Lost T0 - T2	p
Biological							
% (n) Initial age (months)							
4 |— 12	8.1 (14)	6.3 (9)	17.2 (5)		5.1 (6)	14.3 (8)	
12 |— 18	12.7 (22)	11.1 (16)	20.7 (6)		9.4 (11)	19.6 (11)	
18 |— 24	21.4 (37)	20.8 (30)	24.1 (7)	0.09[a]	23.9 (28)	16.1 (9)	0.052[a]
24 |— 30	22.0 (38)	23.6 (34)	13.8 (4)		22.2 (26)	21.4 (12)	
30 |— 36	35.8 (62)	38.2 (55)	24.1 (7)		39.3 (46)	28.6 (16)	
% (n) Males	52.8 (94)	55.2 (80)	42.4 (14)	0.18[a]	53.4 (63)	51.7 (31)	0.83[a]
% (n) Weight at birth < 2,500 g	12.2 (18)	13.7 (17)	4.2 (1)	0.17[b]	10.9 (11)	14.9 (7)	0.48[a]
Anthropometric and Biochemical							
Mean (SD) weight / age z score	-0.186 (±1.12)	-0.183 (±1.11)	-0.200 (±1.21)	0.94[c]	-0.133 (±1.07)	-0.295 (±,1.22)	0.38[c]
Mean (SD) weight / height z score	0.015 (±0.91)	0.066 (±0.92)	-0.209 (±0.81)	0.11[c]	0.088 (±0.92)	-0.128 (±0.87)	0.13[c]
Mean (SD) height / age z score	-0.166 (±1.20)	-0.221 (±1.07)	0.107 (±1.68)	0.82[d]	-0167 (±0.99)	-0.164 (±1.56)	0.59[d]
% (n) Hb < 110.0 g/l	41.6 (178)	42.1 (145)	39.4 (33)	0.77[a]	41.5 (118)	41.7 (60)	0.98[a]
Mean (SD) Initial Hb (g/l)	110.1 (±15.1)	110.2 (±14.8)	109.8 (±16.9)	0.90[c]	111.0 (±14.0)	108.3 (±17.2)	0.26[c]
Social							
% Mothers whose schooling attained ≤ 4th grade (Brazil)	15.0 (n=22)	14.1 (n=18)	21.1 (n=4)	0.43[a]	16.3 (n=17)	11.6 (n=5)	0.46[a]
% Head-of-the-house whose schooling attained ≤ 4th grade (Brazil)	26.4 (n=38)	25.6 (n=32)	31.6 (n=6)	0.58[a]	27.2 (n=28)	24.4 (n=10)	0.73[a]

Statistical tests: [a] X^2; [b] Fischer exact test; [c] ANOVA; [d] Kruskal Wallis

Table 3 – Mean (SD) hemoglobin concentrations (g/l) at the beginning of the study (Hb0), after 4 months of intervention using medication (Hb1) and after 5 months of nutritional guidance (Hb2) considering the children's initial age and hemoglobin in daycare centers in Cuiabá-Brazil, 2000.

Initial age (months)**	n	Hb0 mean (SD)	Hb1 mean (SD)	Hb2 mean (SD)	*Delta* (Hb2-Hb0)	p*
4 |— 18	18	106.7 (17.2)	114.8 (18.9)	119.1 (12.5)	13.9 (13.8)	0.0005
18 |— 24	28	107.3 (10.2)	118.7 (10.3)	118.6 (9.8)	10.4 (8.4)	<0.0001
24 |— 30	26	111.9 (15.0	122.5 (11.6)	125.3 (10.2)	14.6 (13.9)	<0.0001
30 |— 36	46	114.4 (13.4)	123.9 (10.2)	125.6 (8.8)	12.2 (12.8)	<0.0001
Initial Hb (g/l)						
< 95	14	85.9 (6.3)	105.6 (14.6)	111.1 (10.7)	25.2 (11.7)	<0.001
95 to < 110	35	102.8 (4.1)	116.9 (11.0)	120.1 (9.0)	17.3 (8.9)	<0.001
≥ 110	69	120.2 (8.3)	126.1 (9.1)	126.8 (8.7)	6.6 (10.3)	<0.001
Total	118	111.0 (14.0)	121.0 (12.5)	123.0 (10.4)	12.0 (12.1)	<0.0001

* paired t-test; ***Delta* were significant (p<0.001) only between Hb0 and Hb1 regardless of children's age

the end of the study, they obtained a mean of 111.1 g Hb/l, that is, higher than the cutoff point for anemia. Children with a hemoglobin concentration higher then or equal to 95 g/l had an average increase of 10.3 g/l, less than half the increment – 25.2 g/l – in severe anemia.

Considering hemoglobin variation in the 145 children evaluated after taking medication for 4 months, there was an important increase. The mean hemoglobin concentration of 104 (71%) children increased more than 3.0 g/l, so they responded to the treatment. Half the children (49%) presented an increase of 10.0 g/l or even more, attaining maximum *delta* values of 40.0 g/l. Of these 104 children that responded to treatment, half (n=49) were considered "non-anemic" (Hb ³ 110 g/l) at baseline.

Table 4 describes the change in hemoglobin concentrations due to the number of doses and the amount ingested during the 4-month intervention with medication. The children who best complied with the treatment were those diagnosed as anemic. There was a clear trend showing that the better the compliance –

Table 4 – Variation of hemoglobin concentrations due to compliance with four months of weekly interventions (number of doses and volume ingested) with ferrous sulfate in children younger than 36 months in daycare centers. Cuiabá-Brazil, 2000.

Compliance	n*	Mean (± SD) (g/l) Hb0	Hb1	*Delta*	Hb increment (≥ 1 g/l) mean	n (%)
(n doses)						
0 to 8	16	118.1 (±14.1)	122.7 (±14.0)	4.6 (±9.7)		5 (31)
9 to 12	40	109.2 (±15.2)	118.3 (±12.3)	9.1 (±8.2)	4.5	20 (50)
13 to 16	62	105.3 (±14.4)	116.3 (±12.8)	11.0 (±12.0)	6.4	34 (55)
p		0.009	0.197	0.096		
mL ingested (mg Fe ingested)						
0 to 19 (0 to < 500)	16	117.9 (±14.3)	121.4 (±14.0)	3.4 (±8.1)		4 (25)
20 to 31 (500 to <800)	50	106.4 (±15.7)	116.8 (±15.1)	10.4 (±10.2)	7.0	27 (54)
32 to 50 (800 to 1250)	52	107.4 (±14.1)	117.9 (±10.0)	10.4 (±11.4)	7.0	28 (54)
p		0.023	0.529	0.597		

*Total number of children with information on Hb0, Hb1 and compliance.

shown by the number of doses – the higher the increase. Nevertheless, it is important to notice that the solution ingested had no linear relation with hemoglobin increment, given that after 20 ml of oral supplement, the increment was 7.0 g Hb/l and the amount ingested hereafter no longer made any difference.

Table 5 shows the results of the multiple regression analysis in regard to hemoglobin gain during the first four-month follow-up, after only the weekly dose of ferrous sulfate. In model 1, age did not show any statistical correlation with the increase in hemoglobin during the intervention period. The opposite is true for the number of weekly doses of ferrous sulfate ingested by the children: for each dose a mean rise of 0.5 g Hb/l ($p < 0.05$) was observed. Model 2 adds the "initial hemoglobin" variable, and the effect of the variable "number of doses ingested" drops from 0.5 to 0.1 g Hb/l for each weekly dose and loses its statistical significance. Model 3 – that only includes children who were anemic at the beginning – explains the relation between the use of a weekly dose of ferrous sulfate and Hb increase. In this model there was a mean increase of 1.1 g Hb/l for each dose ingested, with a statistically significant correlation ($p < 0.05$), and regardless of age and the initial hemoglobin level. The reverse occurred when only non-anemic children were analyzed, resulting in a negative increment. This result is in tune with Table 4, which shows that compliance to the doses was higher in children with lower hemoglobin levels.

According to daycare center employees, a little more than one-third (38%) of the children presented undesirable effects. These effects were far more frequent in anemic children than with the other children, probably because anemic children had ingested more doses of ferrous sulfate. The events most often registered were vomiting (68%) and diarrhea (33%).

Discussion

There was an increase in hemoglobin concentration in anemic children even after controlling for age and initial hemoglobin. After 4 months of weekly doses there was a mean increase of 15.7 g Hb/l. This important improvement helped reduce by 1/3, in only 4 months, the prevalence of anemia (from 41% to 17%) in the total sample, and tended to control and prevent the deficiency,

Table 5 – Multiple regression models after a 4-month follow-up with weekly ferrous sulfate interventions on the hemoglobin *delta* (g/l) considering age, (months), number of doses ingested and initial Hb level. Cuiabá-Brazil 2000.

Model	Variables	*Delta* Hb	p *	R^2
1	Age	0.08	0.461	0.037
n = 116	**n doses ingested**	**0.51**	**0.043**	
2	Age	0.33	0.001	0.362
n = 116	**n doses ingested**	**0.10**	**0.625**	
	Initial hemoglobin	-3.77	0.001	
3	Age	0.51	0.000	0.328
($Hb < 110.0$)[1]	**n doses ingested**	**1.07**	**0.033**	
n = 56	**Initial hemoglobin**	-4.25	0.000	
4	Age	0.19	0.194	0.156
($Hb \geq 110.0$)[2]	**n doses ingested**	**-0.12**	**0.573**	
n = 60	**Initial hemoglobin**	-3.25	0.003	

* Significance level of the variable in the model
[1] Includes only children with anemia at the beginning of the study ($Hb < 110.0$)
[2] Includes only children who were not anemic at the beginning of the study ($Hb \geq 110.0$)

depending on compliance. This reduction to more than half the initial prevalence of anemia agrees with weekly supplementation studies in pre-school children conducted in Brazil[4, 11] and in other developing countries[9, 10, 14, 15]. The pioneering study with Chinese pre-school children [8] showed that the correction of hemoglobin levels attained 100%.

We expected an improvement in hemoglobin concentrations in the group of anemic children and children less than one year old. In regard to the former, this expectation was due to improved iron uptake when the body lacks the mineral. In the latter, because of the trend observed in hemoglobin levels of a normal population, after a physiological decline after birth, to gradually rise and then become stable, between 120.0 and 125.0 g Hb/l, at approximately 6 months of age[16]. For this study, after controlling for age, the increment continued to be significant. However, when individuals were controlled for initial hemoglobin levels, only the anemic ones obtained a consistent increase, of 1.1 g Hb/l for each dose of ferrous sulfate ingested.

This can also be explained by the study design, in which the result of the exam was informed before the beginning of treatment and, consequently, compliance was higher among children diagnosed as iron-deprived. We must also remember that informing mothers and the respective daycare centers immediately after the diagnosis made the acceptance of the researchers in the institution easier. The losses incurred in the sample were more due to the removal of the child or to illness than to the mother's refusal to have her child taking part in the project. So, although losses were very high, it seems this did not bias results, given the children followed up had the same characteristics of the "lost" ones. Furthermore, child turnover is very high in public kindergartens[5].

Considering a reference population – whose increase in hemoglobin, at the age group between 2 months and 3 years of age, is generally 10.0 g Hb/l[16] –, we can say that the treatment in question improves hemoglobin levels in a short time, even without considering compliance.

Ferreira et al.[4], using the same treatment (2 ml of the same ferrous sulfate solution/week) in children aged 6 to 23 months within the Family Health Program, could observe a 10.0 g/l hemoglobin increase after only 24 weeks, conversely to our present study that showed the same increase in only 16 weeks. The authors agreed that the effects of treatment became stable after the 23rd week. The present study provided iron doses of approximately 6 mg/kg weight/week, the same used in the pioneer work of Liu et al.[8] which was enough for eliminating anemia at the same age, even for those < 100 g Hb/l. It was also higher than the dose used by Schultink et al.[9], Thu et al.[10] and Monteiro et al.[11]. So, the iron dosage level is by far adequate to control and, consequently, prevent anemia.

Although the prevalence of anemia in the daycare centers studied was 41%, 71% of the children responded to medical intervention with iron, showing a sub-clinical state of deficiency of this mineral and reinforcing the FAO/WHO estimate that for each anemic individual there is at least one more with iron deficiency[17]. This high prevalence in preschool children in Cuiabá is not surprising because another study had already found a prevalence of 63%[5], of which one third had severe anemia. The present study showed a lower prevalence probably because it consisted of a higher socio-economic stratum.

Continuing the intervention for the following 5 months with simple nutritional guidance was enough to reduce the prevalence from 17% to 10%. After treatment with medication, daycare centers were told the results of the exams and the importance of continuing to improve bioavailability of meals. At the end of the year, the researchers returned to the daycare centers and observed a mean increase of 2.0 g Hb/l. If we consider this second moment (T1 until T2) as a rough control of the previous (T0 until T1), we can say that the weekly supplementation was significantly efficient.

The individuals responsible for managing the supplement stated that it caused a slight disturbance in the daycare center's routine. Several of the centers lack a specific person to give children medication. They also argued that daycare centers are institutions for healthy children, and that the child's mother or the local health services are the ones responsible for the child's health. A good solution would be the presence of a trained individual in each daycare center exclusively responsible for health issues, or a public health professional that could periodically visit each daycare center and routinely give children the appropriate medication, including ferrous sulfate and vermifuge.

One could say that we must treat the infection first and then the deficiency. But we must also emphasize that iron deficiency is associated to reduced cell immunity and to an increased prevalence of respiratory and gastrointestinal infections, according to an extensive discussion presented by Tomkins & Watson[18]. The same report concludes that treatment with regular doses of iron can reduce morbidity indexes. In addition, we must also reinforce that a public health problem must be treated "en masse". Equally, parasite infections that may be the cause of anemia are not common in this age group of children below 3 years, according to several studies[2, 19] and confirmation from local parasitologists.

The number of doses ingested and the regular weekly treatment seem more closely associated with the raise in hemoglobin levels than the ingested volume of solution. This indicates the importance of maintaining a regular weekly treatment, even if it is necessary to reduce the volume ingested.

This intervention does not mirror normal working conditions at daycare centers because it took place in a research context, with researchers weekly asking daycare center employees about compliance and with a diagnosis before and after the intervention, always submitting the results and identifying the children with higher deficiency. This could be an argument against the possible impact on the population if at any time one tries to implement it with pre-scholars in the public health system. We must observe, however, that the research team can be replaced by committed health professionals aware of the importance of the treatment and of preventing anemia in children in the risk group, regardless of whether they are in daycare centers or part of routine public health programs.

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recebido em: 01/12/03
versão reformulada apresentada em: 03/05/04
aprovado em: 10/05/04