0021-7557/02/78-01/50
Jornal de Pediatria

ORIGINAL ARTICLE

Anemia in children under 3 years of age in public day care centers

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Abstract

Objective: to study the prevalence of anemia in children aged less than 36 months in public day care centers in the city of Cuiabá, state of Mato Grosso, Brazil.

Methods: cross-sectional study with all children (n=271) less than 36 months of age who attended public day care centers in mid-1997. Children were evaluated as to their hemoglobin levels (venous blood, analyzed at the Central State Laboratory) and anthropometric indicators (weight/age, height/age, weight/height).

Results: a high prevalence (63%) of anemia associated with age, weight and height deficit, and time of admittance at kindergarten was observed. The prevalence of malnutrition was 0.8% according to the weight/height ratio, 5.0% according to weight/age deficit, and showed an inadequacy of 10.3% as to the height/age ratio. Thus, the percentage of anemic children was six times higher than the height deficit and twelve times higher than the weight deficit. Malnutrition was not in fact associated with anemia, but at extreme anthropometric cut-off points of height and weight for age (< -2 z score), there is an association between these conditions.

Conclusion: the high prevalence of anemia is regarded as a severe public health problem among preschool children in the city of Cuiabá.

J Pediatr (Rio J) 2002; 78 (1): 50-56: iron-deficiency anemia, epidemiology, child day care centers.

Introduction

Iron deficiency anemia is the most common nutritional deficiency in developing regions of the world. In Brazil, the prevalence of iron deficiency anemia has been increasing and it is presently the most frequent nutritional deficiency, affecting more patients than calorie and protein malnutrition.[1]

Iron deficiency in preschool children has serious implications in terms of impaired psychomotor development of patients. The long-term developmental outcome of iron deficiency has been detected up to three years after the deficiency has been properly treated.[2]

Iron deficiency is more prevalent during the first two years of life due to the increased iron requirements during such rapid development stage and due to low dietary iron intake; the factor of early weaning also contributes to iron deficiency, especially in lower-income populations. Other risk factors can also help deteriorating the iron nutritional status of infants, such as prematurity, low birthweight,

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Manuscript received Aug 10 2000. Accepted for publication Aug 22 2001.

perinatal bleeding, low hemoglobin concentration at birth, frequent infections, frequent intake of tea, and hookworm infestation.[3]

Currently, several researchers from northern and southern Brazil alike have been studying deeply into the problem of iron deficiency in infants. Literature review of the Lilacs database on the problem of anemia in children aged less than five years in Brazil yielded results indicating elevated prevalences that varied from 25 to 68%.[4-9] The results varied significantly in relation to age ranges, population sizes, population selection method (institutional or not), and study objectives. In turn, all studies adopted the World Health Organization (WHO) cutoff point[3] of Hb < 11 g/dl. Considering that prevalences from 10 to 40% and greater than 40% characterize iron deficiency, respectively, as a moderate and as a severe Healthcare problem,[10] it is safe to state that in Brazil iron deficiency is a nationwide healthcare problem.

Public daycare centers usually have many children of lower socioeconomic status. In this sense, in 1997 the Universidade Federal do Mato Grosso entered the national study coordinated by professors Mauro Fisberg and Josefina Braga from the Universidade Federal de São Paulo and Universidade São Marcos to verify the prevalence of anemia and malnutrition in children aged less than three years and enrolled in full-time daycare centers.

In the city of Cuiabá, as far as we know, this is the first study on the prevalence of anemia in preschool children; it is aimed at being the first step toward mapping the situation in the city; this, in turn, will serve as a basis for future intervention policies in a joint effort with the city and state departments of Health.

Patients and methods

Our study population included all 271 children aged less than three years (143 boys and 128 girls) enrolled in one of the eight city daycare centers, or one of the two full-time childcare centers (Centros de Atenção Integral à Criança - CAIC), or the philanthropic daycare center in the city of Cuiabá, between July and September 1997. The 11 institutions studied were located in the four sanitary districts (a division of the department of health) in the city of Cuiabá, totaling 685 enrolled children aged zero to six years.

Fasting venous blood samples (5 ml) were collected by two nursing assistants of the State Central Laboratory (LACEN) who were helped and supervised by the main researcher. The samples were stored in a tube with EDTA and readily sent to the LACEN; the laboratory carried out complete hemogram examinations on the same day. We defined anemia at 11.0 g hemoglobin/dl; and severe anemia at < 9.5 g/dl.

Anthropometric evaluation was carried out after the standardization of procedures and previous training of researchers.[11] Anthropometric measures examined were weight-for-age, height-for-age, and weight-for-height. We adopted the National Center for Health Statistics (NCHS) references as recommended by the WHO.[12] We applied the Z score for the quantitation of the type and severity of malnutrition. The date of birth of children was recorded according to information in the photocopy of the birth certificate kept in the daycare centers files. In case the daycare did not have the documentation, the information was obtained from the immunization records or, as a last resource, from the mother. The birthweight was recorded according to the information in the photocopy of the immunization records kept in the daycare centers files.

After collection of the blood samples, we interviewed the parents of children at the end of the school day regarding socioeconomic characteristics (head of the family; schooling of parents), and history of breastfeeding and weaning.

We applied descriptive analysis (prevalence, median, average and standard deviation) of data and the chi-square test or Fisher's exact test for the association tables; the latter test was used when the stratified samples were small, as in the case of the number of children whose anthropometric measure had a Z score less than -2. Comparison of averages was carried out with the analysis of variance (ANOVA) statistic for continuous variables. The prevalence ratio with a 95% confidence interval was applied in the comparison of prevalences of anemia as related to anthropometric measures and time since enrollment in the daycare. The Epi-Info statistical software was employed in the analysis.[14]

Our study was approved by the Research Ethics Committee of the teaching hospital at the Universidade Federal do Mato Grosso. We held meetings at each daycare center three days prior to carrying out the study to inform the parents and staff about the research and to introduce the researchers. At the meetings, we also provided orientation on anemia, its consequences and forms of diagnosis and treatment. Subsequently, parents were asked to sign an informed consent form and reassured that the non-signing of the form would not exert any influence on how their children were being treated. The administrator of the daycare was responsible for contacting parents who were absent to the meeting in order to obtain their signatures before the collection of data.

After blood exams were carried out, all parents received the results of the exams and all anemic children were indicated to the nearest healthcare unit for treatment.

Results

Only 186 mothers of the 271 children (69%) examined for anemia were located for the interview; often times, relatives or people other than the parents took or picked-up the children at the daycare (neighbor, sibling, other). Table 1 shows some of the characteristics of the children studied. Despite the significant loss (30% of the population sample), the data indicate that the 186 children whose parents were

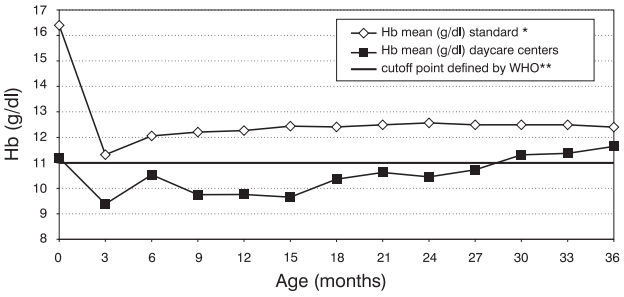
interviewed did not differ, in relation to biological, anthropometric, and biochemical measures, from the excluded 85 children whose parents or guardians were not interviewed but who where submitted to blood and anthropometric examination.

The average (± standard deviation) of the age of mothers was 26 (± 5.5) years. Results indicated that the mother was the head of the family in 36.2% of cases; the father, in 48.6% of cases; and the grandparents, in 13.5% of cases. Over half the heads of families (56.8%) did not finish junior high school, and a small percentage (3.2%) was illiterate. Schooling did not differ when the head of the family was either the father or the mother. Neither the kindred of the head of the family with the child (father, mother, or grandparent) nor the schooling of the head of the family were associated with anemic children.

Results indicated that the median time since enrollment in the daycare was four months; 70% of the children were enrolled for less than five months, thus characterizing a constant change and a reduced amount of time of contact with the institution.

Figure 1 shows the distribution curve for the average hemoglobin values according to age in the population sample. Considering the reference curve for a non-anemic population,[15,16] shown in figure 1, only after two and a half years of age does the average hemoglobin concentration become higher than the WHO cutoff point[3] for anemia (Hb < 11.0g/dl); at age three, the children still did not reach the average concentration of the reference population.

The numbers for the prevalence of anemia and, more specifically, of severe anemia are shown in Figure 2. In our population, the prevalences of anemia and severe anemia were, respectively 63.1% and 22.5%. Hence, there was one severely anemic child for every three anemic children. The highest prevalences observed were within the ages of zero to two years; these prevalances were higher than that of the total population sample. All age groups were diagnosed with high prevalences of anemia, which was always above 30%.



* Brault-Dubuc, Nadeau, Dickie, 1983; Dallman, Siimes, 1979.
** DeMaeyer, 1989.

Figure 1 - Mean Hb values of children from day care centers in Cuiabá, State of Mato Grosso, 1997

Table 2 presents the average hemoglobin concentrations of the population as related to anthropometric measures. There was a trend in scores of anthropometric measures to decrease as the hemoglobin concentration decreased; this decrease, however, was not statistically significant (P > 0.05).

The prevalence of malnutrition (Z score < -2) was 0.8% according to weight-for-height, 5.0% according to weight-for-age, and 10.3% according to height-for-age. Children thus were of shorter height but of proportional weight, since we did not identify a deficit in weight-for-height.

Table 1 - Characteristics of the analyzed children (n=271) whose mothers were interviewed or not regarding birth and nutritional history, Cuiabá, State of Mato Grosso, 1997

Variables	Interviewed (n=186)	Not interviewed (n=85)	P
Hb mean (g/dl)	10.67 (± 1.41)	10.35 (± 1.30)	0.0770*
Male (%)	50.0	58.8	0.1770†
Age mean (months)	23	22	0.3262*
Weight/height mean (z score)	0.015 (± 1.03)	0.137 (± 0.78)	0.3319*
Weight/age mean (z score)	-0.304 (± 1.13)	-0.258 (± 1.00)	0.7467*
Height/age mean (z score)	-0.402 (± 1.27)	-0.517 (± 1.14)	0.4765*

* Student t test ; † Chi-square test

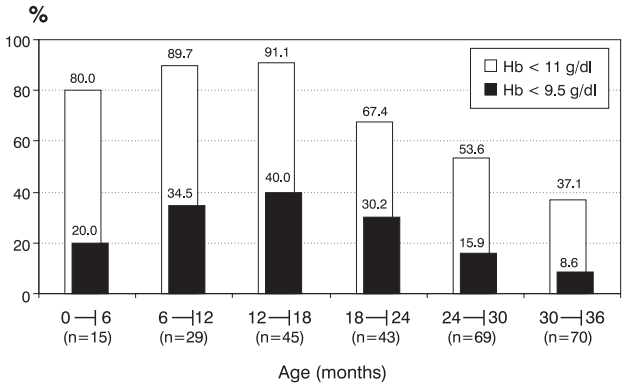


Figure 2 - Prevalence of anemia (Hb <11 g/dl) and of severe anemia (Hb < 9.5 g/dl) according to the age of children from day care centers in Cuiabá, State of Mato Grosso, 1997

Table 3 shows the relation between diagnosis of anemia and some of the biological variables studied and with the time since enrollment in the daycare. Age and the indicators of weight-for-age and height-for-age were associated with the prevalence of anemia. Age groups of children were not associated with weight-for-age but were associated with height-for-age; thus, we carried out a stratified analysis only for the association between anemia and height-for-age; the association was still significant after the stratification.

The ratio for the prevalence of anemia in children with low weight-for-age to that in children without was 1.73 (95% CI = 1.55 to 1.93). The ratio for the prevalence of anemia in children with low height-for-age to that in children without was, after control for age, 1.27 (95% CI = 1.06 to 1.53) and 1.45 (95% CI = 1.17 to 1.80) in the analysis of gross data. There was no statistically significant difference between the prevalence of anemia in children with or without low weight-for-height.

The time since enrollment in the daycare was also associated with anemia, with a statistically significant smaller prevalence of anemics in the group of children enrolled for more than four months. The ratio for the prevalence of anemia in children with less than four months since enrollment in the daycare center to that in those with more than four months was 1.27 (95% CI = 0.98% to 1.63) (Table 3).

In any of the stratum shown in table 3 the prevalence of anemia was always very elevated.

Discussion

Our results corroborate the understanding that iron deficiency anemia is the most prevalent pathology in children aged less than three years; this prevalence is six-fold higher than that of the calorie and protein malnutrition as related to low height-for-age, which affects 10% of children and is related to a previous status of malnutrition. What is more, the prevalence of anemic children is twelve-fold higher as related to low weight-for-age.

Others had already described the elevated prevalence of anemia as a serious public healthcare problem, much more so than malnutrition.[1,6,9,17] Preliminary results from 11 of the 20 state capitals in Brazil where the national study is being carried out indicate that 49.8% of children aged six to 36 months are anemic; the highest prevalence was reported for the city of Recife (81%), and the lowest, for Natal (18%).[18]

The prevalence of iron deficiency anemia was even higher in children aged two to 24 months, which indicates a broader age risk group in our study (22 months); we also included children younger than most studies, whose critical age group is usually from six to 24 months (18 months).[1,4,9]

In general, malnutrition was not associated with anemia; however, when we considered Z scores < -2 as the cutoff point, either for height- or weight-for-age, our results did indicate an association. This hints at the fact that children with previous status of chronic malnutrition were usually affected by iron deficiency as well.

Table 2 - Mean values (± standard deviation) for anthropometric indicators regarding hemoglobin concentration of 240 children aged less than three years from day care centers in Cuiabá, State of Mato Grosso, 1997*

Anthropometric indicators (z-score)	Without anemia (Hb ≥ 11 g/dl) (n=97)	With anemia (Hb < 11 g/dl) (n=145)	With severe anemia (Hb < 9.5 g/dl) (n=48)	P (ANOVA)
Weight/ Age	-0.19 (± 0.91)	-0.36 (± 1.20)	-0.53 (± 1.25)	0.2174
Weight / Height	0.07 (± 0.83)	0.30 (± 1.06)	-0.14 (± 1.14)	0.4754
Height / Age	-0.28 (± 1.12)	-0.53 (± 1.31)	-0.63 (± 1.38)	0.1956

* Of the 271 children submitted to blood test, 31 did not show up for weight and height measurement.

Table 3 - Frequency of anemia and relationship with some variables studied in children aged less than three years from day care centers, Cuiabá, State of Mato Grosso, 1997

Variables		Categories	Total N	Anemia n	Anemia %	P
Gender		Male	143	92	64.3	0.6558*
		Female	128	79	61.7	
Age (months)		2 –| 6	15	12	80.0	<0.0001*
		6 –| 12	29	26	89.7	
		12 –| 18	45	41	91.1	
		18 –| 24	43	29	67.4	
		> 24	139	63	45.3	
Anthropometric indicators (z-score)	Weight / Age	< -2	12	12	100.0	0.0018†
		≥ -2	228	132	57.9	
	Weight / Height	< -2	2	1	50.0	0.6410†
		≥ -2	238	143	60.1	
	Height /Age	< -2	24	20	83.3	0.0139†
		≥ -2	216	124	57.4	
Day care center attendance (months)		≤ 4	208	138	66.3	0.0455*
		> 4	63	33	52.4	

* Chi-square test, † Fisher's exact test

Anemia can be understood thus as a nutritional deficiency that occurs independently of malnutrition, though there is a trend indicating that these two pathologies are associated, as others have shown;[9,17,19] however, we excluded malnutrition as a risk factor for anemia. Moreover, other authors showed that even the more severe forms of malnutrition were not associated with low levels of hemoglobin.[4,6]

It is important to remember that the cutoff point defined by the WHO as an indication of anemia is not very specific and, also, that several children diagnosed as non-anemic would certainly respond to treatment with iron. Consequently, it has been suggested that the hematological values be compared to those of a reference population using Z scores for anthropometric indicators.[9] In this sense, the prevalence of anemia in our population may actually be higher than what the results indicate.

Iron deficiency can be a result of early weaning and low dietary iron intake, which is not always a result of low calorie intake. Though common sources of iron (meat and beans) were part of the daily food intake of children, according to the menu of daycare centers, they are certainly insufficient. Also, the antinutritional factors of teas and other guarana-based beverages, which are very common in the region, may also contribute to the deficiency.

The intake of vitamin C, though present, is also insufficient and usually dissociated from the principal meal, which concentrates the main sources of iron. Consequently, the vitamin C of fruits, which could help to increase bioavailability of iron, is not offered at the same time as the sources of iron and thus does not promote the absorption of the mineral.[3]

According to a study carried out in Brazilian capitals by the Ministry of Health, there is a preponderance of early weaning in the country, even in cases of low dietary iron intake, and little importance is given to exclusive breastfeeding up to age six months. In the 25 capitals studied, the city of Cuiabá was ranked last in the average duration of exclusive breastfeeding. In Cuiabá, the average duration was eight days, in comparison to 34 days in the rest of the country.[20] Early weaning combined with administration of foods that are poor in iron can be related to the onset of iron deficiency. The milk at the daycare centers is not fortified with iron and we observed that all sorts of teas (maté, citron, chamomile, and so on) and guarana syrup were administered to children.

We understand that giving solid foods to preschool children demands patience and time. Children who are at daycare centers do not always count on patience and time considering that if the parents sought these services, they probably do not have the time to care for the child. What is

more, the meal time at daycare centers is usually short and hasty. In this sense, meals are dull and usually not very nutritious, even in institutions where the kitchen and the daycare staff are dedicated at work. These factors alone do not explain the elevated prevalence of iron deficiency, but they may well contribute to the low bioavailability of the mineral.

Another factor that usually determines the onset of anemia is the presence of intestinal parasites, especially hookworms. However, according to the report on results from laboratory testing from the main laboratories in the state, parasitosis affects patients at more advanced ages and its prevalence is small in the age group of less than 36 months. Other authors agree that within this age group parasitosis is not a determinant factor for iron deficiency.[1,6]

There was a small but significant decrease in the prevalence of anemia in children who had been enrolled for over four months. We underscore that results on time since enrollment indicated a short duration of stay and constant changes from one daycare to another. Our results may thus reflect the nutritional status of the lower-income population of the city, considering that they represent the population of these daycare centers.

Considering the hypothesis of a newly-arrived children who is iron deficient, and of the daycare center meals being iron-insufficient (in addition to the antinutritional factors), it would take several months to reverse an existing status of anemia. Situations such as these require short-term measures such as medical supplementation to restore the normal levels of iron. It is also important to provide dietary guidance.

Prolonged iron deficiency is associated with impaired cognitive and motor development in preschool children, even after the control for variables that may bias the results, such as socioeconomic status, schooling of parents, and environmental stimulus. The duration and severity of anemia were associated with impaired development, according to several randomized, double-masked studies.[2,21,22] In a study in Costa Rica,[2] anemic children diagnosed and treated at ages 12 to 23 months continued to perform worse in tests of mental and motor development at age five years, even after complete reversion of the status of anemia and adequate growth.

It is said that a country can only grow and develop if the population is offered the conditions to work and to create. The state of Mato Grosso has presented significant growth in its economy, which is based on the agriculture industry, and it should thus not undermine matters of health and education. In addition, public spending with education should not be dissociated from that with health, since anemic and malnourished populations presented lower cognitive and productive capabilities. The administration of ferrous sulfate to preschoolers is a low-cost and highly beneficial measure that should be encouraged in city public healthcare actions.

The present study serves as a basis for the intervention study on philanthropic and private daycare centers, which started in 2000, for the evaluation of weekly dietary supplementation with ferrous sulfate combined with dietary guidance. It is aimed at supporting a citywide intervention toward achieving the goals agreed between Brazil and the United Nations[23] to reduce this deficiency in one-third until 2003.

Acknowledgments

The authors would like to thank the professors of the Nursing and Nutrition School of the Universidade Federal do Mato Grosso Nilma Ferreira da Silva, Vanessa Cristina Arantes, and Diana Borges Dock Cavallari, and the students of Nutrition Djenane and Helane for their help with the collection of data, typing data, and giving the feedback on results to the daycare centers. We would also like to thank the nursing assistant of the LACEN Glória Maria de Moraes for the collection of blood samples; Dr. Josefina Braga for participating in the idealization and coordination of the national project; and, last but not least, the parents, children, and staff of the daycare centers that gave their consent to participate in the study.

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