Prevalence and risk factors of anemia in children attending daycare centers in Belo Horizonte – MG

Prevalência e fatores determinantes da anemia em crianças assistidas em creches de Belo Horizonte – MG

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Abstract

Objective: To evaluate the prevalence and risk factors of anemia in children attending daycare centers in the city of Belo Horizonte. **Methods:** Cross-sectional study that evaluated 312 children aged 7 to 59 months attending daycare centers of the East Sanitary District of Belo Horizonte. The diagnosis of anemia was determined by finger stick blood samples, using the Hemocue® portable photometer, considering hemoglobin levels below 11.0 g/dL. Weight and height were measured and nutritional status of children was classified according to WHO 2006 criteria. Variables were collected through a questionnaire answered by children´s parents or guardians, containing socioeconomic aspects, in addition to information on maternal and children's health. Multiple logistic regression was performed to assess the association between variables and anemia, with control for confounding variables. **Results:** The prevalence of anemia in the population studied was 30.8%, with a higher prevalence in children ≤ 24 months of age (71.1%). Risk factors for anemia were age ≤ 24 months (OR: 9.08 CI: 3.96 to 20.83), and height-for-age < −1 z-score (OR: 2.1, CI: 1.20 to 3.62). **CONCLUSIONS:** The high prevalence of anemia in children attending day care centers in Belo Horizonte, especially those younger than 24 months and in children with height-for-age < − 1 z-score, demonstrates the importance of nutritional care to infants and strengthens the need for commitment of child care institutions in reducing this deficiency.

Keywords: Anemia. Risk factors. Daycare centers. Preschool. Epidemiology. Children's health,

Resumo

Objetivo: Avaliar a prevalência e fatores determinantes da anemia em crianças assistidas em creches de Belo Horizonte. **Métodos:** Trata-se de estudo transversal com 312 crianças, entre 7 e 59 meses, assistidas em creches de um Distrito Sanitário de Belo Horizonte. O diagnóstico de anemia foi realizado por punção digital e leitura em β-hemoglobinômetro portátil, considerando-se anemia níveis de hemoglobina inferiores a 11,0g/dL. Foram aferidos peso e altura das crianças, sendo o estado nutricional classificado segundo critério OMS (2006). As variáveis foram coletadas por meio de questionário aplicado aos pais ou responsáveis pelas crianças, contendo informações socioeconômicas, maternas e relacionadas à saúde das crianças. Foi realizada a regressão logística múltipla para avaliar a associação entre as variáveis e a anemia, com o controle das variáveis de confusão. **Resultados:** A prevalência de anemia na população estudada foi de 30,8%, sendo esta superior nas crianças com idade ≤ 24 meses (71,1%). Os fatores determinantes da anemia na análise ajustada foram: idade menor ou igual a 24 meses (OR: 9,08; IC: 3,96 – 20,83) e altura/idade < – 1 z escore (OR: 2,1; IC: 1,20 – 3,62). **Conclusões:** A elevada prevalência de anemia em crianças atendidas em creches de Belo Horizonte, especialmente naquelas menores de 24 meses e nas crianças com altura/idade < – 1 z escore demonstra a importância do cuidado nutricional com os lactentes, e reforça a necessidade de comprometimento das instituições de atendimento infantil no combate a esta deficiência.

Palavras-chave: Anemia. Fatores de risco. Creches. Pré-escolares. Epidemiologia. Saúde da criança.

Introduction

Anemia is a global public health problem and it is associated with an increased risk of morbidity and mortality, especially in pregnant women and children younger than five years. Among the types of anemia, nutrient-deficiency anemia represents the greatest nutritional problem nowadays, resulting in a reduction in hemoglobin concentration. With regard to the nutrients responsible for this process, iron deficiency alone is the most common nutritional deficiency[1].

In recent decades, Brazil has gone through a period of nutritional transition, with an important reduction in the prevalence of child malnutrition. However, this reduction has not been observed with regard to nutrient-deficiency anemia. In fact, in the current context, it could be said that there is a major endemic disease in this country, confirmed by the high prevalence of anemia in preschool children.

Estimates from the World Health Organization (WHO) show that anemia affects 54.9% of children in this age group, in Brazil[2]. In addition, the majority of regional studies point to rates higher than 40%[3-6], characterizing anemia as a serious public health problem in this country[7].

Understanding the risk factors present in each population is essential to provide effective prevention and control measures. With regard to children cared for in day care centers, studies have shown that the determinants of anemia in this population are early age, presence of siblings younger than five years, health care of exclusively public day care centers, early weaning, parents' low level of education, low household income and nutritional deficits[3,4,8-10].

In this context, the present study aimed to evaluate the prevalence and risk factors of anemia in children cared for in day care centers of the city of Belo Horizonte, in the state of Minas Gerais.

Methods

A cross-sectional study was conducted

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to provide data on the characterization of the health and nutrition of children cared for in day care centers located in the Eastern Sanitary District of the city of Belo Horizonte, in July 2005. There are 26 day care centers in this district, of which 24 are affiliated with and two are owned by the city of Belo Horizonte municipal government. Among these, only two affiliated day care centers did not agree to participate, resulting in 24 participating day care centers. The present study follows the ethical recommendations of Resolution 196/96 and it was approved by the *Universidade Federal de Minas Gerais* Research Ethics Committee (Official Opinion ETIC 273/04) and City of Belo Horizonte Department of Health Research Ethics Committee (Protocol 0072004). Authors declared there were no conflicts of interest.

The study sample was calculated from the total number of children cared for in the participating day care centers on a full-time basis, comprising 2,344 children. An estimated prevalence of anemia of 40%[11] was used to calculate the sample, with 5% accuracy and 95% confidence interval, resulting in 319 children. In this study, children younger than 60 months were included, because they represent the group most vulnerable to anemia, totaling 312 participants.

An interview was conducted with mothers or adults responsible for the children, after an informed consent form was signed, using a questionnaire which included information about child and maternal data and socioeconomic characteristics. The variables studied had different sample sizes, because participants not always knew how to respond to certain questions, or because the mother and/or adult responsible for the child were not present when the questionnaire was applied. Anthropometric data (weight and height) were collected according to techniques established by the WHO[12]. Weight was measured using an electronic scale with a 150kg capacity and 100g accuracy (Filizola®). The height of children younger than 24 months was measured with an anthropometer. Those aged more than 24 months were measured while standing barefoot, after the anthropometer was adapted to function as a stadiometer (Altura Exata®). Nutritional status was evaluated with the weight/age, height/age, weight/height and BMI/age indices, expressed in Z-scores. Anthropometric indices were categorized into two intervals: lower than - 1 and higher than or equal to - 1, due to the reduced sample size of children with a Z-score lower than - 2. WHO growth curves were adopted as benchmark, using the WHO Anthro software, version 3.0.1[13].

Blood samples were collected with disposable microcuvettes by capillary puncture and hemoglobin concentration was measured with a portable hemoglobinometer (Hemocue). Children with a hemoglobin concentration lower than 11.0 g/dL[7] were considered anemic.

Statistical analyses were conducted with the Epi-info software, version 6.04,[14] and Statistical Package for the Social Sciences – SPSS (2000)[15]. Kolmogorov-Smirnov normality test was performed to evaluate the distribution of numerical data. Univariate analysis was initially conducted to assess the association between anemia and its possible risk factors, followed by multivariate logistic regression. In the regression analysis, the multivariate model was adjusted for all variables significant at 0.20 level, and only those variables with a significance level lower than 0.05 remained in the final model. The Hosmer-Lemeshow test was conducted to verify the adequacy of the logistic model, with a p value of 0.995. In addition, the Mann-Whitney test was performed to compare the median of Z-score of anthropometric indices in the group of anemic children with that found in the group of non-anemic children.

Results

In the present study, a total of 312 children aged between 7 and 59 months were evaluated, with a mean age of 39.1±12.9 months. The majority of children were aged

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between 24 and 48 months (57.1%), of which 14.4% were 24 months or younger and 28.5% were older than 48 months. There was a slight predominance of males (51.6%). The frequency of low weight at birth and prematurity was 13% and 10.3%, respectively. With regard to children with low weight, 52.9% were born full-term. The majority of children were breast-fed (95.5%), with a median of duration of seven months. With regard to exclusive maternal breastfeeding, the frequency was lower (65.8%), with a median of three months. Presence of disease in the 15 days prior to exam was found in 42.4% of children, of which the most frequent were those related to the pulmonary airways (flu and bronchitis). In terms of hospitalization, 48.9% of children had already been hospitalized, the main causes being bronchitis and pneumonia.

Presence of anemia in children prior to this study was reported by 32.8% of participants and 78.3% of the sample had previously taken iron supplements. Mean length of stay in the daycare center was 14.8±11.1 months.

With regard to socioeconomic conditions, approximately half (51.5%) of families received between one and three minimum wages per month and 29% received less than one minimum wage, while mean household income was R$595.40±380.20 (US$ 1047.90±669.15). The majority of mothers (56%) and fathers (68.3%) had less than eight years of education. In addition, most families were comprised of two to four children (54.2%), with a number of dependents equal to or lower than four (67.3%). The majority of fathers (89.0%) and mothers (76.8%) worked at the moment of this study.

Mean maternal age was 28.3±5.9 years, of which only 3% were adolescents. The majority of mothers were married (55.4%), only two (0.7%) did not have a prenatal test performed and 64.9% had a vaginal delivery.

Global prevalence of anemia in the population of this study aged less than five years was 30.8%, while the prevalence in children aged ≤ 24 months was 71.1%. In contrast, this prevalence was 25.3% among children aged between 24 and 48 months, and 21.3% among those aged more than 48 months.

Table 1 shows the prevalence of anemia in children, according to family socioeconomic conditions and maternal variables, of which maternal level of education was the only variable in this group included in the multivariate analysis (p≤0.20). With regard to maternal variables, duration of pregnancy, maternal level of education, number of children and use of ferrous sulfate during pregnancy (p≤0.20) were selected for the multivariate analysis.

Table 2 shows the univariate analysis of child characteristics associated with anemia. The variables included in the multiple logistic regression were as follows: length of stay in the day care center, age, height/age index (HAZ), frequency of exclusive maternal breastfeeding, history of previous hospitalization or presence of anemia prior to this study (p≤0.20).

Table 3 shows the final multivariate analysis model. The determinants of anemia were as follows: height/age index lower than a Z-score of -1 and age lower than or equal to 24 months.

Table 4 shows the median of Z-score in anemic and non-anemic children. Only the height/age index showed a statistically significant difference between groups.

Discussion

The prevalence of anemia in the present study was 30.8%, i.e. approximately a third of children were anemic. According to the WHO, the prevalence of anemia in the population studied is considered to be a moderate public health problem[7] and a severe one in children younger than two years, whose prevalence was 71.1%. A smaller sample size of children younger than 24 months was found, compared to the total population (14.4%). This is due to the composition of day care centers included in this study, which, in their majority, did not care for children younger than one year of

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Table 1 – Prevalence of anemia, crude odds ratio and confidence interval (95%) according to family and maternal characteristics of children attending day care centers in Belo Horizonte, MG.

Tabela 1 – Prevalência de anemia, Odds Ratio bruta e intervalo de confiança (IC 95%) segundo as características familiares e maternas das crianças atendidas em creches de Belo Horizonte, MG.

Variables	N	Anemia		Odds ratio (bruta)	CI 95%	p*
		Yes n (%)	No n (%)			
Paternal level of education	243					
≥ 8 years		25 (32.5)	52 (67.5)	1.14	[0.64 ; 2.05]	
< 8 years		49 (29.5)	117 (70.5)	1		0.64
Maternal level of education	266					
≥ 8 years		39 (33.3)	78 (66.7)	1.46	[0.86 ; 2.49]	0.16
< 8 years		38 (25.5)	111 (74.5)	1		
Monthly household income	262					
> 3 MW		15 (29.4)	36 (70.6)	1		
Between 1 and 3 MW		34 (25.2)	101 (74.8)	0.81	[0.58 ; 2.69]	0.57
< 1 minimum wage		26 (34.2)	50 (65.8)	1.25	[0.40 ; 1.66]	0.56
Number of Dependents	269					
> 4 dependents		28 (31.8)	60 (68.2)	1.19	[0.68 ; 2.07]	
≤ 4 dependents		51 (28.2)	130 (71.8)	1		0.54
Maternal work	271					
No		20 (31.7)	43 (68.3)	1.15	[0.62 ; 2.11]	
Yes		60 (28.8)	148 (71.2)	1		0.66
Paternal work	245					
Yes		09 (33.3)	18 (66.7)	1.18	[0.50 ; 2.76]	
No		65 (29.8)	153 (70.2)	1		0.71
Duration of pregnancy	273					
≥ 37 weeks		75 (30.6)	170 (69.4)	2.03	[0.74 ; 5.54]	0.17
< 37 weeks		05 (17.9)	23 (82.1)	1		
Maternal age	268					
≥ 20 years		77 (29.6)	183 (70.4)	1.26	[0.25 ; 6.39]	0.78
< 20 years		02 (25.0)	06 (75.0)	1		
Number of children	231					
1		21 (24.1)	66 (75.9)	1		
2 to 4		47 (32.0)	100 (68.0)	1.48	[0.81 ; 2.69]	0.20
> 4		11 (29.7)	26 (70.3)	1.33	[0.56 ; 3.14]	0.52
Marital status	269					
{SI, SE, WI}		38 (31.7)	82 (68.3)	1.22	[0.72 ; 2.07]	0.46
{MA, CO}		41 (27.5)	108 (72.5)	1		
Prenatal	267					
No		01 (50.0)	01 (50.0)	2.49	[0.15 ; 40.27]	
Yes		76 (28.7)	189 (71.3)	1		0.52
FS during pregnancy	262					
No		21 (35.6)	38 (64.4)	1.53	[0.82 ; 2.83]	0.18
Yes		54 (26.6)	149 (73.4)	1		
Type of delivery	276					
Forceps, Cesarean section		27 (27.8)	70 (72.2)	1		
Vaginal delivery		53 (29.6)	126 (70.4)	0.92	[0.53 ; 1.59]	0.76

*Ajuste do Modelo Logístico Univariado / * Adjustment of Univariate Logistic Model

SO = solteira, SE = separada, VI = viúva, CF = casamento formal, CI = casamento informal. S.F. = sulfato ferroso
SO = single, SE = separated, VI = widow, CF = formal marriage, CI = informal marriage. S.F. = ferrous sulphate

Table 2 – Prevalence of anemia, crude odds ratio and confidence interval (95%) according to the anemia-related characteristics of children attending day care centers in Belo Horizonte, MG.

Tabela 2 – Prevalência de anemia, Odds Ratio bruta e intervalo de confiança (IC 95%) segundo as características das crianças relacionadas à anemia, em creches de Belo Horizonte, MG.

Variables	N	Anemia		Odds ratio (bruta)	CI 95%	p*
		Yes N (%)	No N (%)			
Stay in the day care center	308					
> 25 months		13 (22.8)	44 (77.2)	1		
15 to 25 months		21 (26.6)	58 (73.4)	1.23	[0.55 ; 2.71]	0.62
< 15 months		60 (34.9)	112 (65.1)	1.81	[0.91 ; 3.63]	0.09
Weight at birth	262					
≥ 2,500g		66 (28.9)	162 (71.1)	1.13	[0.50 ; 2.55]	
< 2,500g		09 (26.5)	25 (73.5)	1		0.77
Sex	312					
Female		48 (31.8)	103 (68.2)	1.09	[0.68 ; 1.78]	0.71
Male		48 (29.8)	113 (70.2)	1		
Height/age (HAZ)	312					
≥ Z-score of -1		56 (26.0)	159 (74.0)	1		
< Z-score of -1		40 (41.2)	57 (58.8)	1.99	[1.20 ; 3.31]	0.01
Weight/height (WHZ)	312					
≥ Z-score of -1		86 (30.3)	198 (69.7)	1		
< Z-score of -1		10 (35.7)	18 (64.3)	1.28	[0.57 ; 2.89]	0.55
Weight/age (WAZ)	312					
≥ Z-score of -1		78 (30.2)	180 (69.8)	1		
< Z-score of -1		18 (33.3)	36 (66.7)	1.15	[0.62 ; 2.16]	0.65
BMI/age (BMIZ)	232					
≥ Z-score of -1		08 (3.9)	197 (96.1)	1		
< Z-score of -1		08 (29.6)	19 (70.4)	1.06	[0.45 ; 2.52]	0.893
Age	312					
> 48 months		19 (21.3)	70 (78.7)	1		
24 to 48 months		45 (25.3)	133 (74.7)	1.25	[0.68 ; 2.29]	0.48
≤ 24 months		32 (71.1)	13 (28.9)	9.07	[3.99 ; 20.59]	< 0.001
Maternal breastfeeding	269					
No		05 (41.7)	07 (58.3)	1.80	[0.55 ; 5.86]	
Yes		73 (28.4)	184 (71.6)	1		0.33
Exclusive maternal breastfeeding	257					
Yes		53 (31.4)	116 (68.6)	1.46	[0.81 ; 2.63]	
No		21 (23.9)	67 (76.1)	1		0.20
Previous hospitalization#	272					
No		48 (34.5)	91 (65.5)	1		
Yes		32 (24.1)	101 (75.9)	0.60	[0.35 ; 1.02]	0.06
Previous disease#	271					
No		42 (26.9)	114 (73.1)	1		
Yes		37 (32.2)	78 (67.8)	1.29	[0.76 ; 2.18]	0.35
Previous anemia#	225					
No		44 (24.7)	134 (75.3)	1		0.09
Yes		30 (34.5)	57 (65.5)	1.60	[0.92 ; 2.80]	
Ferrous sulfate during pregnancy	267					
Yes		57 (27.3)	152 (72.7)	1		
No		20 (34.5)	38 (65.5)	1.40	[0.75 ; 2.61]	0.29

*Ajuste do Modelo Logístico Univariado / * Adjustment of Univariate Logistic Model*
#Anterior a realização deste estudo/ #Previous to the present study*

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Table 3 – Logistic regression analysis for determinants of anemia in children attending day care centers in Belo Horizonte, MG.
Tabela 3 – *Análise de regressão logística para os fatores determinantes da anemia em crianças atendidas em creches de Belo Horizonte, MG.*

Variables	N	Anemia		Odds ratio (O.R.)	CI 95%	p
		Yes N (%)	No N (%)			
Age	312					
> 48 months		19 (21.3)	70 (78.7)	1		
24 to 48 months		45 (25.3)	133 (74.7)	1.18	[0.64 ; 2.19]	0.59
≤ 24 months		32 (71.1)	13 (28.9)	9.08	[3.96 ; 20.83]	<0.001
Height/age (HAZ)	312					
≥ Z-score of -1		56 (26.0)	159 (74.0)	1		
< Z-score of -1		40 (41.2)	57 (58.8)	2.10	[1.22 ; 3.63]	0.007

Table 4 – Median z scores for anthropometric indices in anemic and non-anemic children attending daycare centers in Belo Horizonte, MG.
Tabela 4 – *Mediana de z escore para os índices antropométricos em crianças anêmicas e não anêmicas assistidas em creches de Belo Horizonte, MG.*

Anthropometric indices	Anemia		P
	Absent (Hb≥11g/dL) Med [Min – Max]	Present (Hb<11g/dL) Med [Min – Max]	
Height/age (HAZ)	- 0.34 [-2.85 – 4.17]	- 0.61 [-3.09 – 2.79]	0.009
Weight/height (WHZ)	0.19 [-2.72 – 3.87]	0.46 [-2.73 – 2.42]	0.09
Weight/age (WAZ)	0.01 [-3.44 – 3.51]	0.08 [-2.63 – 2.03]	0.81
BMI/age (BMIZ)	0.22 [-2.53 – 3.96]	0.47 [-3.28 – 2.92]	0.06

Teste Mann-Whitney / Med [Min – Max] = mediana [valor mínimo – valor Máximo]
Mann-Whitney Test / Med [Min – Max] = median [minimum value – maximum value]

age, because they did not have adequate infrastructure for this, as it would involve building nurseries and human milk banks. In addition, it should be emphasized that the selection of children was randomly conducted, instead of a specific age group being chosen.

In view of this situation, it could be assumed that the problem of anemia is day care centers can be even more serious than that found, considering the small proportion of children younger than two years who were not evaluated. Other authors also observed that day care center programs favor children older than two years[4,16,17]. Although children aged less than two years were more vulnerable, especially to iron-deficiency, they are those who often have a lower access to this type of benefit.

The prevalence of anemia in this study was similar to that observed in a study conducted in day care centers of the city of Fortaleza (29.8%)[10] and in another study conducted in the *Centro Educacional Unificado Cidade Dutra* (31.6%), in the city of São Paulo[18]. However, a higher prevalence was found in day care centers of Rio de Janeiro (47.3%)[4] and São Paulo (68.8%)[8].

The determinants of anemia in the present study were child age lower than 24 months and children with a height/age index below a Z-score of -1. Children younger than 24 months were nine times more likely to have anemia than those older than 48 months (p< 0.01). This age group has been extensively described in the literature as a risk factor of anemia, being characterized as a period of very fast growth, resulting in an increase in iron requirements, combined with an inadequate diet, poor in iron-rich

foods and factors that promote iron absorption, such as vitamin C[3,8].

The relationship between anemia and nutritional status has led to conflicting results in the literature. In the present study, children having a height/age index with a Z-score < -1 were two times more likely to have anemia than those with a Z-score ≥ -1, while the median of this index was significantly lower in anemic children (p<0.01). BRUNKEN et al.[19], while evaluating 271 children younger than 36 months, cared for in public day care centers of the city of Cuiabá, observed that, when controlled for age, the prevalence ratio of anemia in children with a height deficit was 1.27, when compared to those without this deficit. A study conducted in children cared for in day care centers of Rio de Janeiro found means of Z-score for height/age and weight/age that were significantly lower in anemic children, compared to non-anemic ones[4].

Household income has been described as a causal factor of anemia, not only due to the inadequate diet provided, both quantitatively and qualitatively, but also due to its association with inadequate basic sanitation, low access to health services, and higher risk of diseases that can reduce appetite and nutrient absorption. A population-based study with children younger than five years in the city of Pelotas (RS) found an inverse association between household income and anemia[20]. However, other authors[4,9] did not find this association, because the relationship between household income and anemia cannot always be observed in homogeneous populations, in terms of level of income. In this sense, the non-association between socioeconomic variables and anemia is justified in the present study, once children belonged to families with a low socioeconomic level.

With regard to maternal characteristics, age and maternal level of education have been considered as determinants of anemia in children younger than five years, because both influence child care practices[21]. However, the present study and others described in the literature did not find this

association[9]. What could have interfered with this study is the reduced sample size of adolescent mothers (3%), thus decreasing the strength of association between maternal age and anemia.

Among the characteristics of children participating in the present study, nutritional status and age were the only variables associated with anemia, as previously described. However, several other factors have been reported, such as low weight at birth and prematurity, due to low iron reserves at birth, associated with higher iron requirements for growth[21]. In addition, early weaning and history of hospitalizations or diseases in the last month of the study have been associated with higher frequency of anemia[9].

It is important to emphasize the role of day care centers for children. There is no consensus in the literature on day care centers' protective effect on the prevention of nutrient-deficiency diseases such as anemia and protein-energy malnutrition. Certain studies show that children who attend day care centers have a higher risk of developing diarrhea and respiratory infectious diseases[22,23]. GURGEL et al.[22], while evaluating children in the city of Aracaju (SE), found an odds ratio of parasite infestation among children cared for in day care centers that was 1.5 times higher than that found among others who did not attend them. These diseases have a negative impact on nutrient intake and/or absorption. Other studies show the importance of day care centers in the improvement of nutritional status and anemia prevention in children, especially those from low-income families[16,19]. In the remaining studies[9,10], there was no association between length of stay in day care centers and lower risk of anemia, as observed in the present study.

The data shown reveal that anemia in children cared for in day care centers of Belo Horizonte is considered an important public health problem, which is more serious among those younger than 24 months. In this sense, the identification of risk factors is key, because its results can help to

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implement interventions aimed at anemia prevention and control. In addition, follow-up of these children's nutritional status is relevant, once there was an association between anemia and nutritional status. Thus, it becomes necessary to increase health care coverage of children younger than 24 months, because they are considered to be a risk group for anemia and other typical childhood diseases.

Apart from these measures, maternal breastfeeding promotion, adequate guidance on complementary feeding, prophylactic supplementation with ferrous sulfate in the first two years of life and food fortification are important measures to prevent and control anemia. However, they must be constantly monitored for satisfactory results to be achieved.

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