Feeding pattern and anemia in infants in the city of Campinas, São Paulo, Brazil

Introdução alimentar e anemia em lactentes do município de Campinas (SP)

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ABSTRACT

Objective: To verify the prevalence of anemia associated with the introduction of complementary food in children less than two years old in the city of Campinas, São Paulo, Brazil.

Methods: A cross-sectional survey was performed in 354 children between 6 and 12 months of age which were registered in the Live Births Information System from Campinas area. Health professionals interviewed the mothers, who answered a questionnaire about food introduction and socioeconomic status. Capillary blood was collected and the hemoglobin level was determined by Hemocue®. Anemia was diagnosed if hemoglobin level was below 11g/dL. Survival analysis was performed to determine the influence of complementary food introduction on anemia.

Results: 66.5% of the children had hemoglobin levels lower than 11g/dl. Anemia was associated to early introduction of the family diet (p=0.036), bread (p=0.012), yogurt (p=0.006), soft drinks (p=0.005), candies (p=0.005) and snacks (p=0.013).

Conclusions: Inadequate complementary food introduction is associated with anemia. This information should be addressed by health programs in order to prevent anemia in children.

Key-words: supplementary feeding, anemia, infant, iron deficiency.

RESUMO

Objetivo: Verificar a prevalência de anemia em crianças do município de Campinas, levando-se em consideração a introdução de alimentos complementares.

Métodos: Estudo transversal realizado com 354 crianças de seis a 12 meses de idade, sorteadas do Sistema de Informações de Nascidos Vivos da cidade de Campinas. Profissionais da área da saúde devidamente treinados realizaram entrevista domiciliar com as mães dos lactentes, as quais responderam a um questionário contendo dados sobre a introdução de alimentos e condições socioeconômicas. Ao final, coletou-se sangue capilar do lactente, para dosagem de hemoglobina com o Hemocue®. Foram consideradas anêmicas as crianças com concentrações de hemoglobina inferiores a 11g/dL. Os dados foram avaliados por análise de sobrevida para verificar a associação da introdução alimentar com a anemia.

Resultados: Dos lactentes estudados, 66,5% apresentaram níveis de hemoglobina <11g/dL. A introdução da dieta da família (p=0,036), pão (p=0,012), iogurte (p=0,006), refrigerante (p=0,005), balas (p=0,005) e dos salgadinhos de saquinho (p=0,013) foi mais precoce nas crianças com anemia.

Conclusões: A inadequada introdução de alimentos pode ser considerada fator associado à anemia. Essas informações devem ajudar a direcionar, com maior precisão, os programas de prevenção e de combate dessa enfermidade no município.

Palavras-chave: suplementação alimentar; anemia; lactente; deficiência de ferro.

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Introduction

Iron deficiency anemia is the most common type of nutritional deficiency and it is caused by a long-term imbalance between the amount of bioavailable iron and the organic need of this oligoelement[1], being more prevalent in women and children, mainly in developing countries. Infants between 6 and 24 months have a 2-fold higher risk of developing the disease than children from 25 months to 5 years old. Anemia is a serious public health problem because it can impair mental and psychomotor development, causing increased rates of morbidity and mortality among mothers and infants, in addition to reducing the individual's work performance and decreasing resistance against infections[2].

In Brazil, there are not national surveys on the prevalence of anemia. However, studies conducted in different regions of the country have shown high prevalence rates, estimating that there are approximately 4.8 million of anemic preschool-aged children[3,4]. The increasing trend of the disease in this group was evidenced by two studies that found an increase in the percentage of anemic children in the municipality of São Paulo[5] from 35.6% during the 1980s to 46.9% in the 1990s and, in the state of Paraíba[6], from 19.3% to 36.4%. Such increase may be caused by changes in the eating habits promoted by the nutritional transition taking place in Brazil.

The World Health Organization (WHO) designed a dietary guideline for children younger than 2 years old including the "Ten Steps for Healthy Feeding of Children Younger Than Two Years"[7] and recommending exclusive breastfeeding on demand up to 6 months old. After that age, the WHO recommends that children should be breastfed up to 2 years old, combined with adequate introduction of complementary food to complement children's diet, with the purpose of minimize the risk of diseases such as anemia, diarrhea, food allergies, and body weight and growth disorders[8].

The objective of the present study was to verify the association between anemia and the introduction of complementary food to children from 6 to 12 months old living in the municipality of Campinas, state of São Paulo, Brazil.

Patients

The patients who participated in this cross-sectional study were randomly selected using computerized draw of lots based on the live-born children database (SINASC)[9] of Campinas. Data collection was carried out upon mother or guardian's authorization. This database provides information on birth (sex, place of birth, type of delivery and birth weight, place of residence, mother's name, among other data), and it includes 98% of the births.

Procedures were conducted so that children's physical, moral, and social well-being was preserved. The participants agreed to participate in this study as volunteers and their inclusion was only possible after the guardians signed the written consent form. The present study was approved by the Research Ethics Committee of Universidade Estadual de Campinas.

By means of the project entitled "Prevalence of Breastfeeding, Introduction of Complementary Foods and Growth of Children Younger than Two Years Old in Campinas – SP," which involved 2,857 children from 0 to 24 months, we selected a subsample to assess anemia. Considering a population of 1,224 children from 6 to 12 months, living in Campinas and included in the above mentioned project, and predicting the possibility of losses (children with health problems, refusals to participate, difficulty to contact the children or address change), we randomly selected 500 children. The guardians of 354 children authorized their participation in the study, which satisfied the criterion of minimum sample size of 343 children.

The inclusion criteria were: child's age, gestational age (full term), birth weight (from 3.000 to 4.000 g), and place of residence (Campinas). Those infants younger than 6 months old and older than 12 months, prematures, with low birth weight or macrosomia, and those who had diseases that could have an influence on the growth process (severe neurologic and pulmonary diseases and genetic syndromes) were excluded.

Methods

Adequately trained health professionals visited 2,857 homes in Campinas (between 2004 and 2005), which had approximately 1 million inhabitants then. These health professionals interviewed the mothers of children between 6 and 12 months old. The mothers completed a structured questionnaire that was previously validated in a pilot study conducted at a day care center located in Campinas. Despite contributing to the training of home interviewers, the data included in this instrument were not entered in the database of the present study.

Mothers were asked about the time of introduction of complementary food, which characterized the status quo

method, reducing the possibility of memory biases. We investigated the following food: milk-based infant formula (modified milk), liquid milk, powder milk (including milk-based infant formula and regular milk), manufactured fruit juice, salty mash (pasty food), family diet (food consumed by the whole family such as rice, beans, food rich in protein, vegetables, among others), French rolls, sweets (soft drink, candies, snacks), honey, yogurt, beef, chicken, egg, vegetables, and sugar. It is important to mention that we did not carry out dietary questionnaires such as diet records, recalls, and questionnaires. We only investigated the month of introduction of complementary food.

With regard to the duration of breastfeeding, the categories suggested by the WHO[10] were used: exclusive breastfeeding - when the child is exclusively breastfed or receives expressed breast milk, and does not receive any other liquid or solid food, except for drops or syrups of vitamins, minerals, and/or medication; predominant breastfeeding - when the infant receives, in addition to breast milk, water or water-based beverages, such as fruit juices and teas; breastfeeding - when the child is breastfed or receives expressed maternal milk, regardless of the fact of receiving other foods or liquids, including non-human milk.

Socioeconomic conditions were investigated regarding maternal educational level (years of schooling) divided into elementary school (up to 8 years), high school (from 9 to 11 years), and university (more than 12 years); marital status (single, separated, widow, married, and living with a partner); and socioeconomic status according to the total number of domestic appliances (from zero to four: refrigerator, freezer, stove, color or black and white TV set, radio, telephone and cell phone, computer, and Internet access). Such classification enabled us to divide the social classes into levels A, B, C, D, and E considering a decrease in the purchasing power, according to the standards of the Brazilian Institute of Geography and Statistics (IBGE)[11].

Interviewers were adequately trained in blood collection at the Hematology Center of Unicamp. Hemoglobin levels were determined by means of capillary sample collected using digital puncture followed by smooth blood expression; the measurement of hemoglobin concentration was carried out just after blood collection using a digital portable hemoglobinometer (Hemocue®), and those children with hemoglobin concentrations lower than 11g/dL were considered to have anemia, whereas those having hemoglobin concentrations ≤9.5g/dL were classified as severely anemic[12]. When a child was diagnosed with anemia, the mother was informed and the child was referred for treatment. The process was overseen by a field supervisor who managed all phases of the study.

The database was entered in the computer program Epi-Info[13], and the data related to anemia were analyzed using absolute frequency (N), percentage (%), and survival analysis (log-rank test and Kaplan-Meier test). Univariate and multivariate logistic regression analyses were used to investigate the association between time of introduction of complementary food and presence of anemia. Significance level was set at 5% ($p<0.05$). The measurements of central tendency and dispersion were estimated using the computer program SPSS[14], and the SAS[15] was used for the other procedures.

The weighted analysis of frequencies and cross-referencing was employed to estimate the prevalence of anemia in our population, correcting the collection bias according to socioeconomic status and adjusting maternal level of education according to the demographic census of 2000[16], which enabled the frequency found in the sample to be similar to that found in the general population.

Results

Table 1 shows that a large number of mothers had completed high school and 16.8% of them had finished university.

Table 1 – Socioeconomic variables of children and their families using weighted data according to maternal level of education, 2004/2005, Campinas, SP

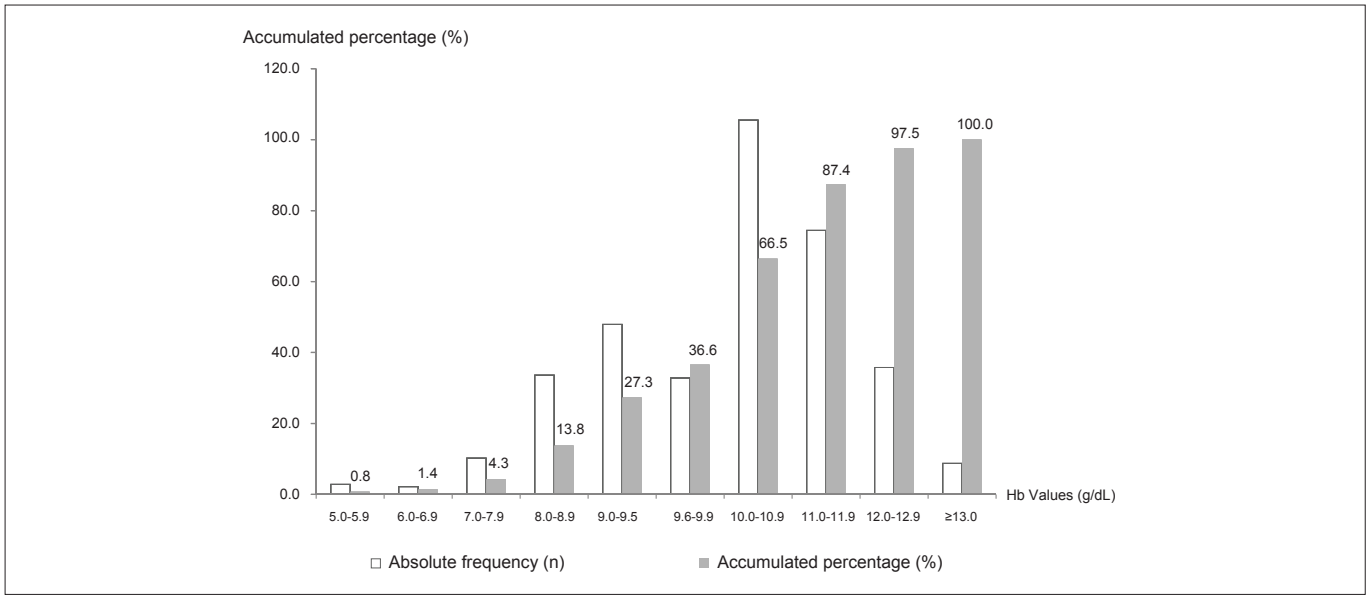
Variables	Sample (n) (total=354)	Percentage (%) (total=100%)
Maternal level of education		
Illiterate	3	0.94
≤4 years	12	3.44
5 to 11 years	279	78.82
≥12 years	60	16.80
Mother's marital status		
Single	50	14.06
Separated	7	2.09
Widow	2	0.42
Married	197	55.64
Living with a partner	98	27.79
Number of domestic appliances		
0 to 4 items	83	23.47
5 to 9 items	194	54.85
10 to 14 items	61	17.29
15 to 19 items	15	4.18
More than 20 items	1	0.21

Most mothers were not married when they were interviewed. The amount of domestic appliances associated with maternal level of education allowed us to classify most of our sample as belonging to social class C according to the IBGE[11], although all social classes were represented in our population.

Among all children assessed, 50.3% were female. According to the weighted analysis, the prevalence of anemia was 66.5% in infants between 6 and 12 months old.

Figure 1 shows that 97 (27.3%) of the infants had severe anemia and more than half of the children investigated had anemia (66.5%, n=235), with hemoglobin concentrations lower than 9.5g/dL and 11g/dL, respectively.

With regard to the time of introduction of complementary foods and presence of anemia, Table 2 shows that French roll, yogurt, family diet, soft drink, candies, snacks, and liquid milk were statistically associated with the disease ($p<0.005$). On the other hand, salty mash ($p=0.061$), milk-based infant formula ($p=0.07$), and powder milk ($p=0.091$) were not associated with anemia, as well as beef ($p=0.772$) and chicken and fish ($p=0.857$), manufactured



Graph 1 – Analysis of absolute frequency (N) of hemoglobin values (Hb) for children between 6 and 12 months old (n = 354) with weighted data according to maternal educational level. 2004/2005 – SP, Brazil.

Table 2 – Time of introduction of complementary foods regarding the presence of anemia (Yes = 241 and No = 113 children). 2004/2005, Campinas, SP

Food	Child with anemia	Median (days)	SE	95%CI days	p value*	Log-rank (χ^2)
French roll	Yes	180	3.9	172-188	0.012	6.31
	No	210	7.3	196-224		
Yogurt	Yes	210	4.0	202-218	0.006	7.51
	No	210	9.7	191-229		
Liquid milk	Yes	210	12.2	186-234	0.027	4.88
	No	300	27.1	247-351		
Family diet	Yes	270	8.9	252-287	0.036	4.41
	No	270	8.8	253-287		
Soft drink	Yes	300	10.0	280-320	0.005	7.89
	No	330	11.9	307-353		
Snacks	Yes	300	7.9	284-315	0.013	6.17
	No	330	15.0	301-359		
Candies	Yes	300	10.7	279-321	0.005	8.06
	No	360	0	360-360		

Survival analysis using the Kaplan-Meier method. *$p<0.05$.

Table 3 – Univariate logistic regression analysis for anemia

Variable	Categories	n	p-value	OR*	95%CI OR+
Introduction of milk-based formula	>180 days	14		1	---
	≤180 days	128	0.129	2.38	0.78-7.27
	No	212	0.027	3.46	1.15-10.39
Introduction of powder milk	>180 days	30		1	---
	≤180 days	166	0.044	2.24	1.02-4.93
	No	158	0.004	3.26	1.46-7.26
Introduction of honey	>180 days	61		1	---
	≤180 days	110	0.01	2.36	1.23-4.51
	No	183	0.003	2.51	1.38-4.55
Introduction of manufactured juice	>180 days	83		1	---
	≤180 days	69	0.062	1.92	0.97-3.81
	No	202	0.036	1.77	1.04-3.01
Introduction of French roll	>180 days	160		1	---
	≤180 days	173	0.044	1.61	1.01-2.56
	No	21	0.427	1.5	0.55-4.08
Introduction of liquid milk	>180 days	79		1	---
	≤180 days	134	0.054	1.8	0.99-3.28
	No	141	0.633	1.15	0.65-2.04
Introduction of salty mash	>180 days	50		1	---
	≤180 days	291	0.666	1.15	0.61-2.17
	No	12	0.308	0.52	0.14-1.84
Introduction of family diet	>180 days	167		1	---
	≤180 days	59	0.25	1.48	0.76-2.89
	No	128	0.896	1.03	0.63-1.69
Introduction of soft drink	>180 days	130		1	---
	≤180 days	45	0.422	1.37	0.63-2.98
	No	179	0.476	0.84	0.52-1.36
Introduction of candies	>180 days	105		1	---
	≤180 days	36	0.76	1.15	0.48-2.73
	No	213	0.176	0.7	0.42-1.17
Introduction of yogurt	>180 days	136		1	---
	≤180 days	155	0.171	1.42	0.86-2.35
	No	53	0.31	0.73	0.39-1.35
Introduction of snacks	>180 days	129		1	---
	≤180 days	45	0.115	1.93	0.85-4.38
	No	180	0.729	0.92	0.57-1.48
Introduction of beef	>180 days	71		1	---
	≤180 days	236	0.749	1.1	0.62-1.93
	No	47	0.648	1.2	0.54-2.67
Introduction of chicken and fish	>180 days	73		1	---
	≤180 days	239	0.963	0.99	0.56-1.73
	No	42	0.84	0.92	0.41-2.07
Introduction of eggs	>180 days	67		1	---
	≤180 days	52	0.422	1.38	0.63-3.01
	No	235	0.505	1.21	0.69-2.15
Introduction of vegetables	>180 days	53		1	---
	≤180 days	179	0.871	1.06	0.56-2.00
	No	122	0.20	1.57	0.79-3.14
Introduction of sugar	>180 days	55		1	---
	≤180 days	153	0.424	1.31	0.68-2.52
	No	146	0.968	1.01	0.53-1.95

Table 4 – Univariate logistic regression analysis for anemia and duration of breastfeeding

Duration of breastfeeding	n	Anemia		p-value	OR	95%CI OR+
		Yes	No			
≥180 days	131	85	46		1	---
120-179 days	107	73	34	0.588	1.16	0.68-2.00
60-119 days	61	42	19	0.589	1.20	0.63-2.29
<60 days	55	41	14	0.2	1.59	0.78-3.21

fruit juice (p=0.996), vegetables (p=0.22), egg (p=0.706), and sugar (p=0.10).

According to the univariate logistic regression analysis, which considered the recommended time of 180 days for weaning (Table 3), we found that when there was not introduction of complementary food or when this introduction occurred before the recommended period, the risk of anemia was significantly associated with some foods. When there was introduction of infant powder milk, the child had a three-fold higher risk of developing anemia (OR=3.08; 95%CI: 1.36-6.95; p=0.007) in comparison with infants who received powder milk after 180 days of life, according to the results of the multivariate logistic regression analysis.

Table 4 shows that the shorter the period a child is breastfed (in days) the higher the risk for anemia (OR=1.56).

Discussion

Campinas has more than 1 million inhabitants and it is considered a technological center in the state of São Paulo. It has low child mortality rates and there are university hospitals located in the municipality, as well as a large number of primary health care units. In spite of these characteristics, our findings show that more than half of the infants assessed had anemia, and 27.3% of them had severe anemia.

In Brazil, there are no national studies so far assessing the magnitude of the problem of iron deficiency. Several studies were conducted in different regions of the country involving different populations, using diverse methods and often collecting data in day care centers and primary health care units, demonstrating high prevalence of anemia due to iron deficiency in children younger than 2 years old[7].

A study conducted more than 10 years ago[5], found an increasing trend in the prevalence of anemia in the state of São Paulo; however, it showed values even lower than those found in the population of Campinas. On the other hand, when the values found in the present study are compared with those of a regional study published by the Ministry of Health in 2004[3], the findings were found to be similar (approximately 67%). This suggests that the prevalence of anemia in general increased and intervention is necessary.

A limitation of the present study is the sample selection method. Since blood collection was performed using an invasive method, the maternal level of education had an influence on the authorization for carrying out the procedure. Therefore, data related to the prevalence of anemia were assessed using a weighted analysis, considering the percentage of maternal level of education and thus minimizing the collection bias, since all social classes were represented in our sample[16].

Children with anemia began receiving liquid milk at 7 months, the same time for the introduction of powder milk to those children who did not have the disease. Also regarding the introduction of powder milk (regular and milk-based infant formula), the data analyzed using multivariate logistic regression demonstrated a reduced prevalence of anemia in the children who consume it. However, since this is a cross-sectional study, we found an isolated association between intake of powder milk and development of anemia. Further studies are needed to compare the different types of milk and the probability of developing the disease.

With regard to the duration of breastfeeding, this factor was not associated with anemia (Table 4), since most infants had already been weaned. Therefore, in our sample, the duration of breastfeeding was short and there was early introduction of some foods. However, we found that the prevalence of anemia was reduced when breastfeeding was longer.

Sweets (soft drinks, snacks, candies) and yogurt were offered to children with anemia when they were around 10 months old, medians of 300 and 210 days, respectively. These foods should be avoided during the first year of life, according to the Dietary Guideline of the Ministry of Health[7] (Step 8). If the introduction of such foods was delayed in 1 month, anemia would not have been detected (Table 2), which reinforces the idea that the consumption of these foods should be discouraged during childhood.

When children were offered French rolls before 6 months of age, there was presence of anemia both in the survival analysis (median of 180 days – Table 2) and in the univariate logistic regression (Table 3), with a 1.61-higher (95%CI OR=1.01-2.56) risk of developing the disease in those children who ate French rolls before 6 months than among those who did not consumed this type of food before 6 months.

Children can eat the family diet provided that the foods are smashed, shredded or chopped in small pieces after they are 8 months old, according to Step 5 of the Dietary Guideline[7]. However, in the present study, children with anemia were offered the family diet early (median of 209 days) in comparison with those children who did not have anemia, who began to eat the family diet approximately at 8 months old.

We found that the intake of varied vegetables and leafy greens is not a habit among children during their first year of life; the median of introduction of vegetables for those with anemia was late, around 7 months of age (210 days) (Table 2).

The amount of iron in the foods depends on its bioavailability. It is recommended that meals containing dairy products and meals containing heme iron should be consumed with an interval between them because of the absorption competition between calcium and iron, while the consumption of foods rich in iron and vitamin C in the same meal increases iron absorption[7]. The iron density contained in complementary foods in developing countries may not fulfill the iron requirements of children younger than 2 years old[17-19]. In the USA, children between 6 to 11 months have diets containing nine-time higher iron density than children from Peru and Mexico. Such difference is reduced to five times in children from 9 no 11 months and it is basically caused by the American habit of consuming iron-fortified food[20].

The Brazilian Society of Pediatrics[4] recommends iron supplementation since weaning before the sixth month of life and for all children older than 6 months, regardless of the type of milk being consumed. The mandatory food fortification in force in Brazil consists in the use of iron and folic acid components in corn and wheat flour, since they are inexpensive products that are part of the usual diet of the population.

There are dietary perceptions, beliefs and taboos regarding the introduction of foods according to different regions of the country. The National Qualitative Survey about Feeding Practices of children younger than 2 years old[11] showed that some maternal perceptions can have an influence on the consumption of foods rich in iron. Mothers believe that the children's body is going through a process of formation and growth and, therefore, they should start receiving "children" or "soft" food, and their diet should be gradually changed until their organism is able to accept the same food consumed by adults. A multicentric study on dietary intake[21] showed that, in general, the diet of Brazilian children younger than 2 years old is characterized by low energy density, which may be related to the type and consistency of the food (soft and diluted).

Therefore, the present study conducted with children from Campinas evidenced high prevalence of anemia and early weaning even among the individuals with higher socioeconomic status, which might be related to dietary mistakes. The time of introduction of complementary food was different for those who had anemia and those who did not have the disease. The factors associated with anemia were inappropriate introduction of powder milk and early introduction of some food having high content of carbohydrates such as French roll, manufactured orange juice, and honey. On the other hand, we found a trend of late introduction of vegetables in those children with anemia. Such information should be addressed by health programs in order to prevent anemia in children. Future studies should quantify the diet consumed by infants using dietary questionnaires to enable the analysis of the diet associated to anemia.

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