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Prevalence of anemia and associated factors in children aged 6-59 months in Pernambuco, Northeastern Brazil

ABSTRACT

OBJECTIVE: To estimate the prevalence of anemia and to identify its associated factors in children aged 6-59 months.

METHODS: This was a cross-sectional study on data from the Third Health and Nutrition Survey of the State of Pernambuco, Northeastern Brazil, with a representative sample of 1,403 children from urban and rural areas. Anemia was diagnosed by means of hemoglobin assays. Multivariate analysis was performed though a hierarchical model, using robust-variance Poisson regression to estimate the prevalence ratio as a function of the following variables: biological factors, morbidity, child nutritional state, socioeconomic factors, housing, sanitation and maternal factors.

RESULTS: The weighted prevalence of anemia was 32.8% overall: 31.5% in urban areas and 36.6% in rural areas. In urban areas, anemia was significantly associated with maternal education, consumer goods, number of children less than five years old in the home, drinking water treatment, maternal age, maternal anemia and the child's age. In rural areas, only maternal age and the child's age were significantly associated with anemia.

CONCLUSIONS: The prevalence of anemia in children in Pernambuco was similar in urban and rural areas. The factors associated with anemia that are presented here should be taken into consideration in planning effective measures for its control.

DESCRIPTORS: Infant. Child. Anemia, epidemiology. Risk Factors. Socioeconomic Factors. Cross-Sectional Studies.

INTRODUCTION

Diagnosing the health and nutritional situation of populations contributes towards developing strategies that aim to combat nutritional deficiencies such as protein-energy malnutrition, iron deficiency anemia and hypovitaminosis A.

Among nutritional deficiencies, anemia affects 1.62 billion people worldwide, and preschool children are affected most, with prevalence of 47.4%.[a] In Brazil, anemia is increasing, unlike malnutrition and hypovitaminosis A.[5] Studies have

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[a] World Health Organization. Worldwide prevalence of anemia 1993–2005: WHO global database on anemia, Geneva; 2008. [cited 2009 Jun 29]. Available from: http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf

indicated high prevalences of anemia among children under five year of age in various regions of the country, reaching 46.9% in São Paulo (Southeastern Brazil]),[11] 54% in Criciúma, Santa Catarina (Southern Brazil),[13] 46.3% in Salvador, Bahia[2] and 40.9% in Pernambuco (both in Northeastern),[17] where the prevalence in rural areas (51.4%) was substantially greater than in urban areas (37.8%) in 1997.[17]

High prevalences of anemia and its consequences for children's health, and especially for their growth and development,[22] have made anemia an important public health problem, given the difficulty in implementing effective measures for controlling it. Its etiology involves many factors, such as socioeconomic, nutritional, biological, environmental and cultural characteristics, and the actions required encompass pertinent and relevant matters within the context of public health.[12,22]

Thus, investigation of determinants of anemia among children under the age of five years is backed by recommendations from the World Health Organization (WHO).[a] According to WHO, generation and maintenance of databases on anemia provide countries with a real instrument for developing control strategies for this problem. Therefore, the present study had the aims of estimating the prevalence of anemia among children aged six to 59 months and identifying associated factors.

METHODS

This study was developed using data from the Third Investigation on Health and Nutrition in the State of Pernambuco (III PESN/PE),[b] of 2006, which covered municipalities representing two geographical spaces in the state: urban (Metropolitan Region of Recife and urban areas in the interior of the state) and rural.

The sample calculation for each geographical area assumed an error of 3.7% and anemia prevalence of 40% for the state of Pernambuco,[17] with a confidence interval of 95%. The whole population of children under the age of five years in each geographical area was considered,[c] and 10% was added to the sample size to compensate for possible losses. This resulted in samples of 740 and 738 children aged six to 59 months in the urban and rural areas, respectively. The sample actually investigated was 717 children in the urban sector and 686 in the rural sector.

The sampling process was similar to what was used in 1991, on the first occasion that this investigation was conducted,[d] in order to ensure that the results would be comparable. The 18 municipalities investigated in I PESN/PE were selected by means of systematic sampling with probability proportional to the size of the population, thereby reflecting the population distribution of the state.

In these previously selected municipalities, census tracts were drawn randomly and systematically: 20 in the urban area and 19 in the rural area, thereby ensuring that both areas would be representative.

A point on the edge of each census tract in the urban area was drawn and, from this point, households with children under the age of five years were located in each block, until the intended number of 40 children per census tract had been completed. In the rural area, starting from a simple random draw to obtain a point on the edge of the census tract, the households closest to this initial mark were visited.

The data were gathered between May and October 2006, by means of forms to record the identification of the household, socioeconomic characteristics, the children's characteristics, histories relating to pregnancy and morbidity, and anthropometric and clinical-laboratory records of the mothers and children.

The anthropometric assessment was done in accordance with the WHO recommendations.[e] Weight and height were measured twice, by different interviewers, and the mean value of the two measurements was recorded. The measurements were repeated if the two weights differed by more than 100 g or the two heights by more than 1 cm.

All the children were weighed without shoes on and wearing a minimum of clothes, on a digital balance of capacity 150 kg and precision of 100 g (Plenna, model MEA-032000). Children under the age of two years were weighed together with the mother or other adult responsible for the child, and the final weight was calculated by subtracting the respective adult's weight, and this was recorded on the form during the fieldwork. The height of children of up to two years of age was measured in dorsal decubitus using an infantometer (CMS Weighing Equipment Ltd., Rollametre model, by Raven), with an amplitude of 100 cm and scale divisions of 0.1 cm. For children over the age of

[b] Third Investigation on Health and Nutrition in the State of Pernambuco, in 2006, conducted following an initiative from the Department of Nutrition, Federal University of Pernambuco, the Instituto de Medicina Integral Prof. Fernando Figueira and the State of Pernambuco Health Department, with financial support from the Ministry of Health and the National Council for Scientific and Technological Development (CNPq procedural no. 505540/2004-5) [unpublished data].

[c] Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2000. [cited 2009 Jun 29]. Available from: http://www.ibge.gov.br/home/estatistica/populacao/censo2000/default.shtm

[d] Governo do Estado de Pernambuco. Crianças e adolescentes em Pernambuco: saúde, educação e trabalho. Recife: UNICEF; 1992.

[e] World Health Organization. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva; 2006.

two years, a portable stadiometer (Alturexata) made of a wooden column that could be disassembled was used. The scale was marked on both sides, with a field of use from 35 cm to 213 cm and scale divisions of 0.1 cm. The children were measured in an upright position, without shoes, with their arms hanging down the sides of the body, and their heels, back and head touching the wooden column.

Venous blood samples were collected from the children aged six to 59 months and women aged 15 to 49 years on the day after the interview, in a place previously determined by the field team. Hemoglobin assays were performed using the Hemocue equipment (Hemocue Limited, Sheffield, UK).

Anemia was diagnosed based on the WHO standards.[a] Individuals with hemoglobin levels lower than 11 g/dl (children) or 12 g/dl (women of reproductive age) were considered to be anemic.

The sample calculation was done separately for the urban and rural areas, and the proportionality of the population under the age of five years in each area was not taken into consideration. Thus, the prevalence of anemia in Pernambuco was weighted according to the respective populations of the geographical areas. For this, the proportions of children under the age of five years in each geographical area were summed, multiplied by their respective anemia prevalences and divided by the total number of children under the age of five years in the state (based on the data in the 2000 census).[c]

The biological characterization was done based on the children's ages and sex. Morbidity was characterized by the presence of diarrhea over the last 15 days. Birth weight and the indices of weight for age and height for age were used to assess the children's nutritional status. For both of these indices, the reference curves used were those of the Brazilian Ministry of Health,[f] as recommended by WHO.[e] The anthropometric assessment was done using the Anthro software, version 3.01 (WHO Anthro 2009, Geneva, Switzerland). In this, the weight/age index was used in accordance with the following criteria: < -2 z-scores = low weight or very low weight and ≥ -2 z-scores = adequate weight or eutrophic state; and the height/weight index as follows: < -2 z-scores = short height and ≥ -2 z-scores = adequate height.

The socioeconomic factors were analyzed using the following variables: geographical area, family income, mother's schooling level and mother's remunerated work. The variables for analyzing the basic sanitation conditions were: origin of the water, treatment for drinking water, sewage system and garbage disposal. The housing characteristics were investigated by means of the following variables: housing conditions, number of people in the household, number of children under the age of five years in the household and consumer goods possessed.

Housing conditions and consumer goods were classified as scores. For housing, the variables of housing type, housing regime, walls, floor, roof and number of rooms received scores between one and three points (worst to best condition, respectively). Thus, the scores for housing conditions ranged from 10 to 18 points in total, and these were brought together as group 1 (10-13 points) and group 2 (14-18 points). The consumer goods scores were established according to the availability of electricity and possession of a television, radio, refrigerator and stove in the child's household. Each item scored one point and thus, consumer goods were brought together as groups 1 (0-1 point), 2 (2-3 points) and 3 (4-5 points).

The maternal factors analyzed were the mother's age and maternal anemia. Health and nutritional care, and food intake were characterized as the number of prenatal consultations and duration of breastfeeding.

Bivariate analysis was performed for each geographical area by means of simple Poisson regression, in order to investigate associations between occurrences of anemia and the independent variables, with a significance level of 5%. The variables that presented a statistical association with anemia with $p < 0.20$ were selected to form part of the multivariate regression models.

The multivariate analysis was performed by constructing conceptual models for anemia based on Osório et al[18] (2004). Six hierarchical levels for determining anemia were taken into consideration, in the following order: socioeconomic factors (geographical area, family income, mother's schooling level and mother's remunerated work); housing conditions and sanitation (housing conditions, consumer goods, number of people in the household, number of children under the age of five years, origin of the water, treatment for drinking water, type of sewage system and garbage disposal); maternal factors (mother's age and maternal anemia); health and nutritional care (number of prenatal consultations); nutritional status and morbidity (diarrhea over the last 15 days, weight/age indicator, height/age indicator and birth weight); and children's biological characteristics (child's age). Two multivariate analysis models were constructed: one for the urban area and the other for the rural area.

Poisson's regression with robust variance was used to investigate how the prevalence of anemia might have

[f] Ministério da Saúde. Orientações para a coleta e análise de dados antropométricos em serviços de saúde: material preliminar da Coordenação Geral da Política de Alimentação e Nutrição/DAB/SAS/MS sobre a avaliação nutricional de crianças: norma técnica – SISVAN. Brasília, DF; 2008.

been influenced by the various explanatory variables.[4,6] The backward method was used: the variables of the first hierarchical level were analyzed together and the variables with significance greater than or equal to 20% were progressively excluded. The variables of the second hierarchical level were then added to the model, and the same procedure was followed, with progressive exclusion of the variables of this level with $p \geq 0.20$. Thus, all the hierarchical levels were analyzed. Upon concluding the models for the urban and rural areas, variables with $p < 0.05$ were taken to be significant. To control for possible confounding factors, variables with $p < 0.20$ were kept in the models at each hierarchical level.

The statistical significance was determined by means of the Wald test for heterogeneity and linear trends for ordinal variables, and the adjusted prevalence ratios and respective 95% confidence intervals were estimated.

The EpiInfo software, version 6.04, and the R software, version 2.10.1 were used for the data processing and analysis.

The project for III PESN/PE was approved by the Research Ethics Committee of the Instituto de Medicina Integral Prof. Fernando Figueira (Procedural no. 1321, 2004). All the children under the age of five years and/or women aged 15-49 years who were diagnosed as anemic received treatment with oral ferrous sulfate.

RESULTS

The mean age of the children studied was 32.6 months (standard deviation, SD = 15.4). It was 32 months (SD = 15.3) in the urban area and 33 months (SD = 15.5) in the rural area. Male children predominated (51.7% in the urban area and 51.2% in the rural area).

The weighted prevalence of anemia for the state of Pernambuco was 32.8% (95% CI: 31.5;36.6). It was 31.5% (95% CI: 28.2;35.1) in the urban area and 36.6% (95% CI: 33.0;40.3) in the rural area, without any statistically significant difference between the areas (p = 0.05).

The variables that were statistically associated with anemia in the urban area were: family income and mother's schooling level; housing conditions, consumer goods, treatment for drinking water, type of sewage system and number of children under the age of five years; mother's age and maternal anemia; number of prenatal consultations; and the child's age (Tables 1, 2 and 3).

For the rural area, the variables associated with anemia were: housing conditions and consumer goods; mother's age; height/age index; and the child's age (Tables 1, 2 and 3).

The prevalence ratios for anemia among children in the urban and rural areas, according to the preestablished hierarchical model are shown in Table 4. The

Table 1. Prevalence of anemia in children aged six to 59 months, according to biological characteristics, morbidity and nutritional status, per geographical area. Pernambuco, Northeastern Brazil, 2006.

Variables	Urban (n = 717)			Rural (n = 686)		
	n	%	PR (95%CI)	n	%	PR (95%CI)
Age (months)		p < 0.001			p < 0.001	
6-24	251	50.6	2.4 (1.92;2.94)	233	65.2	3.0 (2.46;3.63)
≥ 24	466	21.2	1	453	21.9	1
Sex		p = 0.88			p = 0.47	
Male	371	31.3	1.0 (0.79;1.22)	351	37.9	1.1 (0.89;1.31)
Female	346	31.8	1	335	35.2	1
Diarrhea		p = 0.25			p = 0.12	
Yes	111	36.0	1.2 (0.90;1.55)	156	41.7	1.2 (0.95;1.48)
No	606	30.7	1	530	35.1	1
Birth weight (g)		p = 0.34			p = 0.82	
< 2500	65	36.9	1.2 (0.84;1.65)	56	35.7	1.0 (0.66;1.38)
≥ 2500	635	31.3	1	599	37.2	1
Weight/age index		p = 0.36			p = 0.40	
< -2 Z-scores	20	40.0	1.3 (0.75;2.23)	20	45.0	1.2 (0.76;2.03)
≥ -2 Z-scores	688	31.0	1	665	36.4	1
Height/age index		p = 0.05			p = 0.02	
< -2 Z-scores	41	43.9	1.4 (1.00;2.08)	78	47.4	1.3 (1.04;1.75)
≥ -2 Z-scores	666	30.5	1	607	35.1	1

variables that explained anemia differed between the two geographical areas, except for the mother's and child's ages. In the urban area, the significant variables in the final model were: mother's schooling level, consumer goods, number of children under the age of five years, treatment for drinking water, mother's age, maternal anemia and child's age, with adjustment for family income, housing conditions and type of sewage system. In the rural area, only the mother's age and the child's age remained associated with anemia in the final model, with adjustment for the mother's work, housing conditions, consumer gods, treatment for drinking water, maternal anemia and height/age index.

DISCUSSION

In this study, high prevalence of anemia was observed among children aged six to 59 months in the state of

Table 2. Prevalence of anemia in children aged six to 59 months, according to socioeconomic factors, housing characteristics and type of sewage system, per geographical area. Pernambuco, Northeastern Brazil, 2006.

Variables	Urban (n = 717)			Rural (n = 686)		
	n	%	PR (95%CI)	n	%	PR (95%CI)
Family income (minimum wages)		p = 0.04			p = 0.23	
< 2	438	34.5	1.3 (1.01;1.63)	598	37.1	1.2 (0.87;1.79)
≥ 2	265	26.8	1	77	29.9	1
Mother's schooling level (years)		p = 0.01			p = 0.98	
0-8	468	35.3	1.4 (1.11;1.84)	622	36.7	1.0 (0.71;1.42)
≥ 9	243	24.7	1	63	36.5	1
Mother's remunerated work		p = 0.22			p = 0.07	
No	506	33.0	1.2 (0.91;1.51)	559	38.3	1.3 (0.98;1.75)
Yes	209	28.2	1	127	29.1	1
Housing conditions[a]		p < 0.001			p = 0.02	
1	39	51.3	1.7 (1.22;2.34)	66	48.5	1.4 (1.05;1.80)
2	678	30.4	1	620	35.3	1
Number of people in household		p = 0.47			p = 0.50	
6 or more	228	33.3	1.1 (0.87;1.36)	281	38.1	1.1 (0.88;1.31)
2-5	489	30.7	1	405	35.6	1
Number of children < 5 years		p < 0.001			p = 0.24	
2 or more	271	38.0	1.4 (1.12;1.70)	308	39.0	1.1 (0.92;1.36)
1	446	27.6	1	378	34.7	1
Consumer goods[a]		p < 0.001			p < 0.001	
1	7	85.7	2.9 (2.12;4.06)	28	46.4	1.4 (0.92;2.14)
2	70	47.1	1.6 (1.22;2.12)	190	43.7	1.3 (1.07;1.62)
3	640	29.2	1	468	33.1	1
Origin of water		p = 0.02			p = 0.44	
Others	24	50.0	1.6 (1.07;2.46)	599	36.1	0.9 (0.68;1.19)
General network	693	30.9	1	87	40.2	1
Treatment for drinking water		p < 0.001			p = 0.06	
Not treated	194	44.3	1.6 (1.34;2.05)	512	38.7	1.3 (0.99;1.63)
Treated	523	26.8	1	174	30.5	1
Type of sewage system		p = 0.02			p = 0.15	
Others	94	37.2	1.3 (0.98;1.80)	394	39.1	1.1 (0.54;2.23)
Ditch with lid	174	36.8	1.3 (1.03;1.68)	278	33.1	0.9 (0.45;1.92)
Connected to network	447	28.0	1	14	35.7	1
Garbage disposal		p = 0.14			p = 0.84	
Others	10	40.0	1.3 (0.60;2.77)	250	38.4	1.0 (0.74;1.30)
Buried/burned	8	62.5	2.0 (1.16;3.49)	326	34.4	0.9 (0.66;1.16)
Collected	699	31.0	1	110	39.1	1

[a] Values grouped according to scores

Table 3. Prevalence of anemia in children aged six to 59 months, according to maternal factors, health and nutritional care, and food intake, per geographical area. Pernambuco, Northeastern Brazil, 2006.

Variables	Urban (n = 717)			Rural (n = 686)		
	n	%	RP (95%CI)	n	%	RP (95%CI)
Mother's age		p < 0.001			p < 0.001	
< 20	78	46.2	1.6 (1.19;2.03)	58	58.6	1.7 (1.34;2.16)
≥ 20	638	29.8	1	628	34.6	1
Maternal anemia		p < 0.001			p = 0.07	
Present	133	46.6	1.6 (1.31;2.08)	113	44.2	1.2 (0.98;1.57)
Absent	516	28.3	1	543	35.5	1
Number of prenatal consultations		p = 0.03			p = 0.59	
≤ 5	159	38.4	1.3 (1.02;1.65)	264	38.3	1.1 (0.86;1.30)
≥ 6	499	29.7	1	384	36.2	1
Breastfeeding (days)		p = 0.61			p = 0.34	
≤ 119	270	26.3	1.1 (0.81;1.43)	225	33.3	1.1 (0.88;1.45)
≥ 120	303	24.4	1	332	29.5	1

Pernambuco. High prevalence of anemia is not only found in emerging countries like Brazil. Some studies in other countries have recorded similar or higher prevalences. In New Zealand, the prevalence of anemia was found to be 49% among children aged 6 to 11 months and 22% among children aged 12 to 24 months.[20] In Vietnam, 45.1% of the children under the age of five years were found to present anemia.[15] In sub-Saharan African countries, prevalences of 82% in Benin and 83% in Mali were found.[14]

The prevalences of anemia were very similar between the urban and rural areas. In the rural area, the prevalence of anemia among children under the age of 24 months was around three times greater than among the older children. In the urban area, children under the age of 24 months presented prevalence of anemia that was around twice what was found among children over this age. This statistically significant difference in prevalence of anemia between the ages can mainly be explained by the accelerated growth and consequent increased requirement for iron during the first years of life.[8,11,a] Thus, the differences found between the age groups do not constitute a local peculiarity but a problem of universal nature.[7,15,a] In the multivariate analysis for the urban and rural areas, the child's age (which was a variable at the proximal level for determining anemia) was the determinant that most influenced the prevalence of anemia.

An association between anemia and nutritional status in rural areas has also been observed in other studies.[1,14] Low intake of iron-rich foods and diminished nutrient absorption caused by changes to the gastrointestinal epithelium in malnourished individuals contribute towards development of anemia.

Establishment of nutritional deficiencies is linked to the population's socioeconomic conditions.[21,23,a] Thus, the association found between low family income and anemia among children in the urban area corroborates studies both in Brazil and in other countries that have indicated that there is an inverse association between families' purchasing power and the prevalence of anemia among children.[3,10]

The association between mothers' schooling level and the care provided for to children has been greatly discussed in the literature, given that education has a relationship with the capacity to grasp the knowledge needed for adequate healthcare and nutrition for children, just as it provides a chance to enter the labor market and probably better socioeconomic conditions.[14,18,23] The results from the present study reflect this relationship, through showing that the prevalence of anemia was lower among urban children whose mothers had been to school for more than eight years.

In the multivariate analyses, among the variables analyzed in the distal group of associations with anemia, family income lost its statistical significance and remained as an adjustment variable in the urban area, while the mother's schooling level was the only variable that kept its statistical significance in the final model. None of the variables at the distal level remained in the final model for the rural area, which was adjusted for the mother's remunerated work, coming from this level.

Socioeconomic indicators such as housing conditions and possession of goods have been investigated in order to obtain better estimates of the relationship between living conditions and health problems.[1,18,21] The results found indicated that the prevalence of anemia was more than 46% among the children whose households had lower scores for housing conditions and consumer goods in both the geographical areas studied, which suggests that this is a serious public health problem.[a]

Table 4. Adjusted prevalence ratios for anemia in children aged six to 59 months, per geographical area. Pernambuco, Northeastern Brazil, 2006.

Levels/Variables	Urban area[a]			Rural area[b]		
	RP	95%CI	p	RP	95%CI	p
Level 1 - Socioeconomic factors						
Mother's schooling level (years)						
≥ 9	1		p = 0.022			
0-8	1.4	1.05;1.76				
Level 2 - Housing and sanitation conditions						
Consumer goods (as scores)						
3	1		p = 0.005			
2	1.3	0.98;1.80				
1	2.1	1.26;3.56				
Number of children < 5 years						
1	1		p = 0.045			
2 or more	1.3	1.01;1.56				
Treatment for drinking water						
Treated	1		p = 0.028			
Not treated	1.3	1.03;1.65				
Level 3 - Maternal factors						
Mother's age						
≥ 20	1		p = 0.005	1		p < 0.001
< 20	1.5	1.12;1.94		1.6	1.23;2.04	
Maternal anemia						
Absent	1		p = 0.001			
Present	1.5	1.18;1.90				
Level 6 - Biological factors						
Age (months)						
≥ 24	1		p < 0.001	1		p < 0.001
6-24	2.3	1.88;2.93		2.9	2.35;3.53	

[a] Adjusted according to the variables of family income, housing conditions and type of sewage system.
[b] Adjusted according to the variables of mother's work, housing conditions, consumer goods, treatment for drinking water, maternal anemia and height/age index.

Greater numbers of children under the age of five years in the household showed a statistically significant association with anemia, in the urban area. Greater numbers of children in the household implies more domestic work and worse quality of care for the children, and also means greater demand for foods to supply the needs of all members of the family, which may contribute towards greater risk of anemia.[9,23] In the rural area, the number of children under the age five years in the household did not have any impact on the prevalence of anemia. However, this does not indicate that people living in the rural area had better living conditions. On the contrary: this lack of impact may have been due to the worse situation regarding other socioeconomic, health and nutrition factors, given that when these were analyzed within a hierarchical model for determining anemia, they seemed to be superimposed on the influence of the number of children in the household.

Precarious sanitation conditions are linked with anemia, even if indirectly, since such conditions are associated with greater numbers of infectious and parasitic diseases, which in turn contributed towards diminishing the hemoglobin levels.[a] In the present study, the highest prevalence of anemia in the urban area occurred in households that were not using treated drinking water and did not have an adequate sewage system. Studies conducted among preschool children in northeastern Brazil have reinforced this relationship.[2,21]

In the rural area, anemia did not present a statistical association with lack of treatment for drinking water and lack of sewage treatment. However, 74% of the children in the rural area were living in households that were not using treated water for drinking, and 57% did not have adequate sewage systems in their homes.

With regard to maternal characteristics, anemia in children showed a statistical association with teenage mothers in both the rural and the urban areas. This association has also been observed in other studies and is generally correlated with childcare quality.[1,19] The mother's age remained in the final models for the urban and rural areas.

Based on the concept that children's health reflects the family situation, the possibility that a child would present anemia if other members of this family (especially the mother) were anemic is theoretically high. Such an association was found in the present study, thus corroborating previous findings in Pernambuco[19] and also descriptions by Agho et al[1] (2008) in East Timor. Maternal anemia had a greater association with anemia in children in the urban area and, although this factor did not remain in the final model for the rural area, the prevalence of anemia among the children of anemic mothers exceeded 44% in both areas.

Access to quality healthcare services constitutes an indicator of a population's health conditions and thus prenatal consultations are of importance for ensuring that healthy children are born.[1,18,21] In the present study, the association between lower numbers of prenatal consultations and the presence of anemia was statistically significant in the urban area of the state.

The lack of data on food intake formed a limitation to interpretation of the results from this study. The most frequent cause of anemia in children is iron deficiency, generally associated with insufficient intake of this nutrient or consumption of foods that inhibit iron absorption.[10,16,20]

In the final models of the present study, a greater number of variables were statistically associated with anemia among the children in the urban area than among those living in the rural area.

The rural area presented socioeconomic, housing and sanitation conditions that were more homogenous, which made it difficult to establish statistical relationships between these variables and the presence of anemia. Mothers' income and schooling levels in the rural area possibly did not show up as factors associated with anemia because the majority of the families were in the categories of lowest income and lowest maternal schooling level. Likewise, housing and sanitation conditions in rural areas are generally poor. Nationwide data emphasize that rural areas in northeastern Brazil present a worse situation than the national mean, regarding women's schooling and household infrastructure, thus characterizing a gap between urban and rural areas that is still large.[g]

Success in combating anemia depends on understanding its associated factors. This panorama of anemia in Pernambuco contributes towards planning effective measures for its control, including maintenance of government programs for fortification of wheat and maize flour and for iron supplementation, as well as actions that aim to improve the population's socioeconomic, housing, sanitation and health conditions.

[g] Ministério da Saúde. Secretaria de Ciência, Tecnologia e Insumos Estratégicos. PNDS 2006: Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher: relatório: versão preliminar. Brasília, DF; 2008. [cited 2010 May 5]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/relatorio_pnds_2006.pdf

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