Temporal evolution of and factors associated with anemia among women of reproductive age in the state of Pernambuco, Brazil

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Abstract: Anemia is one of the oldest recorded health disorders in history of humanity and still imposes itself as a challenge for collective health in the current world, affecting mainly children, pregnant women and non-pregnant women of reproductive health. The objectives of this cross-sectional study were to analyze the temporal evolution of and factors associated with anemia among women at reproductive age in the state of Pernambuco, Brazil in 1997 and 2006. Material and methods: it included 1.123 (1997) and 1.476 (2006) women aged from 10 to 49 years old. Poisson regression was used to assess associations between anemia and the explanatory variables. The prevalence of anemia in Pernambuco was reduced from 18.7% (1997) to 16.1% (2006), that is, a decline of 13.9%. In contrast, the metropolitan region of Recife (MRR) showed an increase of 6.4%, with higher prevalence in the urban inland and the rural area. Adjusted prevalence ratios showed that only MRR, number of people per household $\geq$ eight, and having no or one domestic good were kept in the final model. The conclusion is that anemia among women has decreased in Pernambuco and in most socio-economic and biological categories, showing a change of the situation and favoring groups who experience adverse life conditions.

Keywords: **anemia, prevalence, women, cross-sectional studies**

I. INTRODUCTION

Anemia is one of the earliest recorded health disorders in the nosographic history of mankind. Its deficiency has also been well established for centuries, especially in relation to primary or secondary iron deficiency in its most common etiopathogenesis, and it is estimated that 50% of the cases are caused by iron deficiency. (1) However, despite the accumulated scientific knowledge of its pathophysiology and epidemiology, the consensual logic and the scientific and technical resources available for its prevention and treatment at a fully acceptable cost by public authorities and society, the problem still remains as a challenge to collective health in today's world. (2) Their biological, social and economic consequences are markedly adverse, being reflected in the statistics of morbimortality, the commitment of learning and the limitation of physical and mental productivity. In reality, anemia is a trans-social pandemic insofar as it affects rich countries and poor regions of the world, spreading in the same geographic space and at the same time affecting different income group. (1-5)

The World Health Organization (WHO) and the Center for Disease Control (CDC) estimate that 1.62 billion people would be anemic and 41.8% of pregnant women and 30.2% of non-pregnant women would suffer. In terms of the biological group reached, these values would be exceeded only by the pre-school segment, with an estimated prevalence of around 50%. (2)

Given the existing questions about epidemiological indicators, there is practically a consensus that, for the most part, (6) the anemia of the pregnant woman prolongs and worsens a situation that precedes the pregnancy itself. Thus, although explicit health care for anemia should normatively integrate the prenatal routine, the problem would have a much more extensive natural history, since it prevails in the vast majority of cases even before the pregnancy process is established. It is a characteristic that represents an important epidemiological assumption, since the anemia of the pregnant woman could represent the extension and the worsening, in clinical and populational level, of a more permanent and prolonged deficiency in the reproductive age.

On the other hand, the many insufficiently evaluated aspects of the problem make it difficult to understand its determinants, including the representation of several living ecosystems in rural and urban areas, the nutritional transition process that has been characterized in Brazil for at least three decades, as well as the programmatic measures to combat anemia, among which the ministerial decree that since 2004 made it mandatory to enrich corn and wheat flours with iron and folic acid, are important factors that justify the pertinence and the present study (7-12).

In this context, the study reported here may anticipate and deepen the epidemiological understanding of the problem in women of childbearing age and, by extension, the risks that would extend to gestation to fetuses and newborns (13), thus amplifying its possible implications. As in the state of Pernambuco, two population-based surveys were conducted, representing urban and rural areas, it is feasible to establish points of construction of a temporal trend (1997 and 2006) of anemia in women aged 10 to 49 years, along with a analytical inventory of biological socio-environmental factors and access to services predictably associated to their occurrence.

II. MATERIALS AND METHODS

It is a cross-sectional, population-based study, evaluating temporal trends (1997-2006) with a quantitative approach, through descriptive and analytical procedures. The field surveys that founded it had as a data

collection tool the questionnaires referring to two state surveys of maternal and child health and nutrition, designated II and III PESN.

The sample of the probabilistic type by census tracts of the Brazilian Institute of Geography and Statistics, with representativeness for the populations of the urban and rural spaces of the state, was constituted by women in the reproductive period of 10 to 49 years.

Data were collected through household interviews to record information on socioeconomic, demographic and anthropometric variables of women; while physical examinations and blood collection were performed in public health units. The presence of anemia was evaluated in a venous blood sample using the Hemo-Cue® equipment in a blood sample obtained by digital puncture. Anemia was defined according to the World Health Organization, and cases with hemoglobin levels below 12 g/dL were considered anemic. (1)

The anthropometric evaluation was performed according to technical procedures recommended by the World Health Organization (1995) and standards of the Growth and Development Monitoring Manual of the brazilian Ministry of Health. (14-15) Body weight was obtained using the electronic digital scale with a maximum capacity of 150 kg and an accuracy of 100 g. To measure the stature was used inelastic tape measure of 200 cm fixed to the wall and portable stadiometer both with precision of 1 mm throughout the length. In order to ensure the accuracy, the measurements were made in duplicate for each individual, with the condition that the difference between the evaluations did not exceed 0.5 cm. When this limit was exceeded, the measurement was repeated, noting the two measurements with the closest values and using their mean for recording effect.

Weight and height measures were used to calculate the BMI/age (BMI/I) [weight (kg)/height(m)^2]/age of women between 10 and 19 years, being defined subsequently the excess weight, based on the recommendations of the World Health Organization (WHO), considering a z score $\geq$ 1. (16) For women aged 20 and over, the diagnosis of overweight also considered the WHO recommendation, with the BMI cut $\geq$ 25 kg/m^2. (14)

The explanatory variables were represented by the geographical location of the household, per capita family income, number of people living in the household, housing occupation regime, public service acess of water, sewage and garbage collection, age group (BMI) and color of the skin - white or black/mulatto (referred by the subjects), years of schooling, possession of household equipments (television, refrigerator, stove and radio) of the interviewee himself.

The research data were typed in double entry, validated, processed and analyzed using EpiInfo software, version 6.04 (CDC/WHO, Atlanta, GE, USA). The anthropometric evaluation of the adolescents was obtained through the Anthroplus-2007 software, and the evaluation of the adult women was through EpiInfo version 6.04. The Statistical Package for Social Sciences (SPSS) version 12.0 (SPSS Inc., Chicago, IL, USA) and Stata 7.0 (Stata Corp., College Station) were used for the statistical analysis. The evolution of anemia was determined by comparing the prevalences and their confidence intervals for 1997 and 2006 and by ratios of proportions, taking as reference the year of 1997. In the comparison of the categorical variables of the groups, the chi- square test to verify heterogeneity or the chi-square test with Yates correction for the dichotomous variables, considering as statistical significance P-values≤0.05. For the multivariate analysis (Poisson regression), the variables with p≤0.20 in the bivariate analysis were selected in a first step. The two investigations used in the study were approved by ethics committees in research with human beings according the brazilian resolution of the National Health Council. The cases with diagnosis of anemia were referred to the local health service for proper follow-up.

III. RESULTS

Figure 1 shows the prevalence of anemia in women of reproductive age in 1997 and 2006, according to the geographical location of the household, with a reduction in state of Pernambuco from 18.7% in 1997 to 16.1% in the year of 2006. When stratifying the sample in the three geographic spaces, Metropolitan Area of Recife (RMR), Urban Interior (UI) and Rural Interior (RI), it is observed that RMR presented an increase in prevalence between 1997 and 2006 and higher prevalences than UI and RI.

The distribution of anemia showed marked differences between 1997 and 2006, with a 13.9% reduction for the whole state, mainly due to the decrease of 25.1% and 22.1%, respectively, in the interior urban (UI) and rural (RI). In contrast, in the Metropolitan Region of Recife (RMR), the prevalence of the problem increased by 6.4%. Regarding the exploratory variables, the most evident changes in the years 1997 and 2006 were observed in dwellings that were not owned or were rented and in the adverse conditions related public services of the sanitation, trash collection and water supply.

In the nine-year interval, there was a decrease of 25.1% in the 10-19 age group, 29.4% in the lowest education group, 19.8% in the lowest income stratum and approximately 39% in the group of families with less than four people.

Within each classification of explanatory variables, in 1997 and 2006, the lowest access to household equipment and the occurrence of abortion were statistically associated with the risk of anemia ($p \leq 0.05$).

From the 13 blocks of variables examined the conditions related to the geographical situation, persons per household, access to household equipment, abortion occurrence, BMI and race were selected for crude prevalence ratios ($p \leq 0.20$) and submitted to analysis of the statistical procedure for the gross adjustment of prevalence ratios, only the RMR, number greater than eight people per household and possession of none or one household equipment was maintained in the final model, with a value of $p \leq 0.05$.

Figure 1. Evolution of anemia in women aged 10 to 49 according to the geographical location of the household. Pernambuco, 1997 and 2006.
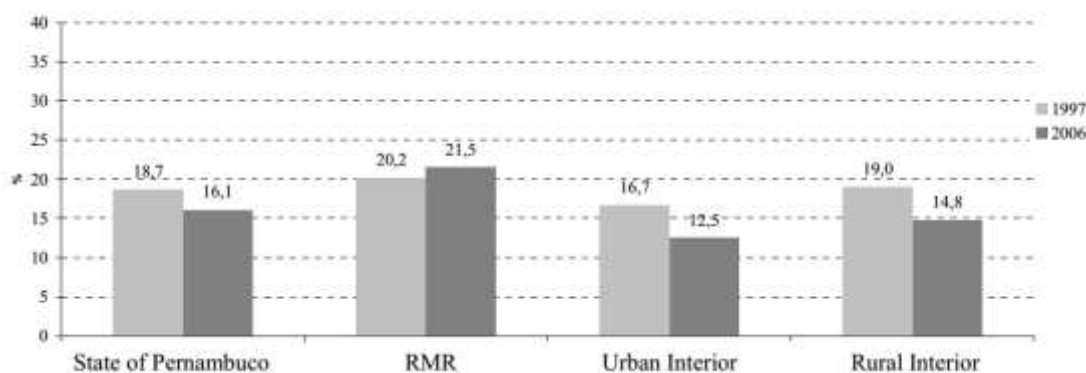
Table 1. Poisson regression for anemia in women aged 10 to 49 years according to demographic, biological and socioeconomic variables. Pernambuco, 2006.

Variables/ Distribution of Results	PR$_{no\ adjusted}$ (95%CI)	p	PR$_{adjusted}$ (95%CI)	p
Geographical situation				
RMR	1,71 (1,2-2,44)	0,003	1,65(1,15-2,36)	0,006
Urban Interior	1		1	
Urban Rural	1,17 (0,83-1,66)	0,36	1,16(0,75-1,51)	0,73
People/households				
<4	1		1	
4 ├ 7	1,15 (0,85-1,51)	0,39	1,12(0,86-1,5)	0,33
≥8	1,4(1,09-2,14)	0,01	1,35(0,99-1,98)	0,05
Household equipments*				
Possesion of 2 or more	1		1	
Possesion of 1 or none	1,6(0,99-2,5)	0,06	1,7(1,04-2,69)	0,03
Abortion				
Occurred	1,33 (0,98-1,8)	0,06	1,33(0,98-1,81)	0,067
None abortion	1		1	
BMI				
< 25	1		1	
≥ 25	0,81(0,63-1,07)	0,2	0,8(0,6-1,05)	0,1
Race				
Mulatto/black	1,46 (1,07-2)	0,016	1,33(0,97-1,8)	0,078
White	1		1	

CI - Confidence Interval
PR - Prevalence ratio
*(television, refrigerator, stove and radio)

IV. CONCLUSIONS

As conclusive observations, contrary to recognized worldwide trends, the prevalence of anemia in women of childbearing age declined by almost 14% in the state of Pernambuco between 1997 and 2006. Atypically, the problem worsened in the geographical space of better living conditions: the Metropolitan Region of Recife. It seems curious to note that, despite the decrease in the prevalence of anemia in all categories (socioeconomic and biological), the largest reductions occurred in the groups theoretically most exposed to risk factors, demonstrating a change of situation that, between 1997 and 2006, passed to favor groups traditionally representative of the most adverse living conditions. In the next state inquiry it is expected that these changes will consolidate, changing the socioeconomic and biological panorama of the distribution of anemia in women during the fertile period.

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