Coexistence of anemia and vitamin A deficiency in women of childbearing age in the Northeast region of Brazil[1]

Coexistência de anemia e deficiência de vitamina A em mulheres em idade fértil no Nordeste do Brasil

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A B S T R A C T

Objective

The aim of this study was to investigate the association between anemia and vitamin A deficiency in women of childbearing age in *Pernambuco*, a state in the Brazilian Northeast.

Methods

A cross-sectional study was conducted making a secondary database analysis of "The Third State Survey on Health and Nutrition" done from May to September 2006. Data were collected from 761 women of childbearing age (10-49 years).

Results

The simultaneous occurrence of the two deficiencies was found in only seven women (0.9%). The prevalence of anemia was of 15.1%, and of vitamin A deficiency, 8.2%. There was no association between the two conditions (*p*=0.380), although a positive correlation was found between retinol levels and hemoglobin concentration (*r*=0.13).

Conclusion

Anemia and vitamin A deficiency did not coexist. Anemia was considered a mild public health problem, while vitamin A deficiency was not considered an epidemiological problem.

Indexing terms: Anemia. Vitamin A deficiency. Women.

RESUMO

Objetivo

O objetivo deste trabalho foi avaliar a prevalência da associação entre anemia e deficiência de vitamina A em mulheres em idade fértil em Pernambuco.

Métodos

Foi realizado estudo transversal com análise secundária do banco de dados da "III Pesquisa Estadual de Saúde e Nutrição-2006", realizada em Pernambuco, Nordeste do Brasil. Foram selecionados, do banco original, dados das 761 mulheres em idade fértil (10 a 49 anos), excluindo gestantes.

Resultados

A ocorrência simultânea das duas deficiências foi encontrada em apenas sete mulheres (0,9%); a prevalência de anemia foi de 15,1%, e a de deficiência de vitamina A, de 8,2%. Não houve associação entre as duas condições (p=0,380), porém foi observada correlação positiva entre valores de retinol e concentração de hemoglobina (r=0,13).

Conclusão

Não houve coexistência de anemia e deficiência de vitamina A, e, separadamente, a anemia foi considerada problema de leve magnitude, enquanto a deficiência de vitamina A não chegou a se caracterizar como problema epidemiológico.

Termos de indexação: *Anemia. Deficiência de vitamina A. Mulheres.*

INTRODUCTION

Micronutrient deficiency (mainly iron, vitamin A and iodine) is a leading nutritional problem affecting a large proportion of the world's population manifestly or silently[1-3]. Vitamin A Deficiency (VAD) has historically been a significant problem, especially in developing countries, and even more so in south and southeast Asia, which accounts for more than half of all global VAD cases[4,5]. The only national survey[6] conducted in Brazil found a VAD prevalence of 12.0% (retinol <0.7µmol/L) in 2006, which did not vary significantly by region. The World Health Organization (WHO) considers that the VAD prevalence in women is low at an estimated 2.5%[7]. On the other hand, the WHO estimates that 50.0% of women have anemia, mainly pregnant women in developing countries[8].

There is evidence that anemia reduces the absorption of vitamin A in the intestine and its bioavailability in the body[9]. In turn, VAD affects erythropoiesis and iron metabolism[10].

An association between VAD and anemia was first reported in the 1920s and 1940s[11,12]. Moreover, poverty, malnutrition, and age may influence the distribution of anemia and VAD in different populations[1,6].

Public nutrition policies are made globally to address these deficiencies and to reduce healthcare costs[13]. In Brazil, the Ministry of Health recommends iron and vitamin A replacement during pregnancy and postnatally, respectively[14,15]. Ideally, women should have appropriate iron and vitamin A reserves at conception because it is harder to correct these deficiencies during pregnancy, when the maternal and fetal metabolic requirements are higher[16].

Considering the lack of information about these two nutritional problems in women, the objective of this study was to estimate the prevalence of anemia and VAD, and the coexistence of both, in women of childbearing age in the Brazilian Northeast.

METHODS

Study design and population

This paper is a secondary analysis based on the *III Pesquisa Estadual de Saúde e Nutrição*

(III PESN-2006, Third State Survey on Health and Nutrition)[17] done in *Pernambuco*, state in the Brazilian Northeast, between May and September 2006. *Pernambuco* has an area of roughly 98,146km^2 and a population of 8,796,032 inhabitants, of which 51.9% are women. Mild food insecurity is found in 11.5% of the households[18] and 17.6% of the population over the age of 15 years is illiterate[19].

There were 801 women available for analysis but 40 pregnant women were excluded, resulting in a sample of 761 women. Given the female population of 4,000,000[20], a prevalence of VAD of 15%[21] and of anemia of 20%[8], an error of 3%, and a Confidence Interval of 95% (95%IC), a representative sample would have to have at least 683 women, so the sample above is representative of the women of childbearing age of the state of *Pernambuco*.

Data source

The original study aimed to update the health, nutrition, and socioeconomic status data of the population of *Pernambuco*, focusing on maternal and child health, and to assess the nutritional status and prevalence of anemia and vitamin A deficiency in women aged 10 to 49 years. Sociodemographic data were collected during home visits using a questionnaire.

Anthropometric measurements, collection of blood sample, and blood tests

The *III Perquisa Estadual de Saúde e Nutrição 2006*[17] randomly selected a representative sample of the state's urban and rural population. Following the interview, anthropometric measurements (height and weight) were taken and blood samples were collected to determine hemoglobin level and serum retinol. The blood samples for both tests were collected at the local laboratory or at home, when the women could not visit the laboratory.

The participants were asked to fast for 12 hours before blood collection. Hemoglobin level was determined by HemoCue© (immediate reading) using a fingerstick and serum retinol was measured by High Performance Liquid Chromatography (HPLC)[22]. Individuals with hemoglobin level ≤12g/dL were considered anemic and with serum retinol <0.70μmol/L were considered vitamin-A deficient, as defined by the WHO[7,8].

Independent variables

This study chose the following independent variables: age group (<20 years, 20-34 years, ≥35 years), setting (urban, rural), level of education (incomplete elementary school, elementary school, high school or higher), race (Caucasian, African Brazilian, other), family income in minimum salaries (the Brazilian minimum salary was roughly US$150.00 per month in 2006), and nutritional status determined by Body Mass Index (BMI) (<18.5=underweight; 18.5-24.9=normal weight; 25-29.9 =overweight; BMI>30=obese).

Statistical treatment

The data were treated by the software Epi Info version 3.5.1, and STATA version 10.1. The prevalences of anemia, VAD, and their coexistence were calculated, along with their respective 95% confidence intervals. The frequency distributions of VAD and anemia were described according to sociodemographic and biological characteristics. Proportions were compared by the chi-square test with a significance level of 5%. The correlation between serum retinol and hemoglobin level was investigated by the Pearson correlation coefficient (*r*).

Study approval

This study was approved by the Research Ethics Committee of the *Instituto de Medicina*

Integral Prof. Fernando Figueira (IMIP) in *Recife*, Brazil, under protocol number 1645/2009. All participants of the original study signed a Free and Informed Consent Form.

R E S U L T S

Of the 761 study women, 49.3% lived in rural areas and 65.3% had completed elementary school. Their mean age and Standard Deviation (SD) were 28.5 ± 6.8 years and 8.7% were adolescents (<20 years). Hemoglobin (Hb) level and serum retinol were determined in all but one woman despite all being tested. The prevalence of anemia was 15.1% (95%CI: 12.7-17.8) whereas the prevalence of VAD was 8.2% (95%CI: 6.4-10.3). Table 1 shows the distribution of anemia and VAD according to the sample's sociodemographic and biological characteristics, which did not affect their prevalence.

Anemia and VAD coexisted in 7 women, a prevalence of 0.9% (95%CI: 0.40-1.98). Anemia and VAD were not associated (χ^2=0.77; *p*=0.380) (Table 2).

There was a weak, positive correlation between hemoglobin level and serum retinol (*r*=0.13, *p*<0.001) (Figure 1).

Table 1. Prevalence of anemia and vitamin A deficiency in women according to sociodemographic and biological factors. *Pernambuco* (Brazil), 2006.
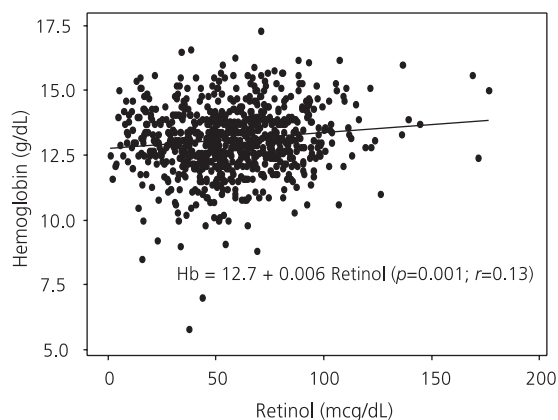
Factor	Total	Anemia		χ^2	*p*	VAD		χ^2	*p*
		n	%			n	%		
Age (years)[1]									
<20	66	14	21.2	3.64	0.162	3	4.5	1.30	0.522
20-34	558	76	13.6			47	8.4		
≥35	135	24	17.8			12	8.9		
Setting									
Rural	375	50	13.3	1.82	0.177	33	8.8	0.43	0.509
Urban	386	65	16.8			29	7.5		
Race[1]									
Caucasian	211	27	12.8	1.07	0.584	17	8.1	0.83	0.935
African Brazilian	26	5	19.2			2	7.7		
Other	517	82	15.9			43	8.3		
Education level[1]									
Incomplete elementary school	518	76	14.7	1.83	0.400	40	7.7	0.48	0.786
Complete elementary school	58	13	22.4			6	10.3		
Complete high school or higher	184	26	14.1			16	8.7		
Family income in minimum salaries[1]									
≤0.25	410	67	16.3	0.87	0.645	36	8.8	1.03	0.596
0.25-0.5	205	29	14.1			17	8.3		
>0.5	133	18	13.5			8	6.0		
Nutritional status[1]									
Underweight	39	7	17.9	3.09	0.378	3	7.7	1.19	0.754
Normal weight	382	60	15.7			29	7.6		
Overweight	223	36	16.1			21	9.4		
Obese	113	11	9.7			7	6.2		
First pregnancy[1]									
No	750	113	15.1	0.19	0.665	60	8.0	1.89	0.169
Yes	10	2	20.0			2	20.0		

Note: [1]Numbers do not add up because of missing data. VAD: Vitamin A Deficiency.

Table 2. Association between serum retinol and anemia in women. *Pernambuco* (Brazil), 2006.

Retinol (µmol/L)	Anemia				Total	χ^2	p
	Yes		No				
	n	%	n	%			
<0.70 (deficient/low)	7	11.3	55	88.7	62	0.77	0.380
≥0.70 (acceptable/normal)	108	15.5	591	84.5	699		

Note: Source: *III Pesquisa Estadual de Saúde e Nutrição* (Third State Survey on Health and Nutrition, PESN, 2006).

Figure 1. Correlations between hemoglobin levels and serum retinol. *Pernambuco* (Brazil), 2006.

DISCUSSION

The study rates of anemia (15.1%) and VAD (8.2%) were considered low, in spite of the high economic and social vulnerability of the sample and the low Human Development Index (HDI) of the area[19]. The two conditions, anemia and VAD, were present in only seven women, making it a low-magnitude problem.

The prevalence of anemia found by the present study was lower than the prevalence of almost 40% found by a previous study done in the state of *Pernambuco* in 1997[23]. Once considered a public health problem of moderate prevalence in this state according to the WHO´s classification[8], the prevalence of anemia decreased significantly, now being classified as a problem of mild magnitude (between 5% and 19.9%). Remarkably, a study conducted in the Brazilian South, which is wealthier and more developed than the Northeast, found a prevalence of anemia of nearly 20% in women of childbearing age[24].

The prevalence of VAD (8.0%) is considered a mild problem according to the WHO´s classification[7]. Studies on VAD in women of childbearing age are still scarce in Brazil since most studies include only children and pregnant women[23,25,26]. Therefore, it is not possible to make a comparative analysis. However, the study VAD prevalence seems to be lower than that found by the *Pesquisa Nacional de Demografia e Saúde* (PNDS, National Demographic and Health Survey) of 2006[6], which found a VAD prevalence of 12.3% in women of childbearing age.

Although these prevalences are still considered high compared to those of developed countries[7,8], the low prevalence of anemia and VAD found by this study may be a reflection of the population's better socioeconomic condition. This assumption is reinforced by the fact that only 5% of the sample was underweight. This finding may also reflect the phenomenon of nutrition transition that occurred in the country in the past decade, characterized by higher rates of obesity and lower rates of malnutrition[27].

The National Program of Postpartum Vitamin A Supplementation may also help to explain the low VAD prevalence. *Pernambuco* is included in this program. Women usually receive vitamin A supplements at the public maternity hospital after delivery[28], but the present study did not verify this information.

Although the coexistence of anemia and VAD was not observed in this study, a positive

correlation was found between serum retinol and hemoglobin level. This result corroborates other studies that found a positive correlation between hemoglobin level and serum retinol, even though they had not been specifically designed to investigate this correlation and used populations with different characteristics[29,30]. The occurrence of this interaction remains debatable[9,10,12,31]. Some studies found no hematological changes in individuals with retinol deficiency, probably due to the hemoglobin levels of patients with VAD[31,32], while others showed that vitamin A supplementation improved hemoglobin levels[26,33].

Anemia diagnosis based on hemoglobin level is one of the limitations of this study because of its limited ability to differentiate iron-deficiency anemia from infectious, hemolytic, and aplastic anemia, among others, or from hemoglobino-pathies[34]. Nevertheless, the WHO recommends the use of hemoglobin level as an indicator of anemia in population surveys[8].

Another limitation of this study is that the original study was designed for other purposes and the number of women with coexistent anemia and VAD was small. These limitations hampered the analysis of an association between the two events in this population, and how they were affected by sociodemographic factors.

Although the study results cannot be generalized to all Brazilians of childbearing age, it raises questions about the actual magnitude of coexistent VAD and anemia. Specifically designed population studies are needed to investigate the association between VAD and anemia, to estimate the prevalence of this coexistence in different regions of the country, and to determine its physiological mechanisms.

CONCLUSION

The prevalence of VAD and anemia in the study population was low, and neither one was associated with socioeconomic or biological factors. Anemia was considered a problem of mild significance, while VAD was not characterized as an epidemiological problem. Although a positive correlation was found between hemoglobin level and serum retinol, the coexistence of anemia and VAD was not observed.

CONTRIBUTORS

M HAZIN COSTA was responsible for the design, selection of variables from the original database, literature review, analysis, and writing of the manuscript. AI SOUZA was responsible for the study design, analysis, and supervision and for writing the manuscript. C BRAGA provided valuable advice and was responsible for data analysis and the final manuscript review. M BATISTA FILHO provided valuable advice. All authors were responsible for the critical review of the manuscript.

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