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

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

Manuela Hazin COSTA
Ariani Impieri de SOUZA
Maria Cynthia BRAGA
Malaquias BATISTA FILHO

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.


1 Article developed as part of the MH COSTA, intitled “Anemia e hipovitaminose A em mulheres em idade fértil no estado de Pernambuco: relações recíprocas e fatores associados”. Instituto de Medicina Integral Prof. Fernando Figueira, 2011.
2 Universidade Federal de Pernambuco, Departamento de Clínica Médica, Disciplina de Hematologia. Recife, PE, Brasil.
3 Instituto de Medicina Integral Prof. Fernando Figueira, Programas de Pós-Graduação em Saúde Materno-Infantil. R. dos Coelhos, 300, Boa Vista, 50070-550, Recife, PE, Brasil. Correspondência para/Correspondence to: AI SOUZA. Email: <ariani@imip.org.br>.
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

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.

Introdução
Micronutrient deficiency (mainly iron, vitamin A and iodine) is a leading nutritional problem affecting a large proportion of the world’s population manifestly or silently1-3. 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 cases4,5. The only national survey6 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%. On the other hand, the WHO estimates that 50.0% of women have anemia, mainly pregnant women in developing countries8.

There is evidence that anemia reduces the absorption of vitamin A in the intestine and its bioavailability in the body9. In turn, VAD affects erythropoiesis and iron metabolism10.

An association between VAD and anemia was first reported in the 1920s and 1940s11,12. Moreover, poverty, malnutrition, and age may influence the distribution of anemia and VAD in different populations5,6.

Public nutrition policies are made globally to address these deficiencies and to reduce healthcare costs13. In Brazil, the Ministry of Health recommends iron and vitamin A replacement during pregnancy and postnatally, respectively14,15. 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 higher16.

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.

Métodos

Study design and population

This paper is a secondary analysis based on the III Pesquisa Estadual de Saúde e Nutrição...
ANEMIA AND VITAMIN A DEFICIENCY IN WOMEN


(III PESN-2006, Third State Survey on Health and Nutrition)\(^1\) done in Pernambuco, state in the Brazilian Northeast, between May and September 2006. Pernambuco has an area of roughly 98,146 km\(^2\) 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\(^2\) and 17.6% of the population over the age of 15 years is illiterate\(^3\).

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\(^4\), a prevalence of VAD of 15%\(^5\) and of anemia of 20%\(^6\), 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\(^7\) 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\(^8\) (immediate reading) using a fingerstick and serum retinol was measured by High Performance Liquid Chromatography (HPLC)\(^9\). 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\(^7\).

**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
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 ($\chi^2$=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.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Total</th>
<th>Anemia</th>
<th>$\chi^2$</th>
<th>$p$</th>
<th>VAD</th>
<th>$\chi^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>66</td>
<td>14</td>
<td>3.64</td>
<td>0.162</td>
<td>3</td>
<td>4.5</td>
<td>1.30</td>
</tr>
<tr>
<td>20-34</td>
<td>558</td>
<td>76</td>
<td>13.6</td>
<td></td>
<td>47</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>≥35</td>
<td>135</td>
<td>24</td>
<td>17.8</td>
<td></td>
<td>12</td>
<td>8.9</td>
<td></td>
</tr>
<tr>
<td>Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>375</td>
<td>50</td>
<td>13.3</td>
<td>1.82</td>
<td>0.177</td>
<td>33</td>
<td>8.8</td>
</tr>
<tr>
<td>Urban</td>
<td>386</td>
<td>65</td>
<td>16.8</td>
<td></td>
<td>29</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Race$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>211</td>
<td>27</td>
<td>12.8</td>
<td>1.07</td>
<td>0.584</td>
<td>17</td>
<td>8.1</td>
</tr>
<tr>
<td>African Brazilian</td>
<td>26</td>
<td>5</td>
<td>19.2</td>
<td></td>
<td>2</td>
<td>7.7</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>517</td>
<td>82</td>
<td>15.9</td>
<td></td>
<td>43</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>Education level$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete elementary</td>
<td>518</td>
<td>76</td>
<td>14.7</td>
<td>1.83</td>
<td>0.400</td>
<td>40</td>
<td>7.7</td>
</tr>
<tr>
<td>school</td>
<td>58</td>
<td>13</td>
<td>22.4</td>
<td></td>
<td>6</td>
<td>10.3</td>
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<tr>
<td>Complete high school or</td>
<td>184</td>
<td>26</td>
<td>14.1</td>
<td></td>
<td>16</td>
<td>8.7</td>
<td></td>
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<tr>
<td>higher</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Family income in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>minimum salaries$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤0.25</td>
<td>410</td>
<td>67</td>
<td>16.3</td>
<td>0.87</td>
<td>0.645</td>
<td>36</td>
<td>8.8</td>
</tr>
<tr>
<td>0.25-0.5</td>
<td>205</td>
<td>29</td>
<td>14.1</td>
<td></td>
<td>17</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>&gt;0.5</td>
<td>133</td>
<td>18</td>
<td>13.5</td>
<td></td>
<td>8</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Nutritional status$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>39</td>
<td>7</td>
<td>17.9</td>
<td>3.09</td>
<td>0.378</td>
<td>3</td>
<td>7.7</td>
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<tr>
<td>Normal weight</td>
<td>382</td>
<td>60</td>
<td>15.7</td>
<td></td>
<td>29</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>223</td>
<td>36</td>
<td>16.1</td>
<td></td>
<td>21</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>113</td>
<td>11</td>
<td>9.7</td>
<td></td>
<td>7</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>First pregnancy$^a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>750</td>
<td>113</td>
<td>15.1</td>
<td>0.19</td>
<td>0.665</td>
<td>60</td>
<td>8.0</td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>2</td>
<td>20.0</td>
<td></td>
<td>2</td>
<td>20.0</td>
<td></td>
</tr>
</tbody>
</table>

Note: $^a$Numbers do not add up because of missing data. VAD: Vitamin A Deficiency.
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. 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 in the state of Pernambuco in 1997. Once considered a public health problem of moderate prevalence in this state according to the WHO's classification, 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.

The prevalence of VAD (8.0%) is considered a mild problem according to the WHO’s classification. Studies on VAD in women of childbearing age are still scarce in Brazil since most studies include only children and pregnant women. 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, 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, 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.

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, 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 anemia in women. The table below shows the association between serum retinol and anemia in women aged 12 to 49 years in Pernambuco, Brazil, 2006.

<table>
<thead>
<tr>
<th>Retinol (µmol/L)</th>
<th>Anemia</th>
<th>Total</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.70 (deficient/low)</td>
<td>7</td>
<td>55</td>
<td>62</td>
<td>0.77</td>
</tr>
<tr>
<td>≥0.70 (acceptable/normal)</td>
<td>108</td>
<td>591</td>
<td>699</td>
<td></td>
</tr>
</tbody>
</table>


The study found that 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.

The prevalence of VAD (8.0%) is considered a mild problem according to the WHO’s classification. Studies on VAD in women of childbearing age are still scarce in Brazil since most studies include only children and pregnant women. 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, which found a VAD prevalence of 12.3% in women of childbearing age.

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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. The occurrence of this interaction remains debatable. Some studies found no hematological changes in individuals with retinol deficiency, probably due to the hemoglobin levels of patients with VAD, while others showed that vitamin A supplementation improved hemoglobin levels.

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 hemoglobinopathies. Nevertheless, the WHO recommends the use of hemoglobin level as an indicator of anemia in population surveys.

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.

**ACKNOWLEDGMENTS**

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**CONTRIBUTORS**

MH 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. MBATISTA FILHO provided valuable advice. All authors were responsible for the critical review of the manuscript.

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