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Gestational Nightblindness among Women Attending a Public Maternity Hospital in Rio de Janeiro, Brazil

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ABSTRACT

This study evaluated the prevalence of gestational nightblindness among postpartum women seen at the University Maternal Hospital of the Federal University in Rio de Janeiro, Brazil and the association of this symptom with a biochemical indicator (serum retinol levels) and sociodemographic, anthropometric and antenatal care variables. In total, 262 postpartum women, who did not receive vitamin A supplementation during pregnancy, were interviewed. Gestational nightblindness was diagnosed through the standardized interview as proposed by WHO. Serum retinol levels were evaluated by spectrophotometry. Gestational nightblindness relating to low levels of serum retinol (<1.05 μmol/L, p=0.000) was diagnosed in 17.9% of subjects interviewed. Less than five antenatal care appointments (odds ratio [OR]=2.179; confidence interval [CI] 95%=1.078-4.402) and a history of one or more miscarriage(s) (OR=2.306; CI 95%=1.185-4.491) were predictors for gestational nightblindness. These findings justify the need for nutritional counselling, aimed at improving the vitamin A nutritional status, especially among pregnant women with a history of previous miscarriages and poor antenatal care.

***Key words*:** Nightblindness; Pregnancy; Prenatal care; Abortion; Vitamin A deficiency; Vitamin A; Brazil

INTRODUCTION

The impact of vitamin A deficiency on reproductive health, in terms of its repercussions on maternal and infant health, has been well-documented (1-5). Identification of women at risk of vitamin A deficiency during pregnancy allows for intervention, aimed at improving maternal hepatic vitamin A reserves and preventing insufficient placental transfer to the foetus, as observed in cases of severe maternal deficiency (6,7).

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The measures currently recommended for the prevention and treatment of gestational vitamin A deficiency and nightblindness are based on supplementation, food enrichment with vitamin A, and alimentary diversification (4,8,9), always considering the ingestion amount safe for each biological moment (10).

To meet the expectations of international health committees and the scientific community, several less-invasive, low-cost indicators have been tested and validated for diagnosing vitamin A deficiency, which is still a public-health problem in various parts of the world (4,5,8).

Evaluation of nightblindness through a standardized interview has been widely employed by researchers in population-based studies, through a low-cost, simple,

culturally-accepted methodology, allowing for the detection of high rates of prevalence of maternal and infant vitamin A deficiency (1-3,11,12).

During the 1930s, Ricketts reported two cases of pregnant women with vitamin A deficiency in the USA, presenting nightblindness associated with vomiting, headache, and anaemia (13). In the 1960s, Dixit reported 38.9% of pregnant women with nightblindness in India, principally in the third trimester, with remission of ocular symptoms during the postpartum period (14). In both the studies, supplementation of vitamin A during pregnancy was followed by remission of symptoms and nightblindness.

Gestational nightblindness was formerly attributed to physiological adjustments in pregnancy (14), but recent studies conducted in Asia have described the association between this ocular symptom and a five-fold risk of maternal mortality during two years postpartum compared to women without gestational nightblindness (2). Increased mortality among infants during the first six months of life also appears to be associated with gestational nightblindness (3). In addition, pregnant women with nightblindness and vitamin A deficiency appear to be more predisposed to complications during pregnancy, such as spontaneous abortion, urinary, genital and gastrointestinal infections, pregnancy-induced hypertension, other digestive signs and symptoms, and decreased appetite (1,15,16). Hence, gestational nightblindness was recently suggested as a marker for high-risk gestations (17).

The International Vitamin A Consultative Group (IVACG) recommended that the rates of maternal nightblindness should be routinely investigated in nutrition and health surveys, given the associated risk for health and nutritional status (4,18). The IVACG also recommends evaluation of gestational nightblindness in regions, such as Africa and Latin America (18).

Thus, the aim of the present study was to describe the prevalence of gestational nightblindness among postpartum women and to evaluate the association of ocular symptom with a biochemical indicator (serum retinol levels) and with obstetric history, antenatal care, sociodemographic and anthropometric variables.

MATERIALS AND METHODS

Study design

The study population comprised postpartum women who had received prenatal care at the University Maternity Hospital of the Federal University in Rio de Janeiro, Brazil. This healthcare facility provides free childbirth care to 1,400-1,500 patients per year from various areas in the city, with characteristics similar to those women treated at other public maternity hospitals in the city of Rio de Janeiro, Rio de Janeiro State, in the southeast region of Brazil.

During 1999-2001, 262 participants were selected for the study on alternative days in four weekly shifts. The sampling and procedures followed a descriptive, cross-sectional study design (19).

All women who were in the hospital on the days data were collected at the maternity hospital, who signed the free informed consent form, met the inclusion criteria, and who were considered low obstetric risk patients (singleton pregnancy, no disease diagnosed prior to the target pregnancy, and no use of supplements containing vitamin A during the gestational period) were interviewed (until six hours after delivery). The respective patient files or prenatal cards were consulted to help fill out a pre-tested questionnaire. After data were collected, all the mothers received dietary counselling.

The sample size was calculated to allow for a comparison of prevalence of vitamin A deficiency diagnosed by means of functional (gestational nightblindness) and biochemical (serum retinol levels) indicators. The prevalence of nightblindness and of serum vitamin A deficiency will not be identical. So, sample-size calculation is based on differences (15%) in assumed nightblindness between both the proportions (functional and biochemical indicators). Thus, with an alpha of 5% and a beta of 10%, the minimum estimated sample size was 197 (20).

Evaluation of vitamin A nutritional status

Both functional (gestational nightblindness) and biochemical (serum retinol levels) indicators were employed for evaluating the vitamin A nutritional status of postpartum women.

To identify nightblindness among the study subjects, we used the standardized interview as proposed by WHO (21) and OPS/Pan American Health Organization (8), including the questions: (i) do you have difficulty seeing during the day?; (ii) do you have difficulty seeing with decreased light or at night?; (iii) do you have nightblindness? Question 3 was explained

to the interviewee as an alteration in her habitual sight pattern under decreased light or at night, adopting the patient's pre-gestational nocturnal vision as the reference. The interviewed subjects did not use any local terms, during fieldwork, for describing the ocular symptoms of nightblindness. The interview was conducted using simple language and examples of places with decreased light, which are common in the same city (17). Women were considered as case subjects when they answered "no" to question 1 and "yes" to question 2 and/or 3, since this ocular symptom reflects the functional role of vitamin A in the formation of rhodopsin (21,22).

For the determination of serum retinol levels, a fasting 5-mL sample of blood was taken by venipuncture in women immediately after delivery (23). Serum retinol was determined by spectrophotometer using the modified method of Bessey *et al*. (24). A cut-off of serum retinol <1.05 µmol/L was used for defining vitamin A deficiency (1,25).

The interviews aimed at diagnosing nightblindness were validated based on their association with the biochemical indicator-serum retinol levels (1).

Complementary information

Gestational age was calculated based on date of the last menstrual period, and the inter-gestational interval was defined as the time interval (in months) between the end of the previous pregnancy, regardless of having resulted in abortion or childbirth, and the beginning of the current or index gestation.

Pre-gestational anthropometric evaluation was calculated according to pre-gestational body mass index (BMI) based on pre-gestational weight, measured up to the 13th week of pregnancy or reported by women, as described in patient records (26). Total gestational weight gain was obtained by subtracting pre-gestational weight from prepartum weight. Adequate weight gain was defined as falling within the ranges established for weight gain according to the pre-gestational BMI categories. Adequate total gestational weight gain for adults and adolescents was defined as ranging from 12.5 to 18 kg for women with BMI <19.8 kg/m^2; from 11.5 to 16 kg for BMI from 19.8 to ≤26 kg/m^2; from 7 to 11.5 kg for BMI from >26.0 to 29.0 kg/m^2; and 7.0 kg for BMI >29.0 kg/m^2. When maternal height was <1.57 m, adequate weight gain corresponded to the lower limit of the recommended range according to the pre-gestational BMI categories (27).

Sanitation was defined as adequate when the household had regular garbage collection, piped running water, and connection to the main public sewage system, and inadequate when one of these services was absent.

Statistical analysis

Bivariate analysis showed an association between the outcome variable—gestational nightblindness—and the independent variables, using the chi-square test. Student's *t*-test was used for testing the equality of means at a statistical significance of 5%. A stepwise logistic regression model was used for multivariate analysis. Criteria adopted for the inclusion/removal of variables in the model were $p<0.10$ and $p>0.05$ respectively. Crude and adjusted odds ratios were calculated (the latter adjusted by the variables included in the model), with a 95% confidence interval. The analysis was performed using SPSS version 10.0.

Ethical issues

The study was conducted through an institutional agreement between the Vitamin A Research Group at the Institute of Nutrition of the Federal University in Rio de Janeiro and the University Maternity Hospital, following approval by the ethics committees of the Maternity Hospital and the National School of Public Health, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil.

RESULTS

The prevalence of gestational nightblindness was 17.9%, and an association was detected between the ocular symptom and vitamin A deficiency, evaluated through serum retinol levels. Table 1 shows that women with nightblindness had lower levels of serum retinol. 38.8% of women with gestational nightblindness had serum retinol levels between 0.70 and 1.049 µmol/L, and 7.7% had serum retinol levels below 0.70 µmol/L (data not shown).

The majority of the mothers were non-white adults with little schooling. Most lived with a husband or partner, and the majority of their homes had adequate sanitation (Table 2). The bivariate analysis did not show any association between nightblindness and these characteristics.

No association was observed between gestational nightblindness and parity, presence of complications in

pregnancy and inter-gestational interval (Table 3). 96.2% of women had received prenatal care at the University Maternity Hospital.

The number of antenatal care appointments was associated with nightblindness. Women who had five or fewer antenatal care check-ups had a greater prevalence of gestational nightblindness (Table 3).

28.6% of the patients had a history of 1 or more abortion(s), and induced abortion was the most frequent in pregnancy prior to the index gestation (Table 4). Among all the interviewees, 34 reported abortion in pregnancy prior to the index gestation; of these, 32.4% presented current gestational nightblindness (Table 4). Another finding was the association between history of abortion in pregnancy prior to the index gestation and inter-gestational interval of less than 24 months (χ^2=38.2; p=0.000; not shown in Table).

Concerning type of miscarriage in the previous gestation, there was a tendency towards association between spontaneous miscarriage and gestational nightblindness (Table 4). This finding was confirmed by the lower serum retinol levels observed among women with spontaneous miscarriages in the previous gestation compared to those with no history of miscarriages (1.31 μmol/L±0.45 and 1.74 μmol/L±0.87; t=3,014, p=0.008).

Table 1. Association between gestational nightblindness and vitamin A nutritional status (serum retinol levels) in postpartum women and mean of serum retinol levels according to presence of gestational nightblindness

Vitamin A nutritional status	With vitamin A deficiency		Without vitamin A deficiency		Total	χ^2 (p value)	Mean of serum retinol (μmol/L) ±SD	t (p value)
	No.	%	No.	%				
Total	53	24.4	164	75.6	217			
With history of gestational nightblindness	18	46.2	21	53.8	39	12.16 (0.000)	1.37±0.67	2.654 (0.009)
Without history of gestational nightblindness	35	19.7	143	80.3	178		1.78±0.87	

SD=Standard deviation

Table 2. Sociodemographic characteristics of postpartum women with and without gestational nightblindness

Characteristics	With history of gestational nightblindness		Without history of gestational nightblindness		Total	χ^2	p value
	No.	%	No.	%			
Total	47	17.9	215	82.1	262		
Maternal age (years)							
<20	5	10.6	32	14.9	37	0.96	0.62
20-34	36	76.6	163	75.8	199		
≥35	6	12.8	20	9.3	26		
Schooling							
Incomplete secondary	36	76.6	160	74.4	196	0.97	0.76
Complete secondary and university	11	23.4	55	25.6	66		
Marital status							
Married/lives with partner	35	74.5	134	62.3	169	2.48	0.11
Single	12	25.5	81	37.7	93		
Colour							
White	19	40.4	97	45.1	116	3.44	0.56
Non-white	28	59.6	118	54.9	146		
Sanitation							
Inadequate	5	10.6	12	5.6	17	1.62	0.20
Adequate	42	89.4	203	94.4	245		

77.5% of postpartum women presented inadequate gestational weight gain. Gestational nightblindness was independent of pre-gestational BMI and gestational weight gain (Table 5).

Table 3. Obstetric and prenatal characteristics of postpartum women with and without gestational nightblindness

Characteristics	With history of gestational nightblindness		Without history of gestational nightblindness		Total	χ^2	p value
	No.	%	No.	%			
Total	47	17.9	215	82.1	262		
Parity							
Nulliparous	25	53.2	96	44.6	121	3.21	0.20
1 to 2 delivery(ies)	17	36.2	106	49.3	123		
3 or more deliveries	5	10.6	13	6.1	18		
Gestational complications							
None	28	59.6	122	56.7	150	0.13	0.94
Anaemia	13	27.6	63	29.3	76		
Others*	6	12.8	30	14.0	36		
Number of prenatal visits							
5 or fewer visits	16	34.0	44	20.5	60	4.03	0.04
6 or more visits	31	66.0	171	79.5	202		
Inter-gestational interval†							
Total‡	33	20.1	131	79.9	164		
<24 months	9	27.3	32	24.4	41	0.11	0.74
≥24 months	24	72.7	99	75.6	123		

*Include pregnancy-induced hypertension, gestational diabetes, urinary tract infection, and sexually transmitted diseases
†Corrected number, excluding primiparas
‡Defined as the time interval (in months) between the end of the previous pregnancy and the beginning of the current or index gestation

Table 4. History of abortion in postpartum women with and without gestational nightblindness

Characteristics	With history of gestational nightblindness		Without history of gestational nightblindness		Total	χ^2	p value
	No.	%	No.	%			
Total	47	17.9	215	82.1	262		
History of abortion							
None	27	57.4	160	74.4	187	5.44	0.02
1 or more	20	42.6	55	25.6	75		
History of abortion in gestation prior to the current							
Yes	11	23.4	23	10.7	34	5.51	0.02
No	36	76.6	192	89.3	228		
Type of abortion in previous gestation							
Spontaneous	5	10.6	9	4.2	14	5.10	0.08
Induced	5	10.6	12	5.6	17		
None	37	78.8	194	90.2	231		

Chi-square for each stratum of abortion across having nightblindness and not having nightblindness is as follows: spontaneous (p=0.07); induced (p=0.20)

Multivariate analysis confirmed the previously-described findings, and the predictive variables for gestational nightblindness identified in the logistic regression model included limited prenatal care (=5 visits) and a history of 1 or more abortion(s) (Table 6).

Table 5. Anthropometric characteristics of postpartum women with and without gestational nightblindness

Characteristics	With history of gestational nightblindness		Without history of gestational nightblindness		Total	χ^2	p value
	No.	%	No.	%			
Pre-gestational body mass index							
Total	45	18.3	201	81.7	246		
Underweight	8	17.8	48	23.9	56	1.56	0.67
Normal	30	66.7	120	59.7	150		
Overweight	5	11.1	18	8.9	23		
Obese	2	4.4	15	7.5	17		
Adequacy of gestational weight gain							
Total	44	18.3	196	81.7	240		
Inadequate	33	75.0	153	78.1	186	0.19	0.66
Adequate	11	25.0	43	21.9	54		

Table 6. Results of logistic regression with predictive variables for gestational nightblindness in postpartum women

Variable	β	Crude odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
History of abortion					
1 or more abortion(s)	0.836	2.155	1.120-4.146	2.306	1.185-4.491
None		1.000	-	1.000	-
Number of prenatal visits					
5 or fewer visits	0.779	2.006	1.008-3.992	2.179	1.078-4.402
6 or more visits		1.000	-	1.000	-
Constant	-2.012				

DISCUSSION

The prevalence (17.9%) of gestational nightblindness observed among postpartum women attending a public maternity hospital in the city of Rio de Janeiro emphasizes that vitamin A deficiency is a major reason for nutritional concern in the region, confirming other findings among pregnant and postpartum women and newborns in the city (28). However, the data of the present study refer to women with no history of chronic pathologies and who were seen at a healthcare unit.

The magnitude of gestational nightblindness observed in the present study was also similar to that reported in other regions of the world (29). Findings of population-based studies on nightblindness have indicated high prevalence rates among pregnant women in Asia. Katz *et al*. observed nightblindness in 11.7% of pregnant women and 16.2% of breastfeeding women in Nepal (11). Dixit reported nightblindness in 38.9% of pregnant women in rural India (14), and more recently Biswas *et al*. reported 6% prevalence in pregnant women treated in hospital in Calcutta, India (25). For the Americas, it is estimated that 6% of women are affected and that Brazil has the highest proportion of cases in this region, based on the extrapolation of prevalence data from preschool children (29).

Christian calculates that 4.8-18% of women develop nightblindness during gestation in different regions worldwide (30). Nightblindness can suggest chronic vitamin A deficiency, and women presenting the ocular symptom have 4-6 times greater probability of presenting the symptom again in subsequent pregnancies and 10 times greater probability of developing nightblindness in the first months postpartum (1,11).

In the present study, the association found between vitamin A deficiency as diagnosed by the standardized interview and that identified by maternal serum retinol levels suggests that the ocular symptom described in the study sample has a nutritional origin. Validation of the standardized interview by means of serum retinol levels and scotopic vision has also been described in studies conducted on pregnant women and preschool children (1,12,25). It should be mentioned that the classic English term 'nightblindness' was employed in the present study for the identification of the ocular symptom of vitamin A deficiency due to lack of an adequate Portuguese term known to both subjects and researcher to designate the symptom. Thus, the explanation provided to subjects about the meaning of the term may have contributed to a correct diagnosis, this strategy being suggested (17).

Nightblindness is the first functional manifestation of vitamin A deficiency, characterized by diminished vision at night or under limited lighting, which can manifest itself during pregnancy and extend throughout lactation (11) or disappear immediately after delivery (14). This evolution was not examined in this study.

The ability of vision to adapt to limited lighting depends on the presence of retinal (a compound with vitamin A activity that could be formed by serum retinol), which binds to opsin to form rhodopsin, allowing vision under limited lighting (2,25).

Requirements of vitamin A increase during pregnancy, especially in the third trimester (31). Physiological haemodilution during pregnancy may contribute to late gestational reduction in maternal serum retinol levels (1). However, recently, Sapin *et al*. have suggested that there are alterations in retinol transport during pregnancy, since they report a difference between the percentages of holo- and apo-RBP (retinol-binding protein) in pregnant women compared to non-pregnant women (32). The clinical significance of this finding is still unknown.

In undernourished women, this expansion of blood volume may be less effective. In addition, a habitual vitamin A-deficient pre-gestational diet can lead to a low hepatic reserve of this nutrient which, if persisting deficient dietary intake of the vitamin during the gestational period, particularly in the third trimester (31), increases the risk of developing vitamin A deficiency disorders, such as nightblindness. It has been suggested that women with low hepatic vitamin A reserves, that can be associated with poor intake (25), are more susceptible to developing ocular signs of this deficiency during the gestational period, due to the continuous transfer of vitamin A through the placenta to the foetus, adjusted by homeostatic processes aimed at ensuring the latter's needs (7,11).

Physiological adjustments combined with high risk of infections can precipitate acute vitamin A deficiency, because of this nutrient's role in the immune system, and trigger the appearance of gestational nightblindness (1,33). The problem has still not been totally elucidated, and IVACG (4,18) recommends routine screening for this ocular symptom in areas at risk of vitamin A deficiency, in addition to developing preventive strategies.

In the present study, postpartum women who had received fewer prenatal consultations and presented a history of abortion were more susceptible to gestational nightblindness and low serum retinol levels. The beneficial effect of prenatal care for obstetric outcome has been demonstrated (34) and can be associated with educational practices and prophylactic and therapeutic measures by health professionals, aimed at the prevention or treatment of infections and complications during pregnancy, thereby improving maternal nutritional status and health.

As for the history of abortions, the study showed an association between this variable and a short intergestational interval, which can contribute to the depletion of hepatic vitamin A reserves and serve as a contributing factor to the appearance of gestational nightblindness (35).

The abortion rate recorded in this study, similar to the international rate, was cause for concern (36). A potential association between nightblindness and spontaneous miscarriage was observed. Other researchers, with contradictory findings, are currently studying this association. Simsek *et al*. described lower serum vitamin A levels among women with a history of habitual spontaneous abortion (15). However, a case-control study by Neela and Raman reported increased serum retinol levels among women with a history of spontaneous abortion (37).

The current study found no association between nightblindness and maternal gestational complications. However, results of studies in Nepal suggest that pregnant women with a history of nightblindness are more susceptible to more severe anaemia, in addition to urinary and genital tract infections, abdominal pain, diarrhoea, pregnancy-induced hypertension, nausea,

vomiting, and lack of appetite compared to women without ocular symptom (1). Note that 51.8% of cases of vitamin A deficiency reported by Christian *et al*. involved more severe deficiency (serum retinol <0.70 μmol/L) (1).

The lack of association between maternal vitamin A deficiency and anthropometric nutritional status in the present study suggests that normal pre-gestational weight and adequate gestational weight gain are neither sensitive nor specific indicators for vitamin A deficiency. A similar finding was reported in 170 Brazilian postpartum women, treated at another public maternity hospital in Rio de Janeiro (23).

It may be concluded that the prevalence of nightblindness observed among women in the present study demands the implementation of antenatal care measures, such as diagnosis of gestational nightblindness and nutritional counselling, aimed at the prevention and treatment of vitamin A deficiency. Although the women in this study regularly used prenatal care services, which include medical follow-up, the results showed a high prevalence of gestational nightblindness. These findings should call the attention of health professionals in primary healthcare facilities to the public-health dimension of vitamin A deficiency, and the need to address it, especially among pregnant women with a history of abortion and five or fewer prenatal visits.

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