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Use of antianemics in prenatal care: A population cohort from a capital city in the North region of Brazil

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ABSTRACT

Anemia during pregnancy is a significant risk factor for adverse maternal and fetal outcomes, including preterm birth, low birth weight, and maternal mortality. In Brazil, anemia prevention and treatment programs are available, but regional variations in prevalence and factors associated with antianemic drug use remain understudied. The objective was to identify the prevalence of gestational anemia and the factors associated with the use of antianemic drugs during pregnancy in a cross-sectional population-based study carried out in Rio Branco, AC. To do so, we planned a cross-sectional, population-based study with a total of 1190 postpartum women who gave birth between April 6 and July 10, 2015, were interviewed about demographic, socioeconomic, reproductive, and prenatal care factors. The prevalence of anemia during pregnancy was found to be 13.8 %, with 93.2 % of women using antianemic drugs, such as ferrous sulfate and folic acid. Factors positively associated with antianemic drug use were higher education (elementary school II RCajust = 2.46; 95 %, CI: 1.01–6.13; high school RCajust = 2.61; 95 %, CI: 1.11–6.12), primiparity (ACadjust = 1.69; 95 %, CI: 0.98–3.74), 6 to 8 prenatal consultations (ACjust = 2.16; 95, CI%: 1.15–4.05), and planned pregnancy (ARjust = 1.94; 95 %, CI: 1.05–3.74). Food security during pregnancy was inversely associated. These findings suggest that while anemia prevention and treatment programs exist, more targeted strategies are needed, particularly for women with lower socio-economic status, to improve maternal and fetal health outcomes.

1. Introduction

Anemia, a widespread nutritional deficiency (Pavord et al., 2020), is a significant public health concern. Efforts to combat it have increased over time. It is characterized by low erythrocyte or hemoglobin levels, typically defined as hemoglobin below 11 mg/dL. During pregnancy, anemia is diagnosed with hemoglobin below 11.0 g/dL in the first trimester and below 10.5 or 11.0 g/dL in the second or third trimester (James, 2021).

Pregnant women with anemia experience reduced oxygen transport and release, particularly noticeable during periods of increased demand (James, 2021). Anemia's impact begins before birth, affecting children and contributing to low birth weight (Girma et al., 2019; Srour et al., 2018). Low birth weight is linked to up to 80 % of newborn deaths (Fowkes et al., 2018). Hemoglobin reduction can trigger compensatory mechanisms, including increased cardiac output and blood flow redistribution, which are less effective in the elderly or debilitated. (Malee, 2021).

The primary causes of pregnancy-related anemia include iron deficiency and acute blood loss. Additionally, a physiological expansion of plasma volume throughout the pregnancy, surpassing the rise in red blood cell and hemoglobin production, contributes to anemia (Berhe et al., 2019; Finkelstein et al., 2020). This hemodilution leads to reduced hemoglobin levels. Conditions like preeclampsia and certain medical comorbidities can limit this expansion (James, 2021). Other causes of pregnancy-related anemia encompass deficiencies in vitamin B12 and folate, hemoglobin or thalassemia variations, inflammatory disorders, hemolysis, blood loss, and most commonly, iron deficiency (Cárdenas

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et al., 2019; James, 2021).

The prevalence of pregnancy-related anemia ranges from 5.4 % in developed nations to over 80 % in developing ones, underlining its severe public health impact (Adam et al., 2018; Fowkes et al., 2018; Srour et al., 2018). In Brazil, where this study takes place, it's a significant public health concern. For instance, in Sudan, the prevalence can reach 53 %, while among Palestinian women, it's 25.7 % (Srour et al., 2018). In Papua New Guinea, a country with a climate similar to Brazil's and malaria, which is also present in Rio Branco, Acre (the research site), the prevalence reaches 71 % (Fowkes et al., 2018). The Pan American Health Organization estimates that 42 % of pregnant women in Brazil are anemic, but studies indicate variations from 5 % to 40 % (Santos et al., 2020). In the Northeast region, an estimated 30 % to 40 % of pregnant women are affected, particularly those with low socioeconomic status. In the North region, one study reports a prevalence of 32.2 %, while in the municipality of Cruzeiro do Sul, Acre state, there is a prevalence of 17.5 % of anemia in pregnant women during the third trimester (Campos et al., 2019; Santos et al., 2020).

Iron needs increase during pregnancy, surpassing 1000 mg, with 500 mg allocated for red blood cell expansion, 300–350 mg for fetal and placental development, and variable losses during childbirth. Inadequate iron levels can lead to maternal-fetal complications (Nasir et al., 2020). The World Health Organization advocates standardized universal supplementation for all pregnant women (Caniglia et al., 2022; Hansen et al., 2020). Strategies include an iron-rich diet with high bioavailability (heme iron in animal products), iron and folic acid-enriched flours, and drug supplements (Caniglia et al., 2022; Hansen et al., 2020; Nasir et al., 2020). Despite these efforts, anemia remains prevalent in developing countries, raising questions about the effectiveness of prevention programs in Brazil's public health system.

Typical supplementation includes folic acid and ferrous sulfate. Folic acid is crucial for erythrocyte maturation, controlling various types of anemia. Pregnancy increases its demand due to fetal growth and cell division, and it's vital for DNA and RNA synthesis, crucial for nervous system development (Bortolus et al., 2021; Girma et al., 2019; Vereen et al., 2019). Ferrous sulfate directly addresses iron needs for both mother and fetus. These compounds aim to reduce anemia incidence and severity in pregnant women. Consequently, this research aims to assess gestational anemia prevalence and factors influencing antianemic drug usage during pregnancy.

2. Materials and methods

2.1. Study overview

The data is part of the "Use of Medication During Pregnancy, Childbirth, and Breastfeeding in Pregnant Women in Rio Branco, Acre," a cross-sectional study. Rio Branco, Acre's capital, is the largest city in the state, with a population of 377,057 in 2015, making up 47.3 % of the state's population. The study took place in two hospitals: Hospital e Maternidade Santa Juliana (HSJ), serving public and private patients, and Bárbara Heliodora maternity hospital, dedicated to public service.

2.2. Participants

Participants needed to reside in the city's urban area. Data collection occurred between April 6 and July 10, 2015, in these two maternity hospitals. The sample size aimed for at least 926 pregnant women based on the 2014 birth statistics (6,943 births) in these hospitals, with a 3 % margin of error, 80 % test power, and an estimated odds ratio of 2.0 for exposure factors. The study included 1,190 postpartum women.

2.3. Proceedings

The study's outcome was defined as "the use of antianemics during the current pregnancy," encompassing the initiation of ferrous sulfate and/or folic acid supplementation at any point during pregnancy. Several independent variables were assessed, including demographic characteristics (maternal age, marital status, and skin color), socioeconomic factors (education, family income, economic class, receipt of social assistance, and food and nutritional security status), reproductive history (parity, pregnancy order, and number of living children), maternal behaviors during pregnancy (smoking, alcohol consumption, physical activity), and variables obtained via interviews. Information related to prenatal care (number of prenatal consultations, public or private care, lab-diagnosed anemia, gestational hypertension, diabetes mellitus, gestational urinary tract infections) was extracted from the pregnant women's cards.

All data were collected through interviews with postpartum women, supplemented with information from their medical records and pregnancy cards. These interviews occurred within 24 h of delivery and used a standardized, semi-structured questionnaire. Interviewers included undergraduate students in health-related fields and trained higher education professionals who were compensated for their participation. Training ensured accurate recording of information as reported by the interviewees and avoided technical jargon. Interviewers worked in shifts to ensure continuous coverage. They were trained to maintain consistency and uniformity in data collection procedures.

Pregnant women were identified through hospitalization records and subsequently approached for participation. Upon agreement, they were asked to sign two copies of the informed consent form, with one copy retained by them. Data collected from interviews, pregnancy cards, and medical records were reviewed, coded, and entered by different typists, with checks for data consistency. Any inconsistencies were addressed by revisiting the instruments or contacting the women by phone. A total of 1,190 postpartum women were interviewed, but only 992 had hemoglobin records on their prenatal cards, explaining the variation in sample size for the anemia analysis.

2.3.1. Study ethics

This study adhered to ethical principles in line with Resolution No. 466/12 of the National Health Council. The researchers obtained permissions from the two data collection institutions. Additionally, the project received approval from both the Research Ethics Committee of the Federal University of Acre and the Research Ethics Committee of the National School of Public Health.

2.3.2. Statistical analysis

This study adhered to ethical principles in line with Resolution No. 466/12 of the National Health Council. The researchers obtained permissions from the two data collection institutions. Additionally, the project received approval from both the Research Ethics Committee of the Federal University of Acre and the Research Ethics Committee of the National School of Public Health.

3. Results

The sample comprised 1,190 pregnant women, averaging 25.14 years (SD = 6.69) in age, with most falling between 25 and 34 years (38.7 %). Approximately 51.3 % had completed high school, 56.4 % reported incomes above 1.5 minimum wages, and 79.4 % belonged to economic classes C, D, and E. The majority had partners (84.0 %).

In terms of prenatal care, 85.1 % received care in the public network, with an average of six or more consultations (60.7 %), and 63.4 % didn't plan their pregnancies. Around 60.7 % were multiparous, with 31.1 % having 2 to 3 live children. Smoking and alcohol consumption were reported in 9.6 % and 12.3 % of pregnancies, respectively, and only 10.7 % practiced physical activity. Antianemic drug use was reported by 93.2 %, and 13.8 % were diagnosed with anemia (hemoglobin < 11 mg/dl). Exclusive use of ferrous sulfate and folic acid was reported by 8.8 % and 10.9 %, respectively, while 73.4 % used both.

In bivariate analysis, pregnant women with higher education levels

(high school CR = 2.74; 95 % CI 1.33–5.65 and elementary II CR = 2.41; 95 % CI 1.05–5.50), family incomes above 1.5 minimum wages (RC = 1.72; 95 % CI 1.03–2.86), more consultations (6 to 8 RC = 2.46; 95 % CI 1.48–4.42 and > 8 consultations CR = 2.14; 95 % CI 1.08–4.24), primiparous women (CR = 2.06; 95 % CI 1.22–3.46), and planned pregnancies (OR = 1.96; 95 % CI 1.15–3.33) were more likely to use antianemics. Pregnant women ≥ 35 years (CR = 0.45; 95 % CI 0.20–0.98), those with food and nutrition security (CR = 0.36; 95 % CI 0.17–0.52), and those with more than 4 live children (OR = 0.41; 95 % CI 0.23–0.74) were less likely to use antianemics during pregnancy (see Table 1 for socioeconomic and demographic characteristics of the population).

It is worth noting that 82.3 % of the women reported having used ferrous sulfate, and 84.5 % reported using folic acid during pregnancy, either alone or in combination. More than half of them reported having used these supplements from the first trimester until the end of pregnancy, as shown in Table 2.

Table 3 displays the variables that remained statistically significant after logistic analysis and were associated with the use of antianemic drugs during pregnancy. In the final model, the likelihood of using antianemics during pregnancy was negatively associated with experiencing food security during pregnancy. The following variables were positively associated with the use of antianemics: having a higher level of education (elementary school II CR adj = 2.46 CI95%: 1.01–6.13; high school CR adj = 2.61 CI95%: 1.11–6.12), being a primiparous (adjusted OR = 1.69; 95 %CI 0.98–3.74), having had 6 to 8 prenatal consultations (adjusted OR = 2.16; 95 %CI: 1.15–4.05) and reporting that the pregnancy was planned (adjusted OR = 1.94; 95 %CI: 1.05–3.74).

Table 4 presents the prevalence, crude and adjusted odds ratios concerning gestational anemia (Hb < 11 g/dL) based on various factors including socioeconomic and demographic characteristics, maternal and prenatal care habits, and morbidities in Rio Branco. In the initial analysis, women aged ≥ 25 years (crude CR = 0.70; 95 % CI: 0.48–1.00) and those with higher education (high school CR = 0.62; 95 % CI: 0.41–0.95) had a reduced likelihood of being diagnosed with anemia during pregnancy. Conversely, individuals who received prenatal care in the private network (crude CR = 1.78; 95 %CI: 1.13–2.81), had a history of anemia prior to pregnancy (crude CR = 2.96; 95 %CI: 2.04–4.30), and were diagnosed with urinary tract infections during pregnancy (crude OR = 1.50; 95 %CI: 1.03–2.13) had a higher chance of being diagnosed with gestational anemia.

After adjusting for relevant factors through logistic analysis, the variables inversely associated with gestational anemia were higher education (complete high school adjusted RC = 0.61; 95 %CI: 0.39–0.97 and higher education adjusted RC = 0.53; 95 %CI: 0.28–1.00) and gestational hypertension (crude OR = 0.43; 95 %CI: 0.25–0.75). On the other hand, the variables positively associated with gestational anemia included prenatal care received in the private network (adjusted OR = 3.22; 95 %CI: 1.76–5.86), a history of anemia prior to pregnancy (adjusted OR = 2.91; 95 %CI: 1.96–4.32), and a diagnosis of gestational urinary tract infection (adjusted OR = 1.45; 95 %CI: 0.98–2.16).

4. Discussion

This study, the first of its kind in Rio Branco, investigated the use of antianemic drugs during pregnancy and its associated factors. The findings revealed that 36 % of pregnant women had been diagnosed with anemia prior to pregnancy, but during pregnancy, the prevalence decreased to 13.8 %. This suggests that the nutritional supplementation program recommended by the Brazilian Unified Health System may have contributed to the reduction in anemia incidence. Moreover, the substantial usage of antianemic substances during pregnancy (93.2 %) supports this observation.

In Rio Branco, the prevalence of gestational anemia with laboratory diagnosis was 13.8 %, with no cases of severe anemia noted. While data

Table 1
Socioeconomic and demographic characteristics, maternal habits and prenatal care, of the study population in the city of Rio Branco - AC, 2015. (N = 1190).

Variable	no	%
Age (years)		
13—18	221	18.6
19 – 24	386	32.4
25 – 34	460	38.7
≥ 35 years	123	10.3
Education		
Elementary School I	77	6.5
Elementary School II	232	19.5
High school	611	51.3
University education	270	22.7
Family income (minimum wages) *		
Up to 1.5 SM	444	43.6
≥ 1.5 SM	574	56.4
ABEP Class**		
a and b	242	20.6
C, D and E	935	79.4
Receipt of Bolsa Família		
No	914	80.9
Yea	216	19.1
marital status		
don't have a partner	190	16.0
with partner	999	84.0
Self-reported skin color		
White	125	10.5
not white	1064	89.5
Food and nutrition security		
Light security and insecurity	777	65.3
Moderate and severe insecurity	413	34.7
prenatal care		
Public	982	85.1
Private	172	14.9
Number of Prenatal Consultations		
None	17	1.4
1 to 5	450	37.8
6 to 8	494	41.5
> 8	229	19.2
Planned pregnancy		
No	751	63.4
Yea	434	36.6
Primiparous		
No	718	60.7
Yea	464	39.3
Number of living children (included RN)		
One	466	39.3
2 or 3	369	31.1
4 or more	352	29.7
Smoked during pregnancy		
No	1076	90.4
Yea	114	9.6
Drank alcohol during pregnancy		
No	1035	87.7
Yea	145	12.3
Practiced physical activities		
No	1046	89.3
Yea	125	10.7
Use of antianemics in pregnancy		
did not use	81	6.8
Used only ferrous sulfate	105	8.8
Used only folic acid	130	10.9
used both	874	73.4
Anemia before current pregnancy		
No	757	64.0
Yea	426	36.0
Diagnosis of anemia in current pregnancy**		
No	855	86.2
Yea	137	13.8

*Minimum salary in force at the time (R$ 788.00).
**ABEP – Brazilian Association of Research Companies.
***Sample only for pregnant women with Hemoglobin registration in the pregnant woman's card (N = 992).

Table 2
Use and duration of use of antianemics, ferrous sulfate and folic acid, in pregnant women in Rio Branco, Acre, 2015.

	Ferrous sulphate		*Folic acid*	
Use of antianemics	**no**	**%**	**No**	**%**
No	211	17.7	185	15.5
Yea	979	82.3	1005	84.5
Total	1190	100.0	1190	100.0
Usage time (n = 882)				
91 to 280 days	425	48.2	483	52.7
61 to 90 days	117	13.3	146	15.9
31 to 60 days	124	14.1	119	13.0
up to 30 days	216	24.5	168	18.3
Total	882	100.0	916	100.0

for 16.6 % of the population were not obtained, the pregnant women for whom data were not collected did not significantly differ from those with collected data in terms of the main characteristics analyzed. The prevalence of gestational anemia observed in this study was lower than the national average, possibly attributable to the well-organized public healthcare system and the diligent efforts of healthcare teams, including the implementation of nutritional supplementation programs, which are positive contributing factors.

Comparatively, a study by the Federal University of Alagoas evaluated anemia occurrence in pregnant women across 15 municipalities in rural and urban areas of the semi-arid region of the state, reporting a prevalence of 50.0 % (da Ferreira et al., 2008). Similarly, a study in Santo Antônio de Jesus, Bahia, identified a 22.64 % prevalence of anemia among pregnant women recruited from basic health units (da Silva,

Table 3
Prevalence, Crude and Adjusted Odds Ratio of the use of antianemics according to socioeconomic and demographic characteristics, maternal habits and prenatal care in the city of Rio Branco - AC, 2015. (N = 1190).

Variables	**n (%)**	**Gross Odds Ratio**	95 %CI	p-value**	**Adjusted Odds Ratio**	95 % CI
Age years)						
13—18	208 (94.1)	1		0.093		
19 – 24	364 (94.3)	1.03	(0.51–2.09)			
25 – 34	429 (93.3)	0.87	(0.44–1.68)			
≥ 35 years	108 (87.8)	**0.45**	**(0.20–0.98)**			
Education						
Elementary School I	66 (85.7)	**1**		**0.054**	**1**	
Elementary School II	217(93.5)	**2.41**	**(1.05–5.50)**		**2.46**	**(1.01–6.13)**
High school	576(94.3)	**2.74**	**(1.33–5.65)**		**2.61**	**(1.11–6.12)**
University education	250 (92.6)	2.08	(0.95–4.56)		1.21	(0.43–3.33)
Family income (minimum salary) ***						
Up to 1.5 SM	408 (91.9)	**1**		**0.037**	1	
≥ 1.5 SM	546 (95.1)	**1.72**	**(1.03–2.86)**		1.13	(0.59–2.16)
ABEP Class**						
a and b	228 (94.2)	1		0.707		
C, D and E	869(92.9)	0.92	(0.58–1.43)			
Receipt of Bolsa Família						
No	833 (93.3)	1		0.187		
Yea	196 (90.7)	0.70	(0.41–1.18)			
marital status						
don't have a partner	171 (90.0)	1		0.06		
with partner	937 (93.8)	1.67	(0.97–2.87)			
Food and nutrition security						
Food Safety	1008(94.3)	**1**		**0.001**	**1**	
food insecurity	40 (83.5)	**0.36**	**(0.17–0.52)**		**0.48**	**(0.24–0.97)**
Number of Prenatal Consultations						
1 to 5	406 (90.2)	**1**		**0.001**	**1**	
6 to 8	474 (96.0)	**2.46**	**(1.48–4.42)**		**2.16**	**(1.15–4.05)**
> 8	218 (95.2)	**2.14**	**(1.08–4.24)**		**1.80**	**(0.99–4.01)**
Smoked during pregnancy						
No	1001 (93.0)	1		0.493		
Yea	108 (94.7)	1.34	(0.57–3.17)			
Drank alcohol during pregnancy						
No	963 (93.0)	1		0.738		
Yea	136 (93.8)	1.13	(0.55–2.31)			
practiced physical activities						
No	973(93.0)	1		0.81		
Yea	117 (93.6)	1.09	(0.51–2.33)			
primiparous						
No	657 (91.5)	**1**		**0.006**	**1**	
Yea	444 (95.7)	**2.06**	**(1.22–3.46)**		**1.69**	**(0.98–3.74)**
planned pregnancy						
No	689 (91.7)	**1**		**0.012**	**1**	
Yea	415 (95.6)	**1.96**	**(1.15–3.33)**		**1.94**	**(1.05–3.74)**
prenatal care						
Public	922 (93.9)	1		0.881		
Private	162 (94.2)	1.05	(0.52–2.10)			
Number of living children						
One	446 (95.7)	**1**		**0.012**		
2 or 3	342 (92.7)	**0.56**	**(0.31–1.03)**			
4 or more	318 (90.3)	**0.41**	**(0.23–0.74)**			

*Adjusted for schooling, family income, food and nutrition security status, number of prenatal consultations, parity and pregnancy planning.
** p-value: Wald's significance test.
***Minimum salary in force at the time (R$ 788.00).
****ABEP – Brazilian Association of Research Companies.

Table 4
Prevalence, Crude and Adjusted Odds Ratio of gestational anemia (Hb < 11 g/dL) according to socioeconomic, demographic, maternal and prenatal care habits and morbidities, in the city of Rio Branco - AC, 2015. (N = 992).

Variables	n (%)	Gross Odds Ratio	95 % CI	p-value**	Adjusted Odds Ratio	95 % CI
Age years)						
up to 25 years	78 (16.0)	1			1	
≥ 25 years	59 (11.7)	0.70	(0.48–1.00)	0.055	0.76	(0.50–1.16)
Education						
Elementary School I and II	44 (17.5)	**1**			**1**	
High school	60 (11.8)	**0.62**	**(0.41–0.95)**	0.095	**0.61**	**(0.39–0.97)**
University education	33 (14.2)	**0.78**	**(0.47–1.27)**		**0.53**	**(0.28–1.00)**
Family income (minimum salary) **						
Up to 1.5 SM	50 (13.7)	1		0.995		
≥ 1.5 SM	66 (13.7)	0.99	(0.67–1.48)			
ABEP Class***						
a and b	29 (14.7)	1		0.707		
C, D and E	107 (13.7)	0.92	(0.58–1.43)			
Receipt of Bolsa Família						
No	102 (13.5)	1		0.837		
Yea	26 (14.1)	1.05	(0.66–1.67)			
marital status						
don't have a partner	18 (11.9)	1		0.465		
with partner	119 (14.1)	1.22	(0.71–2.06)			
Food and nutrition security						
Food Safety	97 (14.9)	1		0.170		
food insecurity	40 (11.7)	0.76	(0.51–1.12)			
Number of Prenatal Consultations						
1 to 5	37 (12.2)	1		0.341		
6 to 8	64 (13.5)	1.12	(0.72–1.73)			
> 8	36 (16.7)	1.43	(0.87–2.36)			
Smoked during pregnancy						
No	123 (13.7)	1		0.648		
Yea	14 (15.4)	1.15	(0.63–2.09)			
Drank alcohol during pregnancy						
No	117 (13.5)	1		0.602		
Yea	18 (15.3)	1.15	(0.67–1.97)			
practiced physical activities						
No	124 (14.20	1		0.459		
Yea	12 (11.5)	0.79	(0.41–1.48)			
primiparous						
No	86 (14.4)	1		0.526		
Yea	50 (13.0)	0.89	(0.60–1.28)			
planned pregnancy						
No	84 (13.6)	1		0.940		
Yea	51 (13.8)	1.01	(0.69–1.47)			
prenatal care						
Public	105 (12.7)	**1**		0.012	**1**	
Private	29 (20.6)	**1.78**	**(1.13–2.81)**		**3.22**	**(1.76–5.86)**
Number of living children						
One	50 (12.9)	1		0.635		
2 or 3	48 (15.3)	1.22	(0.79–1.87)			
4 or more	39 (13.4)	1.04	(0.66–1.63)			
Anemia before current pregnancy						
No	73 (10.0)	**1**		0.001	**1**	
Yea	64 (24.8)	**2.96**	**(2.04–4.30)**		**2.91**	**(1.96–4.32)**
Maternal BMI before 1st pregnancy ****						
Thinness	12 (24.0)	**1**		0.015		
Eutrophy	18 (9.3)	**0.32**	**(0.14–0.73)**			
Overweight	7 (8.9)	**0.30**	**(0.11–0.84)**			
gestational hypertension						
No	126 (15.1)	**1**		**0.020**	**1**	
Yea	11 (7.6)	**0.47**	**(0.24–0.88)**		**0.43**	**(0.25–0.75)**
Gestational diabetes						
No	79 (18.5)	1		0.145		
Yea	7 (10.9)	0.54	(0.23–1.23)			
Gestational Urinary Infection						
No	69 (11.9)	**1**		**0.034**	**1**	
Yes	67 (16.7)	**1.50**	**(1.03–2.13)**		**1.45**	**(0.98–2.16)**
Antianemic use						
Yes	131 (14.0)	**1**				
No	6 (10.9)	**1.32**	**(0.55–3.16)**	**0.521**		

* p-value: Wald's significance test.
**Minimum salary in force at the time (R$ 788.00).
***ABEP – Brazilian Association of Research Companies.
**** Sample includes only primigravidae (N = 386).

2015). In contrast, a population-based study conducted by researchers from the Federal University of Pernambuco found a lower prevalence of anemia in Caruaru at only 5.0 %, categorized as a mild public health concern (de Paula and da Gomes, 2016). Meanwhile, a multicenter study in Peru involving 311,521 pregnant women reported a national prevalence of anemia at 24.2 %, slightly below that observed in Brazil (Hernández-Vásquez et al., 2017).

Both the World Health Organization and the Brazilian Ministry of Health recommend universal antianemic drug supplementation during pregnancy, with folic acid supplementation starting in the preconception period and continuing throughout gestation (Barbosa et al., 2011; Moura, 2022). Despite this consensus, 6.8 % of the women in our study did not utilize this supplementation, and 13.8 % of them received a laboratory diagnosis of anemia.

While ferrous sulfate and folic acid both belong to the B03 group of antianemic preparations according to the Anatomical Therapeutic Chemical Code (ATC), epidemiological studies often assess their use separately. Folic acid, in addition to its role in preventing neural tube defects, should not be underestimated in erythropoiesis, as it contributes to the formation and maturation of erythrocytes and leukocytes and combats gestational anemia (Deniz et al., 2018; Liu et al., 2020; Vereen et al., 2019). However, there is a scarcity of studies that analyze the use of antianemics as a whole, making it challenging to make direct comparisons with our results.

Regarding our data, factors positively associated with the use of ferrous sulfate and folic acid included higher education, primiparity, 6 to 8 prenatal consultations, and planned pregnancy. Conversely, experiencing food insecurity during pregnancy was inversely associated. It appears that higher education and planned pregnancies may lead to more consultations, better healthcare professional monitoring, improved supplementation, and a reduction in the incidence of anemia diagnoses. Anemia prevalence in Brazil varies from 5 % to severe cases exceeding 40 % (Finkelstein et al., 2020; Fowkes et al., 2018). Our findings align with the prevalence of anemia in other Northern cities (Cárdenas et al., 2019; Fondjo et al., 2020; Fowkes et al., 2018).

In this study, the prevalence of antianemic drug use was remarkably high at 93.2 %, with 84.5 % using folic acid and 82.3 % using ferrous sulfate. Given that the diagnosis of anemia stood at just 13.8 %, it indicates that a substantial number of pregnant women opted for antianemics as a proactive measure, aligning with established care protocols for expectant mothers. Nevertheless, there is a school of thought among researchers advocating for a more individualized approach to antianemic supplementation, driven by medical and laboratory diagnosis, tailoring doses and therapeutic regimens to each pregnant woman's specific gestational period (Caniglia et al., 2022; Linhares and Cesar, 2022).

Prescribing folic acid as a prophylactic measure to prevent adverse outcomes in live births is widely endorsed and substantiated in the literature. Beyond its role in preventing neural tube defects (Martinez et al., 2021; van Gool et al., 2018), there are reports of its potential in averting early placental rupture, prematurity, reducing low birth weight, preventing cardiac anomalies, brain tumors, and even mitigating autism risk in early childhood (Al-mashhadane and Amer, 2018; Sampaio et al., 2021; van Gool et al., 2018). However, a cohort of researchers aims to discern potential adverse effects of folic acid supplementation during preconception and pregnancy. It's important to note that these studies often lack robust evidence, methodological rigor, and comprehensive analysis. Nevertheless, some studies suggest an association between folic acid supplementation and respiratory diseases in newborns and children, encompassing conditions like wheezing, asthma, respiratory allergies, and bronchitis (Al-mashhadane and Amer, 2018; Guo et al., 2019; Nasir et al., 2020). Given the limitations of relying solely on increased flour with added iron and folic acid in the diet, as it cannot precisely measure the dose consumed, antianemic supplementation remains a crucial strategy.

Folic acid supplementation is widely endorsed for preventing birth-related complications, including neural tube defects (Martinez et al., 2021; van Gool et al., 2018). It also contributes to averting issues like early placental rupture, prematurity, low birth weight, cardiac anomalies, brain tumors, and even reducing autism risk in early childhood (Al-mashhadane and Amer, 2018; Sampaio et al., 2021; van Gool et al., 2018). However, some studies suggest a potential association between folic acid supplementation and respiratory diseases in newborns and children, including wheezing, asthma, respiratory allergies, and bronchitis (Al-mashhadane and Amer, 2018; Guo et al., 2019; Nasir et al., 2020). Given the challenges in accurately measuring folic acid and iron intake through diet alone, supplementation remains vital.

Adherence to antianemic drug use hinges on sociodemographic, maternal, and healthcare system factors, demanding tailored support for pregnant women (Vos et al., 2017). In Rio Branco, higher-educated and more affluent pregnant women were more likely to use antianemics. This mirrors findings from studies in Brazil, Peru, and Spain, where lower-income and less-educated pregnant women faced hurdles in following supplementation recommendations (Lin et al., 2018; Linhares and Cesar, 2022). The gap between assistance program recommendations and healthcare unit realities is further concerning when combined with the reduced likelihood of antianemic drug use among pregnant women experiencing moderate to severe food insecurity, highlighting a complex interplay of factors (Lin et al., 2018; Linhares and Cesar, 2022).

Primiparity, fewer children, and planned pregnancies are positively linked to increased antianemic drug usage during pregnancy, a pattern consistent with numerous studies. This reflects a heightened sense of maternal self-care, especially when motherhood is approached as a well-prepared and planned endeavor. It also aligns with the argument that women from more privileged social strata tend to have fewer children, affording them the capacity for better family planning (Barbosa et al., 2011; de Andrade et al., 2014).

The importance of an adequate number of prenatal consultations is a unanimous finding across several studies, associated with both greater adherence to antianemic drug use and a lower prevalence of anemia. Notably, in our study, the type of healthcare service, whether public or private, did not significantly impact antianemic drug usage. This underscores that regardless of the healthcare setting, prenatal care remains a crucial strategy for promoting gestational health. The healthcare service's role extends beyond drug prescription to encompass the monitoring of pregnant women's treatment, ensuring that the recommended measures by the WHO and the Ministry of Health are implemented for all expectant mothers (Barbosa et al., 2011; James, 2021; Santos et al., 2020).

However, it's worth noting that our findings indicate that the duration of antianemic drug usage ranged from 91 to 280 days for roughly half of the pregnant women, falling short of the recommended treatment throughout the entire gestational period (James, 2021; Santos et al., 2020).

Possible limitations of the present study include its cross-sectional design, which does not allow for the determination of cause and effect relationships. Reverse causality is also a potential limitation, as well as memory bias, which may occur when collecting information about past events. However, to minimize these limitations, multiple data sources were used, data were confirmed with laboratory evidence, and data collection was standardized.

One limitation of the study is that the dose of antianemic drugs was not analyzed. Although ferrous sulfate 40 mg and folic acid 0.4 mg are available for free access in the city, it is unclear whether all pregnant women who reported using these drugs actually took the recommended dosage.

5. Conclusions

In conclusion, the study highlights the importance of adequate prenatal care in ensuring better maternal and fetal health outcomes. However, there is still a gap between the recommendations and clinical

practice in terms of the use of antianemic drugs during pregnancy, which is influenced by socioeconomic and demographic variables. Although adverse effects may occur, the benefits of antianemic supplementation outweigh the risks and should be considered a low-cost preventive initiative to prevent pregnancy complications. Further studies are needed to investigate a broader range of factors associated with anemia in pregnancy and to explore strategies for improving adherence to antianemic drug use.

CRediT authorship contribution statement

Andréia Moreira de Andrade: Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Alanderson Alves Ramalho:** Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Fernanda Andrade Martins:** Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision. **João Rafael Valentim-Silva:** Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision. **Rosalina Jorge Koifman:** Conceptualization, Methodology, Validation, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2023.102501.

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