Iron supplementation among pregnant women: results from a population-based survey study

Suplementação com sulfato ferroso entre gestantes: resultados de estudo transversal de base populacional

Abstract

Objectives: To measure the prevalence and risk factors associated with iron supplementation among pregnant women in the municipality of Rio Grande, Southern Brazil. **Methods:** All mothers living in this municipality who had children in 2007 were surveyed for demographic, socioeconomic and health care received during pregnancy and childbirth. The statistical analysis consisted of Poisson regression with robust adjustment of variance, and the measure of effect was prevalence ratio (PR). **Results:** Among the 2,557 mothers interviewed (99% of total), 59% were supplemented with iron during pregnancy period. After adjusting for various confounding factors, a higher PR to iron supplementation was observed among teenagers, women with black skin color, primigravidae, who had six or more antenatal visits, who performed prenatal care in public sector and received vitamin during pregnancy. **Conclusion:** There is a clear need to increase the iron supplementation coverage of all pregnant women, especially among those currently considered with low gestational risk.

Keywords: Iron supplementation. Ferrous sulfate. Prenatal care. Anemia. Pregnancy. Pregnant women.

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Resumo

Objetivos: Medir a prevalência e identificar fatores associados à suplementação com sulfato ferroso entre gestantes residentes no município de Rio Grande, RS. **Métodos:** Mães residentes neste município que tiveram filho em 2007 foram investigadas quanto a características demográficas, nível socioeconômico e assistência recebida durante a gestação e o parto. Na análise estatística, foi utilizada regressão de Poisson com ajuste robusto da variância, e a medida de efeito foi razão de prevalências (RP). **Resultados:** Dentre as 2.557 mães entrevistadas (99% do total), 59% foram suplementadas com sulfato ferroso durante a gestação. Após análise ajustando para diversos fatores de confusão, mostraram maior RP à suplementação com sulfato ferroso as gestantes adolescentes, de cor da pele preta, primigestas, que realizaram seis ou mais consultas de pré-natal, que fizeram essas consultas na rede pública e que receberam complexo vitamínico durante a gestação. **Conclusão:** Há evidente necessidade de aumentar a cobertura da suplementação com sulfato ferroso entre todas as gestantes, sobretudo entre aquelas tidas, em geral, como de menor risco gestacional.

Palavras-chave: Suplementação com ferro. Sulfato ferroso. Cuidado pré-natal. Anemia. Gravidez. Gestantes.

Introduction

Iron deficiency is a major cause of anemia during pregnancy, which is characterized by serum hemoglobin concentrations below 11 g/dL[1]. According to the World Health Organization (WHO), it affects at least 4 of every 10 pregnant women and is the underlying cause of approximately 115,000 maternal deaths annually in poor countries[2]. In newborns, maternal anemia can result in prematurity and intrauterine growth restriction[3-5]. The most effective way to correct anemia is through supplementation with ferrous sulfate and an appropriate diet that includes foods rich in iron[5-8]. Most studies approaching this disease seek to determine the effectiveness of supplementation with ferrous sulfate on the hemoglobin levels[3,4,7] and identify the risk factors associated with anemia. These factors include younger age, low socioeconomic status and inadequate living and sanitation conditions, lack of prenatal care or late initiation of prenatal consultations, little weight gain during pregnancy, history of previous miscarriages or stillbirths, diet low in protein, comorbidity during pregnancy, particularly verminoses, among others[9-11]. Despite these numerous studies, none of them attempted to identify factors associated with intake of ferrous sulfate supplementation in government programs. This is relevant because, in Brazil, this micronutrient supplementation is indicated to all pregnant women[12]. This research aimed to determine the prevalence and identify factors associated with ferrous sulfate supplementation during pregnancy among all mothers living in the municipality of Rio Grande, RS, who gave birth in 2007.

Material and Methods

The municipality of Rio Grande is located in the southern half of the State of Rio Grande do Sul, about 300 km (186.411 miles) from Porto Alegre. In 2007, it had 195,000 inhabitants, 95% of whom lived in urban areas. The municipality's gross domestic product (GDP) per capita/year reached R$ 19.700; the infant mortality rate was 16/1.000 and the primary health care network

consisted of 32 basic units. There were also two general hospitals and five clinics for the care of medical specialties[13].

The study included all mothers living in the municipality who gave birth between January 1, 2007, and December 31, 2007, in the only two hospitals in the municipality. However, as the analysis unit was composed of newborns weighing less than or exactly 500 g or with 20 weeks or more of gestation, only mothers of these children were included in this study. The study design was cross-sectional (or prevalence), with a single approach to mothers within 24 hours of delivery. All information in this study were collected using a single precoded questionnaire that sought information as to the family's place of residence, demographic characteristics (age, skin color, marital status), occupation (if exercised paid work in the 12 months prior to or during pregnancy), reproductive history (parity, low weight at birth and prior prematurity) and lifestyle habits of pregnant women (smoking, physical activity, alcohol consumption). Also, information regarding socioeconomic status (maternal education and family income), possession of household appliances (type and quantity available in the household), living (type of construction and floor) and sanitation (type of toilet in the household and access to treated water and sewerage), as well as care received during pregnancy and childbirth (number of visits, trimester of initiation and type of care received) and morbidity during pregnancy (complications in the period and type of treatment received) were collected. Weight at birth was noted from the record book. This weight was obtained by nurses using a pediatric electronic scale accurate to 10 g. Some variables need further clarification: skin color, classified by the very pregnant woman from white, mixed and black; family income, amount received by all residents of the household in the month immediately preceding the interview; low weight at birth, if any previous child was born with less than 2,500g; prematurity, if any previous child was born with less than 37 weeks of gestational age; smoking, if the mother smoked at least one cigarette per day in the last 30 days. The gestational age of the newborns was assessed from the date of last menstrual period (LMP) noted on the prenatal care record.

Ten interviewers were trained to conduct this study. Of these 10, eight were students in the Medicine undergraduate course of FURG (Universidade Federal do Rio Grande) and the other two were social workers. The training consisted of reading the questionnaire and the instruction manual and lessons on how to apply the questionnaire in pairs and before the group of interviewers. During the pilot study, conducted in December 2006, each of the trainees applied at least two complete questionnaires and carried out an anthropometric examination in the children. The identification of pregnant women was made directly in the delivery room and in the maternity, and subsequently confirmed by the Medical Records and Statistics Service (SAME). Upon encountering a postpartum patient resident in the municipality of Rio Grande, she was given a consent form to read and, if she agreed to participate in the study, the questionnaire was then applied. This questionnaire was coded and submitted to the project headquarters for final review and typing.

The questionnaires were double entered by different professionals in reverse order. Every two weeks, the information typed were compared, and any errors were corrected and listed. After that, the consistency of the data was checked, with immediate correction of any differences. Data entry was done using software Epi Info 6.04[14]. The research protocol was submitted to and approved by CEPAS (Research Ethic Committee in the Field of Health) of Universidade Federal do Rio Grande. Moreover, the confidentiality of data was guaranteed, the participation was voluntary and there was the possibility of leaving the study at any time, without the need for justification. Crude and adjusted analyzes were conducted using Poisson regression, with a robust adjustment of variance. The outcome measure was expressed by the prevalence ratio (PR), a confidence interval of 95% (95%CI) and p-value from Wald test for heterogeneity. For the adjusted

analysis, a four-level hierarchical model was prepared[15] to determine the order of entry of variables in the model. In the first level, demographic and socioeconomic variables (age, skin color, maternal education and family income) were included; in the second level, reproductive variables (parity, low weight at birth and prior prematurity); on the third level, the variables related to prenatal care (number of visits, trimester of initiation and type of care received); and on the last level, having referred vitamin intake during pregnancy. All variables were taken to the multivariable model, and those with $p \leq 0.20$ were maintained. The analyses were conducted using Stata 10.0 software[16] and the level of significance used was 95% for two-tailed tests (Chart 1).

Results

For this study, 2,557 postpartum women were interviewed, representing a response rate of approximately 99% among all those who had children in the municipality of Rio Grande in 2007. The description of the sample with regard to demographic, socioeconomic, and gestational characteristics is in Table 1. A fifth of the mothers consisted of adolescents (< 20 years), 70% were of white skin, 13% had up to four years of education and 40% were primiparous. Just over 10% had, in the past, children with low weight at birth or premature. About 60% received prenatal care in the public health system, 72% completed six or more appointments and 74% initiated prenatal care in the first trimester of pregnancy. A quarter of mothers had referred intake of vitamins, and 59% took ferrous sulfate during pregnancy (Table 1). The distribution of outcomes, as well as the results of crude and adjusted analyzes is presented in Table 2. The prevalence of ferrous sulfate supplementation ranged from 47% among those who had less than six visits during prenatal care to 67% among those who underwent consultation in the public health system. In the crude analysis, the following variables showed a significant association to the outcome: maternal age, skin color, family income, parity, number of visits during prenatal care, type of prenatal care received, if prenatal care was received in the public or private health system and vitamin supplementation.

In the adjusted analysis, using the previously established hierarchic model, the following variables remained significantly associated with supplementation of ferrous sulfate: aged 20 or younger (teenagers) (PR = 1.12; 95%CI 1.02 – 1.22) compared to those aged 30 or older; black skin color (PR = 1.15; 95%CI 1.05 – 1.25) compared to white skin color; first pregnancy (PR = 1.15; 95%CI 1.05 – 1.27) compared to mothers with three or more children; six or more prenatal visits (PR = 1.28; 95%CI 1.18 – 1.39) compared to the rest; mothers who underwent prenatal care in the public health system (PR = 1.31; 95%CI 1.22 – 1.42) compared to the private network and finally, mothers supplemented

Chart 1 - Hierarchical analysis model.
Quadro 1 - *Modelo hierárquico de análise.*

Level	Variables	
I	**Demographic** Age and skin color	**Socioeconomic** Maternal education and family income
II	**Reproductive** Parity, low weight at birth and previous prematurity	
III	**Prenatal care** Number of consultations, trimester of initiation and type of care received	
IV	**Diet** Intake of vitamins during gestational period	
Outcome	Received ferrous sulfate supplementation at prenatal	

with vitamin (OR = 1.17; 95%CI 1.09 – 1.25) compared to unsupplemented mothers.

Discussion

This study showed that the prevalence of iron sulfate supplementation is low among the pregnant women studied, particularly among those usually considered as having a lower risk of complications during pregnancy. The highest prevalence of supplementation, after adjustment for potential confounding factors, were observed among adolescent mothers, with black skin color, primiparous, who had six or more prenatal appointments, who received prenatal care in the public health system and who had been supplemented with vitamins. When interpreting these results, one must bear in mind that this is a cross-sectional study, so the situation presented refers to the period of data collection. Moreover, regarding the intake of supplementation, data were based, as in most studies dealing with the subject, only on the account of the mother. Finally, there seems to be no reason for a particular group of mothers to have answered (or remembered) differently from each other regarding their intake (or not) of ferrous sulfate during pregnancy. For these reasons, it is possible to assume that the mentioned limitations do not invalidate the results presented here.

Despite the persisting doubt, for example, about the impact of supplementation with ferrous sulfate in reducing the occurrence of postpartum infections and bleeding[3,4] this supplementation is widely recommended during pregnancy because, in this period, the necessary absorption of iron changes from 0.8 to ≤ 7.5 mg[8]. Moreover, iron has a low cost, high availability and high acceptability, despite some side effects[5]. Finally, there is enough evidence that this intervention can reverse anemia and bring benefits to the mother and especially to the child, such as a lower incidence of prematurity and intrauterine growth restriction and better neuropsychomotor development[3-7].

For all these reasons, WHO universally recommends iron supplementation

Table 1 - Description of the sample according to some demographic, socioeconomic and reproductive characteristics. Rio Grande, RS, 2007.
Tabela 1 - *Descrição da amostra de acordo com algumas características demográficas, socioeconômicas, reprodutivas e gestacionais. Rio Grande, RS, 2007.*

Characteristic	n	%
Maternal age (years)		
15 – 19	516	20
20 – 24	718	28
25 – 29	628	24
≥ 30	695	27
Skin color		
White	1,778	69
Mixed	468	18
Black	311	12
Maternal education (years)		
0 – 4	322	13
5 – 8	923	36
9 – 11	1,071	42
≥ 12	241	9
Family income (tertile)		
Inferior	858	34
Intermediate	847	33
Superior	852	33
Parity		
None	1,010	39
One to two	874	34
Three or more	673	26
Had children with low weight at birth	293	11
Had premature children (< 37 weeks of gestational age)	298	12
Had six or more prenatal consultations	1,816	72
Initiation of prenatal (trimester)		
First	1,794	74
Second	583	24
Third	60	2
Type of prenatal care		
Public	1,493	61
Private	456	39
Received vitamin supplementation at prenatal	662	26
Received ferrous sulfate supplementation at prenatal	1,510	59
Total	2,557	100

Table 2 - Crude and adjusted analysis for factors associated with iron supplementation during pregnancy. Rio Grande, RS, 2007 (n = 2.557).

Tabela 2 - *Análise bruta e ajustada para fatores associados à suplementação com sulfato ferroso durante a gestação. Rio Grande, RS, 2007 (n = 2.557).*

Level*	Characteristic	Supplemented with iron (%)	Crude analysis	Adjusted analysis
			PR (95%CI)	PR (95%CI)
I	Maternal age (years)		p = 0.001	p = 0.002
	15 – 19	66	1.13 (1.03 – 1.23)	1.12 (1.02 – 1.22)
	20 – 24	59	1.01 (0.92 – 1.10)	1.01 (0.92 – 1.10)
	25 – 29	54	0.93 (0.85 – 1.03)	0.93 (0.85 – 1.02)
	≥ 30	58	1.00	1.00
	Skin color		p = 0.01	p = 0.01
	White	57	1.00	1.00
	Mixed	66	1.07 (0.99 – 1.16)	1.07 (0.98 – 1.16)
	Black	61	1.15 (1.05 – 1.26)	1.15 (1.05 – 1.25)
	Maternal education (years)		p = 0.15	p = 0.69
	0 – 4	57	1.00	1.00
	5 – 8	62	1.08 (0.97 – 1.20)	1.07 (0.96 – 1.19)
	9 – 11	58	1.01 (0.91 – 1.13)	1.05 (0.94 – 1.18)
	≥ 12	55	0.95 (0.82 – 1.11)	1.03 (0.88 – 1.21)
	Family income (tertile)		p = 0.05	p = 0.36
	Inferior	62	1.00	1.00
	Intermediate	59	0.95 (0.88 – 1.02)	0.97 (0.90 – 1.05)
	Superior	56	0.91 (0.84 – 0.98)	0.94 (0.87 – 1.02)
II	Parity		p = 0.001	p = 0.01
	None	63	1.15 (1.07 – 1.26)	1.15 (1.05 – 1.27)
	One to two	58	1.02 (0.96 – 1.15)	1.07 (0.97 – 1.17)
	Three or more	55	1.00	1.00
	Had children with low weight at birth?		p = 0.18	P=0.89
	No	59	1.00	1.00
	Yes	55	0.93 (0.83 – 1.04)	1.01 (0.87 – 1.17)
	Had premature children		p = 0.08	p = 0.43
	No	60	1.00	1.00
	Yes	54	0.91 (0.81 – 1.01)	0.95 (0.85 – 1.07)
III	No. of prenatal consultations		p < 0.001	p < 0.001
	< 6	47	1.00	1.00
	≥ 6	64	1.36 (1.25 – 1.48)	1.28 (1.18 – 1.39)
	Initiation of prenatal (trimester)		p = 0.18	p = 0.35
	First	62	1.29 (0.99 – 1.67)	1.20 (0.93 – 1.56)
	Second	62	1.27 (0.97 – 1.67)	1.21 (0.94 – 1.58)
	Third	48	1.00	1.00
	Type of prenatal care		p < 0.001	p < 0.001
	Public	67	1.29 (1.20 – 1.38)	1.31 (1.22 – 1.42)
	Private	52	1.00	1.00
IV	Supplemented with vitamins		p < 0.001	p < 0.001
	No	57	1.00	1.00
	Yes	65	1.15 (1.08 – 1.23)	1.17 (1.09 – 1.25)

*Each variable was adjusted for all other variables on the same level and on previous levels; PR: prevalence ratio.

**Cada variável foi ajustada para todas as demais do mesmo nível e de níveis anteriores; PR: razão de prevalências.*

to pregnant women[1]. However, despite this wide recommendation, there are no recent data regarding iron supplementation coverage by country or region. Studies conducted in the 1990s, when several countries received encouragement from WHO and various funding agencies for research and intervention to make such supplementation, showed that coverage of iron supplementation during pregnancy was 22% in Yemen, 32% in Eritrea, 44% in Tanzania and approximately 75% in Ghana, Indonesia and the Philippines[17-19]. In Thailand and Nicaragua, where there was intervention, anemia rates dropped about 40% over 10 years. In these countries, the coverage rate was approximately 85%[7,20]. Whereas these benefits should be extended to all mothers, the goal of the programs is to achieve the greatest possible coverage. However, it was not what was observed for the municipality of Rio Grande. Coverage for all of them was 59%, ranging from 47 to 67% among those who had less than six prenatal visits during and among those who received prenatal care in the public health system, respectively. It is even more interesting to note that the lowest prevalence observed in relation to receiving supplementation with ferrous sulfate occurred almost entirely in mothers known to have the lowest risk of adverse outcomes during prenatal and childbirth, such as mothers who were not in their teens, had white skin, with a higher number of children and supplemented with vitamins, besides, of course, those who received prenatal care in the private health system, who have a higher socioeconomic status[9-11,20]. This finding is contrary to what was observed in other studies. Generally, patients with higher risks have less access and, therefore, a worse coverage[21]. Therefore, this finding requires further investigation. This study did not assess the reasons why the mothers were not supplemented with ferrous sulfate. However, subsequent consultation with the Department of Health of Rio Grande showed that during the years 2006 and 2007, at least in the central region, there was no lack of this supplement, and the amount held in stock was sufficient to serve about 250 new mothers/month when, on average, 220 births occur. However, it was not possible to assess the availability of ferrous sulfate in the same period in basic health units and clinics, where pregnant women received their prenatal care. Anyway, it seems that the most common cause for the unsupplementation was not due to lack of ferrous sulfate, as reported in another study, but the lack of recommendation or selective recommendation from health professionals[22]. Several strategies have been recommended to overcome problems related to reduced coverage of supplementation with ferrous sulfate. Among them are clarification on the undesirable effects of the drug; greater involvement of pregnant women in their treatment; use of a calendar indicating date and period of the supplementation with ferrous sulfate; facilitation of the drug's distribution, for example, through community health agents; further explanation about direct benefits to pregnant women resulting from iron supplementation, such as better physical performance and increased appetite; demystification of the possibility of a very overweight newborn, which would cause difficulties during childbirth; reiteration of the benefits to the newborn; explanation of the consequences of prematurity and low weight at birth, outcomes strongly associated with iron deficiency; improving of the support to healthcare professionals, keeping them motivated to offer this supplement during pregnancy and during the first years of life, and promotion of campaigns prioritizing community involvement[5,7,8,17,20].

The results presented in this study show that it is necessary to increase the coverage of ferrous sulfate supplementation among pregnant women of Rio Grande, and future studies should seek to understand why this supplementation has not been universalized among these mothers.

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