

## Factors associated with non-adherence to prescribed iron supplement use: a study with pregnant women in the city of Rio de Janeiro

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### Abstract

*Objectives:* to identify factors associated with non-use of iron supplements (IS) by pregnant women attending National Health System (SUS) prenatal care in the Municipality of Rio de Janeiro.

*Methods:* a cross-sectional study was conducted in 2007/2008 with a representative sample of pregnant women using SUS hospitals and basic care in the Municipality of Rio de Janeiro. The group that had gestational age of  $\geq 20$  weeks at the time of the interview and who had been prescribed IS ( $n=1407$ ) was subjected to a Poisson multiple regression model to estimate the association between use and independent variables.

*Results:* of the 1407 pregnant women, 65% reported use of IS. Younger age, black skin/race, larger number of births, not having received guidance on use of IS, not having tried to obtain IS at the SUS (with a stronger association between pregnant women with lower levels of education and lower household assets indicator - HAI) and not having been able to obtain them at the SUS (among pregnant women with lower HAI) were significantly associated with non-use.

*Conclusions:* the guidance of health professionals regarding use of IS and their regular availability may increase adherence to prescription among pregnant women and prevent iron deficiency anemia.

**Key words** Anemia, Anemia, iron-deficiency, Ferrous sulfate, Prenatal care, Pregnancy, Epidemiologic factors

## Introduction

Among pregnant women and women of reproductive age, iron supplements have been seen by the World Health Organization (WHO) as a way of supplementing the most widely applied micronutrient in a country, with significant success. However, the prevalence of anemia in these populations is still high.<sup>1</sup>

Estimates and intervals of the prevalence of anemia among pregnant women around the world between 1995 and 2011 were 43% (CI95%: 39 - 47%) and 38% (CI95%: 34 - 43%) respectively, without evidence of substantial improvement over these sixteen years.<sup>2</sup>

When present in the first or second trimester of gestation, anemia is associated with preterm birth and low birth weight<sup>3</sup> and, in moderate to severe forms, increases the likelihood of the birth of children who are small for gestational age (SGA).<sup>4</sup> Such outcomes are widely associated with higher neonatal mortality.<sup>5</sup>

The concentration of hemoglobin is the most commonly used indicator of anemia at population level, as it is reliable, inexpensive and relatively easy to obtain. Despite the various causes of anemia, its prevalence has frequently been used as a proxy for iron deficiency anemia, which accounts for around 50% of cases.<sup>6</sup>

It is known that routine iron supplementation among pregnant women is effective in increasing the concentration of hemoglobin in the third trimester of gestation, childbirth and postpartum, in reducing the risk of anemia, iron deficiency, iron deficiency anemia and low birth weight,<sup>3</sup> and it is recommended in locations where iron deficiency is one of the major causes of anemia.<sup>6</sup>

In Brazil, it is estimated that 29.6% of women of reproductive age are anemic<sup>7</sup> and a high proportion of pregnant women have been identified as having a diet poor in iron.<sup>8,9</sup> The Ministry of Health thus recommends supplementation with iron sulfate after the 20<sup>th</sup> week of gestation.<sup>10</sup> Through the National Pharmaceutical Care Policy, the funding norms for such care within the National Health System (SUS), the National Report on Essential Medicines, and other legal tools, States and Municipalities are responsible for the whole process of acquisition and distribution of this medication, ensuring free access for pregnant women in receipt of an SUS prescription.<sup>11</sup>

The low adherence of pregnant women to the use of iron supplements (IS) is one of the main obstacles to the effectiveness of such action.<sup>12,13</sup>

Studies with pregnant women in developed and developing countries have identified the following factors associated with less frequent use of IS: younger age,<sup>14,15</sup> black race/skin color,<sup>16,17</sup> low level of education<sup>17-21</sup> and income,<sup>16,21</sup> unemployment,<sup>14</sup> being single without a partner at the start of gestation,<sup>20</sup> multiparity,<sup>14,15,22</sup> fewer prenatal consults,<sup>13,15,18,22</sup> inadequate prenatal care (in terms of start of prenatal care and number of consults),<sup>19</sup> presence of side-effects of supplementation,<sup>13,21,23-25</sup> lack of guidance on use of supplements,<sup>24,25</sup> lack of knowledge of the importance of iron intake<sup>13,24,25</sup> and iron supplementation during pregnancy,<sup>21</sup> not having been diagnosed with anemia during pregnancy<sup>15,24</sup> and unavailability of free supplements in sufficient quantities.<sup>18,21,23,25</sup>

Studies of this subject have already been conducted in two Brazilian cities: one in the State of São Paulo<sup>20</sup> and another in the State of Rio Grande do Sul.<sup>22</sup> However, pregnant women in other States also need to be the target of studies, with a view to comparing findings and identifying important factors for adherence to prescription of IS in diverse Brazilian settings.

The present study aims to identify demographic, socioeconomic, obstetric, and prenatal care structure and processes factors associated with non-use of iron supplements by pregnant women attending low-risk prenatal sessions within the SUS network of the Municipality of Rio de Janeiro.

## Methods

A cross-sectional study was conducted with a representative sample of pregnant women attending low-risk prenatal sessions at basic care units (BCUs) and hospitals within the SUS network of the Municipality of Rio de Janeiro, obtained by way of a two-stage conglomerate sampling plan. In the first stage, a simple random selection was carried out of 40% of eligible BCUs (n=26) and hospitals (n=5) and then the systematic selection of pregnant women, according to order of exit from prenatal consults, until completion of a pre-agreed sample for each health establishment.

The sample size (n=2,187) was established on the basis of a level of significance of 5%, a proportion of 50%, a margin of error of 2.5%, corrected for a finite population (25,208 prenatal consults/month) and for the design effect (1.5). The allocation of the sample was proportionate to the monthly mean number of prenatal consults in each stratum and divided, within the strata, by the number of units sampled: 63% for BCUs (n=53 per BCU), 35% for

hospitals (n=153 per hospital) and 2% for Birth Houses (n=44). The Birth House was excluded from the analysis for inclusion of the design effect, leaving a sample of 2,143 pregnant women.

The interviewing tool was tested in a pilot study. Data collection (interview and photocopy of prenatal card) was carried out between November 2007 and May 2008 by a trained team comprising six supervisors and 36 interviewers. The completed questionnaires went through three stages of review and were typed in duplicate into the database management program (Microsoft Access®).

The pregnant women who declined to participate in the interview and prenatal card photocopying stages (n=142) were asked if they could give their age and level of schooling. According to the Mann-Whitney non-parametric test, these did not differ (in terms of these characteristics) from the pregnant women who agreed to participate in the study, with 5% significance. The decliners (6.6%) were replaced in the sample. The method used for this study has been described in greater detail in a previous publication.<sup>26</sup>

The present study included pregnant women who, at the time of the interview, had a gestational age (GA) of  $\geq 20$  weeks (a group for which the Ministry of Health recommends prophylactic iron supplementation)<sup>10</sup> and who reported receipt of a prescription for use of IS. Women who self-identified as of Asian or indigenous race were excluded, owing to the low level of representation of these groups in the sample (2.4%).

The GA (full weeks) was calculated using the date of the last menstruation (DLM) and ultrasound information (USG) available on the card, with preference being given to USG only when carried out at GA  $\leq 12$  weeks, with a discrepancy of more than one week between the GA obtained based on DLM and USG. In the absence of either of these, the GA registered by the prenatal clinic was used and, if this too was unavailable, the pregnant woman was excluded from the analysis (n=22). The women with and without information on GA did not differ in relation to age and level of schooling, according to the Mann-Whitney test, given a level of significance of 5%.

The relative frequency and 95% confidence interval (CI) of pregnant women was presented for demographic, socioeconomic and obstetric variables [age (adolescents:  $< 20$  years/ adults:  $\geq 20$  years), race/skin color (white/black/mixed), schooling (low:  $< 8$  years/ high:  $\geq 8$  years), employment situation (in paid work/without paid work), marital status (lives with partner/does not live with partner), number of

people in household (1 - 3 people/ 4 or more people), household assets indicator (HAI) (based on the presence of ten assets: radio, fridge/freezer, television, landline telephone, washing machine, private car, microwave, computer, DVD player and air-conditioner) (low:  $\leq 1$ /high:  $> 1$ ),<sup>27</sup> parity ( $< 1/\geq 1$ ), gestational age at start of prenatal care ( $< 17$  weeks/ $\geq 17$  weeks) and report of nausea, emesis or pyrosis as a health problem causing discomfort during pregnancy (yes/no); prenatal care structure [obtained supplement from SUS network (tried to obtain and was able to/tried to obtain and was unable to/did not try to obtain)] and prenatal care process [adequate number of prenatal consults, according to GA at time of interview (yes/no), record of IS prescription on card (yes/no), correct guidance on use of IS (one hour before meals - yes/no),<sup>10</sup> some guidance on use of IS - whether or not in accordance with Ministry of Health norms (yes/no), reported diagnosis of anemia ("During prenatal care, did the doctor or nurse say that you had anemia?" - yes/no) and diagnosis of anemia according to record of test result on prenatal card (hemoglobin  $< 11$ g/dL - yes/no)<sup>10</sup>].

The prevalence of use of IS among the pregnant women and CI95% was estimated on the basis of the question: "Are you taking iron sulfate or another iron medicine?"

As the outcome of interest is not rare, simple Poisson regression models with robust variance were conducted to estimate the intensity of associations between the dependent variable (non-use of IS—yes/no) and the aforementioned independent variables.<sup>28</sup> Estimates of the raw prevalence ratio (PR) and CI95% were then obtained. Interactions between age and race/skin color, as previously described by Jasti *et al.*<sup>17</sup> and among categories relating to obtaining the supplement within the SUS network and schooling, HAI and employment situation were tested. These have not yet been described in the literature.

Multiple Poisson regression models were then carried out, with the dependent and independent variables and significant interactions in the simple Poisson regressions, taking the level of significance to be 20%. Significant independent variables and interactions remained in the final model to explain non-use of IS (with a level of significance of 5%), and the adjusted PR and CI95% estimates were calculated.

The adequacy of the final multiple model was confirmed by analysis of the presence of influential points using Cook's Distance, taking an observation to be influential if it has a Cook Distance value greater than or equal to one.<sup>29</sup> The graph of standar-

dized residuals identified observations with a greater residual and estimated that around 95% of the residuals lay between  $\pm 2$  (as expected when the residuals follow an approximately normal distribution). The most influential observations were examined and the effect of their exclusion on the adjusted association estimates evaluated.

For statistical analysis, each element of the sample was weighted according to the inverse of its probability of selection and calibrated to retain the known distribution of prenatal consults. The analyses were conducted using R version 2.15.3 software.

The study was approved by the Research Ethics Committees of ENSP-Fiocruz (n° 142/06) and SMS-RJ (n° 145 A /2007). There are no conflicts of interests relating to the methods used as part of the investigation or financial interests of the researchers.

## Results

Of the sample selected (n=2,148), 73.1% of pregnant women met the criteria for being included in this analysis. Of these, 1,409 (89.6%; CI95%: 84.3% - 93.3%) reported that IS was prescribed during prenatal care. Two pregnant women did not provide information on use of IS and the sample analyzed by this study was reduced to 1,407 pregnant women.

Most of these were adults (75.9%), of mixed race (49.7%), with eight or more years of schooling (67.7%), without paid work (66.9%), living with a partner (77.8%), with 1 to 3 people living in the household (54.2%), with an HAI greater than one (55.0%) and already one or more childbirths (55.2%) and had begun prenatal care prior to the 17<sup>th</sup> week of gestation (66.3%). Nausea, emesis or pyrosis were reported as a health problem by 7.9% of the pregnant women (Table 1).

As for the structure of prenatal care, 55.4% of the pregnant women tried to obtain IS within the SUS network and succeeded in doing so. In terms of the care process, most pregnant women had an adequate number of prenatal consults (80.4%), had no record of prescription of IS on their medical card (93.1%), did not receive correct guidance on use of the supplement (62.7%), but received some kind of guidance on its use (97.0%). Eighteen percent of the pregnant women were diagnosed with anemia, according to the records of hemoglobin exam results on the card, while 35.9% reported diagnosis of anemia during pregnancy (Sensitivity=0.82; Specificity=0.71; *Kappa*=0.36) (Table 1).

The use of IS during pregnancy was reported by 920 women (65.4%; CI95%: 59.7% - 70.6%). Non-

use of IS was found to be positively associated, with a level of significance of 20%, with: younger age, black race/skin color or mixed race, <8 years schooling, no paid work, parity  $\geq 1$ , having tried but not succeeded in obtaining the supplement within SUS or not having tried to obtain it within SUS, inadequate number of prenatal consults, no record of prescription of supplement on card, not having received correct guidance or any guidance on use of IS and not reporting diagnosis of anemia during pregnancy. The interactions between categories for obtaining the supplement within the SUS, schooling and HAI were significant at a level of 20% (Table 2).

The best model tested in multiple Poisson regression to explain non-use of IS was the one that included age, race/skin color, parity, receipt of some guidance on use of IS, obtaining the supplement within the SUS and interactions between the variable categories relating to obtaining the supplement within the SUS, schooling and HAI, significant at a level of 5%, and the main effects of the schooling and HAI variables (Table 3).

Adjusted analysis of factors associated with non-use of IS during pregnancy (without excluding influential points) found that, for every increase of one year in age, the pregnant women showed a prevalence of non-use of the supplement 1.7% lower than that of the women exactly one year younger.

Black women had a 24.5% greater prevalence of non-use of IS than white women. This association was not significant, at a level of 5%, for mixed race, compared to whites.

Women with one or more childbirths had a prevalence of non-use of supplement 16.5% greater than nulliparous women. Those who received no guidance on use of IS had a prevalence of non-use 73.9% greater than those who did.

Of the women with a high level of education and high HAI, those who did not try to obtain the supplement within the SUS had a prevalence of non-use of IS 1.72 times greater than those who tried to obtain the supplement within the SUS and succeeded. The strength of this association was even greater in the groups of women with high level of schooling but low HAI (PR= 2.369) and those with low level of schooling and either high (PR= 2.967) or low (PR= 2.829) HAI.

For women with high HAI, having tried but not succeeded in obtaining IS within the SUS was not significantly associated with non-use. Of those with low HAI, both with high and low level of schooling, the women who tried to obtain the supplement within the SUS and did not succeed had prevalences of non-use significantly higher than those who tried

to obtain the supplement within the SUS with success (PR= 1.642 and PR= 2.043, respectively), with the strongest association in the group with lowest level of schooling.

Analysis of Cook's Distance and Standardized Residuals (Figure 1) showed the adjusted model to be adequate. Exclusion of the most influential observation (n° 370) increased the strength of association between not having received any guidance on use of IS and having tried and failed to obtain the supplement within the SUS and non-use (in the group of women with low HAI and high level of schooling)

and made these associations statistically more significant (Table 3). Observation n° 370 corresponded to a 27-year-old multiparous pregnant woman of mixed race, with low HAI and high level of schooling, who had not received guidance on use of IS, had tried but failed to obtain the supplement within the SUS and reported having used the supplement. Exclusion of observation n° 374 (the second most influential observation) did not cause significant changes in the coefficients or in the selection of variables significantly associated with the outcome of interest and is not therefore presented.

**Table 1**

Demographic, socioeconomic, obstetric, care structure and care process characteristics of prenatal nutritional care provided by the Brazilian National Health System (SUS) for pregnant women with gestational age (GA)  $\geq$  20 weeks in receipt of a prescription for use of iron supplementation (IS). Rio de Janeiro - RJ, 2007/2008.

Variables	N	%	CI95%
<b>Age (n=1407)</b>			
Adolescents	339	24.1	20.5-28.0
Adults	1068	75.9	72.0-79.5
<b>Race/skin color (n=1407)</b>			
White	354	25.1	22.7-27.7
Black	353	25.1	22.1-28.4
Mixed	700	49.8	47.1-52.4
<b>Education (years of schooling) (n=1407)</b>			
< 8	455	32.3	28.6-36.2
$\geq$ 8	952	67.7	63.8-71.4
<b>Employment situation (n=1407)</b>			
In paid work	466	33.1	29.7-36.8
Without paid work	941	66.9	63.2-70.3
<b>Marital status (n=1407)</b>			
Lives with partner	1094	77.8	73.6-81.5
Does not live with partner	313	22.2	18.5-26.4
<b>Number of people in household (n=1407)</b>			
1 - 3 people	763	54.2	50.7-57.7
4 or more people	644	45.8	42.3-49.3
<b>Household Assets indicator (n=1407)</b>			
$\leq$ 1	634	45.0	37.8-52.5
> 1	773	55.0	47.5-62.2
<b>Parity (n=1407)</b>			
<1	630	44.8	40.8-48.8
$\geq$ 1	777	55.2	51.2-59.2
<b>Gestational age at start of prenatal care (weeks) (n=1380)</b>			
< 17	916	66.3	62.5-70.0
$\geq$ 17	464	33.7	30.0-37.5
<b>Report of nausea, emesis or pyrosis (n=1407)</b>			
No	1297	92.1	90.3-93.6
Yes	110	7.9	6.4-9.7

continue

concluded

**Table 1**

Demographic, socioeconomic, obstetric, care structure and care process characteristics of prenatal nutritional care provided by the Brazilian National Health System (SUS) for pregnant women with gestational age (GA)  $\geq$  20 weeks in receipt of a prescription for use of iron supplementation (IS). Rio de Janeiro - RJ, 2007/2008.

Variables	N	%	CI95%
Obtained IS within SUS network (n=1407)			
Successfully tried to obtain IS within SUS network	779	55.4	38.5-71.1
Unsuccessfully tried to obtain IS within SUS network	385	27.3	20.3-35.7
Did not try to obtain IS within SUS network	243	17.3	8.9-30.9
Adequate number of prenatal consults (n=1394)			
Yes	1121	80.4	76.5-83.8
No	273	19.6	16.2-23.5
Record of prescription of IS on card (n=1392)			
Yes	97	6.9	3.1-14.7
No	1295	93.1	85.3-96.9
Correct guidance on use of IS (n=1407)			
Yes	524	37.3	32.3-42.5
No	883	62.7	57.5-67.7
Some guidance on use of IS (n=1407)			
Yes	1365	97.0	95.9-97.8
No	42	3.0	2.2-4.1
Diagnosis of anemia reported (n=1407)			
Yes	504	35.9	31.9-40.0
No	903	64.1	60.0-68.1
Diagnosis of anemia according to prenatal card record (n=893)			
Yes	160	18.0	14.8-21.6
No	733	82.0	78.4-85.2

**Table 2**

Non-adjusted analysis of factors associated with non-use of iron supplementation (IS) among pregnant women attending Brazilian National Health System (SUS) prenatal services, with gestational age (GA)  $\geq$  20 weeks and in receipt of a prescription for IS use. Rio de Janeiro - RJ, 2007/2008.

Variables	PR	CI95%
Age †	0.985**	0.974-0.996
Race/skin color )		
White	1	-
Black	1,259**	1,021-1,554
Mixed	1,192*	0,965-1,473
Education (years of schooling)		
< 8	1,265***	1,084-1,477
$\geq$ 8	1	-
Employment situation		
In paid work	1	-
Without paid work	1,228***	1,096-1,375
Marital status		
Lives with partner	1	-
Does not live with partner	0,974	0,829-1,145
Number of people in household		
1 - 3 people	1	-
4 or more people	1,011	0,872-1,172

\* $p < 0.20$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ ; † continuous variable; PR= Prevalence ratio.

continue

**Table 2** **concluded**

Non-adjusted analysis of factors associated with non-use of iron supplementation (IS) among pregnant women attending Brazilian National Health System (SUS) prenatal services, with gestational age (GA)  $\geq 20$  weeks and in receipt of a prescription for IS use. Rio de Janeiro - RJ, 2007/2008.

Variables	PR	CI95%
Household Assets indicator		
≤ 1	1,095	0,938-1,278
> 1	1	-
Parity (n=1407)		
<1	1	-
≥1	1,089*	0,980-1,210
Gestational age at start of prenatal care (weeks)		
< 17	1	-
≥ 17	1,038	0,869-1,240
Report of nausea, emesis or pyrosis		
No	1	-
Yes	1,108	0,869-1,412
Obtained IS within SUS network		
Successfully tried to obtain IS within SUS network	1	-
Unsuccessfully tried to obtain IS within SUS network	1,575 ***	1,199-2,069
Did not try to obtain IS within SUS network	2,256***	1,710-2,976
Adequate number of prenatal consults		
Yes	1	-
No	1,380***	1,120-1,700
Record of prescription of IS on card		
Yes	1	-
No	1,395*	0,932-2,089
Correct guidance on use of IS		
Yes	1	-
No	1,092*	0,946-1,261
Some guidance on use of IS		
Yes	1	-
No	1,907***	1,461-2,489
Diagnosis of anemia reported		
Yes	1	-
No	1,118*	0,967-1,293
Diagnosis of anemia according to prenatal card record		
Yes	1	-
No	1,103	0,800-1,521

\* $p < 0.20$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ ; † continuous variable; PR= Prevalence ratio.

**Table 3**

Adjusted analysis of factors associated with non-use of iron supplementation (IS) among pregnant women attending Brazilian National Health System (SUS) prenatal services, with gestational age (GA)  $\geq 20$  weeks in receipt of a prescription for IS use. Rio de Janeiro - RJ, 2007/2008.

Variables	PR (CI95%) (n=1407)	PR (CI95%)• (n=1406)
Age †	0.983 (0.971-0.996)**	0.983 (0.971-0.996)**
Race/skin color		
White	1	1
Black	1.245 (1.045-1.484)**	1.243 (1.045-1.478)**
Mixed	1.187 (0.984-1.431)	1.192 (0.989-1.438)

\*\* $p < 0.05$ ; \*\*\* $p < 0.01$ ; † continuous variable; • Analysis adjusted after exclusion of most influential observation (n° 370); HAI= household asset indicator; PR= Prevalence ratio.

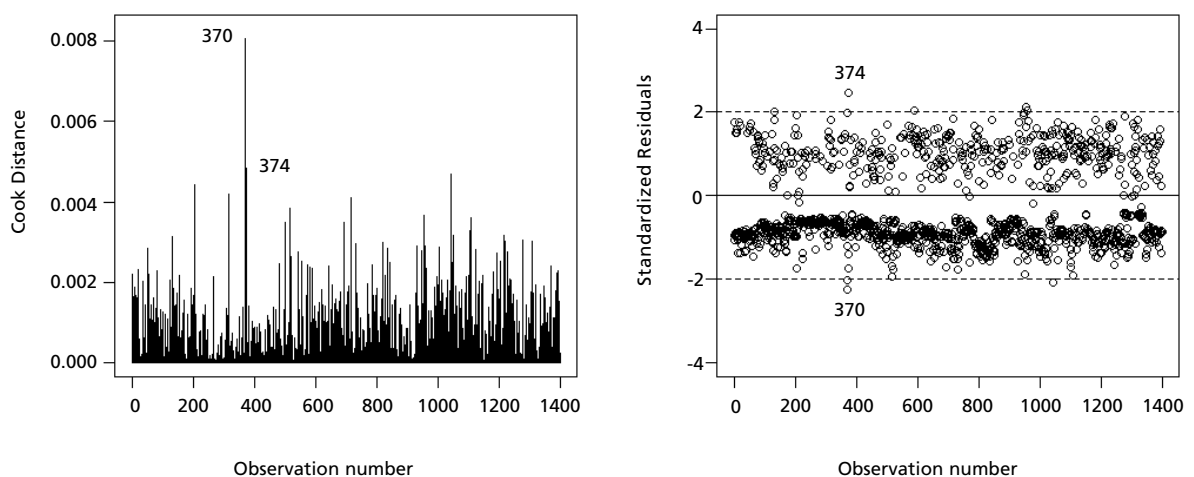
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**Table 3** **concluded**  
 Adjusted analysis of factors associated with non-use of iron supplementation (IS) among pregnant women attending Brazilian National Health System (SUS) prenatal services, with gestational age (GA) ≥20 weeks in receipt of a prescription for IS use. Rio de Janeiro - RJ, 2007/2008.

Variables	PR (CI95%) (n=1407)	PR (CI95%)• (n=1406)
Parity		
<1	1	1
≥1	1.165 (1.020-1.331)**	1.172 (1.029-1.335)**
Some guidance on use of IS		
Yes	1	1
No	1.739 (1.195-2.528)**	1.852 (1.358-2.524)***
≥ 8 years of schooling and HAI >1		
Successfully tried to obtain IS within SUS	1	1
Unsuccessfully tried to obtain IS within SUS	1.376 (0.978-1.936)	1.375 (0.977-1.935)
Did not try to obtain IS within SUS	1.725 (1.292-2.303) ***	1.722 (1.289-2.299)***
< 8 years of study and HAI > 1		
Successfully tried to obtain IS within SUS	1	1
Unsuccessfully tried to obtain IS within SUS	1.538 (0.950-2.489)	1.544 (0.954-2.500)
Did not try to obtain IS within SUS	2.967 (2.108; 4.175)***	2.979 (2.116-4.192)***
≥ 8 years of study and HAI ≤ 1		
Successfully tried to obtain IS within SUS	1	1
Unsuccessfully tried to obtain IS within SUS	1.642 (1.095-2.463)**	1.720 (1.147-2.579)***
Did not try to obtain IS within SUS	2.369 (1.722-3.258) ***	2.361 (1.717-3.247)***
< 8 years of study and HAI ≤ 1		
Successfully tried to obtain IS within SUS	1	1
Unsuccessfully tried to obtain IS within SUS	2.043 (1.496-2.790)***	2.047 (1.498-2.795)***
Did not try to obtain IS within SUS	2.829 (1.928-4.151)***	2.804 (1.911-4.114)***

\*\*p<0.05; \*\*\*p<0.01; † continuous variable; • Analysis adjusted after exclusion of most influential observation (n° 370); HAI= household asset indicator; PR= Prevalence ratio.

**Figure 1**  
 Graphic analysis of adequacy of adjusted model of factors associated with non-use of iron supplementation among pregnant women attending Brazilian National Health System prenatal services. Rio de Janeiro - RJ, 2007/2008.





## Discussion

Given the high prevalence of anemia among pregnant women<sup>7</sup> and the adverse gestational outcomes associated with it,<sup>3,4</sup> as well as inadequate dietary intake of iron,<sup>8,9</sup> the estimate for IS use found in this study (65%) falls far short of that envisaged by the Ministry of Health [which stipulates that every pregnant woman (100%) should receive the iron supplement as of the 20<sup>th</sup> week of gestation].<sup>10</sup>

Studies that have measured the use of iron supplement in a similar fashion have found similar prevalences (varying from 59% to 68%) among users of the SUS network prenatal service in the city of Jundiá - SP - Brazil,<sup>20</sup> in a university hospital in Nigeria<sup>21</sup> and among childbearing women in the municipality of Rio Grande - RS - Brazil<sup>22</sup> and in Cambodia.<sup>18</sup> Lower figures were found in Tanzania (22%)<sup>15</sup> and higher ones in the United States (72%),<sup>16</sup> Denmark (77%),<sup>14</sup> Portugal (81.9%)<sup>19</sup> and Sweden (85%).<sup>24</sup>

Authors who measured the use of iron supplement by other methods found a consumption of 74% of pills prescribed among low-income pregnant women in the United States<sup>17</sup> and 85% in the Philippines.<sup>13</sup> In Senegal, it was found that 58% of pregnant women used 70% or more of iron supplements prescribed<sup>25</sup> and, in Vietnam, the mean duration of use of the supplement was 4.8 months.<sup>23</sup>

The discrepancies observed between the prevalences of use of the iron supplement may be associated with various factors, such as greater use among populations with higher levels of schooling and income,<sup>16-21</sup> who have more extensive prenatal care coverage<sup>13,15,18,19,22</sup> and better access to the supplement.<sup>18,21,23,25</sup> However, the different ways of measuring the use of iron supplements in the studies may also contribute to the variations observed.<sup>12</sup>

Various indirect measures of adherence to iron supplementation have been used in scientific studies,<sup>12</sup> including counting the number of unused pills<sup>13,17,25</sup>; self-reporting the period during which the supplement was taken,<sup>23</sup> the total or mean number of pills consumed per day/week/month<sup>13,14,18,25</sup> and the use of iron supplements as a dichotomous variable.<sup>14-16,18,24</sup>

All these measures have their limitations: (I) when counting unused pills, the missing pills were not necessarily consumed by the pregnant woman; (II) the self-reported number of pills used and months of use may not be accurate due to memory bias or overestimation; (III) the report of current consumption of the supplement does not necessarily indicate that the recommended dosage has been

followed.<sup>12,13</sup> This last limitation also affects the present study, so that the quantities of supplement used may be even less adequate.

As for factors associated with the use of IS during prenatal care, the present study revealed greater use of IS among older women, as observed in studies conducted in Denmark and Tanzania.<sup>14,15</sup> It is possible that younger pregnant women are less well-informed and less concerned with health issues. Furthermore, younger age may also be associated with unplanned pregnancy (a variable not measured in the present study that has also been identified as negatively associated with use of the supplement<sup>14</sup>).

Two studies conducted in the United States<sup>16,17</sup> found an association between black race/skin color with lower use of IS. Jasti *et al.*<sup>17</sup> controlled the effects of schooling (in the adjustment) and income (in the stratification), so that cultural issues and interactions between health professionals and pregnant women, among other factors such as social support, could be better studied in search of explanations for these findings.

One study with pregnant Brazilian women resident in Rio Grande - RS, also in 2007, indicated associations that are directly the opposite of those observed in the present study: lower prevalences of use of IS among adult and white women. One plausible explanation of this is that the services investigated were giving more attention regarding the use of supplements to pregnant women who have historically been identified as more vulnerable.<sup>22</sup>

The association between multiparity and lower use of iron supplements is widely documented in the literature.<sup>14,15,22</sup> Pregnant women who have already been through one or more pregnancies may be less concerned about health in gestation, especially if they have experienced a pregnancy without complications.<sup>14</sup> Another hypothesis is that women with children have more difficulty showing up to health services, which would explain the association between this variable and the lower number of prenatal consults.<sup>13</sup>

Studies carried out with pregnant Swedish and Senegalese women have shown that their perception of the importance accorded to IS by the health professional,<sup>22</sup> the receipt of advice on using the supplement and explanations regarding use were positively associated with adherence to treatment.<sup>24,25</sup>

Such findings corroborate the observations of the present study. However, it is worrying that, although the health professional's advice makes it clear that he or she regards taking the supplement as important, guidance provided in an ineffective manner

may compromise the effectiveness of treatment. Since the absorption of iron salts may be impeded by the formation of insoluble complexes of these with phytates and other elements present in the diet, it is recommended that ingestion of iron sulfate occur on an empty stomach, one hour before meals.<sup>30</sup>

The multiple analysis of the present study, detecting interactions still not described in the literature between HAI, schooling and obtaining the supplement within the SUS, made it possible to investigate the greater complexity of this relation. Non-use of IS was significantly associated with not having obtained the supplement within the SUS (with a stronger association among pregnant women with lower levels of schooling and lower HAI) and not having succeeded in obtaining IS within the SUS (only among pregnant women with lower HAI).

The effect in isolation or combination of two of these three variables has already been reported in previous studies. The association between free, regular and good quality distribution of IS with greater adherence to use of the supplement has been widely documented in the literature.<sup>18,23,25</sup> A lower proportion of use of supplements containing iron has also been reported among women with lower income<sup>16</sup> or lower levels of schooling,<sup>19</sup> as well as

an association between low level of schooling and less use of IS among pregnant women on a low income.<sup>17,20</sup> Multiple analysis has shown the loss of association between illiteracy and lower proportion of use of the supplement once the variable relating to the number of supplements received has been introduced into the model.<sup>18</sup>

As for variables used as a proxy for income, pregnant Vietnamese women who received information by radio or television were significantly more likely to use IS, while knowledge of anemia did not produce this effect. The authors advance the hypothesis that this simplified "HAI" (restricted to radio and television) may provide important information on the economic situation of pregnant women, which is presumed to be related to adherence to treatment.<sup>23</sup>

The observations of the present study show that regular availability in reasonable quantity of IS within the SUS, in addition to the provision of adequate guidance to raise awareness of the need to obtain it, may increase use of the supplement, with consequent prevention of the development of iron deficiency anemia among pregnant women and a reduction in adverse gestational outcomes.

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