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Ferritin levels in pregnant Colombian women

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Abstract

Objective: **Ferritin deficiency is associated with many adverse health outcomes and is highly prevalent worldwide. The present study assesses the prevalence and socio-demographic factors associated with ferritin deficiency in a representative sample of pregnant women in Colombia.**

Methods: **We used data from the cross-sectional, nationally representative survey National Nutritional Survey (ENSIN, 2010). A total of 1,386, (13-49 years old) pregnant women were enrolled. Serum ferritin a concentration was determined by chemiluminescence and sociodemographic date (age, urbanicity geographic region, ethnicity and socioeconomic level-SISBEN), was assessed by computer-assisted personal interview technology. Multivariate analyses using unordered binomial logistic regression models were conducted in the main analysis.**

Results: **The overall prevalence of ferritin deficiency (serum <12μg/L) was 37.2% (95% CI 35.0% to 39.2%). The multivariate logistic regression no shows associated with a probability of serum ferritin deficiencies.**

Conclusion: **A significant prevalence of ferritin deficiency was found in our study population without an association with the studied sociodemographic factors.**

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Key words: *Nutrition. Pregnancy. Ferritin. Deficiency. Prevalence*.

NIVELES DE FERRITINA EN MUJERES GESTANTES DE COLOMBIA

Resumen

Objetivo: **La deficiencia ferritina se asocia con resultados adversos para la salud y es altamente prevalente en todo el mundo. El presente estudio evaluó la prevalencia y los factores sociodemográficos asociados con la deficiencia de ferritina en una muestra representativa de mujeres embarazadas de Colombia.**

Métodos: **Estudio descriptivo transversal, secundario de la información obtenida en la Encuesta Nacional de la Situación Nutricional 2010 (ENSIN 2010) en 1.386 mujeres gestantes entre los 13 y 49 años de edad. Los niveles plasmáticos de ferritina se determinaron por quimioluminiscencia, y los factores sociodemográficos evaluados (edad, etnia, puntaje de SISBEN, región y área geográfica) se recogieron por encuesta estructurada. Se establecieron asociaciones mediante la construcción de modelos de regresión binomial y factores asociados.**

Resultados: **Se encontró una prevalencia global de deficiencia de ferritina (<12μg/L) de 37.2% (IC95% 35.0 a 39.2%). En los modelos de regresión binomial no se encontraron factores sociodemográficos asociados a la deficiencia sérica de ferritina.**

Conclusiones: **A pesar de la importante prevalencia de déficit en los niveles séricos de ferritina en las mujeres gestantes evaluadas, no se observaron factores sociodemográficos asociados a esta deficiencia.**

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Palabras clave: *Nutrición. Gestación. Ferritina. Deficiencia. Prevalencia*.

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Introduction

Ferritin is an intracellular protein consisting of 24 subunits surrounding a core that can store up to 4,500 iron atoms. Plasma (or serum) ferritin concentrations are positively correlated with the amount of total body iron stores in the absence of inflammation[1]. A low concentration of serum ferritin reflects a decrease in these reserves and is produces an iron deficient state.

Currently, iron deficiency is the most common nutritional disorder in pregnant women in industrialized and developing countries[2]. According to UNICEF (1998)[3], approximately 41.8% of pregnant women have anemia due to iron deficiency. Maternal iron deficiency during the first half of pregnancy has been described to increase the risk of intrauterine growth retardation, premature birth and consequently perinatal mortality[4-6] . Furthermore, there is evidence of an increased risk of maternal and perinatal mortality in women with severe anemia during the last trimester[5,7].

Given the risk of nutritional iron deficiency in developing countries, measurement of the prevalence in vulnerable populations, such as pregnant women, is necessary to develop strategies to mitigate this problem[8]. The use of biochemical indicators have been proposed as biomarkers for iron stores, such as 'soluble' transferrin receptor in serum (*sTFR*) and a full hematological profile that includes hemoglobin and ferritin levels[9].

Given the importance of iron for general health, ferritin deficiency is a significant Public Health problem, and its study is a priority for various Health agendas (Profamilia, 2005)[10]. Several studies have documented that iron deficiencies are associated with cognitive dysfunction and poor school performance[9,11]. These effects may be irreversible; therefore, primary prevention by detection of iron deficiency in non-anemic individuals is paramount and justifies the need for this study. Considering the age dependence of iron and the limited understanding of iron levels during pregnancy, it is necessary to clarify which sociodemographic factors are associated with plasma ferritin concentrations in pregnant women.

Depleted iron stores are present before clinical evidence of anemia; therefore, ferritin is one of the most valuable indicators to determine early iron deficiency. This study evaluated the prevalence and sociodemographic factors associated with ferritin deficiency in a representative sample of pregnant women in Colombia.

Methods

The Colombian National Nutrition Survey (ENSIN) was conducted in 2010 by the Colombian Institute of Family Welfare (Instituto Colombiano de Bienestar Familiar)[12]. Details of the survey have been published elsewhere[12]. In brief, participants were selected to represent 99% of the country's population using a multistage stratified sampling scheme. All municipalities from the thirty-two departments in the country were grouped into strata based on similar geographic and sociodemographic characteristics. One municipality was randomly chosen from each stratum, with probability proportional to the population size. Clusters of about ten households each were then randomly chosen from within these strata and household members were invited to participate. The survey included 50,670 households, representing 4,987 clusters from 258 strata. Of the 12,437 women of childbearing age (13-49 years), 1,386 (11.1%) were pregnant. This study was approved by the ethics committee of the National Survey of Nutritional Status.

Serum ferritin was determined by chemiluminescence, using an automatic analyser (ADIVIA Centaur®). Low Serum ferritin level was used as an indicator of Iron deficiency and the cut-off for depleted Fe stores was defined as SF<12 µg/L. Our analysis excludes women with levels of C-reactive protein above1.2 mg/d[12].

The following sociodemographic variables were defined as associated factors: age (13 to 17, 18 to 29 and 30 to 49 years old); urbanicity (urban *or* rural); ethnicity grouped as: a) indigenous, b) black or afro-colombian and c) others (mestizo); geographic region: a) atlantic (north), b) eastern, c) central, d) pacific (west), e) Bogota and f) national territories (south); and social or socioeconomic status determined by the System of Identifying Potential Beneficiaries of Social Programs (SISBEN for its Spanish initials) (1 to 3, and 4 or more)[13]. The SISBEN is an index developed by the National Planning Department of Colombia that takes sociodemographic characteristics, living conditions and access to public services into consideration.

First, we conducted an exploratory analysis of the frequency distribution (measures of central tendency and dispersion for quantitative variables) and relative frequencies (for qualitative variables) using the *Pearson* χ^2 test with and without the *Yates* correction. To estimate the relationship between serum ferritin deficiency and sociodemographic variables in pregnant women (age, urbanicity geographic region, ethnicity and socioeconomic level-SISBEN), binary logistic regression models were used. The first adjusted model was for age, the second model was based on ethnic group, geographic area, socioeconomic levels and urbanicity, and the third model was adjusted by age, ethnic group, geographic area, socioeconomic levels and urbanicity. Odds ratios were considered a confounder if they shifted the model in a constant direction with a proportional increase in the exposure level of at least 10%. All analyses were conducted with the use of the complex survey design routines of the SPSS Statistical software package version 20.

Results

The study cohort consisted of 1,386 pregnant women between the ages of 13 and 40 years (mean age 23.9 years). Ferritin levels ranged from 1.5 to 387 µg/L (mean 25.0 µg/L, 95% CI 23.0 to 26.9 µg/L). Being between 13 and 17 years, living in the Central area and belonging to SISBEN level III showed the lowest average ferritin values (23.3 µg/L, 23.5 µg/L and 24.0 µg/L, respectively). A total of 37.2% of pregnant women had ferritin levels lower than 12 µg/L. Women of African descent, those living in the Atlantic (North) geographic area and those belonging to the age group of 18 to 29 years showed the largest ferritin deficiencies (41.3%, 42.4% and 39.4%, respectively). Additional ferritin values based on sociodemographic variables are shown in Table I.

Table II shows the results from a logistic regression analysis. No association was found between ferritin deficiency and the analyzed sociodemographic factors.

Discussion

The WHO estimates that approximately 33% of the global population has anemia, and at least half of these cases can be explained by ferritin deficiency (UNICEF, 1998)[3]. We found that approximately a third of pregnant women are deficient in ferritin stores (37.2%, 95% CI 35.0%-39.2%). This prevalence is similar to that found

Table I
Prevalence and socio-demographic factors associated with SF deficiency in Pregnant Colombian Women

Characteristics	*SF deficiency (<12 µg/L)*		*Adequate concentration (>12 µg/L)*	
	n	*%** (95% CI)*	*n*	*%** (95% CI)*
Total	518	37.2 (35.0-39.2)	868	62.8 (61.1-64.3)
Age (years)				
13 to 17	70	34.9 (28.3-39.5)	132	65.1 (61.7-67.4)
18 to 29	353	39.4 (37.0-41.6)	534	60.6 (58.5-62.3)
30 to 49	95	32.0 (27.2-35.6)	202	68.0 (65.2-70.0)
Socioeconomic levels				
Level I	321	38.0 (35.3-40.3)	512	62.0 (59.8-63.9)
Level II	45	37.4 (29.7-42.4)	87	62.6 (58.7-65.1)
Level III	33	32.3 (24.5-36.9)	54	67.7 (61.5-71.3)
Level > IV	119	37.0 (33.0-40.1)	215	63.0 (60.5-65.0)
Geographic area				
Atlantic (North)	141	41.3 (38.0-43.9)	184	58.7 (55.8-61.1)
Eastern	56	35.6 (30.2-39.5)	104	64.4 (60.8-66.8)
Central	102	36.9 (33.0-39.8)	181	63.1 (59.7-65.6)
Pacific (West)	66	33.7 (28.2-37.7)	131	66.3 (64.0-68.0)
Bogotá	29	37.3 (30.4-41.7)	49	62.7 (58.0-65.8)
National territories (South)	124	34.6 (30.4-37.6)	219	65.4 (61.6-68.2)
Urbanicity				
Urban	325	37.4 (34.8-39.6)	530	62.6 (60.8-64.2)
Rural	193	36.8 (33.4-39.5)	338	63.2 (60.6-65.3)
*Ethnic group**				
Indigenous	89	38.0 (32.0-41.9)	149	62.0 (56.6-65.4)
Black or Afro-Colombian	66	42.4 (36.8-46.4)	95	57.6 (53.8-60.2)
Others	359	36.3 (33.9-38.5)	621	63.7 (61.9-65.2)

SF: serum ferritin.
*All women analysed by ethnic group were n=1379, another 7 (seven) appertained to "Raizal del archipiélago" and "Palenquera de San Basilio", who were not analysed because this group do not have a representative sample.
**It is not correct to calculate the percentages from the "n" presented in this table, these calculations were taken from weight from the values given to each subject.

Table II
Socio-demographic factors associated with SF deficiency in Pregnant Colombian Women

Characteristics	*Bivariate*	*Adjusted model*[a]	*Adjusted model*[b]	*Adjusted model*[c]
Age (years)[d]				
13 to 17	1.14 (0.66-1.96)	1.14 (0.66-1.96)	1.07 (0.60-1.92)	1.07 (0.60-1.92)
18 to 29	1.38 (0.94-2.03)	1.38 (0.94-2.03)	1.38 (0.93-2.03)	1.38 (0.93-2.03)
Socioeconomic levels[e]				
Level I	1.28 (0.71-2.31)	1.32 (0.73-2.40)	1.26 (0.70-2.29)	1.30 (0.71-2.39)
Level II	1.25 (0.61-2.58)	1.20 (0.58-2.48)	1.24 (0.60-2.57)	1.20 (0.58-2.49)
Level > IV	1.23 (0.66-2.29)	1.23 (0.67-2.28)	1.26 (0.68-2.35)	1.27 (0.68-2.35)
Geographic area[f]				
Atlantic (North)	1.38 (0.90-2.13)	1.38 (0.89-2.13)	1.45 (0.92-2.28)	1.45 (0.92-2.30)
Eastern	1.09 (0.65-1.82)	1.08 (0.65-1.82)	1.20 (0.69-2.11)	1.21 (0.69-2.13)
Central	1.15 (0.73-1.83)	1.15 (0.73-1.83)	1.26 (0.76-2.09)	1.27 (0.77-2.12)
Bogotá	1.17 (0.66-2.08)	1.18 (0.66-2.10)	1.28 (0.69-2.39)	1.30 (0.70-2.43)
National territories (South)	1.04 (0.64-1.69)	1.04 (0.63-1.69)	1.13 (0.67-1.91)	1.13 (0.67-1.90)
Urbanicity[g]				
Urban	1.03 (0.75-1.40)	1.02 (0.75-1.40)	1.05 (0.75-1.46)	1.05 (0.75-1.46)
Ethnic group[h]				
Indigenous	1.08 (0.67-1.74)	1.10 (0.68-1.79)	1.15 (0.68-1.95)	1.18 (0.70-2.00)
Black or afro-colombian	1.29 (0.86-1.95)	1.31 (0.87-1.97)	1.36 (0.80-2.14)	1.37 (0.87-2.15)

SF: serum ferritin.
Odds ratios (95% confidence interval).
[a]adjusted by age.
[b]adjusted by ethnic group, geographic area, socioeconomic levels and urbanicity.
[c]adjusted by age, ethnic group, geographic area, socioeconomic levels and urbanicity.
[d]reference group: 30 to 49.
[e]reference group: level III.
[f]reference group: Pacific (West).
[g]reference group: rural.
[h]reference group: Others.

by Morasso et al.[13], 2002 (32%) in Argentina, which is a population with good health indicators, and the estimate reported by WHO (35%) for Latin America[3]. Our rate is less than previous reports for women of childbearing age in Colombia (17.1%, ICBF, 2010)[13]. Using the cutoff established by WHO (ferritin < 12.0 µg/L), we found that anemia is a mild public health problem in our study population (UNICEF, 1998)[3]. The prevalence observed in this study emphasizes previous studies that have shown anemia occurs early in pregnancy and is associated with a 2.66-fold increase in the relative risk of premature delivery and a 3.1-fold increased risk for low birth weight[4-6]. In addition, inadequate diets low in iron predispose pregnant women to an increased risk and severity of a range of diseases, such as preeclampsia, gestational diabetes and HELLP syndrome[9,11].

As previously observed in Colombia[3,14] and other countries[15,16], the highest prevalence of ferritin deficiency was found in people of African descent or those living in coastal areas (24.5 µg/L and 24.4 µg/L, respectively). This result is consistent with other studies from Nigeria[15] and India[16]. Ferritin deficiency has been associated with poverty, overcrowding and lack of public services, making the pregnant population more vulnerable.

In conclusion, a significant prevalence of ferritin deficiency was found in our study population without an association with the studied sociodemographic factors. Home strategies based on micronutrient fortification and nutritional surveillance have been successful at reducing deficiency of this micronutrient. In addition, the combined use of education and health and wellness strategies have produced viable and sustainable interventions.

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Conflict of interest

The authors declare that they have no conflict of interest.

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