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# INADEQUACIES IN THE TREATMENT OF IRON DEFICIENCY ANEMIA AMONG CHILDREN REGISTERED IN THE NATIONAL PROGRAM OF IRON SUPPLEMENTATION IN FLORIANOPOLIS, SANTA CATARINA, BRAZIL

*Francieli Cembranel[1], Arlete Catarina Tittoni Corso[2], David Alejandro González-Chica[3]*

[1] Doctoral student. Post-Graduate Program in Public Health, *Universidade Federal de Santa Catarina* (UFSC). Florianópolis, Santa Catarina, Brazil. E-mail: francielicembranel@gmail.com

[2] Ph.D. in Public Health. Professor, Nutrition Department and Post-Graduate Program in Nutrition, UFSC. Florianópolis, Santa Catarina, Brazil. E-mail: arlete.ufsc@gmail.com

[3] Ph.D. in Epidemiology. Professor, Nutrition Department, Post-Graduate Program in Nutrition, and Post-Graduate Program in Public Health, UFSC. Florianópolis, Santa Catarina, Brazil. E-mail: david.epidemio@gmail.com

**ABSTRACT**

**Objective**: to identify inadequacies in the treatment of iron deficiency anemia among children enrolled in the National Program of Iron Supplementation (*PNSF*) and treated at public primary health centers in Florianópolis, Santa Catarina, Brazil.

**Method**: a cross-sectional study was performed using secondary data obtained from the *InfoSaúde* system. Information was obtained on the ferrous sulfate dose prescribed for treating iron deficiency anemia, as well as demographic and anthropometric data of all children enrolled in the program in 2010. STATA 11.0 software was used in the analysis and p-values ≤ 0.05 were considered significant.

**Results**: sixty-eight (68) of the 834 children enrolled in the program in 2010 were diagnosed as anemic; 58 of whom received an indication to use ferrous sulfate.

**Conclusion**: children under six months of age (65.1%), living in economically deprived areas (66.7%) and with a height/age Z-score ≥ -1.0 (52.1%) were more prone to receive inadequate supplement dosage (<3 mg/kg/day). The results are relevant to educate health professionals about their role in effectively treating iron deficiency anemia.

**DESCRIPTORS**: Iron deficiency anemia. Comprehensive health care. Child. Therapeutic.

# INADEQUAÇÕES NO TRATAMENTO DA ANEMIA FERROPRIVA ENTRE CRIANÇAS CADASTRADAS NO PROGRAMA NACIONAL DE SUPLEMENTAÇÃO DE FERRO EM FLORIANÓPOLIS, SANTA CATARINA

**RESUMO**

**Objetivo**: identificar inadequações no tratamento da anemia ferropriva entre crianças cadastradas no Programa Nacional de Suplementação de Ferro e atendidas em centros de saúde da rede pública de Florianópolis Santa Catarina.

**Método**: estudo transversal com dados secundários do sistema InfoSaúde. Foram obtidas informações sobre a dose de sulfato ferroso prescrita para tratamento da anemia ferropriva, dados sociodemográficos e antropométricos de todas as crianças cadastradas no Programa Nacional de Suplementação de Ferro em 2010. O *software* STATA 11.0 foi utilizado nas análises e valoresp≤0,05 foram considerados significantes.

**Resultados**: das 834 crianças cadastradas no referido programa, em 2010, 68 foram diagnosticadas como anêmicas, das quais 58 receberam indicação para uso de sulfato ferroso.

**Conclusão**: crianças menores de seis meses (65,1%), residentes em áreas economicamente carentes (66,7%) e sem risco de déficit estatura/idade (escoreZ≥ -1,0 =52,1%) tiveram maior inadequação na dosagem do suplemento recebida (<3mg/kg/dia). Os resultados são relevantes para conscientizar profissionais de saúde sobre seu papel para um efetivo tratamento da anemia ferropriva.

**DESCRITORES**: Anemia ferropriva. Atenção integral à saúde. Criança. Tratamento.

# INADECUACIONES EN EL TRATAMIENTO DE LA ANEMIA POR DEFICIENCIA DE HIERRO EN LOS NIÑOS INSCRITOS EN EL PROGRAMA NACIONAL DE SUPLEMENTOS DE HIERRO EN FLORIANÓPOLIS, SANTA CATARINA, BRAZIL


**RESUMEN**

**Objetivo**: identificar deficiencias en el tratamiento de la anemia por deficiencia de hierro en los niños inscritos en el *Programa Nacional de Suplementação de Ferro* y tratados en los centros de salud pública de Florianópolis Santa Catarina, Brasil.

**Método**: estudio transversal con los datos secundarios del sistema InfoSaúde. Se obtuvo información sobre la dosis prescrita de sulfato de hierro para tratar la anemia por deficiencia de hierro, datos demográficos y antropométricos de los niños inscritos en *Programa Nacional de Suplementação de Ferro* en 2010. El software STATA 11.0 fue usado en el análisis y los valores de $p \leq 0,05$ se consideraron significativos.

**Resultados**: de los 834 niños inscritos en el programa, 68 fueron diagnosticados como anemia, de los cuales 58 recibieron indicación para el uso de sulfato ferroso.

**Conclusión**: los niños menores de seis meses (65,1%), que viven en zonas económicamente desfavorecidas (66,7%) y no hay riesgo de déficit de talla/edad (puntuaciónZ≥-1,0 =52,1%) fueron aquellos que recibieron dosificación más inadecuada del suplemento (<3mg/kg/día). Los resultados son relevantes para educar a profesionales de la salud acerca de su papel para el tratamiento eficaz de la anemia por deficiencia de hierro.


**DESCRIPTORES**: Anemia por deficiencia de hierro. Atención integral a la salud. Niño. Tratamiento.

## INTRODUCTION

Among the various nutritional deficiencies, iron deficiency stands out for being one of the most important and frequent public health problems in children.[1] Anemia is not only present in populations of high-income countries, but also in low- and middle-income countries. It is estimated that anemia is present in 43% of pre-school children worldwide.[1] In Brazil, data from the National Demographic Survey and Child and Women's Health (PNDS) conducted in 2009, revealed that one in four children was anemic.[2] According to a systematic review published in the same year, the prevalence of this disease is even more worrisome in the first two years of life, affecting up to 89.1% of children in this age group.[3]

Iron deficiency anemia has a considerable impact on children´s health, especially in the first two years of life, as it has been associated with motor capacity damage, learning impairments, behavioral changes, and reduced immunological capacity.[4-5] Despite its severity and accumulated knowledge on its etiology, anemia prevails as a serious public health problem in Brazil.[6] Efforts by various international and national organizations to develop guidelines and policies for preventing and reducing iron deficiency anemia in children, including Iron Supplementation Programs and Food Fortification programs, do not seem to achieve the expected effectiveness.[7-11]

The main focus in correcting iron deficiency is to increase hemoglobin blood levels,[12] considering that values below 11g/dL among children aged six to 59 months characterize a deficiency in this mineral.[8] Depending on the severity of iron deficiency and type of iron supplementation chosen, treatment dosage may range from 3 to 5 mg of elemental iron per kilogram (kg) of weight per day.[12-13] This recommendation aims to meet both mineral replacement and supply daily iron requirements for appropriate growth and development, given that during this period iron obtained from food is not sufficient to meet these demands.[12-14] However, the low efficiency of different therapeutic regimens used over the past decades for anemia treatment is striking. Several possibilities can be considered for explaining this occurrence; from a lack of effectiveness of the implemented treatments to problems in the bioavailability of the different iron salts and dosages, or even inadequate prescription and/or adherence to treatments, mainly due to the occurrence of side effects attributed to iron supplementation.[1,15-16]

Thus, given this prior knowledge, and considering the magnitude of anemia as a public health issue, the present study was developed aiming to identify possible inadequacies in treating iron deficiency anemia among children who were attended in public primary health centers in Florianópolis, Santa Catarina, Brazil, and enrolled in the National Program of Iron Supplementation (PNSF)[10] in 2010. The study also aimed to analyze this information according to sociodemographic characteristics and nutritional status to help identify child segments that are more exposed to anemia and inadequacies in their treatment, which may be the target of public health actions for correctly treating this disease.

## METHOD

The study was carried out in the city of Florianópolis, the state capital of Santa Catarina, Southern Brazil. According to the population census conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2010, Florianópolis had a population of approximately 421,240 inhabitants, among which 18,222 were children up to four years of age.[17]

This is a cross-sectional study, using secondary data from the *InfoSaúde* system (version 3.4.5.45). This system was created in 2002 by the Informatics Department of the Municipal Health Department (*SMS*) of Florianópolis, storing individual medical records of all patients attended at computerized health centers of the public network in the municipality. At the beginning of 2010, 35/49 health centers in the public health network in Florianópolis had implemented the *InfoSaúde* system.[18] Data for this study was obtained from these 35 computerized health centers, which were distributed in the five health districts of the municipality: Central (5/6), Mainland (9/11), East (4/9), North (6/11) and South (11/13). The population served in these 35 health centers corresponds to 80% of the total residents of the municipality. Gender and age distribution of the population was similar among those living or not living in the areas covered by *InfoSaúde*.[19]

According to the Ministry of Health, all children under two years of age who attended public health centers at the municipality should have been enrolled in the PNSF,[10] and therefore registered in the *InfoSaúde* system. For that reason, all children enrolled in the *PNSF* in Florianópolis in 2010 were considered eligible for this study. Obtaining the information of interest[20] took place in two stages (Figure 1 shows the study flowchart). Firstly, all *PNSF* records were checked between July and October 2011 to identify all children enrolled in that program in 2010. Secondly, electronic medical records of all these children were reviewed. Access to the medical records was carried out directly at the Informatics Department of the SMS and information obtained from the system was identified.

Three different indicators were considered as dependent variables of the study. The first indicator evaluated was the availability of laboratory blood examination for hemoglobin levels (yes/no), regardless of the presence of the corresponding results in the electronic medical records. It is noteworthy that this laboratory blood test is not a requirement of the *PNSF*, although it could be considering the high prevalence of anemia in the investigated age group.[1,10]

A second indicator was the presence of anemia among those whose hemoglobin laboratory results was recorded. In order to establish the diagnosis of anemia, the World Health Organization (WHO)[8] criterion was adopted (hemoglobin level below 11.0 g/dL for children between six months and six years of age).

The third evaluated indicator was the ferrous sulfate dosage prescribed by the physician for treating anemia (mandatory registration information in the *InfoSaúde*). The different prescribed iron dosages (drops, mL, prophylactic dose on a daily or weekly schedule) were standardized in mg of elemental iron per kg/day. This standardization allowed to identify if the prescriptions for treating anemia were according to the recommendations (at least 3 mg iron/kg/day).[14]

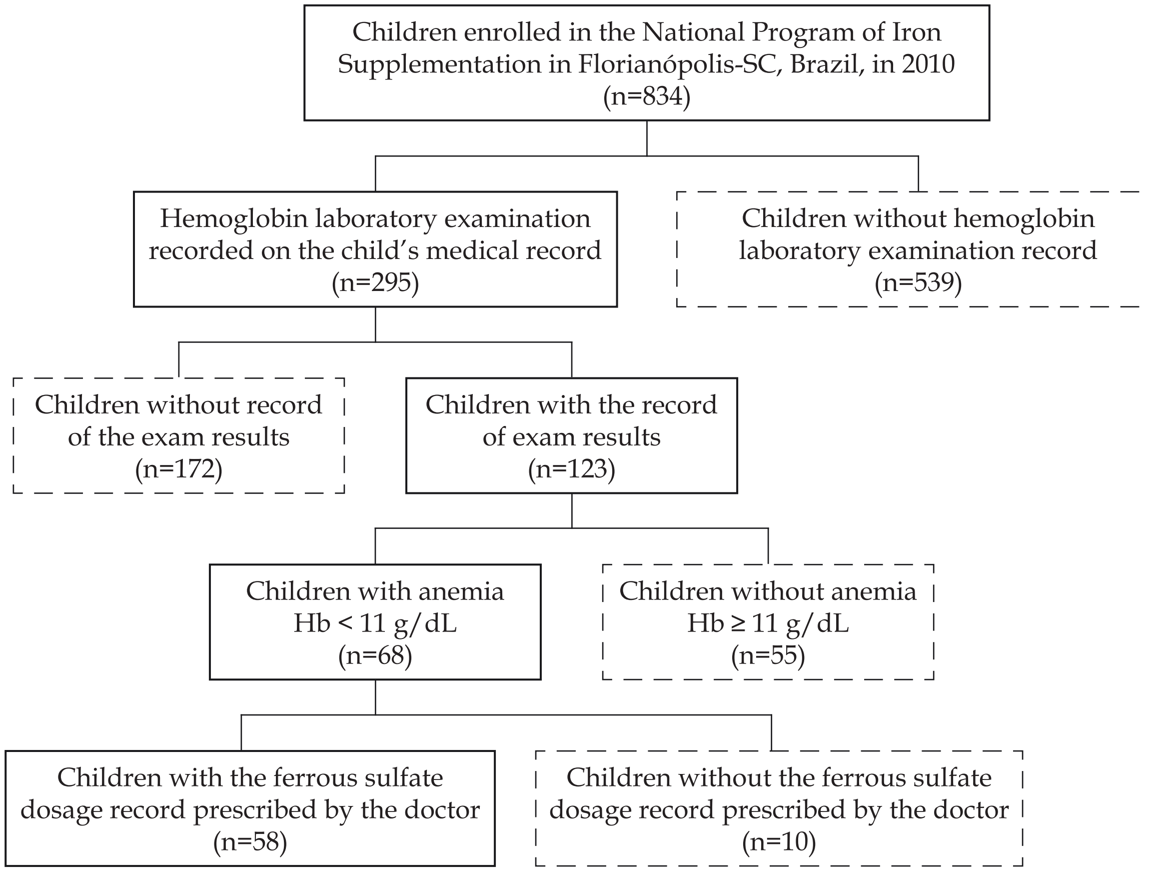


**Figure 1 - Study Flowchart, Florianópolis-SC, 2014**

Independent variables investigated in this study were also obtained from *InfoSaúde* and include child's gender (female or male); child's age (0-6 months, 7-12 months, 13-24 months); mother's skin color (white, black, brown, asiatic, or indigenous); mother's education level in years of studying (0-8, 9-11, 12 or more); and geographical location of the health center (Center, Mainland, East, North and South).

In addition to sociodemographic variables, anthropometric data regarding weight (kg) and height (cm) were also obtained from the medical records and used to evaluate the child's nutritional status at the time of the hemoglobin test. Nutritional status was evaluated through height/age indexes and body mass index (BMI)/age, expressed as mean Z-scores using the WHO Anthro 2005 software (Department of Nutrition, WHO, Geneva, 2006), and the following cut-off points proposed by WHO (2006):[21] Z-score < -1.0 nutritional risk and Z-score ≥ -1.0 no risk of malnutrition.

Data corresponding to the dependent and independent variables were typed in a spreadsheet using the *Microsoft Office Excel®* 2007 program (*Microsoft Corp*., United States), and double checked to avoid possible typing errors. Statistical analysis was performed using the STATA 11.0 software (*Stata Corp., College Station*, United States). The number of health centers included in the study as well as the population covered by them were considered to estimate sample weights, and a set of STATA survey commands used in the analyzes. For descriptive statistics, data was presented as prevalence with their respective 95% confidence intervals (95% CI), adopting the Chi-Square statistical test with Rao-Scott correction to verify possible associations between the variables in the bivariate analyzes. Student's t-test was also used to compare the mean Z-score of the anthropometric indices in anemic compared to non-anemic children. A p-value ≤0.05 was considered as statistically significant.

The project received formal authorization from the SMS Florianopolis and was approved by the Ethics Committee in Research with Human Beings of the *Universidade Federal de Santa Catarina* (2042/2011). There are no conflicts of interest to declare.

## RESULTS

Of the 834 children identified as registered in the PNSF in 2010, 295 (35.4%) had their hemoglobin laboratory examination registered in their records. Except for child´s age (P<0.001), no differences were found according to sociodemographic variables or anthropometric indices among the 295 children who had their hemoglobin laboratory exam recorded and the 539 who did not (Table 1).

**Table 1 - Distribution of children with and without hemoglobin laboratory examination record according to sociodemographic characteristics and nutritional status. Florianópolis-SC, Brazil, 2014**

| Variables | No hemoglobin laboratory examination record % (95%CI) (n= 539) | With hemoglobin laboratory examination record % (95%CI) (n= 295) | p-value* |
|---|---|---|---|
| Gender | | | |
| Female | 48.3 (44.9 - 51.8) | 43.6 (40.3 - 47.1) | 0.202 |
| Male | 51.7 (48.2 - 55.1) | 56.4 (52.9 - 59.8) | |
| Child's age | | | |
| 0 - 6 months | 52.7 (49.3 - 56.2) | 34.6 (31.4 - 38.0) | 0.001 |
| 7 - 12 months | 39.7 (36.4 - 43.1) | 45.9 (42.5 - 49.4) | |
| 13 - 24 months | 7.5 (5.9 - 9.6) | 19.4 (16.8 - 22.3) | |
| Mother's skin color † | | | |
| White | 81.0 (78.0 - 83.7) | 77.4 (74.2 - 80.3) | 0.226 |
| Black, brown, yellow, indigenous | 19.0 (17.1 - 22.9) | 22.6 (19.7 - 25.8) | |
| Mother's education level† | | | |
| 0 - 8 years | 50.6 (47.0 - 54.2) | 46.2 (42.7 - 49.9) | 0.135 |
| 9 - 11 years | 40.8 (37.3 - 44.3) | 47.7 (44.1 - 51.3) | |
| ≥ 12 years | 8.7 (6.8 - 10.9) | 6.1 (4.4 - 8.0) | |
| Geographic location of the health center | | | |
| Center | 23.7 (20.9 - 26.8) | 28.9 (25.8 - 32.1) | 0.104 |
| Mainland | 13.7 (11.4 - 16.2) | 17.6 (15.1 - 20.4) | |
| East | 6.7 (5.1 - 8.6) | 3.3 (2.1 - 4.7) | |
| North | 23.4 (20.6 - 26.4) | 21.3 (18.6 - 24.3) | |
| South | 32.5 (29.3 - 35.8) | 29.0 (26.0 - 32.2) | |
| Anthropometric indexes‡ | | | |
| Height/Age (Z score < -1.0) | 17.2 (11.1 - 24.1) | 22.1 (15.3 - 29.5) | 0.101 |
| Height/Age (Z score ≥ -1.0) | 82.8 (79.5 - 85.7) | 77.9 (74.3 - 81.0) | |
| BMI/Age (Z score < -1.0) | 10.1 (5.0 - 19.2) | 13.7 (7.5 - 23.4) | 0.133 |
| BMI/Age (Z score ≥ -1.0) | 89.9 (87.3 - 92.1) | 86.3 (83.4 - 88.8) | |

95%CI: 95% Confidence Interval. * p-value of the chi-square test. † Maternal variables with missing data, where children without laboratory examination n=497 and children with laboratory examination n=266. ‡ Child's variable with missing data, where children without laboratory examination n=488, and children with laboratory examination n=262.

Among the 295 children whose hemoglobin laboratory tests were registered, only 123 had the result of their hemoglobin level recorded in their electronic medical record. Table 2 shows the characteristics of these 123 children distributed in two groups: anemic (55.3%; 95%CI 46.1% -64.3%) and non-anemic children. In general, no differences were found according to sociodemographic variables or nutritional status between the two groups, although a predominance of males, children in the age group of 7-12 months, with mothers having white skin color and lower educational level (≤ 8 years of study), and children with better nutritional status (Z-score ≥ -1.0) was observed in the group of anemic children. Regarding the geographical location of the health center, a greater percentage of anemic children were identified in the health centers of the Center, Mainland and North health districts of Florianópolis-SC.

**Table 2 - Distribution of children with and without anemia according to sociodemographic characteristics and nutritional status. Florianópolis-SC, 2014**

| Variables | With anemia (Hb<11 g/dL) % (95%CI) (n=68) | Without anemia (Hb≥11 g/dL) % (95%CI) (n=55) | p-value* |
|---|---|---|---|
| Gender | | | |
| Female | 36.6 (28.1 - 45.7) | 48.1 (38.9 - 57.2) | 0.225 |
| Male | 63.4 (54.3 - 71.9) | 51.9 (42.8 - 61.1) | |
| Child's age | | | |
| 0 - 6 months | 34.9 (26.6 - 44.1) | 23.3 (16.4 - 32.1) | 0.342 |
| 7 - 12 months | 40.7 (31.9 - 49.9) | 52.4 (42.8 - 61.1) | |
| 13 - 24 months | 24.3 (17.1 - 33.0) | 24.3 (17.1 - 33.0) | |
| Mother's skin color† | | | |
| White | 74.0 (64.6 - 81.5) | 81.2 (73.2 - 88.2) | 0.361 |
| Black, brown, yellow, indigenous | 26.0 (18.5 - 35.4) | 18.8 (11.8 - 26.8) | |
| Mother's education level† | | | |
| 0 - 8 years | 51.0 (41.4 - 60.4) | 42.4 (32.9 - 51.7) | 0.346 |
| 9 - 11 years | 40.8 (32.1 - 50.8) | 53.7 (43.9 - 62.9) | |
| ≥ 12 years | 8.2 (3.7 - 14.5) | 3.9 (1.0 - 8.7) | |
| Geographic location of the health center | | | |
| Center | 38.6 (29.6 - 47.4) | 28.5 (20.7 - 37.3) | 0.375 |
| Mainland | 20.8 (14.3 - 29.4) | 16.5 (10.2 - 24.0) | |
| East | 2.4 (0.5 - 7.0) | 3.0 (0.9 - 8.1) | |
| North | 22.1 (15.0 - 30.3) | 15.9 (10.2 - 24.0) | |
| South | 16.1 (10.2 - 24.0) | 36.1 (27.3 - 44.9) | |
| Anthropometric indexes‡ | | | |
| Height/Age (Z score < -1.0) | 20.7 (11.2 - 33.4) | 16.0 (7.2 - 29.1) | 0.532 |
| Height/Age (Z score ≥ -1.0) | 79.3 (66.7 - 88.8) | 84.0 (70.9 - 92.8) | |
| BMI/Age (Z score < -1.0) | 25.9 (15.3 - 39.0) | 14.0 (5.8 - 26.7) | 0.127 |
| BMI/Age (Z score ≥ -1.0) | 74.1 (61.0 - 84.7) | 84.0 (73.3 - 94.2) | |

95%CI: 95% Confidence Interval. * p-value of the chi-square test. † Maternal variables with missing data, where Children with anemia n=62, and children without anemia n=52; ‡ Child's variable with missing data, where children with anemia n=58, and children without anemia n=50.
The WHO (2001) criterion was adopted for the diagnosis of anemia, which considers children aged 6 months to 6 years presenting hemoglobin levels below 11.0 g/dL as anemic.

Table 3 presents the mean of hemoglobin levels, height/age and BMI/age Z-scores, and age of anemic and non-anemic children. Only the hemoglobin levels were different between the groups (p<0.001).

**Table 3 – Mean hemoglobin, anthropometric indices and age of the sample and of children with and without anemia enrolled in the National Program of Iron Supplementation. Florianópolis-SC, 2014**

| Variables | Sample (Mean±SD) | Children with anemia (Mean±SD) | Children without anemia (Mean±SD) | p-value* |
|---|---|---|---|---|
| Hemoglobin levels (g/dL) (n= 123) | 10.8 ± 1.2 | 9.9 ± 0.8 | 11.8 ± 0.5 | 0.001 |
| Height/age (Z score) (n= 108)† | 0.10 ± 1.3 | 0.09 ± 1.3 | 0.1 ± 1.3 | 0.895 |
| BMI/Age (Z score) (n= 108)† | 0.04 ± 1.2 | 0.01 ± 1.3 | 0.08 ± 1.1 | 0.764 |
| Age (months) (n= 123) | 10.7 ± 3.7 | 9.8 ± 3.8 | 10.4 ± 3.6 | 0.441 |

SD: standard deviation; * p-value of the T-test; † Variables with missing data

Table 4 presents a comparison of the mean daily iron dosage received by anemic children for treating their condition (children with laboratory diagnosis and supplementation dose prescribed by a physician, n=58), . Generally speaking, children residing in the Central and Southern health districts, and those with adequate height for age (Z-score ≥ -1.0) were those that received lower mean iron dosage per kg/day than the minimum amount recommended for treating anemia (3 mg/kg/day; p<0.05 in both cases). Moreover, female children younger than six months with mothers having white skin color and a higher educational level were those that presented the highest percentage of inadequacy. However, these differences were not statistically significant. A statistical significance was found only for the height/age variable (52.1% for those with Z-score ≥ -1.0, p=0.04), and for the residing health district (66.7% inadequacy for residents in the Central and Southern districts, p=0.026).

**Table 4 - Comparison of the prescribed dosage of ferrous sulphate with the recommendations by the Brazilian Pediatrics Society (3 mg/kg/day) among children with a laboratory diagnosis of anemia and record of ferrous sulfate dose prescribed by the physician. Florianópolis-SC, 2014. (n=58)**

| Variables | Ferrous sulphate dosage in mg/kg/day | | Inadequacy of the prescribed dose (< 3 mg/kg/day) | p-value† |
|---|---|---|---|---|
| | Median (p25-p75) | p-value* | % (95%CI) | |
| Gender | | | | |
| Female | 2.9 (0.5 - 4.3) | 0.321 | 49.4 (36.6 - 63.4) | 0.825 |
| Male | 3.3 (1.3 - 4.6) | | 46.5 (33.3 - 60.1) | |
| Child's age | | | | |
| 0 - 6 months | 2.2 (0.9 - 4.1) | 0.153 | 65.1 (51.9 - 77.5) | 0.112 |
| 7 - 12 months | 3.7 (2.1 - 4.9) | | 33.5 (21.0 - 46.3) | |
| 13 - 24 months | 3.1 (1.0 - 4.6) | | 42.2 (28.6 - 55.1) | |
| Mother's skin color† | | | | |
| White | 2.7 (0.5 - 4.6) | 0.650 | 53.5 (38.6 - 66.7) | 0.280 |
| Black, brown, Asiatic, indigenous | 3.3 (1.9 - 4.3) | | 37.0 (24.8 - 52.1) | |

| Variables | Ferrous sulphate dosage in mg/kg/day | | Inadequacy of the prescribed dose (< 3 mg/kg/day) | p-value† |
|---|---|---|---|---|
| | Median (p25-p75) | p-value* | % (95%CI) | |
| Mother's education level† | | | | |
| 0 - 8 years | 3.2 (0.5 - 4.6) | 0.951 | 43.2 (29.8 - 57.7) | 0.355 |
| 9 - 11 years | 3.0 (1.0 - 4.2) | | 47.9 (33.3 - 61.4) | |
| ≥ 12 years | 2.4 (1.8 - 2.5) | | 79.9 (65.9 - 89.2) | |
| Geographic location of the health center | | | | |
| Center | 1.9 (0.4 - 4.4) | 0.008 | 66.7 (53.7 - 79.0) | 0.026 |
| Mainland | 3.6 (3.2 - 4.4) | | 25.0 (15.3 - 39.0) | |
| East[a] | - | | - | |
| North | 4.5 (4.0 - 4.9) | | 2.0 (1.1 - 3.3) | |
| South | 2.5 (1.9 - 3.1) | | 66.7 (53.7 - 79.0) | |
| Anthropometric indexes‡ | | | | |
| Height/Age (Z score < -1.0) | 4.4 (3.8 - 5.2) | 0.009 | 11.5 (4.5 - 24.3) | 0.040 |
| Height/Age (Z score ≥ -1.0) | 2.7 (0.9 - 4.0) | | 52.1 (37.4 - 66.3) | |
| BMI/Age (Z score < -1.0) | 1.8 (0.5 - 4.9) | 0.615 | 61.1 (47.2 - 75.4) | 0.251 |
| BMI/Age (Z score ≥ -1.0) | 3.1 (1.9 - 4.3) | | 40.2 (26.4 - 54.8) | |

95%CI: 95% Confidence Interval; a - No records of anemia treatment in this geographical area. * p-value of the Kruskal-Wallis test; † p-value of the Chi-square test; ‡ Maternal variables with missing data, where children with prescribed dosage of ferrous sulfate n=53; § Maternal variables with missing data, where children with prescribed dosage of ferrous sulfate n=50.

## DISCUSSION

The purpose of this study was to identify possible inadequacies in the treatment of iron deficiency anemia among children enrolled in the PNSF in Florianópolis, SC, Brazil. Based on our results, three main conclusions can be highlighted. First, laboratory exams for blood hemoglobin levels were performed in a little more than a third of the children, but in less than half of them the examination results were registered in their medical records. Second, among anemic children, 85.3% of the medical records included the physicians' prescription for using iron to treat the disease. Finally, a high percentage of inadequacy of the prescribed ferrous sulfate dosage was found, especially among females, children under the age six months, those who attended health centers in the Central and Southern districts of the municipality, and among those who were not at risk of height/age deficit.

Nutritional anemia due to iron deficiency begins early in life and is related to prematurity and low birth weight, early weaning and inadequate complementary feeding initiated after birth.[22] In Brazil, it is estimated that up to 54% of children under two years of age are anemic.[23] For that reason, several national health policies were implemented, such as the corn and wheat flour iron and folic acid fortification[7,11] and the *PNSF*,[10] which intended to offer iron supplementation to all children in the age group of six to 18 months.

Despite all these investments to prevent and reduce the prevalence of this disease in children, anemia still remains as a neglected disease.[7-9] This is especially because those strategies are not always fully or properly implemented. For example, of the total number of children in the PNSF age group in Florianópolis in 2010 (n=13,197), only 834 were identified as being enrolled in the program, and only 2.4% started and concluded their supplementation with the recommended periodicity for their age group.[20] Moreover, due to its prophylactic nature, the PNSF does not recommend prescribing a laboratory examination to verify the levels of hemoglobin, which is especially important after the age of six months when organic reserves of iron acquired during pregnancy tend to deplete, making the child more susceptible to anemia. Conducting a more thorough examination in this period could guide health professional's behavior regarding the objective of the prescription, whether prophylactic or therapeutic, as an early intervention can increase the quality of life of the child, avoiding the long-term negative repercussions of this disease.[10]

In the present study, blood test examinations were requested for approximately one-third of the children included in the PNSF, and among these, only 42.0% had their hemoglobin levels recorded in the medical record, and 55.3% of them had anemia. These findings are similar to the results included in a systematic review,[23] which showed 60.2% of children under the age five years age attending public health services in Brazil were anemic. What is most striking about these results was the low number of children who had the examination results registered in their medical record, which may be indicative of health professionals failing to record the information or because the child did not return to the consultations during the first year of life. Although adequate filling of information systems is fundamental for planning and management of health services, a high degree of omission in completing medical records has been observed in clinical practice, mainly due to the low epidemiological value given to that kind of information.[24]

Additionally, of the 68 children diagnosed as anemic, only 85.3% had a record of prescriptions for the use of iron salts. This result is quite serious considering that among anemic children, 10 had no record of any treatment indication, and 12 were recommended the PNSF prophylactic dose (25 mg of elemental iron once a week - data not included in the tables), a much lower dosage than that required for treatment of this disease. The recommended doses vary from 3 to 5 mg of elemental iron per kg/day for a period of two to six months, depending on the intensity of anemia, tolerance to treatment and correction of the cause that led to iron deficiency.[14-15] It is known that early treatment of anemia is essential during early childhood.[25] Complete adequacy to this recommendation, however, was not observed in the present study. According to the analyzed data, children up to six months of age were the ones with the highest percentage of inadequacy regarding the treatment dose received (almost twice as high as in older children).

In addition, it was still possible to verify that children at nutritional risk (height/age Z-score <-1.0) were those with the lowest percentage of inadequacy regarding the ferrous sulfate dose for treating anemia. Therefore, our results suggest that the choice of treatment dosage may be influenced by the physical appearance of the children and not necessarily by the hemoglobin laboratory results. In addition, the study also identified that anemic children presented lower height/age and BMI/age Z-scores than non-anemic, although the last difference was not statistically significant. This result was similar to that found by other authors who analyzed the same relationship among children enrolled in day care centers in Belo Horizonte, Minas Gerais.[26] According to these authors, one of the hypotheses explaining the relationship between anemia and nutritional risk/malnutrition is that both nutritional conditions present common risk factors, such as an inadequate diet, difficulties in accessing health care, and lower parental educational levels. Other authors have also found an association of these nutritional conditions with socioeconomic variables.[27] In this study, this relationship becomes clear when we observe that a higher prevalence of inadequacy in the supplement dosage received among anemic children was identified among those served by health centers in the Central and Southern areas of the municipality, services that mostly attend to the most economically deprived population in Florianópolis.[28]

Finally, the use of secondary data is a limitation of this study. Using secondary data often restricts the study to the available variables, making the investigation of other determinants unfeasible. Moreover, the use of this type of data imposes the need to work with missing information on the records. However, it is unlikely that such limitation affected the scientific contribution of this investigation, as the study was carried out with data from 35 health centers, and the individuals using these services are representative of the municipality's population in this age group. It should be emphasized, however, that the external validity of the results found by this study should be carefully analyzed, since the PNSF coverage in Florianópolis in 2010 was low.[20] Still, our results can be considered as an initial exploratory analysis with the purpose of guiding further investigations with primary data, adequate sample size and that include all children attended by the health centers.

## CONCLUSION

The results of this study are relevant to raise awareness among health professionals of the importance of their performance for effective control and treatment of iron deficiency anemia. Parallel to this, we also recommend incorporating an examination of hemoglobin levels as part of the PNSF, considering the high percentages of anemia among children under two years of age, and which could guide the prescription of adequate ferrous sulfate doses when children are diagnosed with anemia. We also suggest encouraging a routine procedure for completing information systems, which can be useful for evaluating and planning health actions.

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Correspondence: Francieli Cembranel
Programa de Pós-Graduação em Saúde Coletiva
1º andar do Bloco H do Centro de Ciências da Saúde
Universidade Federal de Santa Catarina
88040-900 – Trindade, Florianópolis, SC, Brasil
E-mail: francielicembranel@gmail.com

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