

Incidence of Hospitalizations Due to Iron Deficiency Anemia in the Metropolitan Region of Porto Alegre/RS

Incidência de Internações por Anemia Ferropriva na Região Metropolitana de Porto Alegre/RS

Incidencia de Hospitalizaciones por Anemia Ferroférica en la Región Metropolitana de Porto Alegre/RS

RESUMO

Este estudo teve como objetivo verificar a incidência de internações por anemia ferropriva na Região Metropolitana de Porto Alegre (RMPA), entre janeiro de 2020 e julho de 2025, utilizando dados do Departamento de Informática do Sistema Único de Saúde (DATASUS). Foram registradas 1.507 internações no período analisado, com maior ocorrência no município de Canoas, seguido de Porto Alegre, Gravataí e Triunfo. A maioria dos casos foi observada em mulheres (59,59%) e em pessoas brancas (83,1%). Esses achados evidenciam a necessidade de fortalecer políticas públicas voltadas à prevenção e ao diagnóstico precoce da deficiência de ferro, especialmente em grupos vulneráveis.

DESCRIPTORES: Anemia Ferropriva; Epidemiologia; Hospitalização; Saúde Pública; Anemia Hipocrômica.

ABSTRACT

This study aimed to assess the incidence of hospitalizations due to iron deficiency anemia in the Metropolitan Region of Porto Alegre (MRPA) between January 2020 and July 2025, based on data from the Department of Informatics of the Brazilian Unified Health System (DATASUS). A total of 1,507 hospitalizations were recorded during the analyzed period, with the highest incidence in Canoas, followed by Porto Alegre, Gravataí, and Triunfo. Most cases occurred among females (59.59%) and White individuals (83.1%). These findings highlight the need to strengthen public health policies focused on the prevention and early diagnosis of iron deficiency, particularly among vulnerable populations.

DESCRIPTORS: Anemia, Iron-Deficiency; Epidemiology; Hospitalization; Public Health; Anemia, Hypochromic.

RESUMEN

Este estudio tuvo como objetivo verificar la incidencia de hospitalizaciones por anemia ferropénica en la Región Metropolitana de Porto Alegre (RMPA), entre enero de 2020 y julio de 2025, utilizando datos del Departamento de Informática del Sistema Único de Salud (DATASUS). Se registraron 1.507 hospitalizaciones durante el período analizado, con mayor incidencia en el municipio de Canoas, seguido de Porto Alegre, Gravataí y Triunfo. La mayoría de los casos ocurrió en mujeres (59,59%) y en personas blancas (83,1%). Estos resultados evidencian la necesidad de fortalecer las políticas públicas orientadas a la prevención y al diagnóstico temprano de la deficiencia de hierro.

DESCRIPTORES: Anemia Ferropénica; Epidemiología; Hospitalización; Salud Pública; Anemia Hipocrômica.

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INTRODUCTION

Anemia is defined by the World Health Organization (WHO) as an increase or decrease in the size of red blood cells, accompanied by a reduction or not in hemoglobin concentration. According to WHO estimates, anemia affects about 30% of the world's population⁽¹⁾. The etiology of anemia is characterized by abnormal hemoglobin biosynthesis. Developing red blood cells require iron, protoporphyrin, and globin in optimal amounts for hemoglobin production. In this sense, anemias characterized by hemoglobin synthesis can be divided into three groups, depending on which of the three compounds is deficient. In the group of anemias characterized by iron metabolism disorders, iron deficiency anemia is one of the most common⁽²⁾. The symptoms of this disease include fatigue, headache, weakness, poor growth and development, irritability, exercise intolerance, and paleness. In cases of excessive iron deficiency, there may be a desire to eat dirt, paper, starch, among other things⁽³⁾.

Among the etiological factors, one of the most important causes of iron deficiency anemia is poor iron intake. Iron is one of the most studied and best described micronutrients in the literature, performing important functions in human metabolism, such as oxygen transport and storage, energy release reactions in the electron transport chain, conversion of ribose to deoxyribose, cofactor of some enzymatic reactions, and numerous other essential metabolic reactions

In the diet, iron can be found in two forms: organic or heme iron (heme form) and inorganic or non-heme iron (non-heme form). Heme iron is found in hemoglobin and myoglobin, which come from meat in general, poultry, and fish⁽²⁾. Non-heme iron is present in plant-based foods, found in the form of ferric complex, which during digestion is partially reduced to ferrous form, which is more easily absorbed, under the action of hydrochloric acid, bile, and pancreatic juice⁽⁵⁾. Iron deficiency in the body is divided into three stages. Pre-latent iron deficiency or iron depletion refers to a reduction in reserves (serum ferritin) without a reduction in serum iron levels⁽²⁾. The diagnosis of the first stage of iron deficiency is made by measuring serum ferritin. Thus, serum ferritin below 15 ng/mL is attributed to iron deficiency anemia, while values above 100 ng/mL virtually rule out this diagnosis, even in the presence of inflammatory disease or liver disease. The measurement of hemosiderin in the bone marrow can also be used as an indicator of depletion. However, as it is an invasive method, it is not recommended for screening⁽¹⁾.

The second stage of iron deficiency corresponds to a decrease in iron transport. This stage is characterized by a decrease in serum iron and an increase in iron-binding capacity, and these changes result in decreased transferrin saturation⁽¹⁾. As well as an increase in total iron-binding capacity (TIBC). Iron deficiency anemia occurs when the hemoglobin concentration in the blood is below the lower limit of normal, with microcytic eryth-

rocyte production also occurring.

There are several hematological and biochemical parameters that reflect the three stages of iron deficiency and can be used alone or in combination to diagnose the nutritional status of iron in individuals or populations. The diagnosis is made through clinical history (focusing on food consumption and blood loss), physical examination, and laboratory investigation. Patients with iron deficiency have lower serum iron, elevated transferrin, and low transferrin saturation. A complete blood count may show a decreased white blood cell count, hematocrit, serum iron, and hemoglobin concentration. A blood smear shows that the erythrocytes are microcytic (smaller than normal) and hypochromic (lighter than normal)⁽³⁾.

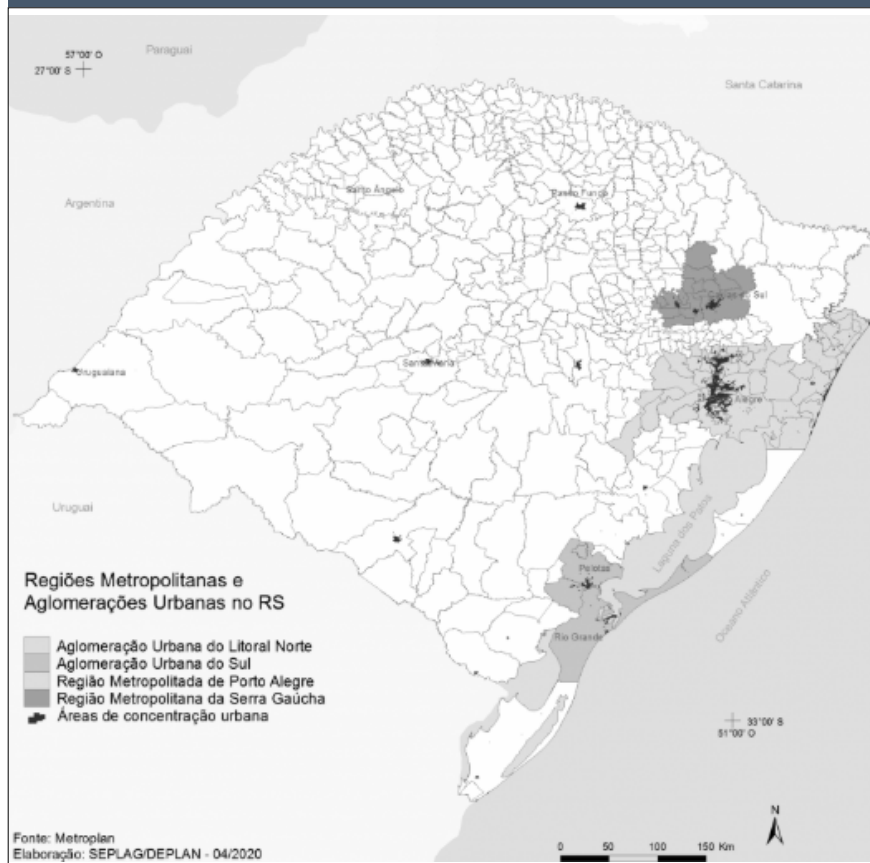
Serum ferritin (SF) is a parameter used to assess body iron stores. It is considered a useful measure because it uses peripheral blood and correlates strongly with iron stored in tissues, in addition to being assessed by highly accurate methods (radioimmunoassay, enzyme immunoassay, or chemiluminescence). TFBC may increase even before iron stores are completely depleted, reflecting depletion of stores; however, it is less sensitive than SI.11 The normal range for TFBC varies between 45 and 70 $\mu\text{mol/L}$ (250-390 $\mu\text{g/dL}$)⁽⁴⁾. Another parameter for assessing iron available to tissues is free erythrocyte protoporphyrin (FEP), since a reduction in iron supply to erythrocytes results in an increase in the concentration of free protoporphyrin within these cells⁽²⁾. At the clinical level, zinc protoporphyrin has

not been used, as it does not appear to correlate with other parameters. The criteria indicated by the World Health Organization (WHO) for diagnosing anemia are based on hemoglobin concentration, considering men, women of childbearing age, and pregnant women with values below 13 g/dL, 12 g/dL, and 11 g/dL, respectively, to be anemic⁽⁴⁾. The objective of this article is to verify the incidence of hospitalizations due to iron deficiency anemia in the metropolitan region of Porto Alegre, with the aim of identifying the municipality with the highest number of cases, as well as the sex and race of those hospitalized.

METHOD

Rio Grande do Sul, one of Brazil's 27 federal units, is located in the southern region and is bordered by the state of Santa Catarina to the north, Argentina to the west, Uruguay to the south, and the Atlantic Ocean to the east. The Metropolitan Region of Porto Alegre (RMPA), also known as Greater Porto Alegre, is the largest metropolitan region in the southern region of Brazil with approximately 4.3 million inhabitants, and the fifth most populous in the country (Figure 1). It is composed of 34 municipalities, the largest of which in terms of population is Porto Alegre, followed by Canoas and Viamão. The term refers to the extension of the capital Porto Alegre, forming a continuous urban area with its neighboring municipalities. These cities are the focus of the data analysis presented in this study, which used the SUS Department of Information and Informatics (DATASUS) system as its source. This system is linked to the Secretariat of Information and Digital Health of the Ministry of Health (SEIDIGI/MS), and its mission is to promote the accessibility, integration, and security of health information, establishing the efficiency of the SUS through technology.

Figure 1: Map showing the location of the metropolitan cities of Porto Alegre.



Source: <https://atlassocioeconomico.rs.gov.br/regiao-metropolitana-da-serra-gaucha>

RESULTS

According to data provided by

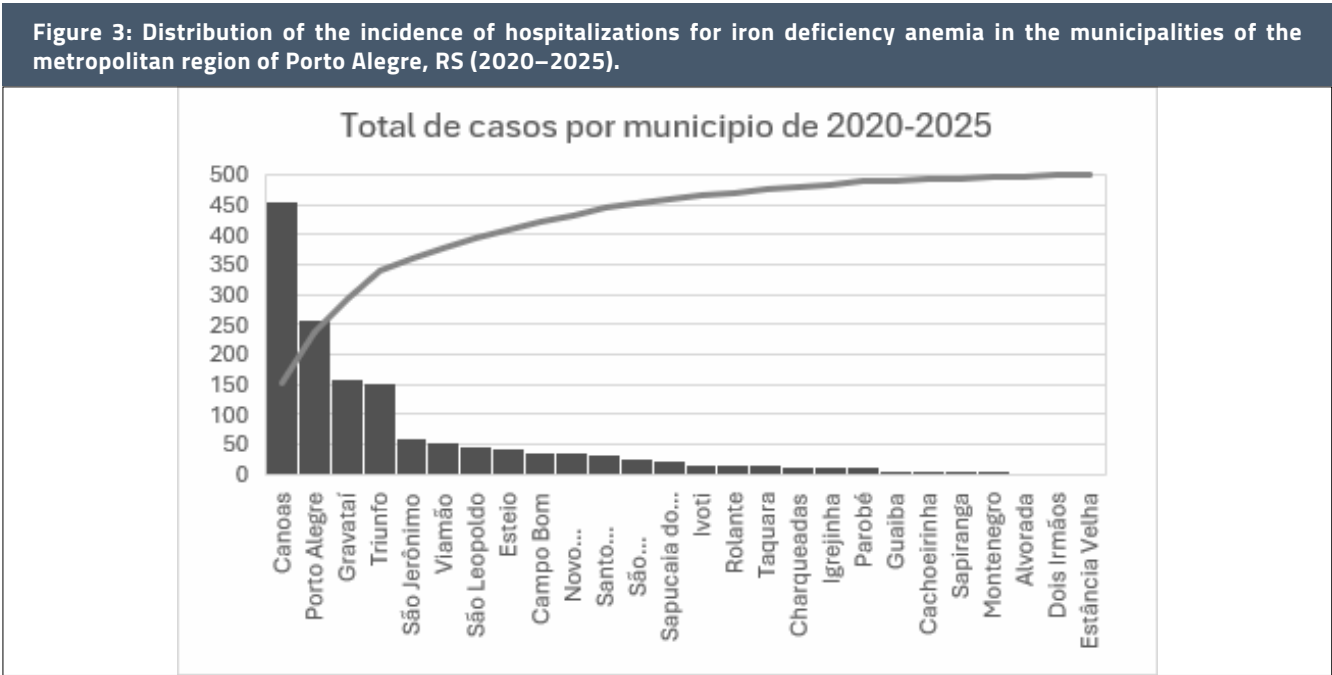
DATASUS⁽¹¹⁾ from January 2020 to July 2025, there were a total of 1,507 cases of hospitalization for iron deficiency anemia in the metropolitan region of Porto Alegre (Figure 2).

Figure 2: Spatial distribution of hospitalizations for iron deficiency anemia in the metropolitan region of Porto Alegre, RS (2020–2025).



When we performed an individual analysis of the municipalities, we found that the highest incidence occurs in Ca-

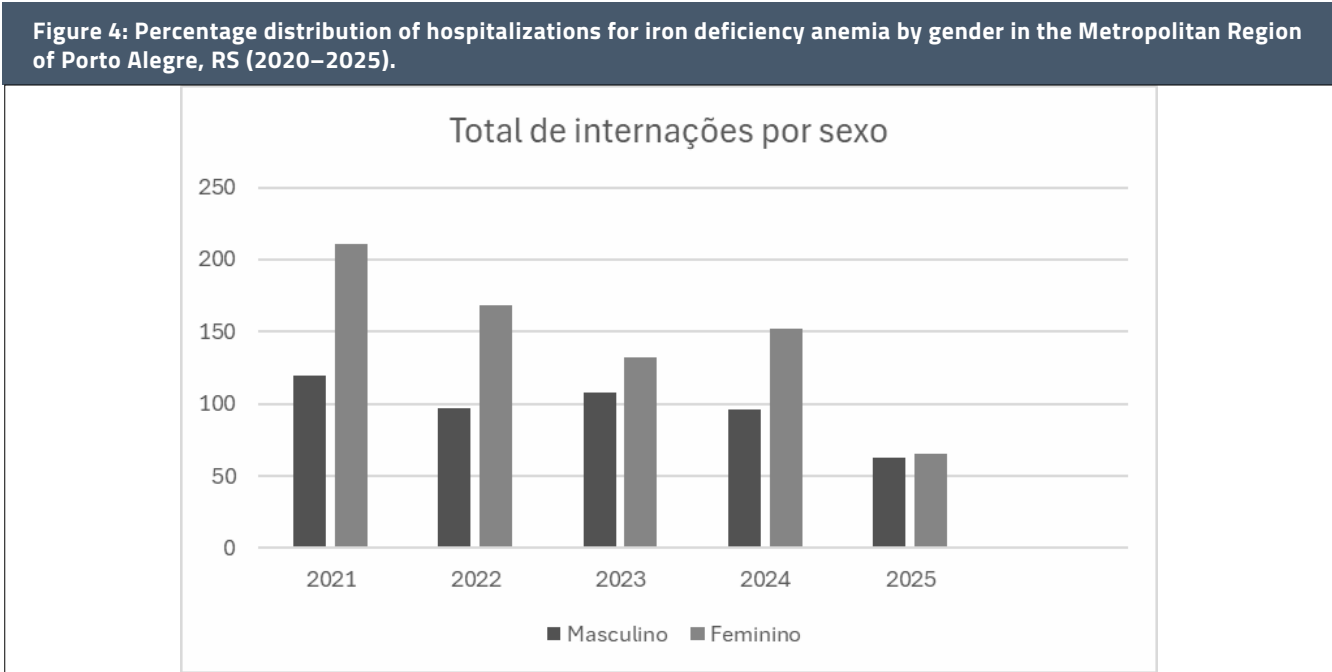
noas, followed by Porto Alegre, Gravataí, and Triunfo, as shown in Figure 3.



Of the total 1,507 hospitalizations analyzed, a higher frequency was observed in females, with 898 cases (59.59%), compared to males, with

609 cases (40.49%). The literature points to a higher prevalence of iron deficiency anemia in women, which is confirmed in this study. This occur-

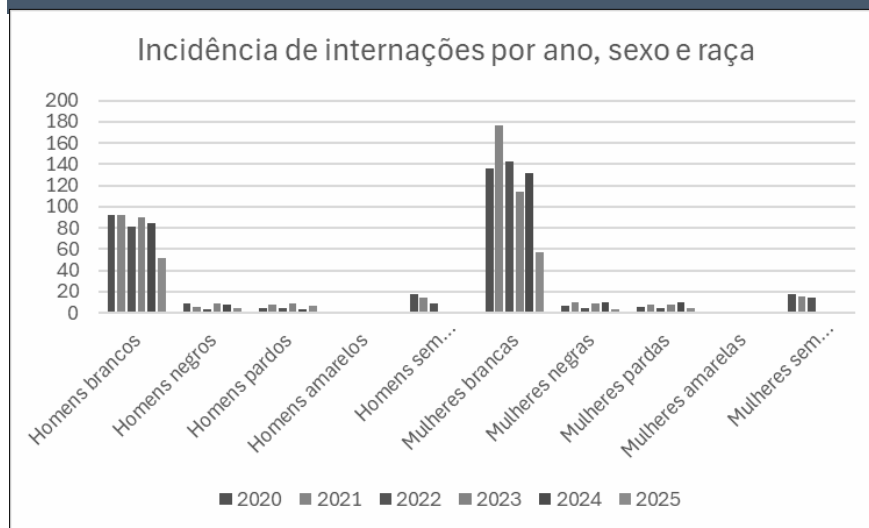
rence is mainly associated with menstrual blood loss and increased iron demand during pregnancy and breast-



Regarding the race variable, the highest prevalence was observed in white people, with 1,251 cases (83.1%). Next, there were 83 cases in black people (5.5%), 79 in brown

people (5.2%), and 4 in yellow people (0.23%). In addition, 90 cases (5.97%) did not have race identification, as shown in Figure 5.

Figure 4: Distribution of cases by race variable.



It is important to note that, during the five years analyzed, there were no hospitalizations of indigenous individuals for iron deficiency anemia in the Metropolitan Region of Porto Alegre. This finding may be related to cultural and dietary factors characteristic of these groups, whose traditional diet consists predominantly of natural and minimally processed foods, rich in micronutrients and with lower levels of artificial additives. In addition, less dependence on processed foods may contribute to a more balanced intake of iron and other essential minerals.

On the other hand, it is also necessary to consider the possibility of underreporting or limitations in racial categorization in DATASUS records, which may lead to gaps in the identification of indigenous people in public health databases. The absence of records, therefore, should not be interpreted exclusively as an absence of cases, but rather as data that requires better qualification of health information and greater inclusion of minority populations in epidemiological surveillance systems.

DISCUSSION

Iron absorption consists of its uptake by mucosal cells, its movement through the cell, and finally its release by the cell so that it can enter the circulation⁽²⁾. There are three processes that release iron into the bloodstream, namely: in the elimination of senescent red blood cells by reticuloendothelial macrophages, which metabolize hemoglobin and heme, iron is released into the bloodstream (Wang; Pantopoulos, 2011); in the stomach, both hematic and non-hematic iron are released from food and quickly form soluble and insoluble iron complexes; in the intestine, soluble iron complexes are captured by the brush border membrane.

After absorption, depending on the body's iron nutritional status, iron can be stored as ferritin in the cytosol of the intestinal cell, returning to the intestinal lumen through the natural desquamation of mucosal cells, occurring over a period of two to four days, or it can be rapidly transported through the cell and enter the intracellular fluid and plasma⁽²⁾. Although several

iron transport proteins and enzymes are involved in the homeostasis process, it has been found that iron metabolism is regulated by hepcidin, a protein synthesized in the liver. It exerts its action through interaction with ferroportin, a transmembrane protein involved in iron efflux from the body⁽¹⁾.

The treatment of iron deficiency anemia was introduced by Bland in 1832 with a compound whose main constituent was ferric carbonate. The "Bland pill" remained the mainstay of iron deficiency treatment for over a hundred years, until the advent of new iron compounds. Currently, treatment consists of guidance on proper food consumption, in addition to the administration of iron compounds orally or parenterally, and occasionally, ^{red} blood cell transfusions. The main iron supplements available and marketed in different countries, including Brazil, are: ferrous salts, ferric salts, amino acid chelated iron, polymaltose iron complex (ferri-polymaltose), and carbonyl iron⁽⁶⁾. The use of ferrous salts, preferably orally, is recommended. Ferrous salts (sulfate, fumarate gluconate, succinate, citrate, etc.) are cheaper and absorbed more quickly, but produce more side effects - nausea, vomiting, epigastric pain, diarrhea or constipation, dark stools, and, in the long term, the appearance of dark spots on the teeth. Absorption is greater when administered one hour before meals. Another recommendation is that the medication should not be administered together with multivitamin and mineral supplements. Iron interacts with calcium, phosphate, zinc, and other elements, reducing its bioavailability⁽⁵⁾.

In terms of global distribution, iron deficiency anemia is the most prevalent worldwide, reaching prevalences above 60% in some regions⁽⁸⁾, and is more common in developing regions, particularly in sub-Saharan Africa, Southeast Asia, and Latin America⁽⁷⁾. According to the World Health Organization (2024) in 2019, the global prevalence of anemia among children aged 6 to 59 months was 39.8%, with the rate reaching 60.2% in Africa. In these areas, factors such as limited availability

of iron-rich foods, intestinal parasites, and adverse socioeconomic conditions contribute to the high prevalence of the disease. In contrast, developed countries have lower rates of iron deficiency anemia, although it is still a public health concern in specific populations.

In Brazil, there is no national survey of the prevalence of anemia, only studies in different regions, which show a high prevalence of the disease⁽¹⁰⁾. In the Northeast region, the prevalence of anemia is over 60% among children under 12 months of age. Similarly, in the Midwest and North regions, a prevalence of over 50% was recorded among indigenous children under

10 years of age and children under 59 months of age, respectively. In the Southeast region, there were about 37% of anemic children between 12 and 72 months of age. In the South region, the prevalence was close to 30% among children under 5 years of age⁽⁸⁾. The increase in the prevalence of iron deficiency anemia in children may be due to changes in eating habits, which accompany the nutritional transition in the country⁽¹⁰⁾.

CONCLUSION

In this study, we found that iron deficiency anemia continues to be an im-

portant public health problem in the metropolitan region of Porto Alegre, with a higher incidence among white females. Our analysis showed that the municipalities of Canoas, Porto Alegre, Gravataí, and Triunfo had the highest number of hospitalizations due to the disease between January 2020 and July 2025. These results reinforce the need to strengthen public policies aimed at the prevention, diagnosis, and adequate treatment of iron deficiency, highlighting the importance of adopting intersectoral strategies that promote nutritional education and easy access to iron-rich foods.

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