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Epidemiological profile of patients hospitalized for thyrotoxicosis between 2013 and 2023 in a Southern Brazil state (Paraná)

Perfil epidemiológico dos pacientes internados por tireotoxicose entre os anos de 2013 e 2023 em um estado do Sul do Brasil (Paraná)

Perfil epidemiológico de los pacientes hospitalizados por tirotoxicosis entre los años 2013 y 2023 en un estado del Sur de Brasil (Paraná)

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Abstract
This study aims to present an analysis of the epidemiological profile of hospitalizations (sex and age group) of patients admitted for thyrotoxicosis in the state of Paraná between 2013 and 2023, with comparisons made to data from the Southern region and from Brazil as a whole over the same period. The data presented are available from the DataSUS online platform of the Brazilian Ministry of Health. In this context, in Paraná, a predominance of hospitalizations among women was observed, with the highest incidence between 30 and 39 years of age, the same age group represented in part of the deaths. In the Southern region, the pattern of hospitalizations was also predominantly female, with emphasis on the same age group; however, deaths were concentrated among women aged 70 to 79 years. At the national level, both hospitalizations and deaths showed a predominance of females, with higher frequency in the 40–49-year age group. The data reveal consistency in the sex profile but regional variations in the most affected age groups. Therefore, further studies are suggested to determine whether these trends will persist over time and to achieve a better understanding of the epidemiology of this endocrinological disorder.
Keywords: Thyrotoxicosis; Hyperthyroidism; Hospitalizations; Age Group; Sex.

Resumo
O presente estudo tem como objetivo apresentar uma análise do perfil epidemiológico das internações (sexo e faixa etária) dos pacientes internados por tireotoxicose no Paraná entre os anos de 2013 e 2023, sendo feitas comparações com os dados obtidos na região Sul e no Brasil ao longo do mesmo período. Os dados expostos são disponibilizados pela plataforma online DataSUS do Ministério da Saúde do Brasil. Nesse âmbito, no Paraná, observou-se predominância

de internações em mulheres, com maior incidência entre 30 e 39 anos, mesma faixa etária presente em parte dos óbitos. Na região Sul, o padrão de internações também foi majoritariamente feminino, com destaque para a mesma faixa etária; contudo, os óbitos se concentraram entre mulheres de 70 a 79 anos. Em nível nacional, tanto as internações quanto os óbitos apresentaram predominância do sexo feminino, com maior frequência na faixa etária de 40 a 49 anos. Os dados revelam consistência no perfil por sexo, mas variações regionais nas faixas etárias mais afetadas. Diante disso, sugere-se a elaboração de mais trabalhos para observar se tais tendências irão se manter com o passar dos anos e para uma melhor compreensão da epidemiologia do distúrbio endocrinológico.
Palavras-chave: Tireotoxicose; Hipertireoidismo; Internações; Faixa Etária; Sexo.

Resumen
El presente estudio tiene como objetivo presentar un análisis del perfil epidemiológico de las hospitalizaciones (sexo y grupo etario) de pacientes internados por tirotoxicosis en el estado de Paraná entre los años 2013 y 2023, realizando comparaciones con los datos obtenidos en la región Sur y en Brasil durante el mismo período. Los datos presentados están disponibles en la plataforma en línea DataSUS del Ministerio de Salud de Brasil. En este contexto, en Paraná se observó un predominio de hospitalizaciones en mujeres, con mayor incidencia entre los 30 y 39 años, el mismo grupo etario presente en parte de los fallecimientos. En la región Sur, el patrón de hospitalizaciones también fue mayoritariamente femenino, destacándose la misma franja etaria; sin embargo, los fallecimientos se concentraron entre mujeres de 70 a 79 años. A nivel nacional, tanto las hospitalizaciones como los fallecimientos mostraron predominio del sexo femenino, con mayor frecuencia en el grupo de 40 a 49 años. Los datos revelan consistencia en el perfil por sexo, pero variaciones regionales en los grupos etarios más afectados. Por lo tanto, se sugiere la realización de más estudios para observar si estas tendencias se mantendrán con el paso de los años y para una mejor comprensión de la epidemiología de este trastorno endocrinológico.
Palabras clave: Tirotoxicosis; Hipertiroidismo; Hospitalizaciones; Grupo Etario; Sexo.

1. Introduction

Thyrotoxicosis is defined as a set of signs and symptoms resulting from excess circulating T3 and T4. While hyperthyroidism refers to the overproduction of thyroid hormones produced by the thyroid gland, thyrotoxicosis is not limited to endogenous production alone, but may result from several other causes of increased hormone concentrations (Vilar, 2021). The underlying causes of thyrotoxicosis usually include Graves' disease (GD) and toxic multinodular goiter (TMNG) (Klubo-Gwiezdzinska & Wartofsky, 2012), with GD being considered the most common cause of hyperthyroidism (Ross, 2023) and the most common cause of thyrotoxicosis in the United States (accounting for 60 to 80% of cases) (Devereaux & Tewelde, 2014).

Toxic multinodular goiter results from hyperplasia of thyroid follicular cells, in which functional capacity becomes independent of TSH regulation (ROSS DS., 2023). In contrast, GD is an autoimmune disorder caused by autoantibodies against the thyroid-stimulating hormone receptor (TSH receptor), known as TRAb, which stimulate hormone synthesis and secretion as well as gland growth (Davies, 2025). As for the epidemiology of Graves' disease, although its exact prevalence is uncertain, it is estimated to affect 3% of women and 0.5% of men, being 5 to 10 times more common in females. Additionally, GD reaches its peak incidence between 30 and 60 years of age (Vilar, 2021), whereas toxic multinodular goiter generally occurs after the age of 50 (Devereaux & Tewelde, 2014).

The manifestations of thyrotoxicosis are very similar to those found in hyperthyroidism, corresponding to predominantly adrenergic characteristics (Nayak & Burman, 2006). The various presentations of moderate or subclinical thyrotoxicosis resemble those of its overt form; the difference lies in the magnitude of the signs and symptoms (ROSS DS., et al. 2016). Several organ systems may be affected by this clinical syndrome - neuropsychiatric, neuromuscular, gastrointestinal, reproductive, dermatologic, ophthalmologic, among others (Nayak & Burman, 2006; Ross, 2025a).

This clinical condition can lead to multiple laboratory abnormalities, such as hyperglycemia, hypercalcemia, elevated alkaline phosphatase, leukocytosis, and increased liver enzymes (Nayak & Burman, 2006). It is also responsible for insulin resistance in hyperthyroid patients alongside a catabolic state (Mehran et al., 2019). Furthermore, manifestations may include normocytic and normochromic anemia and autoimmune thrombocytopenia (Ross, 2025a). Thyrotoxicosis also impairs adrenocortical function by accelerating the metabolism of cortisol and other steroids (Nayak & Burman, 2006). In the

cardiovascular system, uneven redistribution of blood flow may aggravate preexisting diseases or cause cardiac dysfunction. The heart exhibits increased preload, decreased afterload, and greater predisposition to atrial fibrillation due to reduced electrical threshold (Woeber, 1992).

Thyroid storm (TS) is characterized, in summary, as the clinical presentation of signs and symptoms of hyperthyroidism plus four relevant features: fever, tachycardia, central nervous system dysfunction and gastrointestinal symptoms (Velasco et al., 2020). The diagnosis of TS is based on a personal history of thyroid disease or precipitating factors, typical signs or symptoms, and serum concentrations of free T3 and T4 above the normal range and undetectable TSH levels (< 0.1 mIU/L) (Papi et al., 2014). It is important to note that the occurrence of TS is more closely related to the rate of rise in thyroid hormone levels than to their absolute serum values (Velasco et al., 2020). Precipitating factors leading to the transition from thyrotoxicosis to TS include major surgery (particularly thyroidectomy), trauma (mainly involving the neck region), withdrawal of antithyroid drugs, systemic infections, diabetic ketoacidosis, cerebrovascular diseases, pulmonary thromboembolism, childbirth, among others (Papi et al., 2014).

Distinguishing severe thyrotoxicosis from life-threatening thyrotoxicosis - thyroid storm - is a matter of clinical judgment. Although scales such as the Burch Wartofsky Point Scale exist to help classify the severity of thyrotoxicosis, it is more important to treat the patient aggressively for hyperthyroidism rather than to question whether the case fully meets the criteria for TS or mild thyrotoxicosis. The scale assists physicians by providing an estimate of the likelihood that thyrotoxicosis is progressing to a severe form (Velasco et al., 2020). The Burch-Wartofsky scale assesses clinical parameters including temperature, central nervous system effects (agitation, delirium, psychosis, lethargy etc.), hepatic and gastrointestinal dysfunction, cardiovascular dysfunction (tachycardia and atrial fibrillation), heart failure, and precipitating events (Ross, 2025b). It is important to emphasize that there is no arbitrary serum T4 or T3 threshold that distinguishes severe thyrotoxicosis from TS (Nayak & Burman, 2006).

Therefore, patient treatment must include control of endogenous thyroid hormone production, blockade of systemic effects, general clinical support and management of the underlying cause (Velasco et al., 2020).

Although the clinical understanding of thyrotoxicosis is widely discussed in the literature, epidemiological studies remain limited in the national context. Considering the severity of the condition, especially when it progresses to thyroid storm, it becomes essential to understand its population behavior. This study aims to present an analysis of the epidemiological profile of hospitalizations (sex and age group) of patients hospitalized for thyrotoxicosis in Paraná between the years 2013 and 2023, making comparisons with data obtained in the Southern region and in Brazil during the same period. Through this investigation, the goal is to identify patterns of occurrence by age group, sex, and region, contributing to strategies for prevention, early diagnosis, and appropriate management.

2. Methodology

This is an exploratory study with a qualitative and quantitative approach, conducted through a documentary research of direct source (Pereira et al., 2018) in the data collection from the Brazilian Ministry of Health's DataSUS platform, establishing the epidemiological profile of patients hospitalized with thyrotoxicosis in the state of Paraná from 2013 to 2023 and illustrating these findings with a column chart that categorizes the data by age group and by the State and Southern Region of the country, employing absolute frequencies (number of cases) and relative frequencies (percentages) for interpretation (Shitsuka et al., 2014). The DataSUS Tabnet website provides data according to the "ICD-10 Morbidity List." Therefore, for the present study, the option "Thyrotoxicosis" was selected. Based on this selection, analyses were performed on hospitalizations and deaths by year of care from 2013 to 2023, stratified by the age groups available on the website and by sex. Information from the state of Paraná

was compared with data from the Southern region and from Brazil as a whole. All these data can be verified and are available at: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

The researchers requested a waiver of the informed consent form (ICF) because the data to be collected are already publicly accessible through the DataSUS Platform.

3. Results and Discussion

3.1 Total hospitalizations due to thyrotoxicosis

For the initial discussion, data on the total number of hospitalizations for thyrotoxicosis from 2013 to 2023 in Paraná, in the Southern region and in Brazil were used - that is, the sum of all hospitalizations throughout the years mentioned - which are presented in Figure 1. These data were categorized according to the age groups provided by DataSUS and selected based on the year of care.

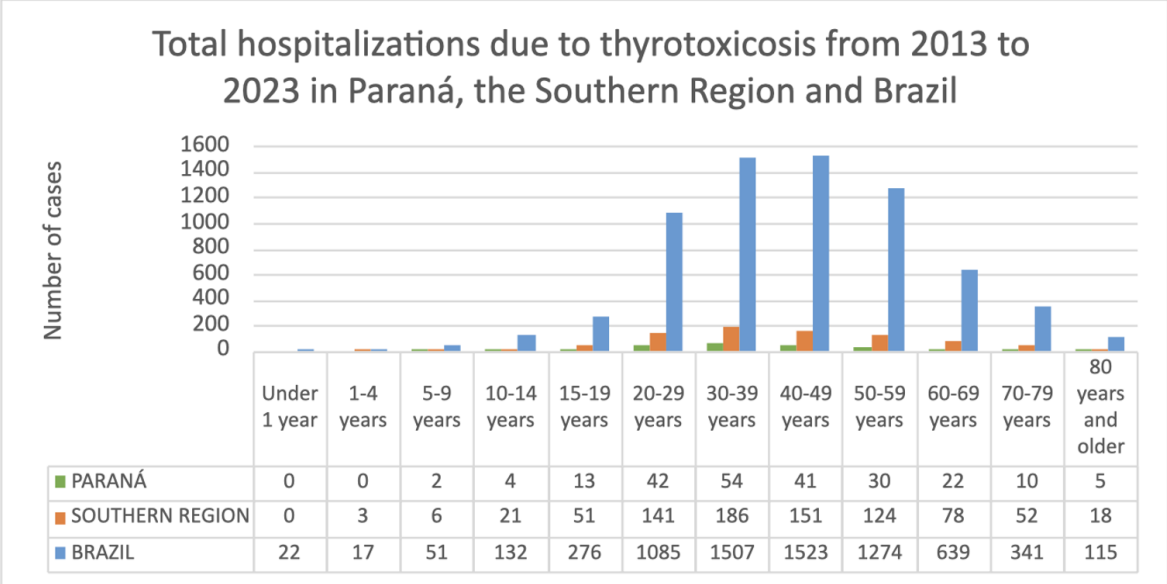
According to the information presented in Figure 1, Paraná showed the highest prevalence of the endocrinological disorder in the 30–39-year age group, corresponding to 54 cases out of a total of 223 (24.21%). The second most affected age group was 20–29 years, with 42 cases (18.8%), followed by the 40–49-year group with 41 hospitalizations (18.83%). The age group with the lowest number of hospitalizations in Paraná - excluding those with no occurrences, such as <1 year and 1–4 years - was 5–9 years, with 2 cases out of 223 (0.89%). The second and third least prevalent groups were 10–14 years, with 4 cases (1.79%), and ≥ 80 years, with 5 cases (2.24%), respectively.

The data in Figure 1 regarding total hospitalizations for thyrotoxicosis in the Southern region from 2013 to 2023 show the highest prevalence in the 30–39-year group, with 186 cases (22.38%) out of a total of 831. The second and third most frequent groups were 40–49 years (151 cases or 18.17%) and 20–29 years (141 cases or 16.96%). At the national level, the same period demonstrates the highest number of cases in the 40–49-year age group (1523 cases out of 6982, or 21.81%). The second most affected group was 30–39 years (1507 cases or 21.58%), followed by 50–59 years, with 1274 cases (18.24%).

Still according to Figure 1, the age group with the lowest number of hospitalizations in the Southern region from 2013 to 2023 was 1–4 years, with 3 reported hospitalizations (0.36%) out of 831, excluding the <1 year group, which had no recorded data. The second and third lowest hospitalization rates corresponded to the 5–9-year group (6 cases or 0.72%) and the ≥80-year group (18 cases or 2.16%), respectively. Nationally, the age groups with the lowest number of hospitalizations during the period, in ascending order, were 1–4 years (17 cases out of 6982 or 0.24%), <1 year (22 cases or 0.31%), and 5–9 years (51 cases or 0.73%). Thus, it can be concluded that the age groups with the lowest occurrence of thyrotoxicosis throughout the observed years are those at the extremes of age.

Based on the data presented above, it is observed that, from 2013 to 2023, Paraná does not differ abruptly from the patterns observed in the Southern region and in Brazil. This is evidenced by the fact that Paraná and the Southern region share the same three age groups with the highest prevalence - 30–39, 40–49, and 20–29 years - in different orders but with similar percentages. Furthermore, when Paraná is compared with national data, a relevant difference is noted: the 50–59-year age group ranks third nationally, with 1274 cases (18.24%), whereas in Paraná it ranks fourth, with 30 cases (13.45%). In the Southern region, it also ranks fourth, representing 124 hospitalizations (14.92%). In contrast, the 20–29-year age group, which is the third most frequent in Paraná (18.83%), accounts for 15.53% of total national cases, with 1085 hospitalizations, ranking fourth at the national level.

Figure 1 – Total hospitalizations due to thyrotoxicosis by age group from 2013 to 2023 in Paraná, the Southern region and Brazil.



	Under 1 year	1-4 years	5-9 years	10-14 years	15-19 years	20-29 years	30-39 years	40-49 years	50-59 years	60-69 years	70-79 years	80 years and older
PARANÁ	0	0	2	4	13	42	54	41	30	22	10	5
SOUTHERN REGION	0	3	6	21	51	141	186	151	124	78	52	18
BRAZIL	22	17	51	132	276	1085	1507	1523	1274	639	341	115

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

3.2 Analysis of hospitalizations by age group

Figure 2 presents the distribution of the number of hospitalizations for thyrotoxicosis from 2013 to 2023 in Paraná, considering the different age groups provided by DataSUS. These data were organized according to the year of care, allowing for a more detailed analysis of the evolution of hospitalization numbers throughout the period mentioned above.

It is noteworthy that 2023 recorded the highest number of hospitalizations for thyrotoxicosis, representing 43 cases out of 223 (19.28%). The year 2022 ranked second, with 23 cases, corresponding to 10.31% of the total for the entire period. Thus, an increase of 86.96% was observed from 2022 to 2023 in the total number of recorded cases, since the values remained with minimal significant variation between 2018 and 2022. The formula used for this calculation was as follows: the current value (43 cases in 2023) minus the previous value (23 cases in 2022), with the result divided by the previous value and multiplied by100 to express the percentage. Another example of an increase in the total number of cases occurred between 2014 and 2015, rising from 10 to 18 hospitalizations, representing an 80% increase. The same method was used to determine the percentage increase from 2014 to 2015.

As previously described, 2023 showed the highest incidence of hospitalizations due to thyrotoxicosis in Paraná over the observed years. In this context, it is important to highlight that most hospitalized patients in that year belonged to the 30–39-year age group, representing 12 of the 43 cases (27.90%). These findings are consistent with the initial analysis for Paraná, which considered the sum of all cases from 2013 to 2023 and also identified the 30–39-year group as the most prevalent. The 20–29-year group ranked second, with 10 cases, followed by the 40–49-year group, with 8 cases. Conversely, the age group with the lowest number of hospitalized patients in 2023 was 70–79 years, with 2 occurrences (4.65%).

Regarding the year with the lowest number of recorded cases in Paraná, 2014, as shown in Figure 2, a total of 10 hospitalizations were reported. Of these, 4 cases (40%) occurred in the 20–29-year group, 3 cases (30%) in the 30–39-year group, 2 cases (20%) in the 40–49-year group, and 1 case (10%) in the 5–9-year group. Even though 2014 presented the lowest number of registered hospitalizations, the same predominant age groups were observed when compared with Figure 1, which shows that the 20–29, 30–39, and 40–49-year groups had the highest numbers in Paraná from 2013 to 2023.

Figure 2 – Number of hospitalizations due to thyrotoxicosis by age group from 2013 to 2023 in Paraná.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
5-9 years	-	1	-	-	-	-	-	-	-	1	-	2
10-14 years	-	-	-	1	1	1	-	1	-	-	-	4
15-19 years	2	-	-	-	-	2	-	2	-	4	3	13
20-29 years	4	4	3	5	1	2	2	3	6	2	10	42
30-39 years	3	3	5	3	3	5	10	6	3	1	12	54
40-49 years	4	2	1	6	2	5	1	2	2	8	8	41
50-59 years	1	-	4	1	2	1	3	3	7	5	3	30
60-69 years	-	-	4	1	7	2	-	1	1	1	5	22
70-79 years	1	-	1	2	-	1	1	-	2	-	2	10
80 years and older	-	-	-	-	-	2	2	-	-	1	-	5
Total	15	10	18	19	16	21	19	18	21	23	43	223

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Figure 3 presents the number of hospitalizations for thyrotoxicosis from 2013 to 2023 in the Southern region of Brazil. According to the figure, the highest number of hospitalizations occurred in 2023, with 108 cases (12.99%) out of 831. It is also observed that there was an increase of 25.58% from 2022 to 2023, rising from 86 to 108 cases.

When comparing Figure 2 with Figure 3, it becomes evident that the 33.33% decrease in the number of cases from 2013 to 2014 and the 86.96% increase from 2022 to 2023 observed in Paraná were not reflected in the analysis of data for the Southern region. This is demonstrated by the fact that the Southern region experienced an increase of 10.77% from 2013 (65 cases) to 2014 (72 cases). Between 2022 (86 cases) and 2023 (108 cases), the Southern region showed a 25.58% increase in hospitalizations, representing the highest percentage rise observed within the analyzed period. Furthermore, the greatest reduction in hospitalizations - 19.77% - occurred between 2015 and 2016 in the Southern region.

The lowest number of cases recorded in Paraná occurred in 2014, with 10 hospitalizations (Figure 2), representing 4.48% of the total for the state. Among these 10 cases, it is noteworthy that 40% were within the 20–29-year age group. In the same year, the Southern region (Figure 3) recorded 72 cases, accounting for 8.66% of the total hospitalizations in the region. Of these 72 cases, 17 (23.61%) occurred in the 20–29-year age group. Although the percentages differ, both locations showed the highest number of cases in 2014 within the 20–29-year group. Despite the finding shown in Figure 3, Graves' disease typically reaches its peak incidence between 30 and 60 years of age, with predisposing factors including family history (particularly maternal), in addition to other polygenic, environmental and endogenous components such as smoking, bacterial or viral infections, and even stress through neuroendocrine pathways (Vilar, 2021).

In this regard, the year with the lowest number of hospitalizations in the Southern region was 2018, with 63 occurrences (7.58% of the total accumulated throughout the studied period). Among all recorded cases, 15 occurred in the 40-49-year age group (23.80% of that year's total), as shown in Figure 3. Conversely, the state of Paraná recorded 21 hospitalizations in 2018, corresponding to 9.41% of its total accumulated cases. Of these 21 cases, the age groups with the highest occurrence were 30–39 years and 40–49 years, both with 5 cases each, representing 23.80%. In summary, Paraná and the Southern region showed convergence in 2018, as the 40–49-year age group presented the same percentage of occurrence and was the age group with the highest hospitalization rate in both locations.

Figure 3 – Number of hospitalizations due to thyrotoxicosis by age group from 2013 to 2023 in the Southern region.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
1-4 years	-	-	1	-	-	1	-	-	-	-	1	3
5-9 years	-	1	1	-	-	-	-	-	1	2	1	6
10-14 years	1	1	-	3	3	2	-	5	1	4	1	21
15-19 years	6	5	4	-	2	8	3	5	3	9	6	51
20-29 years	12	17	12	14	8	6	16	10	19	6	21	141
30-39 years	18	14	18	17	13	11	20	15	14	22	24	186
40-49 years	10	11	18	8	11	15	15	8	14	16	25	151
50-59 years	10	10	12	10	14	6	10	12	10	14	16	124
60-69 years	3	6	11	10	13	7	2	4	9	4	9	78
70-79 years	3	6	8	6	5	3	6	2	3	7	3	52
80 years and older	2	1	1	1	1	4	2	3	-	2	1	18
Total	65	72	86	69	70	63	74	64	74	86	108	831

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Figure 4 presents the number of hospitalizations for thyrotoxicosis from 2013 to 2023 in Brazil. The first point to be noted is that, in comparison with Figures 2 and 3 - which correspond to Paraná and the Southern region, respectively - both previous tables did not show any recorded cases of thyrotoxicosis in children under 1 year of age. Additionally, the table for Paraná does not present reported cases in the 1–4-year age group. Data referring to pediatric patients under 1 year of age throughout the years analyzed represent 0.31% of the national total (22 cases out of 6982). Regarding the 1–4-year age group, the total at the national level amounts to 17 cases (0.24%). The same observation applied to the Southern region shows 3 cases (0.36%) over the eleven years evaluated.

The pediatric age group demonstrates an increase in the incidence of Graves' disease during puberty, with approximately 80% of pediatric cases occurring after 11 years of age (Lafranchi & Wassner, 2024). In this regard, Figure 4 shows a progressive increase in the total number of cases in the 5–9-year (51 cases or 0.73%), 10–14-year (132 cases or 1.89%), and 15–19-year (276 cases or 3.95%) groups. Hyperthyroidism occurs in approximately 1 in every 5000 children and adolescents. In a national population-based study on thyrotoxicosis conducted in the United Kingdom and Ireland in 2004, the annual incidence was 0.9 per 100000 children under 15 years of age (Lafranchi & Wassner, 2024).

It is important to recall that 2023 showed the highest number of thyrotoxicosis cases in the period analyzed in Paraná (19.28% of cases) and in the Southern region (12.99% of cases). Accordingly, 2023 also resulted in the highest number of cases in Brazil, with 833 cases (11.93%), as displayed in Figure 4.

Revisiting the 86.96% increase in total recorded cases from 2022 to 2023 in Paraná, as shown in Figure 2, it is clear that this substantial rise was not mirrored at the national level. Nationally, the increase from 2022 (799 cases) to 2023 (833 cases) was 4.26%. Furthermore, the 33.33% reduction in cases from 2013 to 2014 observed in Paraná was not reflected in national data. Instead, there was an increase from 445 cases in 2013 to 524 cases in 2014, corresponding to a national rise of 17.98%. Additionally, the highest percentage increase in hospitalizations in the country occurred between 2020 and 2021, growing from 497 to 672 cases, representing a 35.21% increase. Conversely, the most pronounced reduction occurred between 2019 (712 cases) and 2020 (497 cases), reflecting a 30.20% decrease.

The lowest number of thyrotoxicosis cases in Brazil between 2013 and 2023 (Figure 4) occurred in 2013, with 445 cases (6.37%) out of a total of 6982 cases recorded over the eleven years. In contrast, according to Figure 2, the lowest number of registered cases in Paraná occurred in 2014, with only 10 hospitalizations (4.48%) out of 223 cases. During this same period, Brazil recorded 524 hospitalizations (7.50%) due to thyrotoxicosis.

Figure 4 – Number of hospitalizations due to thyrotoxicosis by age group from 2013 to 2023 in Brazil.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
Under 1 year	2	3	1	1	4	3	2	1	3	1	1	22
1-4 years	-	2	2	-	-	4	1	2	2	2	2	17
5-9 years	2	4	4	5	3	4	1	4	5	10	9	51
10-14 years	9	11	15	12	15	11	10	15	13	13	8	132
15-19 years	25	22	27	17	33	27	24	23	20	32	26	276
20-29 years	83	102	96	80	100	111	119	74	86	97	137	1085
30-39 years	101	119	154	131	147	153	180	102	119	154	147	1507
40-49 years	79	110	115	108	141	129	152	134	166	187	202	1523
50-59 years	84	85	87	102	117	115	119	77	137	172	179	1274
60-69 years	35	34	59	66	76	67	49	36	64	77	76	639
70-79 years	19	26	34	30	26	30	44	19	44	36	33	341
80 years and older	6	6	9	8	5	16	11	10	13	18	13	115
Total	445	524	603	560	667	670	712	497	672	799	833	6982

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Figure 5 corresponds to the number of deaths due to thyrotoxicosis between 2013 and 2023 in the state of Paraná. It is important to highlight that the data for the years 2013, 2015, 2019, 2022, and 2023 did not show any deaths recorded from the disease in the state.

Based on the data presented in Figure 5, there are no records of deaths in the age groups corresponding to under 1 year, 1–4, 5–9, 10–14, 15–19 and 60–69 years. Moreover, the total number of deaths attributed to thyrotoxicosis in Paraná was 8 cases out of 223 hospitalizations (3.58%) from 2013 to 2023. Among these deaths, 2 (25%) occurred in individuals aged 30–39 years, and another 2 (25%) in those aged 50–59 years. Additionally, one death was recorded in each of the following age groups - 20–29, 40–49, 70–79 and 80 years and older - each representing 12.5%.

Figure 5 also shows that the years 2016 and 2021 recorded two deaths each, representing the years with the highest mortality in Paraná, while the remaining years presented only one death each. These two deaths per year correspond to 2 (10.52%) deaths out of 19 hospitalizations in 2016, and 2 (9.52%) out of 21 hospitalizations in 2021. Figure 5 further shows that each year within the analyzed period had deaths in different age groups, except for 2017 and 2020, which both presented one death in the 30–39 age group. In this context, the data show one death in the 40–49 age group (12.5% of the total) in 2014 (the year with the lowest number of hospitalizations in the state), one death in the 20–29 and one in the 70–79 age group in 2016, one death in the 30–39 group in 2017, one death in the 80 years and older group in 2018, one death in the 30–39 group in 2020, and two deaths in the 50–59 age group in 2021 (25%).

Figure 5 – Number of deaths due to thyrotoxicosis by age group from 2013 to 2023 in Paraná.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
Under 1 year	-	-	-	-	-	-	-	-	-	-	-	0
1-4 years	-	-	-	-	-	-	-	-	-	-	-	0
5-9 years	-	-	-	-	-	-	-	-	-	-	-	0
10-14 years	-	-	-	-	-	-	-	-	-	-	-	0
15-19 years	-	-	-	-	-	-	-	-	-	-	-	0
20-29 years	-	-	-	1	-	-	-	-	-	-	-	1
30-39 years	-	-	-	-	1	-	-	1	-	-	-	2
40-49 years	-	1	-	-	-	-	-	-	-	-	-	1
50-59 years	-		-	-	-	-	-	-	2	-	-	2
60-69 years	-	-	-	-	-	-	-	-	-	-	-	0
70-79 years	-	-	-	1	-	-	-	-	-	-	-	1
80 years and older	-	-	-	-	-	1	-	-	-	-	-	1
Total	0	1	0	2	1	1	0	1	2	0	0	8

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Figure 6 presents the number of deaths due to thyrotoxicosis by age group from 2013 to 2023 in the Southern Region of Brazil. Based on the data, it can be observed that, among the years analyzed, the only ones with no recorded deaths from the thyroid hormonal disorder were 2015 and 2023. It is noteworthy that the year with the highest number of hospitalizations in the region, 2023, did not report any deaths related to the condition. Conversely, the year with the lowest number of hospitalizations, 2018, recorded one death in the age group of 80 years and older. When compared with the data in Figure 3, the year 2018 registered 63 hospitalizations due to thyrotoxicosis, with 4 cases in the 80 years and older age group. Thus, the percentage of deaths relative to the total number of hospitalizations was approximately 1.58% (1 death out of 63 hospitalizations), and the percentage of deaths relative to the number of hospitalizations in the 80 years and older group in 2018 was 25%.

According to Figure 6, the age groups under 1 year, 1–4 years, 5–9 years and 10–14 years show no documented deaths within the 2013–2023 period in the Southern Region. The total number of deaths recorded in the region was 16 (1.92%) over the eleven years analyzed. The age group with the highest number of deaths was 70–79 years (4 cases or 25%). The age groups 30–39 years and 50–59 years each presented 3 deaths (18.75%). The age group 80 years and older accounted for 2 deaths (12.5%). Age groups with 1 recorded death each (6.25%) were 15–19, 20–29, 40–49 and 60–69 years.

The year 2021 had the highest number of deaths due to thyrotoxicosis in the Southern Region during the study period, with 4 (25%) of the 16 total deaths as shown in Figure 6. Among these 4 cases, one occurred in the 30–39 age group, two in the 50–59 group, and one in the 70–79 group. When comparing these findings with Figure 5, both Paraná and the Southern Region presented the highest number of deaths in 2021. Paraná recorded 2 (25%) deaths out of 8, whereas the Southern Region reported 4 (25%) deaths out of 16. Therefore, Paraná reflected the regional pattern in that year. It is relevant to mention that these 4 deaths in the Southern Region occurred among 74 hospitalizations (Figure 3), indicating that 5.40% of hospitalizations resulted in death.

The year 2014 had the second highest number of deaths in the Southern Region, with 3 cases (4.16%) - one in each of the following age groups: 40–49, 50–59 and 70–79 years - out of 72 hospitalizations. Considering the above, Figure 3 shows that in 2014 the age groups with the highest number of hospitalizations were: 20–29 years (17 cases), 30–39 years (14 cases), and 40–49 years (11 cases). Additionally, Figure 3 documents 10 hospitalizations among patients aged 50–59 years and 6 among those aged 70–79 years. Consequently, the mortality rates for that year were 9.09% for the 40–49 age group, 10% for the 50–59

group, and 16.66% for the 70–79 age group.

Figure 6 – Number of deaths due to thyrotoxicosis by age group from 2013 to 2023 in the Southern Region.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
Under 1 year	-	-	-	-	-	-	-	-	-	-	-	0
1-4 years	-	-	-	-	-	-	-	-	-	-	-	0
5-9 years	-	-	-	-	-	-	-	-	-	-	-	0
10-14 years	-	-	-	-	-	-	-	-	-	-	-	0
15-19 years	-	-	-	-	-	-	1	-	-	-	-	1
20-29 years	-	-	-	1	-	-	-	-	-	-	-	1
30-39 years	-	-	-	-	1	-	-	1	1	-	-	3
40-49 years	-	1	-	-	-	-	-	-	-	-	-	1
50-59 years	-	1	-	-	-	-	-	-	2	-	-	3
60-69 years	1	-	-	-	-	-	-	-	-	-	-	1
70-79 years	-	1	-	1	-	-	-	-	1	1	-	4
80 years and older	1	-	-	-	-	1	-	-	-	-	-	2
Total	2	3	0	2	1	1	1	1	4	1	0	16

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Figure 7 depicts the number of deaths due to thyrotoxicosis between 2013 and 2023 in Brazil. Unlike the findings of Paraná and the Southern region, the national data indicate that there was not a single year without deaths attributed to the disease. Furthermore, there are no records of deaths among pediatric patients in the age groups younger than 1 year, 1 to 4 years, and 5 to 9 years. Over the analyzed period, 127 deaths (1.81%) occurred among 6982 hospitalized cases.

The year 2023 - as discussed previously - corresponded to the highest number of hospitalizations in Paraná, the Southern region and Brazil. At the national level, and according to Figures 4 and 7, there were 833 hospitalizations, with 8 recorded deaths (0.96%) due to thyrotoxicosis. Among these 8 deaths, the age groups with the highest numbers were 40-49 years (202 hospitalizations and 2 deaths, representing 0.99%) and 20-29 years (137 hospitalizations and 2 deaths, corresponding to 1.45%).

According to Figure 7, the year with the greatest number of deaths in Brazil was 2019, with 17 deaths (2.38%) among 712 hospitalizations documented by DataSUS. Of these 17 deaths, 5 (29.41%) occurred in the 40 to 49 age group; 3 (17.64%) in the 20 to 29 age group; 3 (17.64%) in the 30 to 39 age group; 2 (11.76%) in the 50 to 59 age group; 2 (11.76%) among individuals aged 80 years or older; 1 (5.88%) in the 15 to 19 age group; and 1 (5.88%) in the 60 to 69 age group. Considering Figure 1, which outlines the national data, the age group with the highest number of hospitalizations from 2013 to 2023 was also the 40 to 49 age group, which likewise presented the highest number of deaths in 2019. This predominance may be associated with predisposing and precipitating factors that increase the risk of deterioration of the thyrotoxic state. More specifically, predisposing factors include polygenic factors, environmental exposures (such as smoking and bacterial or viral infections), and stress (Vilar, 2021). Precipitating factors include major surgery, trauma, withdrawal of antithyroid drugs, cerebrovascular disease, pulmonary thromboembolism, childbirth, among others (Papi et al., 2014).

Although 2013 had the lowest number of hospitalizations due to thyrotoxicosis in the country, when analyzing the 2013–2023 period, it was not the year with the fewest deaths, as it recorded 7 deaths (1.57%) among 445 hospitalizations (Figures 7 and 4). In this scenario, 2015 was the year with the lowest number of deaths, totaling 5 deaths (3.93% of the 127 deaths recorded), with 2 (40%) occurring in the 20 to 29 age group and 1 (20%) in each of the following groups: 30-39, 40-49 and 70-79 years.

As shown in Figure 7, the age group with the highest number of deaths due to thyrotoxicosis in Brazil throughout the analyzed period was the 40 to 49 age group, with 25 deaths (19.68% of the total 127 deaths). This was followed by the 30 to 39

age group, with 23 deaths (18.11%). Additionally, among the 127 deaths, 20 (15.74%) occurred in individuals aged 20 to 29 years; 17 (13.38%) in the 50 to 59 age group; 15 (11.81%) among those aged 80 years or older; 13 (10.23%) in those aged 70 to 79 years; and 12 (9.44%) in individuals aged 60 to 69 years. Only one death (0.78%) was recorded in each of the 10 to 14 and 15 to 19 age groups.

Figure 7 – Number of deaths due to thyrotoxicosis by age group between 2013 and 2023 in Brazil.

Age Group	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	TOTAL
Under 1 year	-	-	-	-	-	-	-	-	-	-	-	0
1-4 years	-	-	-	-	-	-	-	-	-	-	-	0
5-9 years	-	-	-	-	-	-	-	-	-	-	-	0
10-14 years	-	-	-	-	-	-	-	-	1	-	-	1
15-19 years	-	-	-	-	-	-	1	-	-	-	-	1
20-29 years	2	2	2	3	2	-	3	3	-	1	2	20
30-39 years	2	4	1	2	2	2	3	1	2	3	1	23
40-49 years	1	6	1	1	2	2	5	1	2	2	2	25
50-59 years	-	1	-	2	3	2	2	-	4	3	-	17
60-69 years	1	-	-	3	2	1	1	1	1	1	1	12
70-79 years	-	2	1	1	-	1	-	2	3	2	1	13
80 years and older	1	-	-	1	1	6	2	1	-	2	1	15
Total	7	15	5	13	12	14	17	9	13	14	8	127

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

Although the three locations analyzed presented similar age groups with the highest number of hospitalizations (30–39 years in Paraná and the Southern region, and 40–49 years in Brazil), an examination of Figures 5, 6, and 7 shows that the age groups with the highest number of deaths over the study period were not the same across these areas. In this regard, among the 8 total deaths in Paraná, 2 (25%) occurred in individuals aged 30–39 years, and 2 (25%) in those aged 50–59 years (Figure 5). In Brazil, there were 25 deaths (19.68% of 127) in the 40–49 age group, which also corresponded to the group with the highest prevalence of hospitalizations nationally (Figure 7). Conversely, in the Southern region, the age group with the highest number of deaths was 70–79 years, accounting for 4 (25%) of the 16 deaths, despite not being one of the groups with the highest number of hospitalizations (Figure 6).

Within this context, it is also possible to analyze the proportion of deaths in each location relative to the total number of hospitalizations. In Paraná, 8 deaths occurred among 223 hospitalizations, indicating that 3.58% of hospitalized cases resulted in death. In the Southern region, this proportion was 1.92% (16 deaths among 831 cases), and in Brazil, 1.81% of hospitalizations resulted in death (127 of 6982 cases). Thus, the mortality rate observed in Paraná is nearly double that of the Southern region and the national rate. It is important to consider that variability in mortality rates may reflect regional differences in healthcare infrastructure, resource availability, and the level of professional training. Further investigation is necessary to fully understand the specific factors contributing to the higher mortality from thyrotoxicosis in Paraná.

3.4 Analysis of hospitalizations by sex

For this analysis, data on the total number of hospitalizations due to thyrotoxicosis from 2013 to 2023 in Paraná, in the Southern region and in Brazil, available on the DataSUS platform, were used. Subsequently, these data were stratified by sex

(female and male) and by year of hospitalization, resulting in Figure 8.

Regarding hospitalizations by sex in Paraná, it is evident that there were 223 admissions between 2013 and 2023, of which 175 (78.47%) involved female patients, while 48 (21.52%) corresponded to male patients. Similarly, when analyzing data from the Southern region, 831 hospitalizations were recorded, with 648 (77.97%) female and 183 (22.02%) male patients. In addition, in Brazil, among the 6982 hospitalizations for thyrotoxicosis, 5436 (77.85%) occurred in women and 1546 (22.14%) in men.

In Paraná (Figure 8), the year with the highest number of female cases was 2023, with 30 cases (17.14% of 175), followed by 2018 and 2019, each with 18 cases (10.28%). The year with the lowest prevalence among females was 2014, with 9 (5.14%) recorded cases. Despite these variations, analysis of Figure 8 shows that in none of the years from 2013 to 2023 did the number of male hospitalizations for thyrotoxicosis exceed that of females. In both the Southern region and Brazil, the year with the highest number of female cases was also 2023. On the other hand, the year with the lowest prevalence of female cases was 2018 in the Southern region (7.4% of 648 cases) and 2013 in Brazil (6.12% of 5436 cases. Nevertheless, the data show that over the 11 years analyzed, the prevalence of thyrotoxicosis was higher among females than males both in the Southern region and in Brazil.

In this regard, based on Figure 8, it is evident that the female population was the most affected by the endocrine disorder during the analyzed period, which aligns with the epidemiology of Graves' disease, estimated to affect 3% of women and 0.5% of men, being 5 to 10 times more common in females (Vilar, 2021). It is worth noting that even during adolescence, a marked predominance in females is observed, with a ratio of approximately 5:1. This suggests that estrogen secretion may in some way influence the autoimmune predisposition to Graves' disease (Lafranchi & Wassner, 2024). Furthermore, considering that the female population was the most affected by the clinical syndrome, it is relevant to mention that hyperthyroidism tends to result in reduced menstrual bleeding and oligomenorrhea in women (Redmond, 2004), as well as being associated with infertility, anovulation, and, in postmenopausal women, severe osteoporosis (Devereaux & Tewelde, 2014).

Figure 8 – Number of hospitalizations due to thyrotoxicosis by sex from 2013 to 2023 in Paraná, the Southern region, and Brazil.

PARANÁ

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	2	1	3	3	6	3	1	2	8	6	13	48
Female	13	9	15	16	10	18	18	16	13	17	30	175
Total	15	10	18	19	16	21	19	18	21	23	43	223

SOUTHERN REGION

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	14	12	18	15	19	15	12	13	17	21	27	183
Female	51	60	68	54	51	48	62	51	57	65	81	648
Total	65	72	86	69	70	63	74	64	74	86	108	831

BRAZIL

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	112	94	136	112	163	138	129	118	150	200	194	1546
Female	333	430	467	448	504	532	583	379	522	599	639	5436
Total	445	524	603	560	667	670	712	497	672	799	833	6982

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

3.5 Analysis of deaths by sex

Figure 9 presents information on the number of deaths due to thyrotoxicosis by sex from 2013 to 2023 in Paraná, in the Southern Region and in Brazil. Regarding the data from Paraná, it can be observed that of the 8 total deaths recorded in the

DataSUS platform, 3 (37.5%) occurred in males, while most deaths (5 cases or 62.5%) occurred in females.

Still according to Figure 9, the years with the highest number of documented deaths in Paraná were 2016 and 2021, each with 2 deaths out of 19 and 21 hospitalizations, respectively. In 2016, there was 1 death in the 20–29-year age group and 1 in the 70–79-year group, both in females. In 2021, there were 2 deaths among patients aged 50–59 years, one male and one female.

In the Southern Region - according to the data shown in Figure 9 - 16 deaths caused by the endocrine disorder were recorded over the eleven-year period analyzed. Of these cases, 13 (81.25%) occurred in females and 3 (18.75%) in males. Referring back to Figure 3, it is noted that the year 2023 had the highest number of hospitalizations (108) and no recorded deaths. The second-highest number of hospitalizations occurred in 2022 and 2015, both with 86 cases. In 2022, there was 1 female death in the 70–79-year age group, while in 2015 no deaths were reported. Furthermore, 2018 had the lowest number of hospitalizations in the region (63), with 1 female death in the age group of 80 years or older.

Regarding Figure 9, the year with the highest number of deaths from thyrotoxicosis in the Southern Region was 2021, with 4 cases, of which 3 (75%) occurred in females and 1 (25%) in a male. Among these, 2 (50%) deaths occurred in the 50–59-year age group, 1 (25%) in the 30–39-year group, and 1 (25%) in the 70–79-year group.

The data in Figure 9 related to Brazil show a total of 127 deaths, with 100 (78.74%) occurring in females and 27 (21.25%) in males over the studied years. Based on this perspective, the year with the highest number of hospitalizations was 2023, which recorded 8 deaths (0.96% of 833 hospitalizations), all in females. According to Figure 7, the affected age groups were as follows: 1 death (12.5% of 8) in each of the age groups 30–39, 60–69, 70–79 and ≥80 years. The age groups 20–29 and 40–49 years each had 2 recorded deaths (25%). In contrast, the year with the fewest hospitalizations in Brazil—2013—had 7 recorded deaths (1.57% of 445 hospitalizations), of which 5 (71.42%) occurred in females and 2 (28.57%) in males. The age distribution of these deaths was as follows: 2 deaths each in the 20–29 and 30–39-year groups, and 1 death in each of the groups 40–49, 60–69, and ≥ 80 years.

As evidenced by Figure 9, 2019 was the year with the highest number of deaths from thyrotoxicosis in Brazil (17 cases), with 13 (76.47%) in females and 4 (23.52%) in males. Of these 17 cases, 5 (29.41%) occurred in the 40–49-year group, 3 (17.64%) in the 20–29-year group, 3 (17.64%) in the 30–39-year group, 2 (11.76%) in the 50–59-year group, and 2 in those aged 80 years or older. Additionally, 1 death (5.88%) occurred in each of the age groups 15–19 and 60–69 years. Conversely, 2015 was the year with the lowest mortality (5 cases), with 2 deaths (40%) in the 20–29-year group and 1 death (20%) in each of the 30–39, 40–49, and 70–79-year age groups.

Figure 9 – Number of deaths from thyrotoxicosis by sex from 2013 to 2023 in Paraná, in the Southern Region and in Brazil.

PARANÁ

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	-	1	-	-	1	-	-	-	1	-	-	3
Female	-	-	-	2	-	1	-	1	1	-	-	5
Total	0	1	0	2	1	1	0	1	2	0	0	8

SOUTHERN REGION

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	-	1	-	-	1	-	-	-	1	-	-	3
Female	2	2	-	2	-	1	1	1	3	1	-	13
Total	2	3	0	2	1	1	1	1	4	1	0	16

BRAZIL

Sex	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Male	2	2	2	1	4	2	4	1	4	5	-	27
Female	5	13	3	12	8	12	13	8	9	9	8	100
Total	7	15	5	13	12	14	17	9	13	14	8	127

Source: chart developed by the autor using data from: https://datasus.saude.gov.br/informacoes-de-saude-tabnet/.

3.6 Comparative analysis: hospitalizations and deaths by age group and sex

Bringing together the previously analyzed aspects, Figures 2 and 8 show that, among the 223 hospitalizations recorded in the state of Paraná in the DataSUS platform, 175 (78.47%) occurred in females, with 54 (24.21%) of these cases in the 30–39-year age group. Considering Figures 5 and 9, among the 8 total deaths in Paraná, 2 (25%) occurred in individuals aged 30–39 years and another 2 (25%) in the 50–59-year group. In addition, 5 (62.5%) of these deaths occurred in females. Therefore, it can be concluded that the predominant epidemiological profile of deaths due to thyrotoxicosis in Paraná between 2013 and 2023 consists of female patients (62.5%) aged 30–39 years and 50–59 years.

In the Southern Region, based on Figures 3 and 8, the epidemiology of hospitalizations due to thyroid dysregulation from 2013 to 2023 is characterized by a predominance of females in the 30–39-year age group, similar to what was observed in Paraná. This is because, among the 831 total hospitalizations, 648 (77.97%) occurred in females, and 186 (22.38%) were within this age bracket. Regarding the epidemiological pattern of deaths from the same disorder, according to Figures 6 and 9, females continue to outnumber males, and the 70–79-year age group presents the highest mortality compared to the others. In this context, among the 16 deaths due to thyrotoxicosis, 13 (81.25%) occurred in females, with 4 (25%) deaths in the 70–79-year age group.

At the national level, according to Figures 4 and 8, the epidemiological profile of hospitalized patients indicates that, among 6982 cases, 5436 (77.85%) occurred in females, with 1523 (21.81%) individuals aged 40–49 years. Regarding Figures 7 and 9, which cover mortality among these hospitalized patients, of the 127 deaths due to thyrotoxicosis recorded in Brazil, 100 (78.74%) occurred in females, and 25 (19.68%) belonged to the 40–49-year age group. In this case, there is a clear convergence between the profiles of hospitalized and deceased patients, both in terms of predominant sex and age group.

3.7 General data analysis

Based on the information presented, it is understood that the epidemiological profile of patients hospitalized due to thyrotoxicosis between 2013 and 2023 aligns with the higher prevalence of Graves' disease among women aged 30 to 60 years (Vilar, 2021). This conclusion applies to all analyzed locations (Paraná, the Southern Region and Brazil), since the predominant profile in the hospitalization datasets primarily consisted of female patients aged 30 to 49 years.

It is important to mention that non-genetic risk factors for the development of Graves' disease include smoking, psychological stress and female sex (De Leo et al., 2016). It is worth emphasizing that more women than men develop Graves'

disease (approximately 4:1), a difference possibly mediated by higher estrogen levels - associated with enhanced immunologic reactivity - or low testosterone levels. However, the presence of an additional X chromosome may also contribute to the increased female susceptibility to this form of hyperthyroidism, as the higher prevalence persists after menopause (Davies, 2025).

In Paraná, the female population presented 3.64 times more hospitalizations due to thyrotoxicosis than males across the evaluated years. In the Southern Region, females had 3.54 times more hospitalizations, while in Brazil, females were 3.51 times more frequently hospitalized compared with males. In this regard, it is relevant to highlight that hyperthyroidism in general is also more common in females than in males (5:1) (Ross, 2023).

In the United States, the prevalence of hyperthyroidism is estimated to be approximately 1.2%, comprising 0.5% overt disease and 0.7% subclinical hyperthyroidism (Bahn et al., 2011). It should also be emphasized that the global prevalence of hyperthyroidism is approximately 1.3%, increasing to 4–5% among elderly women (Ross et al., 2016). When considering this information and comparing it with Figure 1 - without stratifying by sex - it becomes evident that Paraná, the Southern Region and Brazil do not exhibit this same age-related increase. This pattern is visually identifiable in Figure 1, which shows a decline in the number of hospitalizations beginning at 40–49 years of age in Paraná and the Southern Region, and at 50–59 years in Brazil. Furthermore, according to Figure 1, in Brazil, the age groups 60–69, 70–79, and ≥ 80 years account for 1095 of 6982 hospitalizations (15.68%). Additionally, the two most prevalent age groups nationwide - 30–39 and 40–49 years - together represent 3030 hospitalizations, or 43.39% of the total.

Therefore, it can once again be observed that the proportion of thyrotoxicosis cases does not reflect the age-related increase seen with hyperthyroidism. Nevertheless, even though older adults do not represent the predominant group, it is important to understand that the clinical presentation of the disease in this population differs from that seen in younger age groups. This difference occurs because apathetic thyrotoxicosis often manifests in elderly patients, presenting as muscle weakness, weight loss, atrial fibrillation, palpitations, dizziness, syncope or even memory loss (Nayak & Burman, 2006). Additionally, it is important to note that approximately 2% of elderly individuals with hyperthyroidism present with this apathetic form (Lee & Pearce, 2023).

It should be emphasized that the transition from thyrotoxicosis to thyroid storm involves significant physiological stress, leading to severe thermoregulatory dysfunction, altered mental status and multiorgan failure, including adrenergic crises characterized by tachycardia and hypertension, among other manifestations (Goldberg & Inzucchi, 2003). The incidence of thyroid storm occurs in fewer than 10% of hospitalized patients with thyrotoxicosis. Despite the low frequency of this condition, appropriate clinical management is crucial, as mortality rates range from 20% to 30% (Nayak & Burman, 2006). Thus, it is essential to highlight that accurate diagnosis is indispensable for the proper treatment of thyrotoxicosis (Bahn et al., 2011).

In this context, an analysis of hospitalization data from Paraná between 2013 and 2023 shows that 3.58% of cases progressed to death (8 deaths among 223 hospitalizations). In comparison, the percentages observed in the Southern Region and Brazil as a whole were lower, at 1.92% and 1.81%, respectively. From this perspective, it is relevant to mention that, compared with the euthyroid state, overt hyperthyroidism is associated with a 35% to 400% increase in all-cause mortality (related to exacerbation and severity of the clinical condition) and a 20% increase in cardiovascular mortality. Mortality is associated with the cumulative duration of time an individual remains hyperthyroid, regardless of the treatment modality used (Lee & Pearce, 2023).

In a study conducted in Italy, a considerably higher prevalence of thyrotoxicosis was observed in a group of patients hospitalized in intensive care units due to COVID-19 in 2020 (HICU-20 group), compared with another group admitted in the same unit in 2019 without COVID-19 (HICU-19 group). Patients with viral infection exhibited lower TSH levels and elevated free thyroxine (T4) levels in some cases, suggesting thyrotoxicosis (Muller et al., 2020).

Accordingly, when analyzing the DataSUS records for 2019 and 2020 - the same years highlighted in the cited study -

it becomes evident that there was no increase in hospitalization cases in Paraná, the Southern Region or Brazil (Figures 2, 3, and 4). Instead, a decrease was observed. This can be seen, for example, in Paraná, where 19 cases were recorded in 2019 and 18 in 2020, representing a 5.26% reduction. In the Southern Region, there were 74 hospitalizations in 2019 and 64 in 2020, indicating a 13.51% decrease. Finally, at the national level, Brazil recorded 712 cases in 2019 and 497 in 2020, corresponding to a 30.20% reduction. It is also important to highlight that, when analyzing mortality data for the same locations and period (Figures 5, 6 and 7), Paraná recorded no deaths in 2019, compared to one in 2020. In the Southern Region, both years recorded one death. Brazil showed a reduction in deaths from 2019 to 2020, decreasing from 17 to 9.

4. Conclusion

In a concise manner, the present study presents correlations between data on patients hospitalized for thyrotoxicosis in Paraná compared with the Southern region and Brazil from 2013 to 2023, including information on deaths and hospitalizations stratified by sex and age group, highlighting relevant findings for understanding the epidemiological profile of this endocrinological disorder. Given the above, comparing the presented data with the cited references is challenging, as many of them address thyrotoxicosis indirectly or in a fragmented manner. This limitation underscores the need for more specific studies on the epidemiology of the condition, enabling a more comprehensive analysis of its incidence, distribution, and impact on public health.

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