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Research Article

Analysis of conditions related to diabetic foot in the pre and post COVID-19 pandemic in Brazil

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Abstract

With the COVID-19 pandemic, an exacerbation of hospitalizations due to diabetic foot was noted in Brazil, which was due to the loss of access to primary health care by the population, especially the most economically disadvantaged in a country with a vast continental extension and very unequal, economically. We carried out an observational, retrospective and descriptive analysis of hospital data on hospitalization for diabetic foot treatment, using SIH/SUS and DataSUS between 2015 and 2023. Mortality, length of stay, costs, nature of care and demographic distribution of procedures were analyzed. During the period, 196,523 hospitalizations were recorded for the treatment of complicated diabetic foot. In addition, 5,711 cases of deaths were associated with a fatality rate of 0.54%. In relation to financial expenditure, the Northeast Region stood out with the highest expenditure rate. The most socially vulnerable regions had higher hospitalization and mortality rates, although there was little change in financial resources during the pre- and post-pandemic period. This situation highlights the need to promote greater regional equity in indicators and access to health to minimize preventable problems such as UPD. Situations such as the one experienced in the COVID-19 pandemic served to highlight the shortcomings of the country's health system and how the health-disease process is strongly linked to local socioeconomic conditions, making it necessary to promote collective health measures aimed at minimizing disparities regions in Brazilian territory. The lack of data collected by the health event registration system in the country constitutes a limitation in the present study, which makes us suggest greater rigor and diversity in the collection of information in order to better translate the reality of the data presented here.

Keywords: diabetic foot, hospitalizations, COVID-19 pandemic

Introduction

Diabetic foot or diabetic foot ulcer (UPD) is defined as a complex pathophysiological condition, which consists of a heterogeneous metabolic disorder, in which lesions appear on the feet of individuals with diabetes mellitus (DM), due to chronic hyperglycemia1. This pathology is an important public health problem, as it is one of the main causes of hospitalization and hospital expenses for patients with DM.2 Considering all hospitalizations together, costs in Brazil reached 9.23 million dollars (quote of 07 May 2024) in 20143, with expenses being 5 times greater for patients with diabetic foot than without.4 This condition is costly both for the State and for patients with diabetic foot who are subject to expenses related to hospitalization time , rehabilitation and the risk of unemployment. 5.6

When the risk of cardiovascular events and mortality is analyzed, individuals with DM are twice as likely as those without diabetes.7 More recent studies have observed a strong association between the increased risk of mortality among diabetic patients with UPD.8 Patients with diabetic foot syndrome have high mortality rates and low life expectancy.9, as diabetic foot complications have a prevalence of 25% and are the main reason for hospitalization and amputation in people with diabetes.5 Therefore, diabetic patients with foot ulcers have a mortality rate twice as high when compared to that of diabetic patients without foot ulcers.2 Therefore, it is imperative to track and continue monitoring these individuals, aiming to reduce the mortality trend and costs related to complications. of the diabetic foot.

The pathophysiological changes of Diabetic Foot Syndrome are grouped by the triad accompanied by neuropathy, ischemia and infection of the region.10 According to Volmer-Thole11, 50% of cases of this syndrome occur due to neuropathies, 15% due to angiopathies and 35% due to mixed causes. Hyperglycemia, a condition to which individuals with DM are exposed11, leads to the development of microangiopathic changes due to

oxidative stress and the accumulation of substances, such as sorbitol. Furthermore, the component of atherosclerotic lesions must be highlighted, which these individuals have a risk factor for developing, which contributes to the course of this pathology,12 The neuropathic component of this clinical condition is lesions of peripheral neuron fibers. of these patients11,13, which can cause anhidrosis and muscular atrophy of the internal components of the feet and leg muscles, promoting a deformation known as hammer toes and claw toes.13

The clinical manifestations of the diabetic foot are generally associated with reduced sensitivity to pain and temperature initially, and in more advanced cases there is reduced sensitivity to vibration and superficial touch.14 As a result, patients lose sensitivity to mechanical, painful stimuli , chemical or thermal under normal conditions.14 However, the diagnosis of this disease faces difficulties, given the similarity with other situations such as osteomyelitis, soft tissue infection, inflammation or osteoarthropathy15, as well as the difficulty in performing wound cultures, given that all open lesions are colonized by microorganisms.16

Among the main risk factors for the development of this syndrome are male sex, the presence of peripheral neuropathy and other associated risk factors such as dyslipidemia and systemic arterial hypertension.11,17,18 It is worth highlighting that this condition has a strong social component. , given that the individual's socioeconomic level interferes with the course of the history of the disease in question, given the importance of continuous medical monitoring, whether for early diagnosis or for the adoption of effective therapeutic measures.11,13

To establish treatment for diabetic foot, the stage the patient is in must be taken into account to draw up the therapeutic plan. In general, it is necessary to pay attention to pain control and the associated risk factors that the patient presents concomitantly, such as hyperlipidemia and hypertension19. Furthermore, it is extremely important to control blood glucose through the use of drugs, dietary control and encouraging exercise, and in cases of associated infection, treat with specific antibiotic therapy for each culture.11,13,18 .20

Furthermore, with the advent of the COVID-19 pandemic, important correlations between the Coronavirus and the treatment of patients with diabetic foot were observed, considering that viral infection and inflammation exacerbate hyperglycemia and complicate the treatment of DM.21 Associated with Therefore, the pandemic context also made it difficult for patients to access primary access providers for continuity of care, and facilitated the dissemination of false or misleading information.21

In this study, we will describe the metrics of hospitalizations and mortality from diabetic foot recorded in the Brazilian Government's public health data system, showing the impact that socio-economic conditions in different regions of Brazil have on the prognosis of diabetes in the Brazilian population.

Goals

Primary objective: To describe the hospitalization characteristics of patients undergoing treatment for complicated diabetic foot in Brazil between 2015 and 2023.

Secondary objective: Understand the costs involved with mortality and hospitalization of patients throughout the period.

Methodology

It is an observational, retrospective and descriptive study of secondary data, extracted from the SUS Hospital Information System – Sistema Único de Saúde – (SIH/SUS), available in the DataSUS database, referring to hospital procedures in Brazil between the years 2015 to 2023, by place of residence, relating to the treatment of complicated diabetic foot.

The data obtained was processed using Microsoft Excel software, where tables and graphs were created relating to the collected data, which can be verified through the TabNet portal, at the following access link: https://datasus.saude.gov.br/.

To describe hospitalization, mortality and costs due to diabetic foot in Brazil, demographic regions were evaluated (North, Northeast, Central-West, Southeast, South), excluding the Federative Unit. The variables of deaths, mortality rate, hospitalizations, days of stay, value of hospital services, total and average value and the nature of care (elective or urgent) were used, with all values being analyzed with the dollar value of 5, 06, based on the quote made on May 7, 2024.

To calculate the hospital fatality rate for hospitalization for the treatment of complicated diabetic foot between the years 2015 and 2023, the ratio was calculated between the number of deaths in that period and the number of people hospitalized for this condition. To calculate the hospital prevalence rate of hospitalization for the treatment of complicated diabetic foot in relation to all hospitalizations in Brazil between the years 2015 and 2023, the ratio was made between the number of hospitalizations for complicated diabetic foot and the number of general hospitalizations according to the Brazilian region, in the same period.

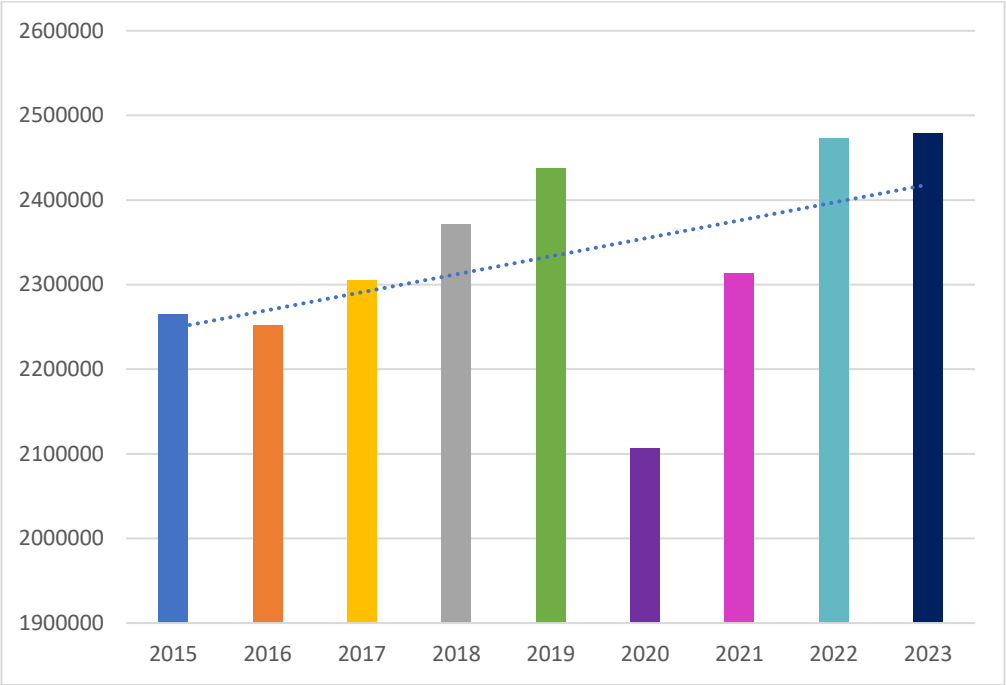
In this study, the following temporal division was considered: the years prior to 2020 being pre-pandemic; 2020 the current year of the pandemic, 2021 period of gradual reopening; 2022/2023 or post-pandemic.

As it is a public health database, analysis by the Ethics Committee was not required.

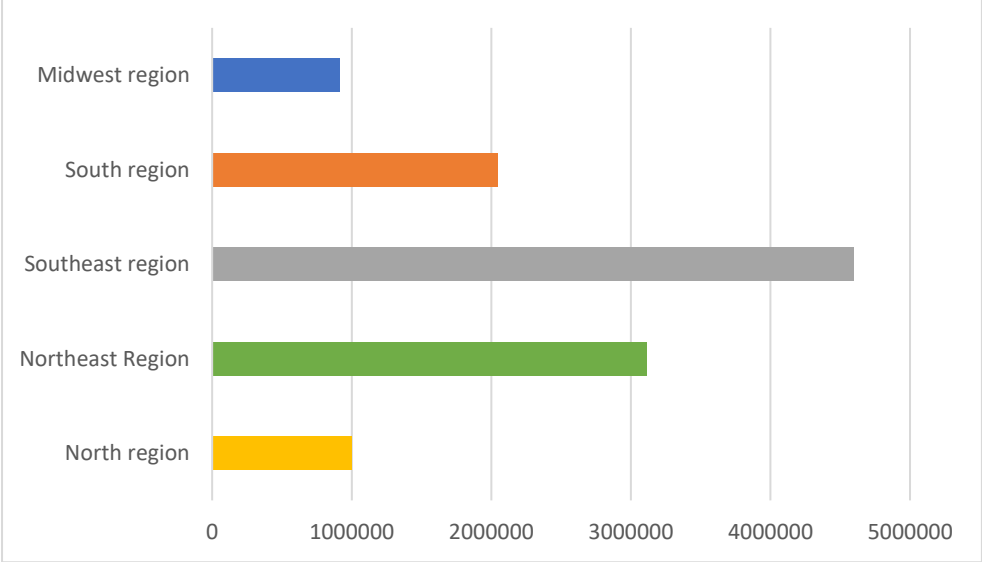
Results

Between 2015 and 2023, 196,523 hospitalizations were recorded for the treatment of complicated diabetic foot in Brazil. The total number of deaths due to this pathology in the same period was 5,711 cases, with this it is possible to calculate the hospital fatality rate for complicated diabetic foot, with a rate of 0.54%. When analyzing the general Brazilian panorama, during the years studied, it was noted that there was a tendency for a general increase in the number of deaths related to diabetic foot in the years of the pandemic (2020 – 2022) and a reduction in the pre- and post-pandemic period (2015- 2020 and 2023, respectively).

According to Graph 1 "Average of total hospitalizations for complicated diabetic foot per year between 2015-2023", this average remained regular during the period, except in 2020 with a maximum variation of (2,106,364.6 hospitalizations), to (2,478,858.2 hospitalizations) in the year 2023, while analyzed by region in graph 2: "Average of total hospitalizations for complicated diabetic foot by region between 2015-2023", there is a predominance of the Southeast region and Northeast with respective averages: (4,595,328.2 hospitalizations) and (3,113,296.3 hospitalizations). The following continue to decline: South, North and Central-West with respectively (2,045,891.1 hospitalizations), (996,751.66) hospitalizations) and (915,854.44 hospitalizations).

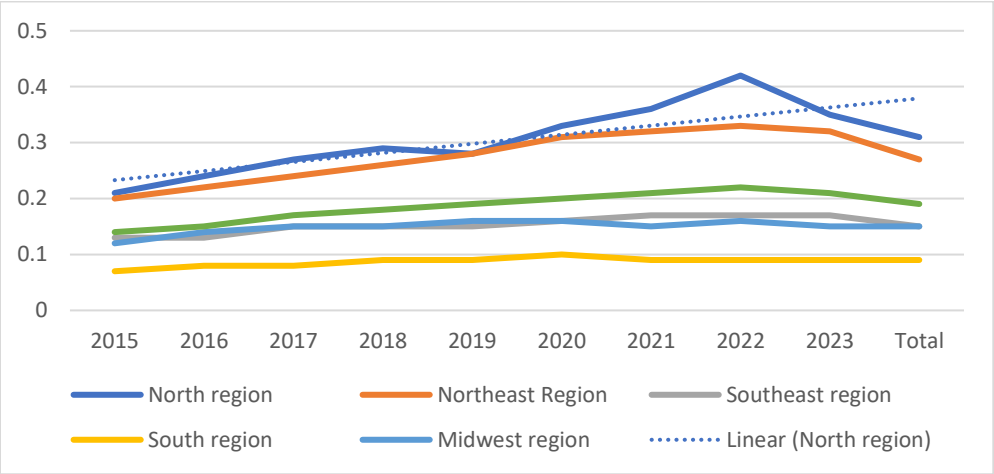


Graphic 1 Average total number of hospitalizations for complicated diabetic foot per year between 2015-2023 in Brazil.

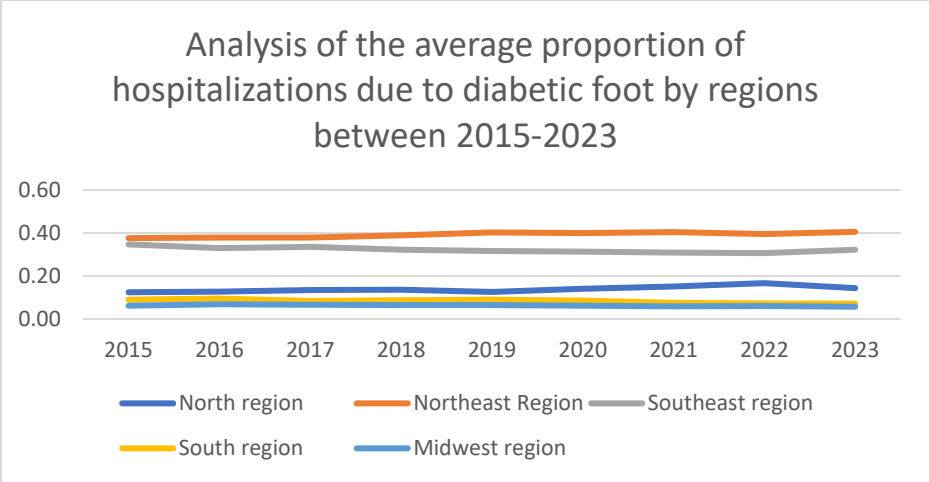


Graphic 2 - Average total number of hospitalizations for complicated diabetic foot by region between 2015-2023.

Still on hospitalizations for complicated diabetic foot, it can be seen in graph 3: "Analysis of the proportion of hospitalization rate for diabetic foot and general hospitalizations between 2015-2023" (in its prevalence rate), a predominance in both variables due to regions: North and Northeast, with a peak in the average number of hospitalizations in the North region in the year 2022 with a rate of 42% and in the Northeast region with 33% in the same year. However, when analyzing graph 4: "Analysis of the average proportion of hospitalizations for diabetic foot by Regions between 2015-2023", the highest numbers are seen in the Northeast and Southeast, with the Northeast region playing a leading role throughout the period (2015-2023).

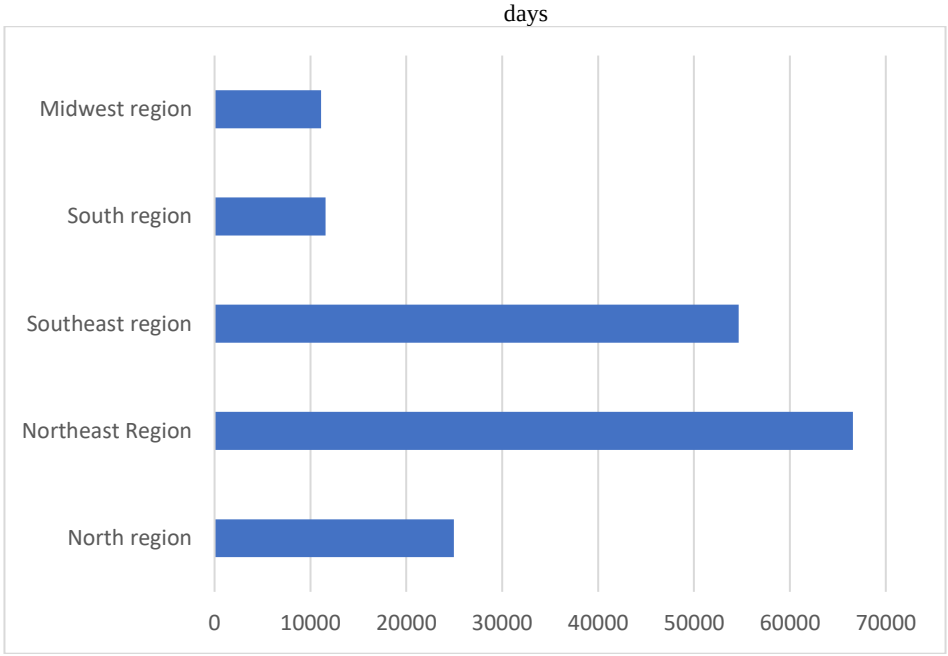


Graphic 3: Analysis of the proportion of hospitalization rates for diabetic foot and general hospitalizations between 2015-2023 in Brazil.



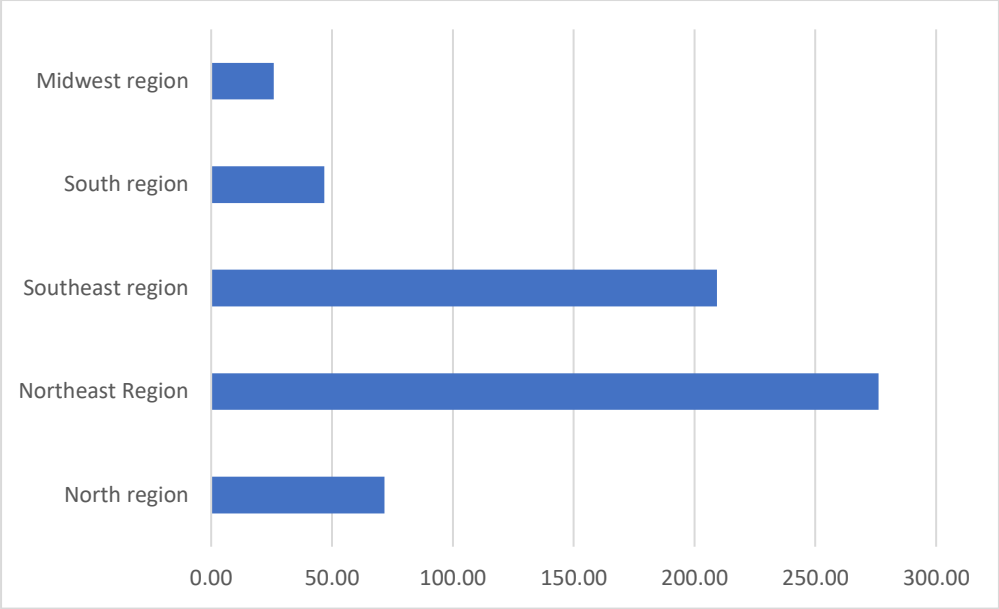
Graphic 4: Analysis of the average proportion of hospitalizations for diabetic foot by Regions between 2015-2023 in Brazil

Regarding the analysis of graph 5: "Average days of stay for treatment of complicated diabetic foot by Region between 2015-2023", there is the absolute leadership of the Northeast Region (66,564.33 days), followed by: Southeast, North, South and Central-West with: (54,660 days), (24,960.56 days), (11,561.22 days), (11,091.56 days), respectively. However, when the average number of hospitalizations per year (2015-2023) is available, with the lowest average (25,838.2) starting with the year 2015, there is a significant increase in this average, especially at the end of the year. period between 2021-2023 with a predominance in 2022, which totals 43,054.8 days



Graphic 5: Average days of stay for treatment of complicated diabetic foot by Region between 2015-2023.

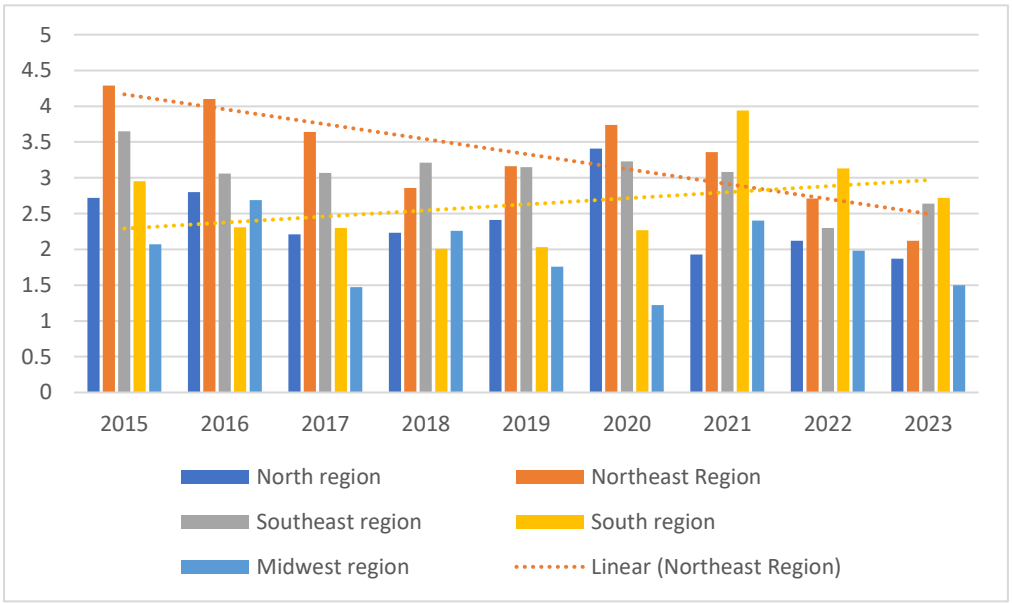
Analyzing graph 6: "Average of deaths per hospitalization for treatment of complicated diabetic foot by Region between 2015-2023", there is a significant value in the Northeast region (276.11 deaths), followed in descending order by regions: Southeast, North, South and Central-West, with (209.33 deaths), (71.78 deaths), (46.78 deaths) and (25.89 deaths). When analyzing the same average according to the year (2015-2023), there is a slight predominance of the year 2021 (147.6 deaths), followed by 2020, 2022 and 2019 with: (138.6 deaths), (134 deaths) and (130 deaths), respectively.



Graphic 6: Average number of deaths per hospitalization for treatment of complicated diabetic foot by Region between 2015-2023 in Brazil.

Regarding the analysis of the lethality rate by year and Region, calculated based on the total value of hospitalizations for treatment of diabetic foot by Region between 2015-2022, there is a frequent predominance of the Northeast Region during the period 2015-2017 with a central tendency of regression expressed: 4.29%, 4.10% and 3.64%. In the period: 2018-2020 there is an alternation between Southeast and Northeast, with still a slight predominance of the Northeast. In the period between 2021 and 2023, the lethality rate predominates in the South Region, with a central tendency of regression expressed: 3.94%, 3.13%, 2.72%, respectively.

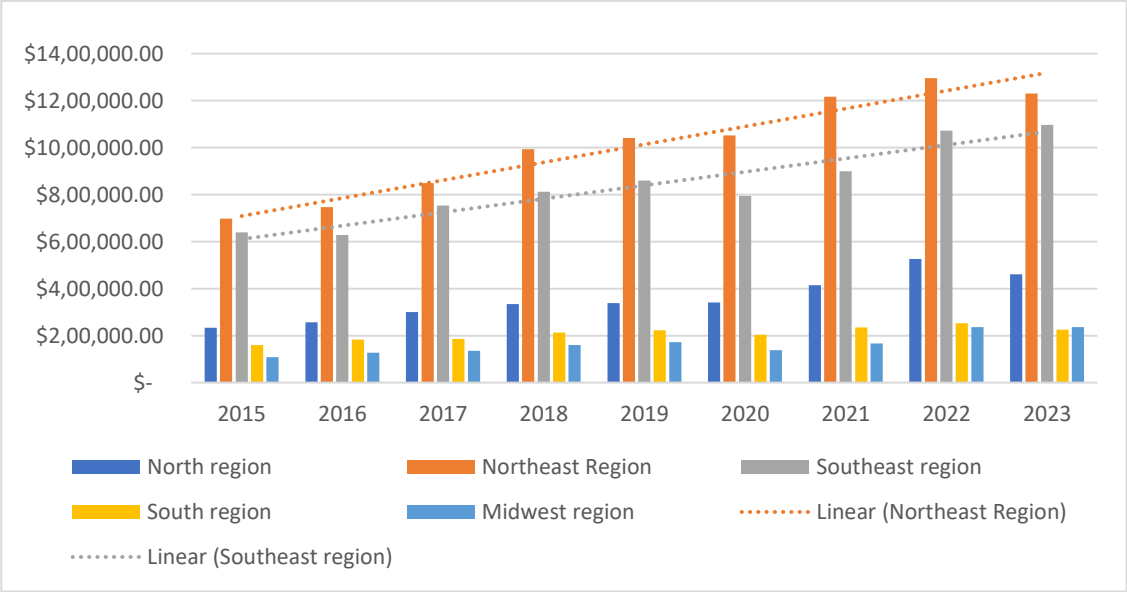
The general panorama of the hospital mortality rate showed a predominance of higher rates in the Northeast Region between 2015 (4.29) and 2017 (3.64). In 2018, the Southeast Region surpassed and led with the highest mortality rate (3.21), while in 2019, the Northeast and Southeast Regions did not show significant differences, leaving comparable rates: 3.16 and 3. 15, respectively. In 2020, the Northeast region again presented the highest mortality rates in the country (3.74), followed by the North and Southeast regions, respectively 3.41 and 3.23. In the years between 2021 and 2023, the South Region surpassed this rate, becoming the leader as the region with the highest mortality rate in the country with rates of 3.94, 3.13 and 2.72, respectively. According to Graph 7 of mortality rate, an increasing trend was evident in the South Region and a reduction rate in the Northeast Region in the period. The Central-West Region showed an annual variation with a significant reduction rate (54%), with a rate of 2.69% in 2016 and a rate of 1.22% in 2020.



Graphic 7: Distribution of hospital mortality rate due to complicated diabetic foot by Brazilian region between 2015-2023

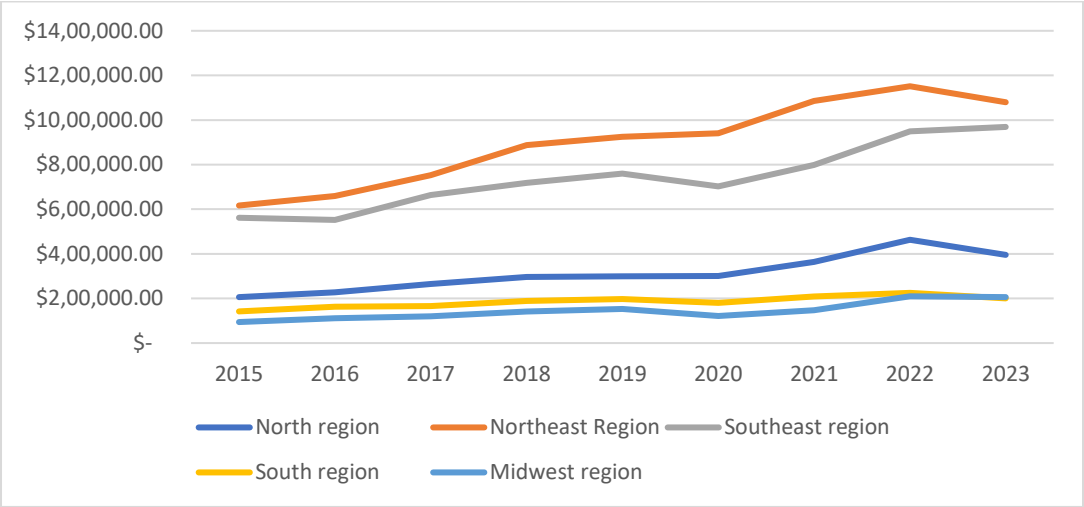
The analysis based on the type of care (elective or urgent) revealed that the urgent nature presented the most significant values in all Regions with regard to the number of days of stay and total values. The Northeast Region had the highest values with 2,431 deaths in the Emergency Department and 68 elective deaths; followed by the Southeast Region with 1874 emergency deaths and 28 elective deaths; in the North Region with 621 emergency deaths and 32 elective deaths; South Region with 417 emergency deaths and 8 elective deaths; and finally the Central-West Region with 231 emergency deaths and 3 elective deaths. In relation to the mortality rate, the perspective remained, thus a higher rate was noted in the emergency nature, with emphasis on the Northeast region (3.26), followed by the Southeast Region (3.03), the South Region (2 .67), North Region (2.42) and Central-West Region (1.92), respectively.

According to graph 8 "Total amount spent by region per year on diabetic foot care between 2015 and 2023", the total amounts spent on the treatment of complicated diabetic foot were higher in the Northeast Region throughout the analyzed period (from 2015 to 2023), presenting an average of $1,013,706.92 being the highest value in 2022, $1,296,341.86, totaling an increase of 27.9% when compared to the average and $1,229,877.60 in 2023, presenting an reduction of $66,464.26 (5.13%), when compared to 2022. Following this, the southeast region had the second highest average expenditure per diabetic foot: $839,521.73, with the highest amount spent in 2023 ($1,096 ,882.27, an increase of 46.5% when compared to the average). The North region had the third highest average spending on diabetic foot treatment ($355,920.23), however, a discrepancy is noticeable between the average amounts spent in the Northeast and Southeast regions when compared to the North region. This Region presents the highest value in 2022 ($525,894.72 with an increase of 48% when compared to the average), and, like the Northeast region, in 2023 there is a noticeable reduction, in this case of $64,644.78 (reduction of 12.29% when compared to 2022), leading to expenditure of $461,249.94. The fourth Region to present the highest expenses was the South region, with an average of $209,015.58 and the highest amount spent in 2022 ($253,026.53, representing an increase of 21.1% when compared to the average), being noticeable a decrease in spending in 2023 of $27,936.68 (11%), corresponding to a total of $225,089.85 for that year. Thus, the Region that presented the lowest expenditure was the Central-West, with an average of $164,373.83, with the highest amount spent also in 2022 ($236,746.87, 44% increase when compared to the average) and with a brief cost reduction in 2023 of $1,179.20 (5%) when compared to 2022, totaling $235,567.67 that year. With this, it is concluded that the Northeast Region has the highest expenses with this treatment and that all regions had higher expenses in 2022, except the Southeast region.



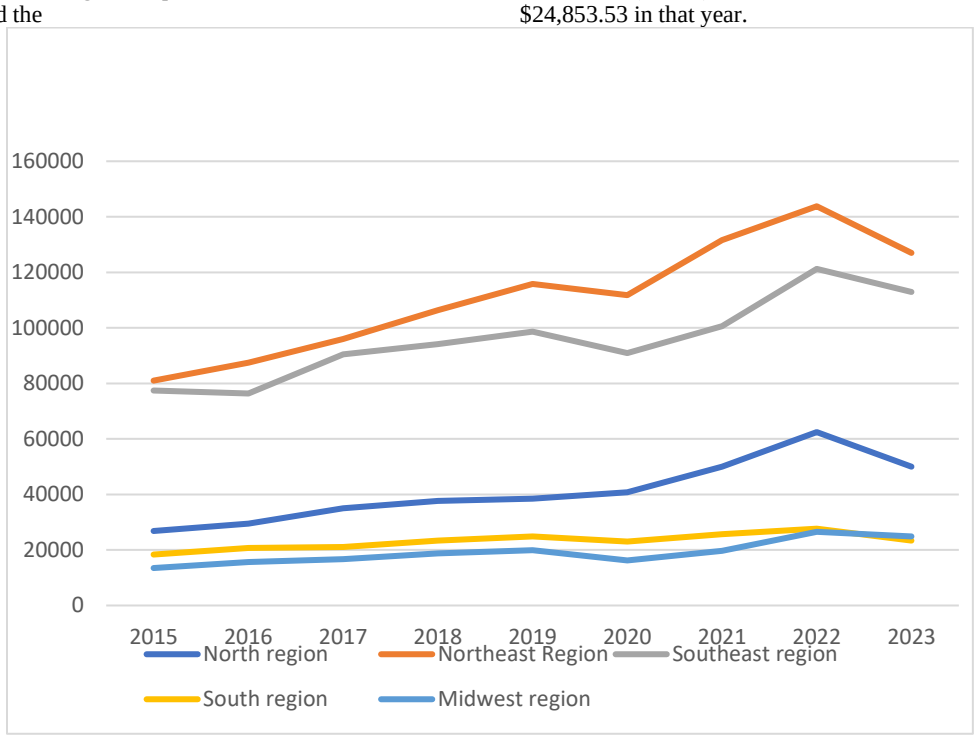
Graphic 8: Total amount spent by region of year on diabetic foot care between 2015 and 2023.

Likewise, according to graph 9 "Distribution of Hospital Service Values for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023", the values spent on hospital services for the treatment of complicated diabetic foot evidenced in the research were highest in the Northeast Region in the period analyzed (from 2015 to 2023), presenting an average of $899,751.75 spent, with the highest value identified in 2022 ($1,151,278.41, with an increase of 28% when compared to the average) and with a reduction of $72,004.38 (6.25%) when compared to 2022 in 2023, totaling $1,079,274.03. The second Region to present the highest expenditure on diabetic foot with hospital services in the period studied was the Southeast Region, with an average of $741,668.42, with the highest value evidenced in 2023 ($969,042.25, with an increase of 30 .7% when compared to the average). The third Region that presented the highest hospital expenses was the North, with an average of $312,984.76 and the highest amount spent in 2022 ($463,037.35, representing an increase of 47.94% when compared to the average), with a reduction in 2023 of $67,118.57 (16.95%) when compared to 2022, totaling $395,918.79 for that year. Following it, the South Region presented an average of $185,678.50 in the years analyzed, with the highest amounts spent in 2022 ($225,141.26, representing an increase of 21.25% when compared to the average) and a reduction of $ 25,136.48 (11.17%) in 2023 when compared to 2022, totaling $200,004.77 in that year. The region that had the lowest expenditure on hospital services in the treatment of complicated diabetic foot was the Central-West region, with an average of $144,685.02 and the highest amount spent was in 2022 ($209,535.58, representing an increase of 44, 82% when compared to the average), with a reduction of $3,438.14 (1.64%) in 2023 when compared to 2022, totaling $206,097.43 in that year.



Graphic 9: Distribution of Hospital Service Fees for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023.

Regarding the amount spent on professional services in the years analyzed (2015-2023), seen in graph 10 "Value (in dollars) of professional services by Region and Year of service (2015-2023)", the Northeast Region was the one that presented the highest average ($223,304.20), with the highest value identified in 2022: $143,788.40, representing a reduction of $79,515.86 (35.6%) when compared to the average. Still in the Northeast Region, in 2023 a reduction of $16,790.25 (11.68%) was identified when compared to 2022, totaling $126,998.10 in that year. The second Region to present the highest expenses was the Southeast, with an average of $192,442.20 and with the highest amount spent in 2022: $121,235.50, representing a reduction of $71,206.65 (37%) when compared to the average. In 2023, in this same Region, a reduction of $8,269.49 (6.82%) was identified when compared to 2022, totaling $112,966.10 in that year. The third Region to present the highest expenditure was the North, with an average of $82,694.50 and the highest expenditure in 2022: $62,458.57, representing a reduction of $20,235.93 (24.47%) when compared to the average. In this Region, a reduction of $12,427.93 (19.9%) was identified in 2023 when compared to 2022, totaling $50,030.63 in that year. The fourth Region to present the highest expenses was the South, presenting an average of $46,429.55, with the highest amount spent identified in 2022: $27,661.29, representing a reduction of $18,768.25 (40.42%) when compared to the average . In this same Region, in 2023, a reduction of $4,254,326 (15.38%) was identified compared to spending in 2022, totaling $23,406.97 that year. The Region that presented the lowest expenditure was the Central-West, presenting an average of $38,390.39 and the highest expenditure identified was in 2022: $26,536.62, representing a reduction of $11,853.77 (30.88%) when compared to the average. In 2023, in this same region, a reduction of $1,683.09 (6.34%) was identified when compared to 2022, totaling $24,853.53 in that year.

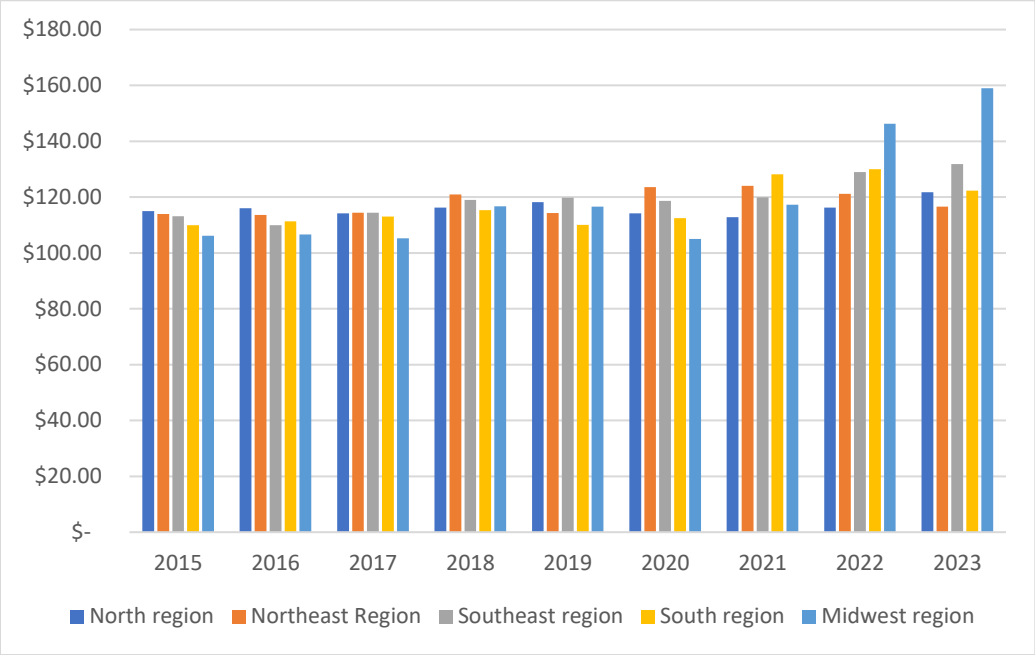


Graphic 10: Value (in dollars) of professional services by Region and Year of service (2015-2023).

It is important to highlight that the value of the hospital service added to the value of the professional service corresponds to the total value. During the period evaluated, a constant pattern was noted in relation to the Brazilian Regions, with the Northeast leading the expenditure on hospital, professional and, therefore, total services, followed by the Southeast, North, South and Central-West.

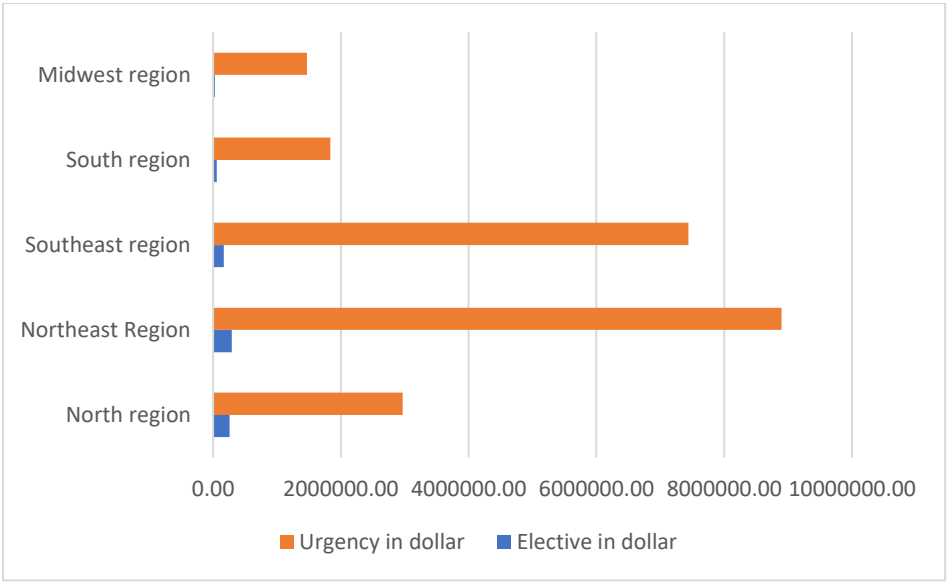
In general, when analyzing the average amount spent on hospitalizations, in graph 11 "Distribution of Average Values for Hospitalizations for the

Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023", an increase was evident in all Regions. However, it was noted that the region that showed the greatest increase in this value during the analyzed period (2015-2023) was the Central-West, considering that in 2015 the average amount spent was $ 106.17, in 2023 it was $158.97, for a total increase of $52.80 (49.73%). The Southeast Region was the second to show the greatest growth in this aspect, while in 2015 the average amount spent was $113.16 and in 2023 it was $131.79, representing an increase of $18.63 (16.47%). Followed by the South Region, which showed an increase of $12.37 (11.15%), considering that in 2015 the average amount spent was $109.96 and in 2023 it was $122.33. The North region showed an increase of $6.74 (5.86%) when comparing the value of 2015 ($114.98) and 2023 ($121.72), being the fourth region to show a greater increase. When analyzing the Northeast region, this was the one with the smallest increase between 2015 and 2023: $2.73 (2.39%), otaling $113.92 in 2015 and $116.64 in 2023.



Graphic 11: Distribution of Average Values of Hospitalizations for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023

When analyzed in graph 12 "Total value according to the nature of care by region for the treatment of complicated diabetic foot between 2015-2023", the total amount spent according to the nature of care by region for the treatment of complicated diabetic foot between 2015 and 2023, the Northeast Region presented the highest expenses of both elective and urgent nature, being respectively $292,871.22 and $8,895,528.11. The Southeast Region was the second to present the highest expenses with emergency care ($7,441,926.30), however, in relation to elective procedures, the second to present the highest expenses was the North Region ($258,997.88). The North Region was the third to present the highest expenditure on emergency procedures ($2,968,742.74), and the Southeast Region was the third to present the highest expenditure on elective procedures ($167,934.46). The South Region was the fourth to present both the highest expenditure on elective and urgent procedures ($58,355.50 and $1,837,051.19, respectively). Finally, the Central-West region had the lowest expenditure on both elective and urgent procedures ($26,880.00 and $1,468,893.84, respectively).

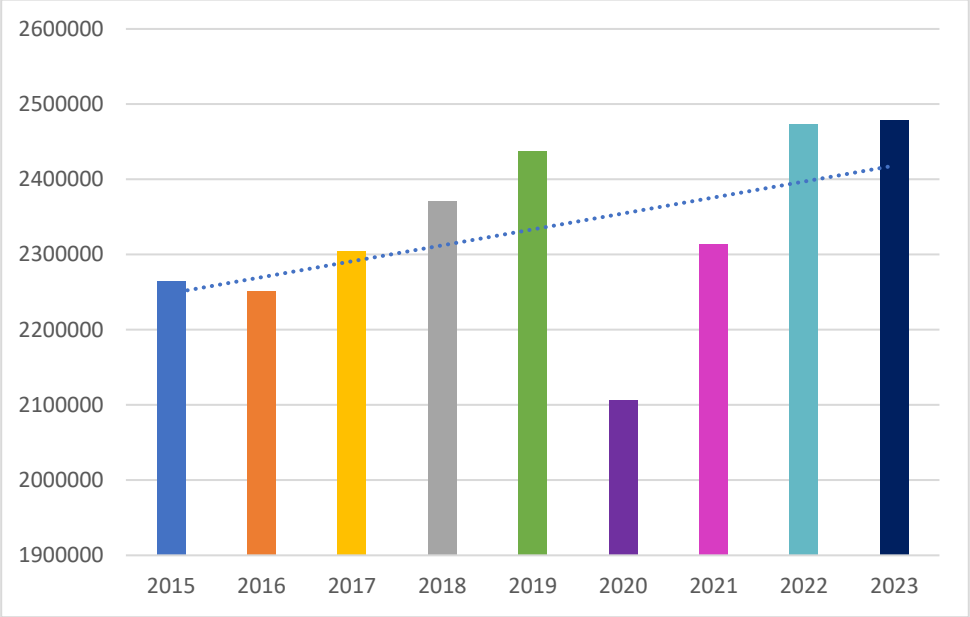


Graphic 12 Total value according to the nature of care by region for complicated diabetic foot treatment between 2015-2023

Discussion

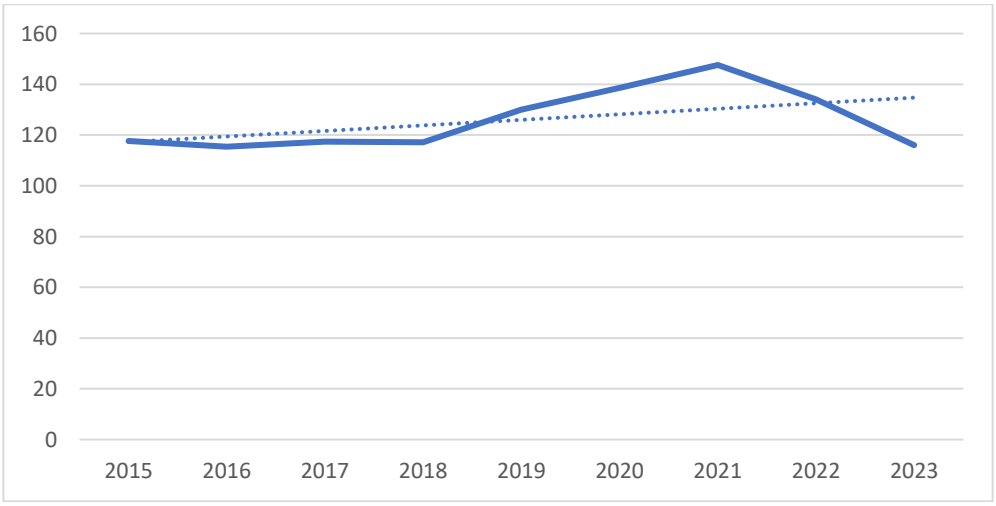
The pandemic period generated impacts on the population and access to healthcare in general, however, it is clear that some individuals were more susceptible to problems related to restrictive measures, such as diabetic patients. This scenario occurs because these individuals had part of their treatment discontinued and their care routine changed, which directly impacted the numbers associated with complications of this health condition.23,24 UPD is a condition that requires tripod prevention measures , early screening and treatment, thus restricting some aspect of the aforementioned tripod, leads to an increased chance of complications associated with it, such as amputations and sepsis.23,25

The distribution of the number of hospitalizations for Complicated Diabetic Foot Treatment across Brazilian regions reflects the impact of the restrictions required during the pandemic period. According to graph 13, there was a reduction of approximately 14% from 2019 to 2020, considered the year in which the COVID-19 pandemic began in Brazil. The Northeast and Southeast regions stand out, which showed the biggest reductions this year, reflecting the consequences, especially of the closure of Primary Care in the country.23 These results are in line with research carried out in other countries, such as a study carried out in France that showed a reduction in hospitalizations for UPD in the country during the pandemic.26 This situation is related to the discontinuity of outpatient treatment that patients with UPD suffered during the pandemic.



Graphic 13: Average total number of hospitalizations for treatment of complicated diabetic foot per year, between 2015-2023 in Brazil.

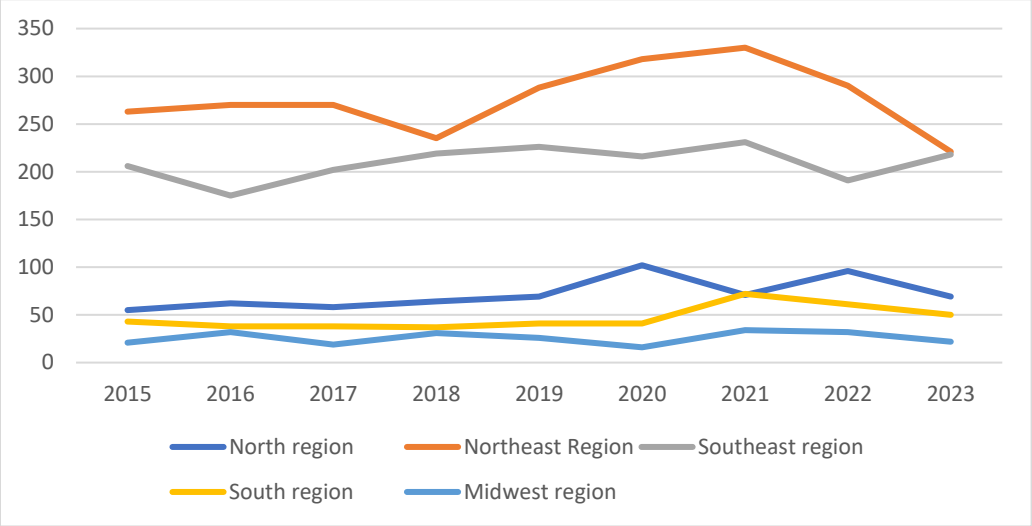
Another important aspect to be highlighted was the peak in the average number of deaths in 2021, evidenced by graph 14. It is believed that there is a strong association between the decrease in care in the previous year and the worsening of the condition of patients with UPD, which would justify the increased number of deaths during the period of reopening of access to outpatient and hospital environments. This would happen, since this health condition is strongly associated with closer monitoring, a fact that was interfered with during the pandemic lockdown.23,27 A reduction was also evidenced in the years 2022 and 2023, returning to the averages prior to the period of pandemic. These values are in line with a study carried out in the United States that showed reductions in the number of post-pandemic deaths due to UPD, with a return to closer ties with the healthcare system and optimized treatment.25



Graphic 14: Average number of deaths due to hospitalization for treatment of complicated diabetic foot per year, in the period between 2015-2023 in Brazil

The northeast region stands out with the highest number of deaths due to UPD, according to graph 15 "Distribution of deaths of patients undergoing treatment for complicated diabetic foot by region in Brazil between 2015-2023", and during the pandemic period and gradual reopening, there was a

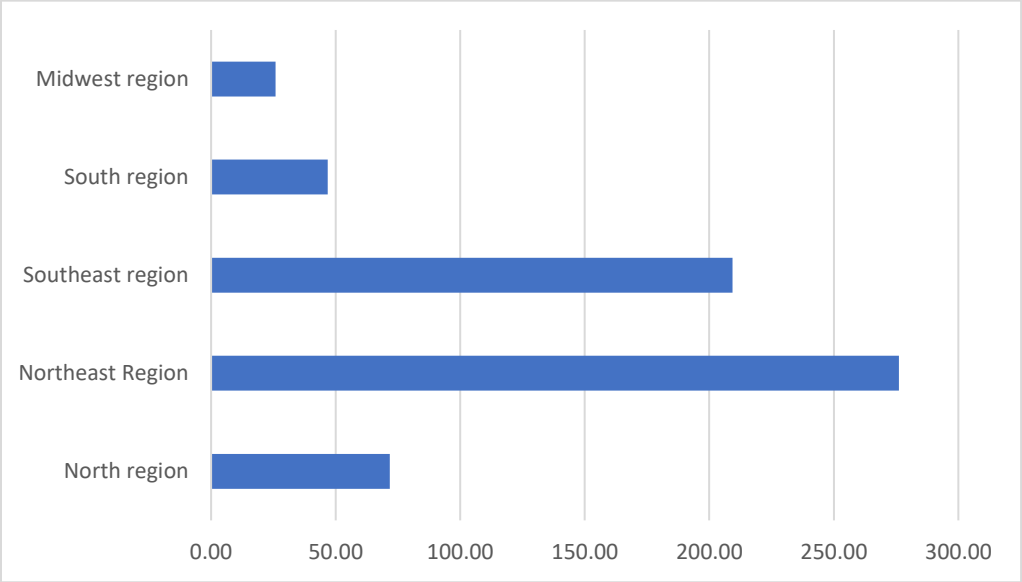
median of 324 deaths (2020: 318 deaths and 2021: 330 deaths), with a progressive reduction in this number in the post-pandemic period (2021-2022). Based on this premise, the drastic increase in deaths in 2020 is notable and regrettable, since the inevitable prioritization of public health infrastructure with the latent calamity inevitably influences the sudden resurgence of NCDs, especially UPD 29.



Graphic 15: Distribution of deaths of patients undergoing treatment for complicated diabetic foot by region in Brazil between 2015-2023.

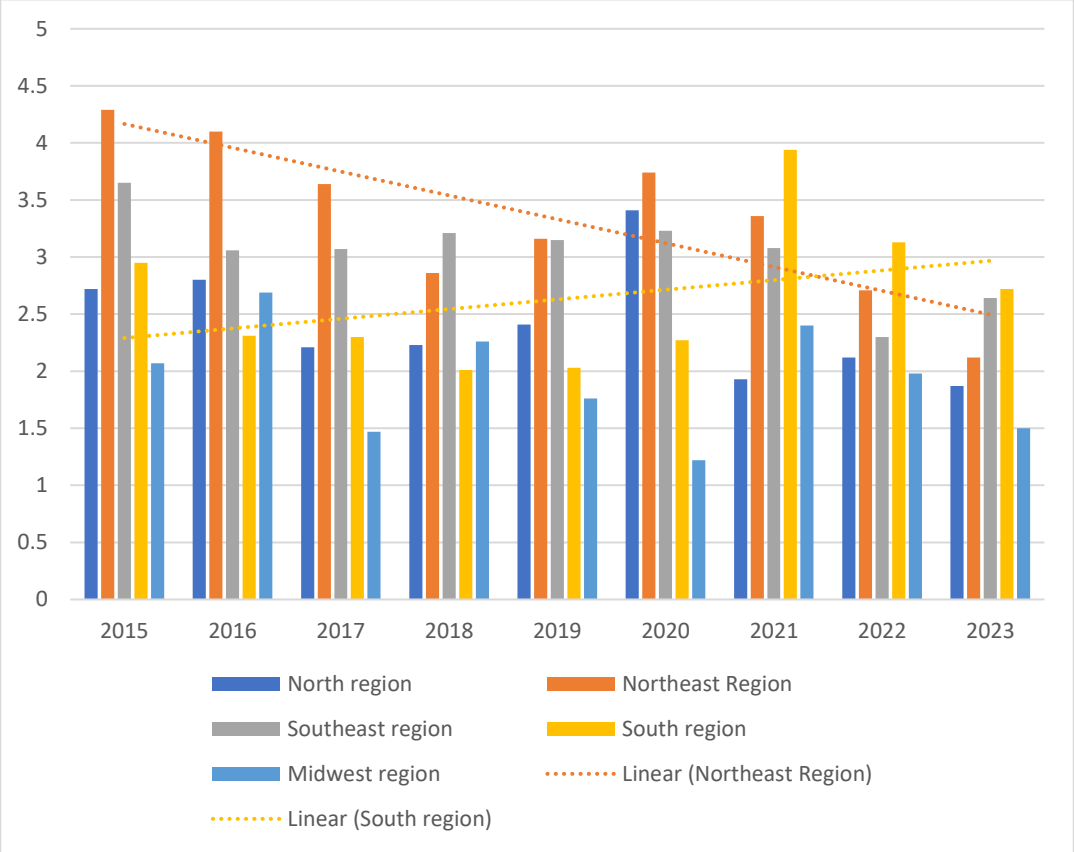
Furthermore, the aforementioned region also has the highest average, according to graph 16 "Average of deaths per hospitalization for treatment of complicated diabetic foot by region between 2015-2023", with a significant lead of 276.11 in relation to the southeast region with 209.33. Analogously to the protagonism in terms of the absolute number of deaths due to UPD, contextualizing the periods covered, it becomes essential to consider the strong social component historically linked to the northeast region, since the socioeconomic condition of individuals interferes clumsily in the course of the disease, enhancing their risk factors 30,31.

Such epidemiological circumstances, therefore, increase during the course of treatment, unequivocally affecting the most underserved.



Graphic 16: Average number of deaths per hospitalization for treatment of complicated diabetic foot by region between 2015-2023 in Brazil.

However, the increase in the mortality rate is noticeable, according to graph 17 "Lethality rate due to hospitalization for treatment of complicated diabetic foot between 2015-2023", especially in the period of gradual reopening until the “post pandemic”, in the South region This growth takes place mainly in 2021, when the fatality rate in the South region (3.94) exceeds that of the Northeast region (3.36), which increased during the beginning of the pandemic.



Graphic 17: Mortality rate due to hospitalization for treatment of complicated diabetic foot between 2015-2023

One hypothesis for this fact is underreporting resulting from the stress of the public network in the pandemic context, where in 2020, statistical values contextualized to the UPD contradict each other. While the Northeast region presents the minimum value (47.3%) in Brazil in relation to the proportion of people diagnosed with diabetes mellitus, it also presents the lowest percentage (33%) among individuals with diabetes who underwent an eye fundus examination in 2020 32. Analogous to the statistical contrast, among the 54.6% of households registered in the Family Health Strategy (ESF), the Northeast region is the protagonist in this regard (66.2% of those registered). Regarding the presence of electronic medical records, only 1.3% of the 14% implemented in the ESF is present in the northeastern region 32. In this way, the pauperization of data related to notification by UPD in the Brazilian public health system is evident.

The Northeast region was the one with the highest amounts spent on hospital services and total amounts on the treatment of complicated diabetic foot, as evidenced in graph 8 "Total amount spent by region per year for diabetic foot care between 2015 and 2023" and in graph 9 " Distribution of Hospital Service Fees for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023". Furthermore, it is also the region that leads the total amount spent according to the nature of care by region for complicated diabetic foot treatment between 2015 and 2023, both elective and urgent. In accordance with this, the average number of days of stay for treatment of complicated diabetic foot in this region is the highest identified: approximately 66,564 days, taking into account the association of social determinants with hospitalizations and complications of DM 28 and that this region has the highest Brazil's poverty index, according to the 2022 IBGE census, when it held 27% of Brazil's total population, but concentrated 43.5% of the population in poverty and 54.6% of the population in extreme poverty, a fact that is closely related to the high mortality rates seen in the region, considering that in line with the article “Relationship indicators of social development and mortality due to diabetes mellitus in Brazil: spatial and temporal analysis” this variable (the poverty indicator) remained statistically associated with the outcome28.

However, despite the Northeast region leading these expenses, it is important to point out that the Central-West region showed a greater increase in the average amount spent on hospitalizations between 2015 and 2023, as evidenced in graph 11 "Distribution of Average Values for Hospitalizations for Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023", totaling an increase of approximately 50% while the Northeast region demonstrated the smallest increase, totaling only 2.4%, when compared to the other regions. These values do not correspond to the regional hospitalization rate, as seen in graph 2 "Average of total hospitalizations for complicated diabetic foot by region between 2015-2023" considering that the Central-West region presented a basically constant rate of hospitalizations while the Northeast region showed increasing values over the years.

Furthermore, it is important to highlight that, due to the closure of Primary Care in the country23 with the COVID-19 pandemic, relatively all regions showed a reduction in the amounts spent on hospital services and in the total amounts spent by Region and Year of care in 2020, as seen in graph 8 "Total value spent by region per year on diabetic foot care between 2015 and 2023 and in graph 9: Distribution of Hospital Service Values for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023". except for the North and Northeast regions, which showed slight increases, which may be related to the leadership in the mortality rate evidenced in these regions in the year analyzed, considering that the spread of the virus caused a substantial increase in the number of deaths throughout the country. In addition to worsening the health condition of individuals with DM.28 Furthermore, health indicators in people with chronic non-communicable diseases, such as DM, show worse performance in participants benefiting from Bolsa Família, while they present, in a greater proportion, with less education, are black/brown and are concentrated in the North and Northeast regions. They also show a higher occurrence of obesity, multiple comorbidities, high cholesterol levels, alcohol and tobacco use.28 Although not all regions showed cost reductions, they all had a reduction in both the days of stay and the rates of hospitalizations. This fact may be closely related to the restriction in the

supply of health services, which led to changes in the care routine regarding the care and management of these patients' feet. 23

Regarding the average amount spent on hospitalizations, most regions showed a reduction in 2020, except for the South and Northeast regions, despite both regions showing a reduction in the hospitalization rate in the year analyzed, according to graph 11 "Distribution of the Average Values of Hospitalizations for the Treatment of Complicated Diabetic Foot by Region in Brazil between 2015 and 2023". However, these two regions had an increase in the mortality rate during this period, a fact that may be statistically significantly related to indicators of income distribution, such as the Gini index, and access to healthcare (FHS coverage).2

Conclusion

During the present study, it was noted that the pandemic context unfortunately further complicated the already expensive treatment, exacerbating the condition and making access to medical care difficult. This fact is closely related to the trend of a general increase in the number of deaths related to diabetic foot in the years of the pandemic (2020 – 2022), given the closure of primary care. Furthermore, it is essential to highlight that, due to the closure of primary health care during the pandemic, hospitalization rates in all regions decreased, especially in 2020. Therefore, in 2022, with the effective reopening of health services, these numbers they grew again.

It is important to emphasize that the Northeast region had the worst rates of hospital mortality, lethality, deaths, hospitalizations and longer hospital stays, in addition to high amounts spent on complicated diabetic foot, especially during the pandemic period. In agreement, the Northeast led the expenditure on hospital, professional and, therefore, total services, followed by the Southeast, North, South and Central-West, this being a constant pattern in the period analyzed.

The most socially vulnerable regions had higher hospitalization and mortality rates, although there was little change in financial resources during the pre- and post-pandemic period. This situation highlights the need to promote greater regional equity in indicators and access to health to minimize preventable problems such as UPD. Situations such as the one experienced in the COVID-19 pandemic served to highlight the shortcomings of the country's health system and how the health-disease process is strongly linked to local socioeconomic conditions, making it necessary to promote collective health measures aimed at minimizing disparities regions in Brazilian territory.

The lack of data collected by the health event registration system in the country constitutes a limitation in the present study, which makes us suggest greater rigor and diversity in the collection of information in order to better translate the reality of the data presented here.

References

1. Niva Piran, Farhadian M, Ali Reza Soltanian, Shiva Borzouei. Diabetic foot ulcers risk prediction in patients with type 2 diabetes using classifier based on associations rule mining.
2. Cardoso NA, Cisneros L de L, Machado CJ, Procópio RJ, Navarro TP. Fatores de risco para mortalidade em pacientes submetidos a amputações maiores por pé diabético infectado. Jornal Vascular Brasileiro. 2018 Dec;17(4):296–302.
3. CRM-RJ 52-52723/7 DLB |. O alto custo do pé diabético no Brasil [Internet]. Sociedade Brasileira de Diabetes. 2021 [cited 2024 Apr 20].
4. Toscano C, Sugita T, Rosa M, Pedrosa H, Rosa R, Bahia L. Annual Direct Medical Costs of Diabetic Foot Disease in Brazil: A Cost of Illness Study. International Journal of Environmental Research and Public Health. 2018 Jan 8;15(1):89.
5. Pérez-Panero AJ, Ruiz-Muñoz M, Cuesta-Vargas AI, Gónzalez-Sánchez M. Prevention, assessment, diagnosis and management of diabetic foot based on clinical practice guidelines. Medicine [Internet]. 2019 Aug;98(35):e16877.
6. Apelqvist J, Bakker K, van Houtum WH, Nabuurs-Franssen MH, Schaper NC. International consensus and practical guidelines on the management and the prevention of the diabetic foot. International Working Group on the Diabetic Foot. Diabetes/metabolism research and reviews [Internet]. 2000 [cited 2019 Nov 25];16 Suppl 1:S84-92.
7. Preis SR, Hwang SJ, Coady S, Pencina MJ, D'Agostino RB, Savage PJ, et al. Trends in All-Cause and Cardiovascular Disease Mortality Among Women and Men With and Without Diabetes Mellitus in the Framingham Heart Study, 1950 to 2005. Circulation. 2009 Apr 7;119(13):1728–35
8. Brownrigg JRW, Davey J, Holt PJ, Davis WA, Thompson MM, Ray KK, et al. The association of ulceration of the foot with cardiovascular and all-cause mortality in patients with diabetes: a meta-analysis. Diabetologia. 2012 Aug 14;55(11):2906–12.
9. Guarnotta V, Radellini S, Vigneri E, Cernigliaro A, Pantò F, Scondotto S,et al. Diabetic foot ulcers: Retrospectivecomparative analysis from Sicily between two eras. Singh K, editor. PLOS ONE. 2021 Dec 7;16(12):e0259405.
10. Benjamim G, Pitta B, Castro A, Magno A, Soares M, Do C, et al. ARTIGO ORIGINAL Perfil dos pacientes portadores de pé diabético atendidos no Hospital Escola José Carneiro e na Unidade de Emergência Armando Lages Profile of the patients with diabetic foot receiving care at the José Carneiro School Hospital and at the Armando Lages Emergency Unit [Internet]. [cited 2024 Jan 19].
11. Volmer-Thole M, Lobmann R. Neuropathy and Diabetic Foot Syndrome. International Journal of Molecular Sciences [Internet]. 2016 Jun 10;17(6):917.
12. Duarte N, Gonçalves A, De Revisão A. Pé diabético Diabetic foot. Angiologia e Cirurgia Vascular | [Internet]. 2011;7:65.
13. De Luccia N. Doença vascular e diabetes Vascular disease and diabetes. No1 49 J Vasc Br [Internet]. 2003;2(1):49–60.
14. Rümenapf G, Morbach S, Rother U, Uhl C, Görtz H, Böckler D, et al. Diabetisches Fußsyndrom – Teil 1. Der Chirurg; Zeitschrift Fur Alle Gebiete Der Operativen Medizen [Internet]. 2021;92(1):81–94.
15. Pérez-Panero AJ, Ruiz-Muñoz M, Cuesta-Vargas AI, Gónzalez-Sánchez M. Prevention, assessment, diagnosis and management of diabetic foot based on clinical practice guidelines. Medicine [Internet]. 2019 Aug;98(35):e16877.
16. Peres Lapetina Gonçalves Saraiva B, Daud Ribeiro J, De Araújo Casa B, Hideki Osugi R, Sawazaki Nakagome G, Vitorino de Castro Neto O, et al. Early diagnosis of diabetic neuropathy and prophylaxis of diabetic foot. Journal of Human Growth and Development [Internet]. 2023 Aug 14 [cited 2023 Sep 22];33(2):206–12.
17. Caiafa JS, Castro AA, Fidelis C, Santos VP, Silva ES da, Sitrângulo Jr. CJ. Atenção integral ao portador de pé diabético. Jornal Vascular Brasileiro. 2011;10(4 suppl 2):1–32
18. Diabetes I. Brasil. Ministério da Saúde. II. Brasil. Secretaria de Estado de Saúde do Distrito Federal. III. Grupo de Trabalho Internacional sobre Pé Diabético. IV Título
19. Russell JW, Zilliox LA. Diabetic Neuropathies. Continuum : Lifelong Learning in Neurology [Internet]. 2014 Oct 1;20(5 Peripheral Nervous System Disorders):1226–1240.
20. Connor H, Boulton AJM, Ward JD.The Foot in Diabetes(1stedn), John Wiley and Sons: Chichester, 1987; 1 – 168.
21. Gerd Köhler, Eichner M, Abrahamian H, Kofler M, Sturm W, Menzel A. Diabetische Neuropathie und diabetischer Fuß (Update 2023). Wiener Klinische Wochenschrift. 2023 Jan 1;135(S1):164–81.
22. Bornstein SR, Rubino F, Ludwig B, Rietzsch H, Schwarz PEH, Rodionov RN, et al. Consequences of the COVID-19 pandemic

for patients with metabolic diseases. Nature Metabolism. 2021 Feb 25;3(3):289–292.
23. https://saberaberto.uneb.br/server/api/core/bitstreams/c438c725-f61e-408f-84d2-07d571e3742e/content TCC SOBRE A PANDEMIA
24. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7263238/
25. https://diabetesjournals.org/care/article/44/7/e146/138819/Increase-in-Diabetes-Mortality-Associated-With MORTALIDE NOS EUA
26. https://pubmed.ncbi.nlm.nih.gov/33797791/ impacto da epidemia nas internações por pé diabético – FRANÇA
27. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7263238/
28. Santos Garces T, Lídia L, Damasceno V, Jó G, Sousa B, Ribeiro V, et al. Artigo Original Relação indicadores de desenvolvimento social e mortalidade por diabetes mellitus no Brasil: análise espacial e temporal* [Internet].
29. Diniz DS, Teixeira E dos S, Almeida WGR de, Souza MS de M. Covid-19 e Doenças Negligenciadas ante as desigualdades no Brasil: uma questão de desenvolvimento sustentável. Saúde em Debate [Internet]. 2022 Jun 24 [cited 2022 Oct 5];45:43–55.
30. Duarte N, Gonçalves A, De Revisão A. Pé diabético Diabetic foot. Angiologia e Cirurgia Vascular | [Internet]. 2011;7:65.
31. Rümenapf G, Morbach S, Rother U, Uhl C, Görtz H, Böckler D, et al. Diabetisches Fußsyndrom – Teil 1. Der Chirurg; Zeitschrift Fur Alle Gebiete Der Operativen Medizen [Internet]. 2021;92(1):81–94.
32. Muzy J, Campos MR, Emmerick I, Silva RS da, Schramm JM de A. Prevalência de diabetes mellitus e suas complicações e caracterização das lacunas na atenção à saúde a partir da triangulação de pesquisas. Cadernos de Saúde Pública [Internet]. 2021;37(5).