

Femur fractures in elderly in Brazil from 2015 to 2020: analysis of costs, time of hospitalization and total deaths

Fraturas de fêmur em idosos nas diferentes regiões do Brasil de 2015 a 2020: análise dos custos, tempo de internação e total de óbitos

Jefferson Carlos Araujo Silva¹ 

Mara Dayanne Alves Ribeiro² 

Luan Nascimento da Silva³ 

Hudson Azevedo Pinheiro⁴ 

Lidia Mara Aguiar Bezerra⁵ 

Sabryna Brito Oliveira⁶ 

¹Corresponding author. Universidade de Brasília (Brasília). Distrito Federal, Brazil. jeffcasilva@gmail.com

²Hospital Regional do Norte (Sobral). Ceará, Brazil. mara_dayanne2@hotmail.com

³Hospital Escola da Universidade Federal de Pelotas (Pelotas). Rio Grande do Sul, Brazil. luan.nascimento2222@gmail.com

⁴Secretaria de Estado de Saúde do Distrito Federal (Brasília). Distrito Federal, Brazil. hudsonap@gmail.com

⁵Universidade de Brasília (Brasília). Distrito Federal, Brazil. lidia.bezerra@gmail.com

⁶Centro Universitário Metodista Izabela Hendrix (Belo Horizonte). Minas Gerais, Brazil. sabrynnabrito@gmail.com

ABSTRACT | INTRODUCTION: Femur fractures in the elderly generate increased functional demand for those who have and are responsible for a high number of hospital admissions. **OBJECTIVE:** Retrospectively analyze the total number of cases, costs, length of hospital stay, and total deaths from femoral fractures in the elderly in different regions of Brazil from 2015 to 2020. **METHODS:** Ecological study of temporal and retrospective series that evaluated fracture data of femur fracture in the elderly, based on data available on the websites of the Ministry of Health. The following variables were evaluated: total cases, Average Hospital Stay (AHS), number of deaths, mortality rate, hospitalization costs, total and per day of hospitalization, Average Fracture Cost (AFC), and Length of Hospitalization for Fracture (LHF) in each region. **RESULTS:** A total of 328,008 elderly people suffered a femur fracture during the study period. The Southeast region leads in cases, deaths, and LHF; the second-place alternates between the South (2015, 2016, and 2020) and Northeast (2017 and 2019) regions. Concerning the AHS, the North and Northeast regions appear in first and second place, respectively, in all years, being above the national average in all years studied. **CONCLUSIONS:** There is a discrepancy for cases of femoral fractures in the elderly among Brazilian regions, whether in the number of cases, costs, or total deaths. The higher population density in regions such as the Southeast and the South contributes to the higher rates of femur fractures in the elderly, given that they are also the majority in these regions compared to the others.

KEYWORDS: Aged. Femoral Fractures. Hospitalization. Health Care Costs.

RESUMO | INTRODUÇÃO: As fraturas de fêmur em idosos geram aumento da demanda funcional nesses indivíduos e são responsáveis por um alto número de internações hospitalares. **OBJETIVO:** Analisar retrospectivamente o total de casos, os custos, o tempo de internação e o total de óbitos por fratura de fêmur em idosos nas diferentes regiões do Brasil de 2015 a 2020. **MÉTODOS:** Estudo ecológico de série temporal e retrospectivo que avaliou os dados de fratura de fêmur em idosos, a partir de dados disponíveis nos sites de Ministério da Saúde. Foram avaliadas as seguintes variáveis: total de casos, Tempo Médio de Permanência Hospitalar (TMPH), número de óbitos, taxa de mortalidade, gastos com internações, total e por dia de internação hospitalar, Gasto Médio por Fratura (GMF) e o Tempo de Internação por Fratura (TIF) em cada região. **RESULTADOS:** Um total de 328.008 idosos sofreram fratura de fêmur no período estudado. A região Sudeste lidera em número de casos, óbitos e TIF; o segundo lugar alterna entre as regiões Sul (2015, 2016 e 2020) e Nordeste (2017 e 2019). Em relação ao TMPH, as regiões Norte e Nordeste aparecem em primeiro e segundo lugar, respectivamente, em todos os anos, ficando acima da média nacional em todos os anos estudados. **CONCLUSÕES:** Há uma discrepância para os casos de fratura de fêmur em idosos entre as regiões brasileiras, seja no número de casos, nos custos ou no total de óbitos. A maior densidade populacional em regiões, como Sudeste e Sul, contribui para as maiores taxas de fraturas de fêmur em idosos, haja vista que estes também são maioria nessas regiões em comparação as demais.

PALAVRAS-CHAVE: Idoso. Fraturas do fêmur. Hospitalização. Custos de Cuidados de Saúde.

Introduction

Population aging is a reality in both developed and underdeveloped countries. In Brazil, the total number of elderly populations in 2020 was 29.2 million individuals, representing 14% of the total population, and it is estimated to be 72.4 million in 2100.¹ It is important to emphasize that, as a continental country, Brazil has a very scattered population distribution, strategies, and budget for disease prevention and forms of care for the elderly population between Brazilian regions.²

The exponential increase in the elderly population and its irregular distribution throughout the country raise elderly-associated issues, making us reflect on prevention and care measures aimed at the main diseases that affect this population. In elderly individuals, Non-Transmissible Chronic Diseases (NCDs) and bone fractures are among the main reasons for reduced quality of life and preventable deaths.³

The elderly population is more likely to fracture a bone due to the loss of bone and muscle mass resulting from the natural aging process. Furthermore, balance deficits that make those individuals susceptible to fall events can contribute to a higher incidence of fractures.⁴ Among those incidents, femur fractures are considered a serious public health problem due to their high lethality and treatment costs.⁵

Femoral fractures in elderly individuals are usually a result of low-energy trauma and are closely related to malnutrition, reduced functional mobility, decreased visual acuity, and issues.⁶ Fractures of the femur in the proximal region are more common, including the femur neck fractures, transtrochanteric and subtrochanteric. In most cases, there is an indication for surgical correction. However, in specific cases, such as incomplete fractures, without displacement, or due to the patient's non-clinic condition to undergo surgery, conservative treatment may be indicated.⁷ Femoral fractures are responsible for the increase in the functional demand of the elderly population and overloading family members, who, in most cases, become caregivers.⁸

Many strategies aim to prevent femur fractures, whether direct or indirect measures, such as encouraging the regular practice of physical activity and integration into social groups. All these measures aim to maintain or gain muscle mass and improve balance and functional independence, conditions that indirectly prevent the occurrence of femoral fractures.^{5,9} However, it seems that these measures have not yet been able to reduce the number of individuals who suffer femoral fractures in Brazil.²

Given the regional differences observed in Brazil, our study hypothesizes a difference in costs, hospitalization length, and total deaths from femoral fractures in the elderly population among the Brazilian regions. Therefore, this manuscript aimed to retrospectively analyze the total number of cases, costs, hospitalization length, and total deaths due to femoral fractures in elderly individuals from the Brazilian regions between 2015 and 2020.

Methods

We carried out an ecological study¹⁰ of temporal and retrospective series. Data from cases of femoral fractures that occurred in the Brazilian elderly population from 2015 to 2020 were enrolled in this study. Data collection took place between February and March 2021. The studied population consisted of all cases of femur fractures that occurred in elderly individuals living in Brazil between 2015 and 2020 and who were also registered in DATASUS. To obtain the referred data, the following steps were taken: "DATASUS > ACESSO A INFORMAÇÃO > TABNET > SEÇÃO: EPIDEMIOLÓGICAS E DE MORBIDADE > Morbidade Hospitalar do SUS (SIH/SUS) > Geral, por local de internação - de 1984 a 2007 > Brasil por região e unidade da federação (<http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sih/cnv/miuf.def>)".¹¹ We also used the following filters: "linha: região, conteúdo: internações ou óbitos, coluna: inativa, períodos disponíveis: 2010 a 2020. Lista Morb. CID-10: Fratura do fêmur.". In addition, we used the secondary data referring to the S72 code of the CID-10.

With the data in hand, we evaluated the following variables: total cases, average hospitalization length (AHL), number of deaths, mortality rate, costs with hospitalizations (total and per day), the average cost per fracture (AC), and time of hospitalization due to fracture (THF) in each Brazilian region. The central search refers to femur fractures and the comparison between the Brazilian regions.

The AHL for femur fractures was calculated by the ratio between the total numbers of hospitalization days by the total numbers of hospitalized patients, as in the formula below:

$$\text{AHL} = (\text{Days of hospitalization due to femoral fractures}) / (\text{Hospitalized patients})$$

The expenses of the Brazilian universal healthcare (Sistema Único de Saúde – SUS) with hospital admissions were analyzed based on the total cost, the cost per day of hospitalization (CPDH) and the ACF, which was calculated using the following formula:

$$\text{ACF} = (\text{Average length of hospitalization}) / (\text{Total expenses})$$

$$\text{CPDH} = (\text{Expenses with hospitalizations}) / (\text{Days of hospitalization})$$

We also calculated the simple absolute and relative frequency of the studied variables. As this was a study that included data of public domain, approval by the Ethics Committee for Research with human beings was not required.

Results

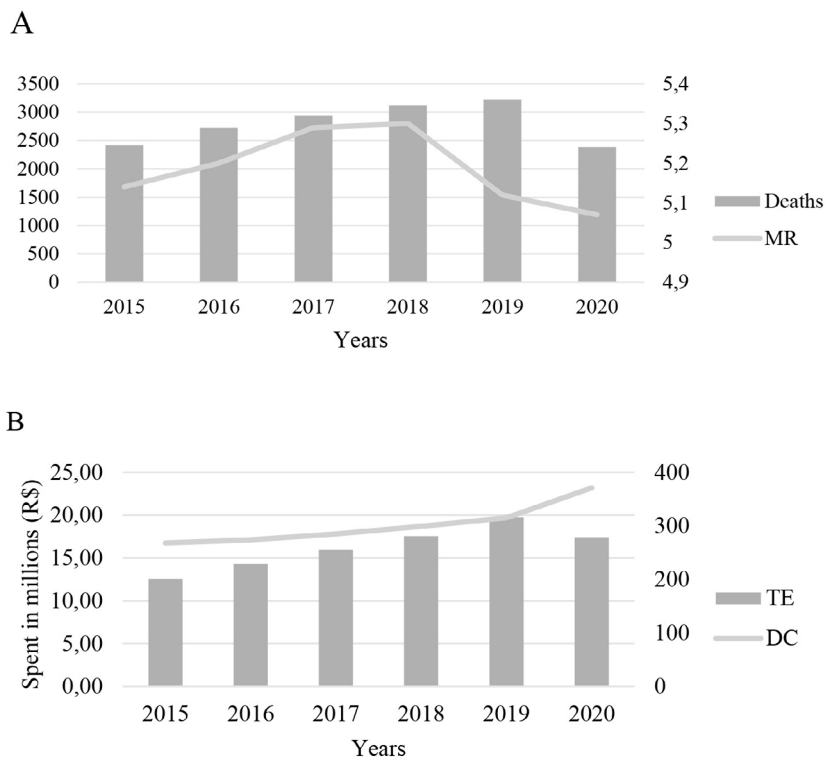
328,008 elderly individuals suffered a femoral fracture and were treated by the SUS in Brazil between 2015 and 2020. The cases increased from 2015 to 2019 (47,138; 52,130; 55,034; 58,298; 63,102 cases,

respectively for each year), but in 2020 the number of cases dropped to 52,306. During the studied time, it was observed that the AHL of the affected individuals varied along with the associated deaths. Although patients had fewer days of hospitalization (AHL = 9.1 days in 2015 and 2016, 8.8 days in 2017 and 2018, 8.5 days in 2019, and 7.1 days in 2020), the number of deaths and mortality rate continued to increase in the first three studied years, but falling in the last two years (Figure 1. A).

The costs of these fractures increased over the years, which is inversely proportional to the AHL parameter. Figure 1. B shows the total expenses and the CPDH of Brazilian elderly femoral fractures in recent years. The ACF variable points out that the expenses in Brazilian Reais gradually increased between 2015 and 2019 (12.58; 14.29; 15.95; 17.56 and 19.75 million reais, respectively, for each year), but it decreased in 2020 (17.40 million reais).

The territorial analysis of cases of femur fractures shows that Brazilian regions differ from each other. In all studied years, the southeast regions lead in cases, deaths, and THF. Second place alternates between the south region (2015, 2016, and 2020) and the northeast region (2017 and 2019). In fourth and fifth places are the Midwest and North regions, respectively. According to the AHL variable, the north and northeast regions appear in first and second place, respectively, and both regions are above the national average in all studied years. Considering the SUS total expenses, the regions that spent the most on hospitalizations in all years were the southeast and south regions, followed by the Northeast, Midwest, and North regions. However, the CPDH in each region seems not to be proportional to the total expenses as the most expensive daily rate, regardless of the analyzed year, was in the south region. Table 1 describes the general panorama of femoral fractures during the studied period, including the number of cases and deaths, hospitalization, and associated expenses.

Figure 1. Overview of cases, deaths, hospitalization, and expenses, in Reais, with femur fractures in elderly individuals assisted by the SUS in Brazil between 2015 and 2020. A) Association between the number of deaths and the mortality rate due to femoral fractures in the Brazilian elderly population assisted by the SUS from 2015 to 2020. B) Relation between total expense and cost per day, in Reais, of femur fractures in elderly patients assisted by the SUS in Brazil from 2015 to 2020



MR: mortality rate; TE: total expenses; DC: daily cost

Table 1. Overview of cases, deaths, hospitalization and expenses, in Reais, associated with femur fractures in elderly patients treated by the SUS in Brazil, by region, from 2015 to 2020

CASES AND DEATHS												
Year	2015		2016		2017		2018		2019		2020	
Region	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
N	1,807	65	1,904	69	1,983	70	2,272	78	2,472	79	1,972	62
NE	8,751	304	9,148	315	10,446	382	10,915	423	12,215	439	9,965	350
MW	2,917	138	3,363	158	3,635	167	3,984	215	4,667	173	3,537	140
SE	24,217	1,363	27,374	1,592	28,797	1,736	30,004	1,825	32,115	1,951	26,859	1,402
S	9,446	545	10,341	587	10,173	588	11,123	579	11,633	579	10,153	430
Brazil	47,138	2,415	52,130	2,721	55,034	2,943	58,298	3,120	63,102	3,221	52,306	2,384
HOSPITALIZATION^a												
Year	2015		2016		2017		2018		2019		2020	
Region	Days	Mean^b	Days	Mean	Days	Mean	Days	Mean	Days	Mean	Days	Mean
N	22,900	12.5	22,698	12.1	24,484	12.2	27,193	11.7	29,740	12.3	13,697	8.6
NE	87,733	10	88,479	9.6	101,515	9.7	108,382	9.8	114,139	9.3	71,221	8
MW	25,618	8.9	29,953	8.8	31,472	8.5	34,578	8.5	34,258	7.5	20,669	6.5
SE	214,953	8.9	252,229	9.2	256,151	8.8	256,281	8.5	265,887	8.3	171,066	7
S	77,147	8.2	80,563	7.8	78,829	7.6	90,454	8	89,554	7.7	56,312	6.5
Brazil	427,995	9.1	473,922	9.1	492,451	8.8	516,888	8.8	533,578	8.5	332,965	7.1
ANUAL AND DAILY EXPENSES^c												
Years	2015		2016		2017		2018		2019		2020	
Region	Annual	Daily^d	Annual	Daily	Annual	Daily	Annual	Daily	Annual	Daily	Annual	Daily
N	339,214	185	433,460	231	453,680	226	542,921	234	511,313	211	487,050	306
NE	1,888,641	216	2,143,460	233	2,476,481	237	2,856,048	258	3,376,216	275	2,851,626	320
MW	718,489	250	860,823	251	983,955	266	1,113,354	274	1,423,389	312	1,126,078	354
SE	6,690,920	277	7,436,442	271	8,389,645	288	9,252,202	306	10,393,965	324	9,268,609	379
S	3,104,236	330	3,626,289	351	3,771,978	364	4,015,553	355	4,323,920	372	3,750,017	433
Brazil	12,585,172	268	14,296,445	274	15,956,396	285	17,565,124	299	19,756,174	315	17,405,144	371

a) Days of hospitalization. b) Mean cost per patients c) Values in Reais. d) Daily cost (DC). N = North; NE = Northeast; MW = Midwest; SE = Southeast; S = South.

Discussion

The present study aimed to retrospectively investigate the total number of femoral fractures in the Brazilian elderly population, comparing the Brazilian regions. The analysis was directed towards hospital expenses, hospitalization length, and the number of deaths. It is an important investigation that shows the impacts and consequences of femur fractures, both for the elderly population and the Brazilian health system. Those kinds of fractures are responsible for reducing life expectancy, generating physical disability, and most of them are preceded by an elderly fall accident.¹² The approach used here has already been investigated in other studies in Brazil, but none of them contemplated all the variables we analyzed in this manuscript.

We observed a discrepancy among the Brazilian regions for the number of cases of femur fractures. The region with the most cases was the southeast region; this was also the region with the most expenses compared to the other Brazilian regions. However, when we analyzed the average length of hospitalization, the north and northeast regions were ahead of the southeast region, respectively. The southeast region is the most populous in the country, which may have contributed to the largest number of cases, mainly in Rio de Janeiro, São Paulo, and Minas Gerais.¹³

Another survey identified that in the north of the country, hospitalizations due to femoral fractures are more incident in female individuals aged over 80 years, and this kind of fracture is responsible for half of the total deaths from bone fractures between 2015 and 2019 in individuals over 60 years old.¹⁴ These data corroborate with the findings of another study that identified the epidemiological profile of femoral fractures in elderly people in the state of Espírito Santo.¹⁵ Both studies demonstrate similar profiles of elderly femur fractures in different Brazilian regions. However, our study found out that there is a difference in the average length of hospitalization for the same clinical condition and that the northern region had a longer average time than the others regions. This fact may be related to the greater access to health services in the southeast and south regions

and services with better infrastructure, which could speed up recovery time, contributing to faster hospital discharge compared to other Brazilian regions.¹⁶

It is noteworthy that the highest expenses with femur fractures occurred in the southeast and south regions, while these same regions had shorter hospitalizations. These data corroborate a study that verified the occurrence of femoral fractures from 2008 to 2018, and they found out that the highest occurrence of this clinical condition was in the southeast regions and during the winter season. They also demonstrated that the highest costs with femur fractures occurred in the southeast region, while the northern region had the lowest expenses.¹⁷ This may be related to the lower amount of elderly femoral fractures in the north region.

Hospitalization costs for elderly femur fractures correspond to 2% of the entire cost of elderly hospitalizations in Brazil. In 2008, the north region spent 1.2% with hospital admissions due to a femur fracture, in which 0.5% of the hospitalized elderly had a diagnosis of femoral fracture. This considerably lower number compared to other Brazilian regions may be associated with the lower population density.¹⁸

The hospitalization length contributes negatively to the elderly who suffered a femur fracture and contributed to the emergence of hospitalization acquired diseases, such as infection of the urinary tract, pneumonia, pressure injury, and sepsis, in addition to increasing the mortality rate.¹⁹ A study carried out in a teaching hospital in Paraná showed that prolonged hospitalization while awaiting surgical correction was associated with the onset of pressure injuries and an increase in the mortality rate. If the waiting time for the surgical procedure were more than eight days, it was directly associated with death outcome.²⁰ In our study, the highest rates of deaths from femur fractures were registered in the southeast region, followed by the south region, while the Midwest and North regions corresponded to the lowest rates. The southeast region had the longest total length of hospitalization, which may have contributed to the highest death rates in this region.

The mortality of elderly individuals diagnosed with femur fractures is closely related to the presence of comorbidities, such as liver dysfunction and sarcopenia²¹, in addition to the longer hospitalization, an age over 81 years old and female gender contribute to the increase in mortality rate.⁷ Isolated, the femur fracture is a factor that contributes to mortality and bone mineral density decreases about 40% after 6 months of the fracture occurrence, and, in elderly individuals, this also contributes to an increase in frailty.²²

A time-series study identified that from 2008 to 2018, there was a 76.9% increase in elderly hospitalization records due to femur fractures, in which the mortality rate was 5%. The southeast region had the highest mortality rate (5.53%), while the longest hospitalization period was in the midwest region and the highest cost in the south region.²³ In our study, the southeast region had the highest number of deaths. However, it is the lowest AHL for the condition. This result may be associated with the concentration of wealth in the southeast and south regions, which provided improved health services and greater access to these services for the population.¹⁶ Elderly deaths from femur fractures have significant representation in Brazil and a strong association with factors that have already been well described in the literature, such as the presence of comorbidities and prolonged hospitalization.²⁴ Thus, it is necessary to optimize these issues to reduce the death rate due to this clinical condition.²⁵

The ecological approach allowed us to perform an analogy between Brazilian regions, as this collective view can visualize the complexity of the system and public health on populations, such issues are less possible to be addressed at the individual level. In this line of view, the ecological study can be used as an explanatory framework for the studied health problems to determine a health intervention proposed by public health policies. Therefore, map out where investments in health care are necessary, in which region help is needed more and which

level of health care should be prioritized, whether at primary, secondary, tertiary, and quaternary levels.²⁶

Optimizing the rehabilitation of an elderly individual after suffering a femur fracture can reduce their hospitalization length, but for this, physiotherapy should be started as soon as the fracture is corrected, and treatment should be continued even after hospital discharge.²⁷ Early mobilization of elderly victims is recommended after the surgical procedure, and it is associated with reduced mortality 6 to 12 months after the femur fracture. In addition, patients who walk within ten days after the surgical procedure have lower mortality rates.²⁸ All of it impacts the hospitalization length, the elderly functional recovery, although there is a reduction in the individual's functional autonomy, and the reduction in the demand for caregivers after hospital discharge.^{8,29}

This study highlights the need for health actions that should also be directed to the medium and long term because after the occurrence of the fracture along with the aging process. There is an increase in the propensity to fall, which is increased by the fear of falling, factors that have repercussions in the functional capacity, and post-traumatic stress symptoms related to the fall event.^{30,31} However, this study has limitations. Among them, the data do not allow for a cause-effect association. The greater number of cases and the higher costs in the southeast region can be inferred from the greater population density in the region.

Conclusion

In Brazil, femur fractures in the elderly population continue to occur frequently, and there is a discrepancy, whether in the number of cases, costs, and total deaths between the Brazilian regions. The greater population density in certain regions, such as the southeast and south, may contribute to the greater total numbers of femoral fractures, given that they are also the majority in these regions compared to the others.

There was an increase in the number of femoral fractures cases in Brazil in the first four studied years, but it dropped in 2020, which is inversely what was observed for the AHL parameter, which decreased between 2015 and 2020. The diagnosis costs gradually increased between 2015 and 2019 but also decreased in 2020. The number of deaths continued to grow in the first three years but decreased in the last two analyzed years.

The southeast region has the largest number of cases, deaths, and THF, and the highest AHL was observed in the north and northeast. Along with the midwest region, the north and northeast regions were the ones with the lowest expenses. On the other hand, the highest expenses were observed in the southeast and south regions.

In Brazil, discrepancies in femur fractures situations deserve individual attention and the direction of specific public health policies for each region.

Authors contributions

Silva JCA, Ribeiro MDA, Silva LN e Oliveira SB participated in the study design, data analysis, manuscript writing, and critical review. Pinheiro HA e Bezerra LMA participated the manuscript critical review.

Competing interests

The authors declare no financial, legal, or political conflicts involving third parties (government, corporations and private foundations, etc.) for any aspect of the submitted manuscript (including, but not limited to, grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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