





RESEARCH ARTICLE

Hospital admissions for dementia in the Brazilian public health system over the last decade

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Abstract

OBJECTIVE: The rise in dementia prevalence, particularly in lower- and middle-income countries (LMIC), places a significant burden on healthcare systems. However, comprehensive data on dementia hospital admissions are scarce.

METHODS: We analyzed admission rates for dementia, cost of hospital admissions, lengths of hospital stay, and in-hospital deaths in 2010 and 2019 in Brazil.

RESULTS: Admission rates declined from 19.7/100,000 inhabitants in 2010 to 14.6/100,000 in 2019. In-hospital mortality increased from 3.9% in 2010 to 8.8% in 2019, particularly for short-term stays. Although 9.6% of hospital admissions occurred in regions with lower economic power in 2010 and 10.4% in 2019, these regions had higher mortality, reaching 4.3% of in-hospital deaths in 2010 and 9.3% in 2019.

CONCLUSION: The observed trends, alongside sex and regional disparities, underscore the need for targeted investment in healthcare infrastructure and training to improve dementia care in LMIC.

Highlights

- The rate of hospital admissions for dementia was similar in 2010 and 2019 in Brazil.
- The cost per hospital admission in 2010 decreased by 38.5% compared with 2019.
- There was an increase in short-term hospital stays for dementia in 2019 compared to 2010, accompanied by an increase in mortality rates for these short-term stays.
- While hospital admissions for dementia decreased in men and increased in women, the in-hospital mortality due to dementia increased for both sexes.

1 | INTRODUCTION

Dementia affects over 55 million individuals worldwide, and this number is projected to triple by 2050 due to the aging population.¹

Alberto Fernando Oliveira Justo and Natalia Gomes Gonçalves contributed equally to this study.

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ments like frailty, functional disability, and sensory deficits. Such health problems, more prevalent in dementia patients, contribute to clinical trajectories associated with a high risk of medical decompensations and unexpected healthcare needs.^{4,5} This situation poses considerable challenges for families and healthcare systems, coupled with profound economic implications.^{6,7} The global cost of dementia, which reached USD 1.3 trillion in 2019, exemplifies this burden, accounting for 0.4% of the gross domestic product of LMICs.⁸⁻¹⁰

About 40% of individuals aged 65 years or older needing acute care for unplanned conditions have dementia as a comorbidity, leading to higher hospital admission costs.⁵ Dementia is linked to in-hospital mortality, longer hospital stays, greater disability, and increased rates of institutionalization after discharge.^{11,12} An American study found that, even after adjusting for age differences, the care costs for hospital admissions of patients with dementia were approximately USD 55,938, compared to USD 49,285 for patients without dementia.¹³ Although dementia is frequently referred to as a comorbidity, data from a general hospital in the United Kingdom indicated that 5% of patients admitted to the hospital had dementia as the primary cause of admission, potentially reaching 10% among those with vascular dementia.¹⁴ In that earlier study, Natalwala et al. (2008) found that behavioral and psychological symptoms of dementia were the main causes of hospital admission, underscoring the complexity of hospital admissions due to dementia.¹⁴ Moreover, a meta-analysis of 10 studies found that many hospital admissions among people with dementia were potentially preventable.¹⁵

Despite ongoing efforts to enhance dementia care, much remains to be understood about its impact on healthcare systems.^{16,17} Comprehensive data on hospital admissions due to dementia are notably absent. Studies from HICs have primarily focused on clinical and psychological factors related to hospital admissions rather than dementia as the primary cause of hospital admission.^{6,14,15} While previous research in LMICs explored dementia as the primary reason for admission, these studies based on aggregated databases have not deeply investigated important aspects such as sex differences, length of stay, and mortality rates.^{16,17} Therefore, we aimed to perform detailed comparisons of hospital admissions due to dementia among Brazilians aged 50 years or older in 2010 and 2019. Utilizing a more comprehensive, individual-level dataset than previous researchers, we were able to report on potential changes in sociodemographics and hospital outcomes, such as length of stay and mortality, over these 10 years.

2 | METHODS

2.1 | Study population

We used data from the Department of Informatics of the National Health System (DATASUS) of the Brazilian Ministry of Health (MH-Brazil) website.¹⁸ The DATASUS information is sourced from the Brazilian public healthcare system, which offers healthcare for all Brazilians for free. DATASUS includes data from the Hospital Information System, which contains information on hospital admission records.

RESEARCH IN CONTEXT

1. **Systematic review:** About 40% of patients aged 65 or older admitted to hospitals have dementia as a comorbidity or the primary cause for admission in high-income countries.
2. **Interpretation:** Utilizing an extensive, individual-level dataset of hospital admissions in Brazil, we reported changes in sociodemographics and hospital outcomes. Although Brazilian regions with lower economic power represented a small proportion of hospitalizations for dementia, these areas showed higher mortality compared to others with greater economic power. Our findings demonstrate an urgent need for targeted healthcare investments in infrastructure and training within the health system, a situation that is likely true in other low- and middle-income countries (LMICs) worldwide.
3. **Future directions:** Other studies from LMICs focusing on hospital admissions for dementia as a primary cause, as well as comorbidity, are needed to further understand the landscape of dementia hospital admissions in areas with limited resources and rapidly aging populations.

These registers are collected through the municipal health secretaries, and data collection methods remained consistent throughout the study period. Data are anonymized and publicly available. This study used existing public data, so approval from an ethics committee was not required.

For data extraction, hospital admissions for dementia were defined by the presence of the following International Classification of Diseases version 10 (ICD-10) codes in the hospital admission records: F00 (Dementia caused by Alzheimer's disease), F01 (Vascular dementia), F02 (Dementia caused by other diseases classified elsewhere), F03 (Unspecified dementia), and G30 (Alzheimer's disease). These ICD-10 codes represent the primary causes of hospital admission. Our inclusion criteria comprised individuals aged 50 years or older who lived in Brazil in 2010 or 2019. The rates and proportions and hospitalization cost calculated for this manuscript are described in Supplementary Material 1.

2.2 | Statistical analysis

Continuous variables were compared using unpaired Student's *t* test, and frequency variables were compared using chi-squared. Data analyses were conducted using Prism version 8.0 (GraphPad Software, San Diego, CA, USA). The alpha level was set at the 5% level.

3 | RESULTS

The mean age among people 50 years or older admitted to the hospital due to dementia increased from 71.8 (SD 11.7) years old in 2010

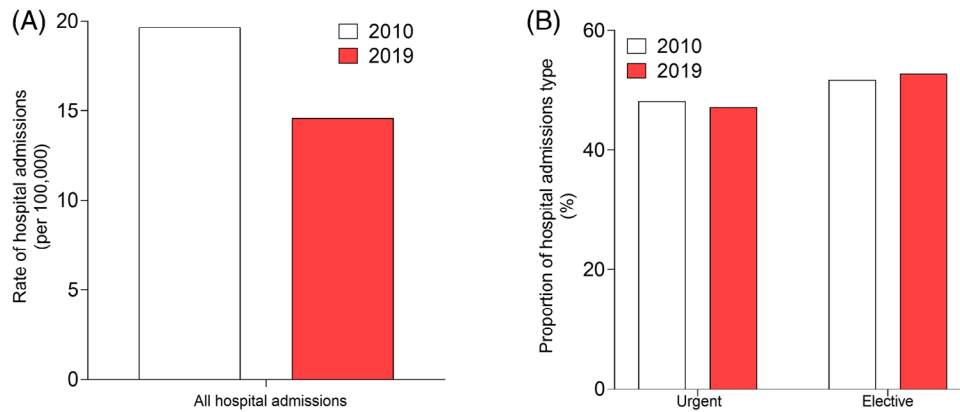


FIGURE 1 Dementia hospital admission rates among Brazilian population aged ≥ 50 years in 2010 and 2019. (A) Rate of hospital admission for dementia and (B) proportion of hospital admission types due to dementia stratified by urgent and elective causes.

to 74.1 (SD 12.1) years old in 2019 ($p < 0.001$), while the mean age among people 50 years or older admitted to the hospital for all causes increased from 66.8 (SD 11.4) to 67.2 (SD 11.3) years old in 2010 and 2019 ($p < 0.001$), respectively. The absolute number of hospital admissions for dementia decreased from 7778 in 2010 to 7672 in 2019. To gain insight into the shifting patterns of dementia admissions, we categorized the admissions based on the type of hospital admission, region income levels, and sex. Only the lower-economic-power region showed a slight increase in hospital admissions, rising from 746 to 795, while all other variables experienced a downward trend (Table S1). Women represented 54.2% of hospital admissions for dementia in 2010 and 54.9% in 2019 ($p = 0.52$). Additionally, 9.6% of hospital admissions for dementia in 2010 and 10.4% in 2019 happened in lower-economic-power regions ($p = 0.60$).

The rate of hospital admissions for dementia decreased when comparing 2010 (19.7 per 100,000 inhabitants) to 2019 (14.6 per 100,000 inhabitants), although the difference was not statistically significant ($p = 0.35$, Figure 1A). While the proportion of urgent hospital admissions slightly decreased (from 48.2% in 2010 to 47.2% in 2019, $p = 0.78$), the proportion of elective admissions slightly increased (from 51.8% in 2010 to 52.8% in 2019, $p = 0.88$), but neither reached statistical significance (Figure 1B). The rate of hospital admissions for dementia decreased in both higher- and lower-economic-power regions in Brazil (higher economic power: from 55.6 per 100,000 inhabitants in 2010 to 47.6 per 100,000 inhabitants in 2019 [$p < 0.001$], lower economic power: from 16.9 per 100,000 inhabitants in 2010 to 8.9 per 100,000 inhabitants in 2019 [$p < 0.001$]) (Figure 2A,B). The proportion of hospital admissions for dementia decreased in 2019 when compared with 2010 in both higher- and lower-economic-power regions (higher economic power: from 2.6% in 2010 to 2.1% in 2019 [$p < 0.001$], lower economic power: from 0.7% in 2010 to 0.6% in 2019 [$p < 0.001$, Figure 2C]).

In analyses stratified by sex, we found that the rate of hospital admissions for dementia decreased in men (from 21.8 per 100,000 inhabitants in 2010 to 12.1 per 100,000 inhabitants in 2019 [$p < 0.001$]), while there was a slight increase in women (from 15.0 per

100,000 inhabitants in 2010 to 20.4 per 100,000 inhabitants in 2019 [$p < 0.001$]) (Figure 3).

Regarding the cost of hospital admissions, even after adjusting for the inflation index, we found a notable decrease of 38.5% in cost per hospital admission, from USD 643.45 in 2010 to USD 395.80 in 2019 ($p < 0.001$, Table 1).

We observed an increase in the rate of short-term hospital stays (≤ 7 days) from 3.03 per 100,000 inhabitants in 2010 to 3.7 per 100,000 inhabitants in 2019 ($p < 0.001$), while the rate of intermediate-term hospital stays (8–14 days) remained constant (1.3 per 100,000 inhabitants in 2010 and 1.4 per 100,000 inhabitants in 2019, $p = 0.69$), and the rate of long-term hospital stays (≥ 15 days) showed a decline from 15.3 per 100,000 inhabitants in 2010 to 10.3 per 100,000 inhabitants in 2019 ($p < 0.001$, Figure 4).

The percentage of in-hospital mortality due to dementia increased from 3.9% in 2010 to 8.8% in 2019 ($p < 0.001$, Figure 5A). The percentage of in-hospital deaths due to dementia also increased in higher- (from 3.7% in 2010 to 8.8% in 2019, $p < 0.001$) and lower-economic-power regions (from 4.3% in 2010 to 9.3% in 2019, $p < 0.001$) (Figure 5B) and in men (from 3.3% in 2010 to 7.8% in 2019, $p < 0.001$) and women (from 4.4% in 2010 to 9.6% in 2019, $p < 0.001$) (Figure 5C). The relative frequency of in-hospital mortality due to dementia increased in 2019 compared to 2010 in all lengths of stay but remained consistent throughout the categories (short-term stays: from 9.6% in 2010 to 18.7% in 2019, $p < 0.001$, intermediate-term stays: from 16.5% in 2010 to 18.2% in 2019, $p = 0.44$; long-term stays: from 1.8% in 2010 to 3.0% in 2019, $p < 0.001$) (Figure 5D).

4 | DISCUSSION

In Brazilian adults aged 50 years and older, we found a decrease in the rate of hospital admissions for dementia in 2019 compared to 2010. Our results also identified sex differences as admissions for dementia decreased in men but increased slightly in women. Additionally, comparison of 2019 to 2010 revealed that the rate of short-term

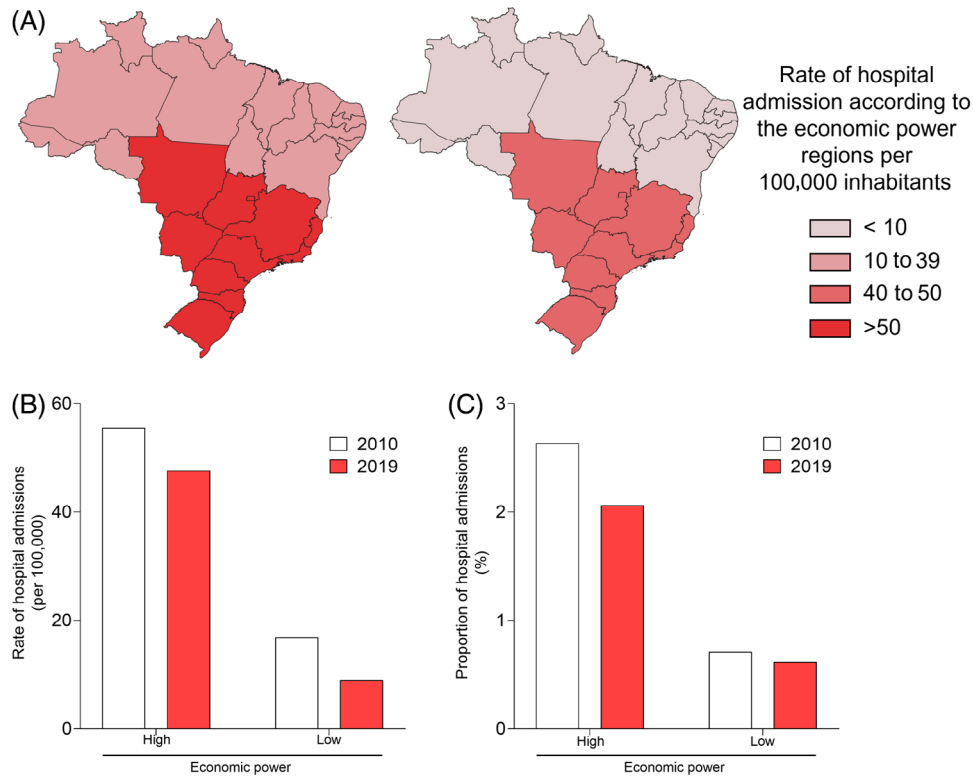


FIGURE 2 Rate of dementia hospital admissions due to dementia among Brazilian population aged ≥ 50 years in 2010 and 2019, stratified by regional economic power. (A) Illustrative map of dementia hospital admission rates in 2010 and 2019. (B) Rate of hospital admissions and (C) proportion of hospital admissions due to dementia.

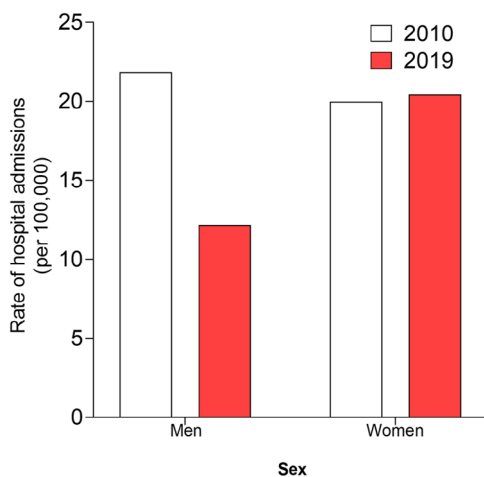


FIGURE 3 Rates of dementia hospital admissions among Brazilian population aged ≥ 50 years in 2010 and 2019 stratified by sex.

hospital admissions increased, whereas the rate of long-term admissions decreased. Of note, in-hospital mortality among patients admitted for dementia increased in 2019 compared to 2010, particularly for short hospital stays. Persistent regional differences are evident as regions with lower economic power experienced not only fewer hospital admissions for dementia but also higher in-hospital mortality rates for the condition. Altogether, these findings show relevant changes and

disparities in the nature, duration, and outcomes of hospital admissions for dementia in LMICs over the last decade.

Our findings extend those of two recent studies on hospital admissions for Alzheimer's disease and related dementias in Brazil.^{16,17} In contrast to our results, which indicate a decline in dementia-related hospital admissions, these previous studies reported an increase between 2010 and 2019.^{16,17} However, it should be noted that we used a more comprehensive set of ICD-10 codes related to dementia, adding data from the codes F00, F01, F02, and F03 to G30. Furthermore, we obtained more detailed information via a unique data retrieval method. While Feter et al. and Piovesan et al. relied on TabNet, an online service that provides publicly accessible data, we utilized TABWIN software, which directly accesses local data repositories.^{18,23} Although the impact of these different tools on outcomes is not fully understood, variations in data processing are known to produce inconsistent results.^{24–26} Direct access to the original data allowed us to scrutinize finer details, uncovering noteworthy trends such as the rise in elective, short-term, and in-hospital mortality rates for admissions due to dementia. These nuanced findings are particularly relevant for understanding the evolving landscape of hospital care for dementia in LMICs, like Brazil, where the surge in dementia cases is particularly acute and the availability of high-quality data may be compromised.^{2,27}

A study from Italy demonstrated that patients with dementia have a higher in-hospital mortality rate, with a doubled risk of death compared to patients without dementia. In a prospective cohort study

TABLE 1 Adjusted total cost and per-admission cost of dementia hospital admission among Brazilian population aged ≥ 50 years in Brazilian real (BRL) and US dollar (USD).

Calendar year	Total cost		Per-admission cost		
	BRL	USD	BRL	USD	
2010	19,748,632.16	5,004,721.78	2539.04	643.45	REF
2019	11,982,233.23	3,036,577.09	1561.83	395.80	↓ 38.48%

Note: The value of BRL 3.95 per USD 1.00 was used for the dollar exchange rate.²²

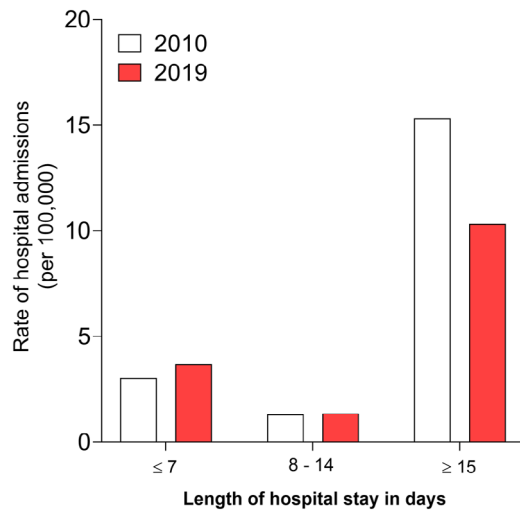


FIGURE 4 Rates of hospital admissions for dementia among Brazilian population aged ≥ 50 years in 2010 and 2019, by length of hospital stay in days.

(3 to 5 years) conducted in LMICs involving participants aged 65 and older, the highest mortality rate was observed in China (65.9%), followed by Cuba (57.4%), Puerto Rico (53.0%), India (46.3%), the Dominican Republic (43.3%), Venezuela (32.7%), and Mexico (26.9%). Additionally, the study found that sex-specific crude mortality rates were lower in women compared to men, with rates of 138.4 versus 188.4 per 1000 person-years. In a case-control study from Germany involving subjects aged 60 years or older, the in-hospital mortality rate was higher in those with dementia (14%) compared to those without (11.7%). Similarly, a retrospective 6-year study from Spain with individuals aged 65 years or older showed that the mortality rate was 19.3% in those with dementia and 8.7% in those without. These findings highlight the stark differences in in-hospital mortality rates for patients with dementia across LMICs and HICs, underscoring the need for tailored healthcare strategies to address these disparities.

Our findings that hospital admissions for dementia decreased were surprising. Dementia cases have increased steadily and are estimated to reach 152 million in 2050.²⁸ This unexpected result might be attributed to the high rates of dementia that go undiagnosed. Such a significant level of underdiagnosis in hospitals can make people living with dementia more vulnerable, potentially leading to higher mortality rates.^{29,30} A previous study showed that in 43% of acute medical admissions of individuals aged 70 years or older had dementia. However, only 50% had been diagnosed, which is closely associated with

frequent hospital admissions and increased risk of emergency department visits.^{11,31} Various factors can impede the diagnosis of dementia in the hospital admission context, including (i) the absence of specialists such as neurologists, psychiatrists, and geriatricians during the hospital stay; (ii) the time-consuming nature of dementia diagnosis; and (iii) the complexity of diagnosing dementia in individuals who are unwell or taking medications who may be experiencing delirium or subsyndromal delirium.

We found the rates of urgent hospital admissions and elective admissions were similar when comparing 2019 to 2010. A study from England showed that patients with dementia had a higher rate of emergency hospital admission compared to elective admissions, particularly during the first year after diagnosis.³² Unfortunately, the available data for our study did not allow us to correlate the times between hospital admission and dementia diagnosis. Another study from South London reported that the number of emergency admissions was approximately 250% higher compared to elective admissions from 2008 to 2016. These differences may be attributed to various factors, such as the accessibility and structure of healthcare systems, the availability of preventive and community care, and differences in the management of chronic conditions. In the UK, the higher rate of emergency admissions might reflect a more responsive system to acute exacerbations or crises in dementia care, as well as greater public awareness and diagnosis rates. Conversely, the similar rates of urgent and elective admissions in Brazil might indicate limitations in accessing timely preventive and community healthcare services, leading to a higher dependency on hospital care for both routine and emergency needs. Additionally, differences in healthcare infrastructure, resource allocation, and public health policies between HIC and LMIC may also play a significant role in these observed trends.

The length of hospital stay differed from 2010 to 2019. Although short hospital admissions (≤ 7 days) increased, there was a decrease in longer hospital admissions (≥ 15 days). This is in line with a previous study that found that hospital admission length for patients with dementia significantly decreased when comparing admissions before and after January 1997 in the United States.³³ These results may also reflect better discharge planning. A previous study showed that if discharge planning occurred early during hospital admission, the length of hospital admissions for patients with dementia decreased.³³ However, our results showed that shorter hospital stays had higher mortality for people with dementia, and the mortality increased in 2019 compared to 2010, with the highest proportion of mortality for short hospital stays. Contrary to previous literature from high-income countries, our findings suggest that an increased proportion of deaths in

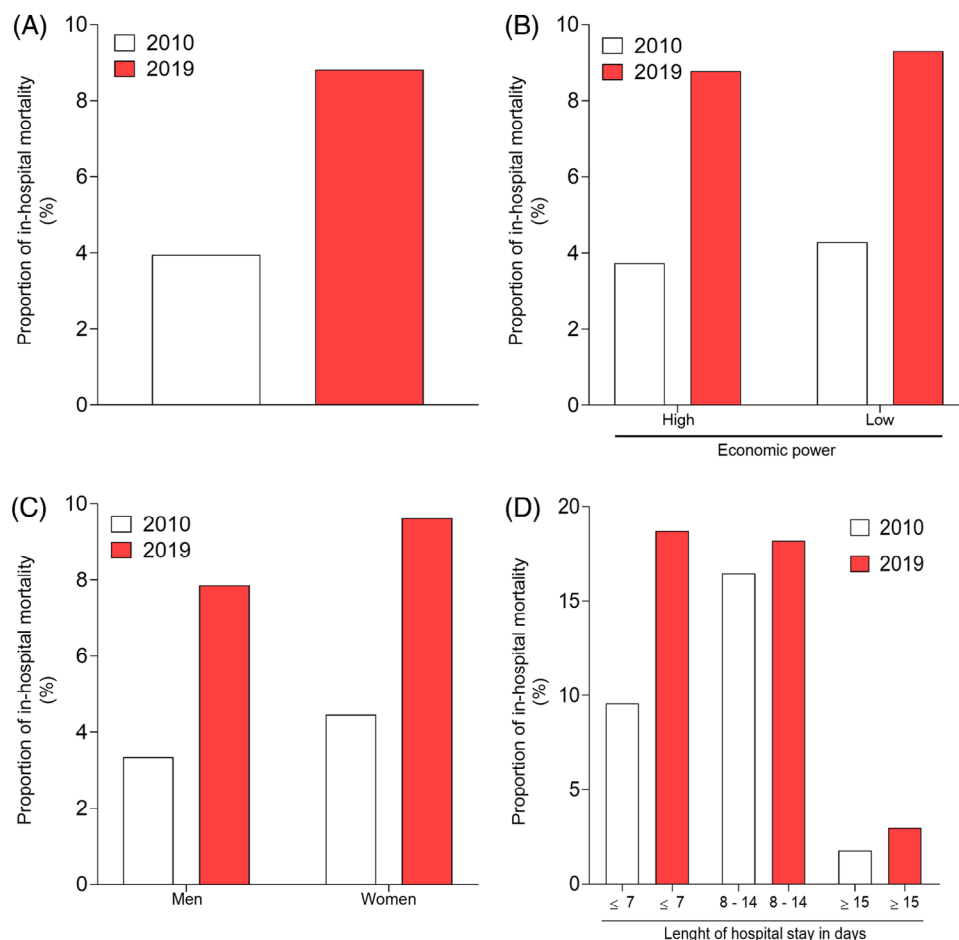


FIGURE 5 Proportion of in-hospital mortality due to dementia among Brazilian population aged ≥ 50 years in 2010 and 2019. Proportion of (A) total in-hospital mortality, (B) in-hospital mortality stratified by Brazilian economic power regions, (C) in-hospital mortality stratified by sex, and (D) in-hospital mortality by length of hospital stay.

patients with dementia accompanied the transition to shorter hospital stays.

A prior investigation revealed that the overall all-cause mortality rate without medical assistance in Brazil stood at an average of 7.1%.³⁴ However, this figure exhibits significant regional variation. Specifically, in the North region, the proportion of deaths without medical assistance has reached 13.5%, while in the Northeast, it has escalated to 18.9%.³⁴ In contrast, the Southeast, South, and Midwest regions demonstrate notably lower rates of 2.2%, 2.8%, and 1.6%, respectively.³⁴ Our study determined that the lower-economic-power region exhibited lower rates of hospital admissions for dementia, coupled with a disproportionately higher percentage of dementia-related in-hospital deaths in 2010 and 2019. The deficient access to medical assistance in the North and Northeast regions, which face challenges such as lower socioeconomic status and limited healthcare access, seems to be associated with a decreased probability of hospital admission for individuals with dementia.³⁴ This observation highlights a multifaceted challenge faced by individuals in lower-income regions. The underlying factors contributing to this phenomenon likely encompass not only limited access to healthcare facilities but also barriers such as delayed diagnosis, inadequate medical intervention, insuffi-

cient support for dementia management, and, consequently, higher mortality rates.

Hospital admission due to dementia is associated with a high economic burden. Evidence from the United States showed that, in 2008, the costs for hospitalization were 14% higher than those associated with hospital admissions of patients without dementia.¹³ However, a recent study reported that in 2022, the annual hospital admission costs for people living with dementia were almost three times higher than for those without a dementia diagnosis (USD 7316 vs USD 2738).³⁵ A study conducted in Norway reported that neurological diseases, including dementia, constituted 15.4% of total health spending.³⁶ On the other hand, in 2019, the overall annual expenses per person associated with hospital admissions for dementia in LMICs, including Argentina, Brazil, Iran, Colombia, China, and Iran, ranged from USD 591 to USD 25,511.¹⁰ The average costs of USD 396 to 643 in our study are among the lowest values. The fact that the cost per hospital admission in Brazil decreased by 38.5% in 2019 compared to 2010 may reflect a shift in the profile of hospital stays, characterized by an increase in short-term stays and a decrease in long-term stays.

In a previous cohort study conducted between 2003 and 2007, the authors investigated the incidence of dementia in individuals 65

years or older in seven lower- to middle-income countries, including Cuba, the Dominican Republic, Venezuela, Mexico, Peru, China, and India.³⁷ The study findings revealed that the incidence rate of dementia was 18.2 to 30.4 cases per 1000 person-years. Additionally, the study found that individuals with dementia faced significantly higher mortality hazards of 1.56 to 5.69 compared to individuals without dementia.³⁷

Our findings on increased in-hospital mortality among dementia patients are consistent with a previous study that analyzed dementia-related deaths in the United States from 2000 to 2017.³⁸ Interestingly, the authors reported that the number of dementia-related deaths increased from 83,694 in 2000 to 261,914 in 2017, a 212.94% rise. The study also highlighted that dementia-related deaths increased by 246.50% for men and 198.99% for women.³⁸ In contrast, we observed an increase in hospital mortality in both men and women, with more pronounced increase in women. This phenomenon could be partly attributed to the fact that men had a greater number of comorbidities, more admissions, and a longer duration of hospital stay.

Our findings should be interpreted in light of certain methodological constraints. First, it is important to note that our dataset was sourced from electronic records. While these records are mandatory, we acknowledge the potential of missing or inaccurate information, particularly in economically disadvantaged regions with limited recourses. Second, our data rely exclusively on hospital admission due to dementia as the primary cause. However, dementia is more common as a comorbid condition in older patients admitted to hospitals, which probably led to the underestimation of our rates. Additionally, we do not exclude the possibility of overdiagnosis, as delirium is common among hospitalized patients and may complicate the accurate diagnosis of dementia. Finally, our collected dataset does not consider the distinction between initial hospital admissions and cases of re-admissions to the hospital. Despite these limitations, this study has strengths. First, it adds important evidence regarding hospital admissions for dementia in a LMIC. Although efforts have been made to extend research on dementia in LMICs, most studies on dementia hospital admissions have been conducted in HICs. We also used comprehensive data from the National Health System, a universal and free healthcare service accessible to everyone in the country. This allowed us to conduct a thorough analysis encompassing data from all regions and various socioeconomic groups nationwide. Finally, we used data before the COVID-19 pandemic, reducing the influence of the pandemic on hospital admission.

5 | CONCLUSION

In conclusion, hospital admission rates for dementia decreased in Brazil in 2019 compared to 2010. However, this trend was overshadowed by a concerning rise in mortality rates during brief hospital stays. Notably, disparities in hospital admissions persisted across regions of varying economic power. To address these disparities and improve the quality of life for people living with dementia in LMICs, fur-

ther research is needed with detailed hospital records, particularly in lower-economic-power regions.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest. Author disclosures are available in the [Supporting information](#).

CONSENT STATEMENT

Consent is not required as the data utilized are sourced from the Hospital Information System, where all data are anonymized and publicly available.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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