DOI: 10.1590/1413-81232018234.09962016

ARTICLE

Fall-related admission and mortality in older adults in Brazil: trend analysis

Débora Regina de Oliveira Moura Abreu [1]
Elisiane Soares Novaes [1]
Rosana Rosseto de Oliveira [1]
Thais Aidar de Freitas Mathias [1]
Sonia Silva Marcon [1]

Abstract *Objective: To analyze the trend of fall-related morbidity and mortality in older adults in Brazil from 1996 to 2012. Method: This is an ecological study of fall-related admission and mortality rate trends in older adults by gender, Brazilian regions, and Brazilian state capitals using data from the Hospital Information System of the Unified Healthcare System (SIH-SUS) and from the National Mortality Information System (SIM). Trend analyses were based on polynomial regression models. Results: Mortality rates increased in all regions and state capitals, and admission trends varied in regions and state capitals. The admission rates in 1996 and 2012 were 2.58 and 41.37 per 10,000 older adults, respectively, and the mortality rates per 10,000 older adults increased from 1.25 in 1996 to 3.75 in 2012. Males mortality rates were higher during the entire period. Conclusion: Fall-related mortality and admission rates increased in Brazil but varied by gender and state of residence. The results of this study do not only monitor the problem over time but may also help plan technological and human resources to prevent and control falls.*

Key words *Accidental falls, Older adult, Mortality, Hospitalization, Time Series Studies*

[1] Programa de Pós-Graduação em Enfermagem, Departamento de Enfermagem, Centro de Ciências da Saúde, Universidade Estadual de Maringá. Av. Colombo, Zona 07. 87020-900 Maringá PR Brasil. debora.drom@gmail.com

Introduction

Population ageing has been observed in Brazil and globally[1], changing the population's morbidity and mortality profiles as the so-classified external causes of injury increased, even though most are preventable[2].

In Brazil hospitalizations for external causes of injury paid by the Unified Healthcare System (SUS) increased 19.1% from 2000 to 2010. A total of 973,015 hospitalizations for external causes of injury were registered in 2011, representing 8.6% of all hospitalizations paid by the Unified Healthcare System (SUS) at a cost of one billion reais. In 2013 external causes of injury were responsible for 151,683 deaths in Brazil, ranking third among the main causes of death in adults[3].

Regarding external causes of injury, falls are among the main reasons for hospital admission in Brazil, especially in older adults, making falls a growing public health problem[4,5]. According to the World Health Organization, 28% to 35% of individuals aged more than 65 years fall at least once a year, and this proportion increases to 32% to 42% in older adults aged more than 70 years[6].

In 2013 93,312 individuals older than 60 years were admitted for falls by the Unified Healthcare System (SUS). In that same year, falls killed 8,775 individuals in the country[7].

The frailty of older adults together with extrinsic factors, such as poor lighting and slippery floors, results in falls having significant consequences on older adults' physical and psychological health[8], and may also affect the lives of their family members[9,10]. Additionally, this problem increases the risk of older adults losing their independence and autonomy, and being institutionalized, consequently increasing healthcare costs and the demand for specialized services[11]. Age and comorbidities are among the main factors associated with fall-related mortality as death is not caused directly by the fall but by its consequences[12].

Nationwide studies that analyze both fall-related hospital morbidity and mortality in older adults have not been found in the literature yet. Hence, the present study aimed to analyze fall-related admission and mortality trends in older adults in Brazil and Brazilian state capitals from 1996 to 2012.

Methods

This is an ecological time series study of fall-related admission and mortality rate trends by gender in Brazilian regions, state capitals, and Federal District from 1996 to 2012. Admission-related data were collected from the Hospital Information System of the Unified Healthcare System (SIH-SUS) and analyzed with respect to the secondary admission diagnosis. Mortality data were obtained from the Mortality Information System of the Ministry of Health (SIM-MS). Both information systems are available at SUS Information Technology Department (Datasus) site[7].

The analysis began in 1996 because it was then that the Mortality Information System (SIM) started to register causes of death using the International Statistical Classification of Diseases and Related Health Problems (Tenth Revision), ICD-10[13]. Admissions and deaths coded W00 to W19 from the "fall" category were selected.

Older adults were defined as individuals aged 60 years or more, as established by the first article of the Statute of Older Adults, Law 10,741/2003. Data from Brazilian state capitals were chosen because the Mortality Information System of the Ministry of Health (SIM-MS) has better coverage in large population centers due to possible biases related to the heterogeneous characteristics of the populations of different Brazilian states[14].

The admission and mortality rates were given by the ratio of the number of events to the number of older residents in that year and location by gender, collected from the demographic Census of 200, 2010, and estimates per 10,000 inhabitants, also available at the Datasus site.

Trend analysis used a polynomial regression model in which the admission and mortality rates were considered the dependent variables (Y), and the study years, the independent variable (X). The moving average centered on three terms was calculated to smoothen the series. The first tested model regarded a simple linear regression model, followed by second- and third-order models. The determination coefficient (r^2) was calculated as a measure of the dependent variable variance. Residual analysis was also performed to confirm the assumption of homoscedasticity. A significant trend was defined as one whose estimated model had $p < 0.05$[15]. The statistical soft-

Ciência & Saúde Coletiva, 23(4):1131-1141, 2018

ware SPSS v. 21.0 was used for the time series trend analysis. This project was approved by the Human Research Ethics Committee of the State University of Maringa.

Results

From 1996 to 2012, there were 66,876 fall-related deaths and 941,923 admissions for fall-related secondary diagnosis in people aged 60 years or more in Brazil. Brazilian capitals accounted for 32.3% of these deaths and 21.2% of these admissions.

The fall-related mortality rate of older adults in Brazilian capitals increased 200%, going from 1.25 to 3.75 per 10,000 older adults, an increase of 15% per year from 1996 to 2012. The highest mortality rates in 2012 occurred in Vitória (7.98), Goiânia (7.52), Florianópolis (7.03), and Porto Velho (6.81). The fall-related admission rate increased from 2.58/10,000 in 1996 to 41.37/10,000 in 2012. The state capitals with the highest number of admissions in 2012 were: São Paulo (51.83), Natal (48.13), Belo Horizonte (46.36), and Porto Alegre (45.02) (data not shown).

Polynomial regression analysis for both fall-related admissions and mortality in older adults revealed a growing trend in Brazil, Brazilian regions, and twelve Brazilian state capitals (São Luís, Teresina, Fortaleza, Natal, João Pessoa, Recife, Maceió, São Paulo, Florianópolis, Cuiabá, Porto Alegre, Brasília). The capitals Boa Vista and Macapá experienced higher admission rates (1.46 and 1.50 per year, respectively) but stable mortality rate; Rio de Janeiro was the only capital with a mean yearly increase of 0.82 in fall-related admission rate and a mean yearly decrease of 0.16 in mortality rate for older adults in the same period.

The capitals Goiânia, Curitiba, Vitória, Salvador, Rio Branco, Manaus, and Belém experienced decreases in fall-related admission rates and increases in fall-related mortality rates, while Porto Velho, Palmas, Aracajú, Belo Horizonte, and Campo Grande experienced stable fall-related admission rates and increases in fall-related mortality rates (Table 1). Additionally, Palmas presented the highest fall-related mean admission rate in older adults for the entire study period (84.46), and the Midwest region had the highest mean mortality and admission rates (4.70 and 42.08, respectively) (Table 1). On the other hand, the highest increases in mortality rates occurred in Cuiabá (0.47 per year), Campo Grande (0.42), Curitiba (0.41), and São Luís (0.40).

Mortality rates were higher in males during the whole study period. Brazil, the Federal District, and 20 state capitals presented growing mortality rate trends in men and women (Table 2).

The admission rate trends for women increased in Brazil, the Federal District, and 13 state capitals. The admission rate trends for men increased in the Federal District and other 14 state capitals, as did the mortality rates. Admission rates were also higher in males in most Brazilian state capitals (Table 3).

Discussion

Fall-related admission and mortality rates increased in older adults in Brazil between 1996 and 2012. This period was characterized by an increase of about 8.5 million people aged 60 years or more, with more individuals living in the Southeast, Northeast, and Midwest regions, followed by the South and North regions[7].

Population ageing is a global phenomenon, and falls are among the health problems that most affect older adults[1]. Fall-related mortality rate in older adults is increasing in other countries, especially developed countries, such as the United States, Canada, and Australia, and in developing countries, such as India, China, and Brazil[6,9,16,17].

Fall-related mortality rate in older adults increased from 1.25 in 1996 to 3.75 in 2012 (an increase of 200% in the period and 15% per year). On the other hand, fall-related admission rate increased from 2.58 to 41.37 per 10,000 older adults. The number of deaths classified as "poorly specified causes" in the group of "external causes of injury" decreased during the period. This improvement in information quality over the years may partly explain the increase in fall-related rates.

The variation in the quality of information registered in the information systems of different localities may have influenced the results. A nationwide Brazilian study found that external causes of injury are better registered in the South and Southeast regions[18].

Better quality of mobile prehospital medical services, which were created by the implementation of the national policy for mobile emergency care in 2003, is among the factors that could have contributed to the higher number of fall-related admissions in Brazil as these services increase survival and even change the death location profile from home to hospital, which may also increase admission rate[1,19].

Table 1. Analysis of the mortality rate trend and hospitalization for falls in older adults. Brazil and state capitals. 1996 to 2012.

Location	Mortality rate			
	Model	R^2	p	Trend*
Brazil	**y = 2.28+0.15x**	**0.96**	< **0.001**	↑
Northern Region	**y = 2.41+0.13x**	**0.92**	< **0.001**	↑
Rio Branco	y = 1.83+0.27x	0.80	< 0.001	↑
Manaus	y = 2.47+0.15x	0.66	< 0.001	↑
Boa Vista	y = 1.41+0.06x	0.10	0.244	-
Belém	y = 2.58+0.09x	0.60	0.001	↑
Macapá	y = 1.12-0.01x	0.00	0.819	-
Porto Velho	y = 3.45+0.26x	0.58	0.001	↑
Palmas	y = 2.45+0.20x	0.35	0.020	↑
Northreastern Region	**y = 2.21+0.12x**	**0.85**	< **0.001**	↑
São Luís	$y = 3.46+0.40x-0.01x2-0.004x^3$	0.95	< 0.001	↑
Teresina	y = 1.88+0.12x	0.68	< 0.001	↑
Fortaleza	y = 1.77+0.14x	0.83	< 0.001	↑
Natal	$y = 0.79-0.11x+0.01x2+0.003x^3$	0.57	0.006	↓/↑
João Pessoa	y = 1.85+0.18x	0.88	< 0.001	↑
Recife	$y = 2.60-0.04x+0.01x^2$	0.46	0.010	↓/↑
Salvador	y = 2.05+0.20x	0.56	0.001	↑
Maceió	$y = 2.61+0.05x+0.01x^2$	0.37	0.024	↑
Aracajú	$y = 3.82+0.19x-0.04x^2$	0.71	< 0.001	↑
Southeastern Region	$\mathbf{y = 2.98+0.06x+0.01x^2}$	**0.83**	< **0.001**	↓/↑
Belo Horizonte	$y = 1.66+0.08x+0.03x^2$	0.82	< 0.001	↑
Vitória	y = 7.15+0.09x	0.44	0.007	↑
Rio de Janeiro	$y = 3.29-0.16x+0.008x2+0.003x^3$	0.65	0.002	↓
São Paulo	$y = 2.92+0.27x+0.02x2-0.004x^3$	0.83	< 0.001	↑
Southern Region	**y = 3.77+0.26x**	**0.88**	< **0.001**	↑
Curitiba	y = 4.66+0.41x	0.88	< 0.001	↑
Florianópolis	$y = 0.82+0.26x+0.06x^2$	0.91	< 0.001	↑
Porto Alegre	y = 3.31+0.12x	0.71	< 0.001	↑
Midwestern Region	**y = 4.70+0.32x**	**0.91**	< **0.001**	↑
Campo Grande	y = 3.51+0.42x	0.93	< 0.001	↑
Cuiabá	y = 3.37+0.47x	0.88	< 0.001	↑
Goiânia	y = 4.44+0.033x	0.96	< 0.001	↑
Brasília	y = 5.73+0.23x	0.62	0.001	↑

it continues

Population ageing not accompanied of the proper adjustments in infrastructure and other measures that facilitate mobility and promote quality of life in this population may be contributing to the higher number of fatal fall victims. Public way conditions (broken and irregular sidewalks, inadequate lighting) are extrinsic factors that, together with intrinsic senescence-related factors (nutritional status, vitamin deficits, vision loss, hearing impairment, and balance disorder, among others) impact fall epidemiology, deserving special attention from managers[1].

Table 1. continuation

Location	Hospitalization rate			
	Model	R^2	p	Trend*
Brazil	**y = 39.02-0.81x-0.23x2+0.05x³**	**0.91**	< **0.001**	↓/↑
Northern Region	**y = 25.14-1.99x**	**0.48**	**0.004**	↓
Rio Branco	y = 58.93-3.32x-0.50x2+0.11x³	0.62	0.003	↓
Manaus	y = 13.10-1.78x	0.63	< 0.001	↓
Boa Vista	y = 25.50+1.46x-0.23x²	0.83	< 0.001	↑
Belém	y = 27.90-4.07x	0.63	< 0.001	↓
Macapá	y = 22.67+1.50x	0.61	0.001	↑
Porto Velho	y = 22.20-0.61x	0.26	0.054	-
Palmas	y = 84.46+7.08x	0.24	0.065	-
Northreastern Region	**y = 24.83+0.93x**	**0.60**	**0.001**	↑
São Luís	y = 14.68-1.60x+0.22x2+0.06x³	0.57	0.006	↓/↑
Teresina	y = 30.06+3.32x	0.93	< 0.001	↑
Fortaleza	y = 37.07+1.19x	0.51	0.003	↑
Natal	y = 36.43+2.89x	0.64	< 0.001	↑
João Pessoa	y = 29.01+1.48x	0.71	< 0.001	↑
Recife	y = 3.59+0.22x	0.37	0.016	↑
Salvador	y = 25.91-0.76x-0.18x2+0.03x³	0.85	< 0.001	↓
Maceió	y = 28.63+0.83x-0.33x²	0.84	< 0.001	↑
Aracajú	y = 41.06-0.81x	0.12	0.204	-
Southeastern Region	**y = 39.78+1.59x-0.28x²**	**0.89**	< **0.001**	↑
Belo Horizonte	y = 50.17+0.02x	0.00	0.983	-
Vitória	y = 44.43-1.04x-0.61x²	0.70	< 0.001	↑/↓
Rio de Janeiro	y = 21.60+0.89x-0.22x²	0.82	< 0.001	↑
São Paulo	y = 42.19+2.43x	0.81	< 0.001	↑
Southern Region	**y = 33.81-2.26x-0.18x2+0.07x³**	**0.85**	< **0.001**	↓/↑
Curitiba	y = 14.38-0.94x	0.50	0.003	↓
Florianópolis	y = 47.73+1.61x-0.28x²	0.84	< 0.001	↑
Porto Alegre	y = 49.22-2.26x-0.30x2+0.10x³	0.93	< 0.001	↓/↑
Midwestern Region	**y = 42.08-1.49x-0.36x2+0.07x³**	**0.94**	< **0.001**	↑/↓/↑
Campo Grande	y = 12.11+0.13x	0.03	0.558	-
Cuiabá	y = 44.13+1.22x-0.55x²	0.84	< 0.001	↑
Goiânia	y = 58.72-4.49x-0.65x2+0.14x³	0.93	< 0.001	↑/↓
Brasília	y = 37.82+1.50x	0.53	0.002	↑

* ↑ Increasing; ↓ Decreasing; - Stable; ↑/↓ Increasing/Decreasing; ↓/↑ Decreasing/Increasing.

External causes of morbidity and mortality are considered avoidable, so it is up to managers, politicians, health professionals, and society in general to invest in measures that effectively prevent their occurrence. Fall prevention consists of multifactorial interventions, exercise programs that improve balance, changes in the home environment, reduced use of psychotropic drugs, cataract surgery, vitamin D and calcium supplementation, and health professional sensitization and training, among others[20,21].

The different rates of admission and mortality found in Brazilian state capitals corroborate a cross-sectional study of older adults living in the

Table 2. Trend of fall-related mortality in older adults by gender. Brazil and state capitals. 1996 to 2012.

Location	Male			
	Model	R^2	p	Trend*
Brazil	**y = 2.59+0.16x**	**0.97**	**< 0.001**	↑
Northern Region	**y = 2.88+0.16x**	**0.91**	**< 0.001**	↑
Rio Branco	y = 2.19+0.35x	0.83	< 0.001	↑
Manaus	y = 3.39+0.19x	0.65	< 0.001	↑
Boa Vista	y = 1.92-0.02x	0.01	0.730	-
Belém	y = 2.52+0.11x	0.54	0.002	↑
Macapá	y = 1.56+0.002x	0.00	0.980	-
Porto Velho	y = 4.92+0.24x	0.32	0.028	↑
Palmas	y = 2.49+0.28x	0.37	0.016	↑
Northeastern Region	**y = 2.65+0.15x**	**0.85**	**< 0.001**	↑
São Luís	$y = 3.40+0.48x-0.03x2-0.01x^3$	0.92	< 0.001	↑
Teresina	y = 2.26+0.09x	0.38	0.014	↑
Fortaleza	y = 2.30+0.19x	0.78	< 0.001	↑
Natal	y = 1.41-0.02x	0.04	0.453	-
João Pessoa	y = 2.55+0.22x	0.86	< 0.001	↑
Recife	y = 3.33-0.01x	0.01	0.680	-
Salvador	y = 2.57+0.26x	0.64	< 0.001	↑
Maceió	y = 3.28+0.07x	0.22	0.075	-
Aracajú	$y = 4.99+0.24x-0.07x^2$	0.83	< 0.001	↑
Southeastern Region	$\mathbf{y = 3.76+0.10x+0.02x^2}$	**0.88**	**< 0.001**	↑
Belo Horizonte	$y = 2.51+0.14x+0.03x^2$	0.84	< 0.001	↑
Vitória	y = 90.01+0.10x	0.21	0.082	-
Rio de Janeiro	$y = 3.77-0.014x+0.01x2+0.004x^3$	0.67	0.001	↓/↑
São Paulo	$y = 3.88+0.034x+0.02x2-0.005x^3$	0.85	< 0.001	↑
Southern Region	**y = 3.82+0.26x**	**0.92**	**< 0.001**	↑
Curitiba	y = 4.61+0.32x	0.82	< 0.001	↑
Florianópolis	$y = 0.98+0.24x+0.06x^2$	0.86	< 0.001	↑
Porto Alegre	y = 3.40+0.20x	0.76	< 0.001	↑
Midwestern Region	**y = 5.08+0.29x**	**0.90**	**< 0.001**	↑
Campo Grande	$y = 4.08+0.62x-0.02x2-0.01x^3$	0.95	< 0.001	↑
Cuiabá	y = 3.68+0.40x	0.75	< 0.001	↑
Goiânia	y = 4.84+0.38x	0.96	< 0.001	↑
Brasília	y = 6.21+0.15x	0.37	0.016	↑

it continues

urban areas of 100 municipalities in 23 Brazilian states. The data show that the Midwest region has the highest prevalence, followed by the Southeast, South, Northeast, and North regions[9]. New studies are much needed to better understand the reasons behind these regional differences.

The study mortality rates were higher in males during the whole study period. Studies that found higher fall-related prevalence rates in males associated this fact to men's greater participation in intense and dangerous physical activities, ignoring the limits of their physical capacity, and usually, these events are more severe, resulting in hospitalizations and death. A study of falls in older adults treated by prehospital care found that men have more severe trauma[1]. Additionally, they are more susceptible to comorbidities than women of the same age[22]. These data reinforce men's greater vulnerability to external causes of morbidity and mortality[23].

Some considerations must be made regarding database quality. The first consideration regards SIM, which discloses only the primary cause of death, impairing assessment of oth-

Table 2. continuation

Location	Female			
	Model	R^2	p	Trend*
Brazil	**y = 2.02+0.15x**	**0.95**	**< 0.001**	↑
Northern Region	**y = 2.06+0.11x**	**0.88**	**< 0.001**	↑
Rio Branco	y = 1.50+0.20x	0.49	0.004	↑
Manaus	y = 1.76+0.12x	0.54	0.002	↑
Boa Vista	y = 0.91+0.15x	0.54	0.002	↑
Belém	y = 2.61+0.07x	0.49	0.003	↑
Macapá	y = 0.57-0.03x	0.03	0.519	-
Porto Velho	y = 2.01+0.28x	0.72	< 0.001	↑
Palmas	y = 2.50+0.12x	0.13	0.191	-
Northeastern Region	**y = 1.93+0.10x**	**0.81**	**< 0.001**	↑
São Luís	y = 3.42+0.29x	0.90	< 0.001	↑
Teresina	y = 1.61+0.14x	0.68	< 0.001	↑
Fortaleza	y = 1.42+0.11x	0.68	< 0.001	↑
Natal	$y = 0.61-0.16x+0.01x2+0.005x^3$	0.69	0.004	↓/↑
João Pessoa	y = 1.40+0.16x	0.83	< 0.001	↑
Recife	y = 2.19-0.05x+0.02x2	0.75	< 0.001	↓/↑
Salvador	y = 1.73+0.17x	0.46	0.006	↑
Maceió	y = 2.57+0.03x	0.05	0.402	-
Aracajú	y = 2.78+0.15x	0.45	0.006	↑
Southeastern Region	**$y = 2.47+0.04x+0.01x^2$**	**0.73**	**< 0.001**	↓/↑
Belo Horizonte	y = 1.61+0.04x	0.10	0.253	-
Vitória	y = 5.86+0.09x	0.43	0.008	↑
Rio de Janeiro	y = 3.07-0.06x	0.45	0.006	↓
São Paulo	$y = 2.27+0.23x+0.01x2-0.004x^3$	0.79	< 0.001	↑
Southern Region	**y = 3.74+0.26x**	**0.83**	**< 0.001**	↑
Curitiba	y = 4.70+0.48x	0.89	< 0.001	↑
Florianópolis	y = 0.70+0.28x+0.06x2	0.89	< 0.001	↑
Porto Alegre	y = 3.26+0.07x	0.32	0.027	↑
Midwestern Region	**y = 4.40+0.35x**	**0.92**	**< 0.001**	↑
Campo Grande	y = 3.30+0.48x	0.92	< 0.001	↑
Cuiabá	y = 3.11+0.53x	0.91	< 0.001	↑
Goiânia	y = 4.15+0.29x	0.90	< 0.001	↑
Brasília	$y = 5.88+0.57x-0.03x2-0.01x^3$	0.86	< 0.001	↑

* ↑ Increasing; ↓ Decreasing; - Stable; ↓/↑ Decreasing/Increasing.

er causes. Another limitation is associated with underreporting, which results in distorted information about the actual mortality profile[24]. The second consideration refers to the quality of the admission-related information provided by the SIH-SUS, which may contain classification errors of diagnosis on admission associated with the difficulty of using ICD-10, and variations related to time, location, and legal nature of the institution, as administrative hospital employees are not trained to treat data as necessary from the health information point of view[25].

Although the Mortality Information (SIM) and Hospital Admission Systems are important sources of data, when confronted with primary information sources, studies have found the need to improve the quality of external cause-related coverage and filling out[26,27]. Questioning the recorded information quality and data reliability does not only contribute to the organization of health information but also collaborates to the planning of healthcare team actions[28].

However, it is important to use information systems to monitor the rates of mortality and ad-

Table 3. Fall-related hospitalization trend in older adults by gender. Brazil and state capitals. 1996 to 2012.

Location	Male			
	Model	R^2	p	Trend*
Brazil	**y = 34.87+0.93x-0.21x²**	**0.67**	**0.001**	↑
Northern Region	**y = 26.12-1.61x**	**0.43**	**0.008**	↓
Rio Branco	y = 51.72+0.29x	0.01	0.761	-
Manaus	y = 13.08-1.96x	0.68	< 0.001	↓
Boa Vista	y = 26.19+1.82x-0.23x²	0.76	< 0.001	↑
Belém	y = 28.51-3.40x	0.62	< 0.001	↓
Macapá	y = 27.18+1.63x	0.65	< 0.001	↑
Porto Velho	y = 21.30-0.73x	0.32	0.028	↓
Palmas	y = 94.42+9.91x	0.30	0.035	↑
Northeastern Region	**y = 22.55+0.81x**	**0.61**	**0.001**	↑
São Luís	y = 22.60+0.52x	0.08	0.294	-
Teresina	y = 30.32+3.16x	0.92	< 0.001	↑
Fortaleza	y = 32.24+0.91x-0.14x²	0.58	0.002	↑
Natal	y = 39.61+2.28x-0.44x²	0.89	< 0.001	↑
João Pessoa	y = 24.87+0.92x	0.44	0.007	↑
Recife	y = 2.89+0.12x	0.21	0.088	-
Salvador	y = 25.64+0.40x-0.12x²	0.60	0.002	↑
Maceió	y = 16.44+057x	0.30	0.036	↑
Aracajú	y = 37.84-1.03x	0.17	0.121	-
Southeastern Region	**y = 30.85+1.58x**	**0.67**	**< 0.001**	↑
Belo Horizonte	y = 50.01-0.02x	0.00	0.981	-
Vitória	y = 47.53-1.12x-0.60x²	0.74	< 0.001	↑/↓
Rio de Janeiro	y = 15.27+0.79x	0.53	0.002	↑
São Paulo	y = 38.14+2.46x	0.86	< 0.001	↑
Southern Region	**y = 28.65-2.08x-0.16x2+0.63x³**	**0.83**	**< 0.001**	↓/↑
Curitiba	y = 12.43-0.73x	0.50	0.003	↓
Florianópolis	y = 30.83+1.51x	0.55	0.001	↑
Porto Alegre	y = 42.54-2.49x-0.87x2+0.09x³	0.87	< 0.001	↓/↑
Midwestern Region	**y = 43.36-1.61x-0.38x2+0.08x³**	**0.96**	**< 0.001**	↑/↓/↑
Campo Grande	y = 12.10-0.01x	0.00	0.972	-
Cuiabá	y = 46.45+1.13x-0.62x²	0.81	< 0.001	↑/↓
Goiânia	y = 62.26-5.18x-0.69x2+0.16x³	0.95	< 0.001	↑/↓
Brasília	y = 38.60+1.82x	0.63	< 0.001	↑

it continues

mission for external causes in Brazilian regions and states for scientific and health policy creation purposes as their continuous and intense use will lead to greater classification of their records[18].

Final considerations

Expenditures associated with the provision of care to individuals with fall-related injuries increase yearly due to the growing rates of fall-related admission and mortality in older adults.

Table 3. continuation

Location	Male			
	Model	R^2	p	Trend*
Brazil	**y = 42.41+1.04x-0.25x²**	**0.62**	**0.001**	↑
Northern Region	**y = 24.42-2.28x**	**0.51**	**0.003**	↓
Rio Branco	y = 51.14-0.72x	0.11	0.236	-
Manaus	y = 13.11-1.63x	0.58	0.001	↓
Boa Vista	y = 20.33+1.73x	0.66	< 0.001	↑
Belém	y = 27.50-4.52x	0.63	< 0.001	↓
Macapá	y = 18.94+1.40x	0.55	0.001	↑
Porto Velho	y = 23.07-0.49x	0.15	0.153	-
Palmas	y = 78.57+4.32x	0.14	0.176	-
Northeastern Region	**y = 26.26+1.00x**	**0.58**	**0.001**	↑
São Luís	y = 12.54-1.84x+0.19x2+0.06x³	0.69	0.001	↓/↑
Teresina	y = 29.85+3.44x	0.93	< 0.001	↑
Fortaleza	y = 45.72+1.34x-0.21x²	0.64	0.001	↑
Natal	y = 39.70+3.29x	0.66	< 0.001	↑
João Pessoa	y = 31.63+1.83x	0.80	< 0.001	↑
Recife	y = 4.00+0.28x	0.42	0.009	↑
Salvador	y = 26.08-1.03x-0.22x2+0.03x³	0.87	< 0.001	↓
Maceió	y = 34.29+1.00x-0.42x²	0.85	< 0.001	↑/↓
Aracajú	y = 43.07-0.66x	0.08	0.297	-
Southeastern Region	**y = 35.37+1.59x**	**0.59**	**0.001**	↑
Belo Horizonte	y = 61.53-2.13x-0.60x2+0.06x³	0.81	< 0.001	↓
Vitória	y = 30.87-0.98x	0.10	0.239	-
Rio de Janeiro	y = 18.97+0.95x	0.41	0.010	↑
São Paulo	y = 44.95+2.40x	0.78	< 0.001	↑
Southern Region	**y = 37.13-2.38x-0.18x2+0.08x³**	**0.85**	**< 0.001**	↓/↑
Curitiba	y = 15.73-1.08x	0.50	0.003	↓
Florianópolis	y = 40.46+1.71x	0.58	0.001	↑
Porto Alegre	y = 53.17-2.12x-0.31x2+0.10x³	0.94	< 0.001	↑
Midwestern Region	**y = 41.06-1.39x-0.35x2+0.06x³**	**0.90**	**< 0.001**	↑/↓/↑
Campo Grande	y = 12.11+0.25x	0.09	0.276	-
Cuiabá	y = 42.18+1.29x-0.48x²	0.79	< 0.001	↑
Goiânia	y = 56.06-3.97x-0.62x2+0.12x³	0.91	< 0.001	↑/↓
Brasília	y = 31.26+1.26x	0.43	0.008	↑

* ↑ Increasing; ↓ Decreasing; - Stable; ↓/↑ Decreasing/Increasing.

Nonetheless, fall-related admission and mortality rates in older adults vary by gender and by state capital of residence.

Reversal of the ever growing trend in fall-related admission and mortality rates requires efforts in the articulation of social policies in all spheres of management. Accident and fall prevention strategies for community-dwelling older adults should emphasize education, professional training, the creation of safer environments, and prioritization of studies on older adult falls. In addition to monitoring falls over time, the present study results may help plan technological and human resources to prevent and control this problem. New studies are justified to better explain the growing rates of falls and the regional and demographic fall-related differences.

Collaborations

DROM Abreu, ES Novaes, RR Oliveira, TAF Mathias and SS Marcon participated in all stages of the present study, to say: 1. Design and design or analysis and interpretation of data; 2. Article writing or critical review relevant intellectual content; 3. Final approval of the version to be published. 4. Be responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work.

References

1. Meschial WC, Soares DFPP, Oliveira NLB, Nespollo AM, Silva WA, Santil FLP. Elderly victims of falls seen by pre hospital care: gender differences. *Rev. Bras. Epidemiol* [serial on the Internet]. 2014 [cited 2015 Mar 07]; 17(1):3-16. Available from: http://dx.doi.org/10.1590/1415-790X201400010002ENG
2. Gasparotto LPR, Falsarella GR, Coimbra AMV. Falls in elderly: basics concepts and updates of research in health. *Rev Bras Geriatr Gerontol* 2014; 17(1):201-209.
3. Brasil. Ministério da Saúde (MS). *Saúde Brasil 2011: uma análise da situação de saúde e a vigilância da saúde da mulher*. Brasília: Editora do Ministério da Saúde; 2012.
4. Pinho TAM, Silva AO, Tura LFR, Moreira MASP, Gurgel SN, Smith AAF, Bezerra VP. Avaliação do risco de quedas em idosos atendidos em Unidade Básica de Saúde. *Rev Esc Enferm USP* 2012; 46(2):320-327.
5. Gomes ECC, Marques APO, Leal MCC, Barros BP. Factors associated with the danger of accidental falls among institutionalized elderly individuals: an integrative review. *Cien Saude Colet* [serial on the Internet]. 2014 [cited 2015 Mar 07]; 19(8):3543-3551. Available from: http://www.scielo.br/pdf/csc/v19n8/1413-8123-csc-19-08-03543.pdf
6. World Health Organization (WHO). Falls. Fact sheet N° 344. [Internet]. 2012 [cited 2015 Mar 07]; Available from: http://www.who.int/mediacentre/factsheets/fs344/en/
7. Brasil. Ministério da Saúde (MS). Datasus. *Informações de Saúde* [base de dados na Internet]. Brasília: 2015. [acessado 2015 Ago 13]. Disponível em: http://www2.datasus.gov.br/DATASUS/index.php
8. Maia BC, Viana PS, Arantes PMM, Alencar MA. Consequências das quedas em idosos vivendo na comunidade. *Rev. Bras. Geriatr. Gerontol*. 2011; 14(2):381-393.
9. Siqueira FV, Facchini LA, Silveira DS, Piccini RX, Tomasi E, Thumé E, Silva SM, Dilélio A. Prevalence of falls in elderly in Brazil: a countrywide analysis. *Cad Saude Publica* 2011; 27(9):1819-1826.
10. Cruz DT, Ribeiro LC, Vieira MT, Teixeira MTB, Bastos RR, Leite ICG. Prevalência de quedas e fatores associados em idosos. *Rev Saude Publica* 2012; 46(1):138-146.
11. Abreu HCA, Reiners AAO, Azevedo RCS, Silva AMC, Abreu DROM. Incontinência urinária como fator preditor para quedas em idosos hospitalizados. *Rev. esc. enferm*. USP [serial on the Internet]. 2014 [cited 2015 Mar 07]; 48:851-856. Available from: http://dx.doi.org/10.1590/S0080-6234201400005000011
12. Franco LG, Kindermann AL, Tramujas L, Kock KS. Fatores associados à mortalidade em idosos hospitalizados por fratura de fêmur. *Rev. Bras. Ortop*. 2016; 51(5):509-514.
13. Organização Mundial da Saúde (OMS). *Classificação Estatística Internacional de Doenças e Problemas relacionados à Saúde*. São Paulo: Editora da Universidade de São Paulo; 1994.
14. Melo CM, Bevilacqua PD, Barletto M. Produção da informação sobre mortalidade por causas externas: sentidos e significados no preenchimento da declaração de óbito. *Cien Saude Colet* [serial on the Internet]. 2013 May [cited 2015 Mar 09]; 18(5):1225-34. Available from: http://dx.doi.org/10.1590/S1413-8123 2013000500007.
15. Latorre MRDO, Cardoso MRA. Análise de séries temporais em epidemiologia: uma introdução sobre os aspectos metodológicos. *Rev Bras Epidemiol* 2001; 4(3):145-152.
16. Wong ELY, Woo J, Cheung AW, Yeung PY. Determinants of participation in a fall assessment and prevention programme among elderly fallers in Hong Kong: prospective cohort study. *J Adv Nurs* 2011; 67(4):763-773.
17. Hu G, Baker SP. Explanation for the Recent Increase in the Fall Death Rate Among Older Americans: A Subgroup Analysis. *Public Health Reports*. [serial on the Internet]. 2012 [cited 2015 Mar 07]; 127: 275-282. Available from: http://www.publichealthreports.org/issueopen.cfm?articleID=2842
18. Mello Jorge MHP, Laurenti R, Gotlieb SLD. Análise da qualidade das estatísticas vitais brasileiras: a experiência de implantação do SIM e do SINASC. *Cien Saude Colet* 2007; 12(3):643-654.
19. Machado CV, Salvador FGF, O'Dwye G. Serviço de Atendimento Móvel de Urgência: análise da política brasileira. *Rev Saude Publica* 2011; 45(3):519-528.
20. Williams HG, Ullmann G. Development of a Community-Based Fall Prevention Program: Stay in Balance. *J Phys Act Health* 2012; 9(4):571-580.
21. Poll MA, Hoffmeister ACM, Tier CG, Santos SSC. Ocorrência de hospitalizações de idosos por quedas. *Cienc Cuid Saude* 2014; 13(3):447-454.
22. Stevens JA, Ryan G, Kresnow M. Fatalities and injuries from falls among older adults – United States, 1993-2003 and 2001-2005. *JAMA* 2007; 297(1):32-33.
23. Martins ET, Boing AF, Peres MA. Motorcycle accident mortality time trends in Brazil, 1996-2009. *Rev Saude Publica* 2013; 47(5):931-941.
24. Yuen EJ. Severity of illness and ambulatory care- sensitive conditions. *Med Care Res Rev* 2004; 61(3):376-391.
25. Pepe VE. Sistema de informações hospitalares do Sistema Único de Saúde (SIH-SUS). In: Brasil. Ministério da Saúde (MS). *A experiência brasileira em sistemas de informação em saúde*. Brasília: MS; 2009. p. 65-86. Vol. 2.
26. Melo CM, Bevilacqua PD, Barletto M, França EB. Quality of data on deaths from external causes in a medium-sized city in Minas Gerais State, Brazil. *Cad Saude Publica* 2014; 30(9):1999-2004.
27. Mathias TAF, Andrade SM, Tomimatsu MF, Soares DF, Sapata MP, Frascarelli AS, Souza RK. Reliability of the diagnoses of hospital admissions for external causes financed by the Brazilian Unifed Health System-SUS in two cities in the State of Paraná, Brazil. *Cien Saude Colet* 2014; 19(10):4257-4265.
28. Arruda GO, Molena-Fernandes CA, Mathias TAF, Marcon SS. Hospital morbidity in a médium-sized city: differentials between men and women. *Rev. Latino-Am Enfermagem* 2014; 22(1):19-27.

Article submitted 11/04/2016
Approved 25/06/2016
Final version submitted 27/06/2016