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Hospitalizations in older adults from the Zona da Mata of Minas Gerais, Brazil: data from the Unified Health System, 2016–2018

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ABSTRACT

Introduction: The growing older population increases proportionately the demand for hospital care due to the increase in health problems. **Objective:** To estimate the prevalence and incidence of hospitalizations, and to investigate associated factors in older adults from the Zona da Mata of Minas Gerais, Brazil, between 2016-2018. Secondly, to provide a more comprehensive epidemiological overview of hospitalizations, the following were estimated: monthly hospitalization rate; hospital mortality rate; frequency of hospitalizations according to diagnosis, hospitalizations for conditions sensitive to primary care and in-hospital death; and hospital costs. **Methods:** This is an ecological and descriptive-analytic study. Data were obtained from the Brazilian Hospital Information System (SIH/SUS). **Results:** The prevalence of hospitalizations was 35.1% (31.2% in women and 39.7% in men). The monthly rate of hospitalizations was higher in older men when compared with older women (Rate-Ratio=1.35 [95% CI=1.27-1.43]) and adult men between 40–59 years (Rate-Ratio=2.42 [95% CI=2.26-2.58]). The cumulative incidence of hospitalization was 144/1,000 older persons (125/1,000 women and 169/1,000 men). Factors significantly associated with hospitalizations were: male sex (PR=1.52 [95% CI=1.11-2.08]); hospitalization in surgical bed (PR=1.93 [95% CI=1.05-3.56]); absence of death (PR=1.94 [95% CI=1.03-3.65]); and hospital stay ≥15 days (PR=0.71 [95% CI=0.54-0.95]). The cost of hospitalizations was R$ 220,8 million (mean of R$ 201,700/day). **Conclusion:** The findings strengthen the need for preventive healthcare for the older population living in the Zona da Mata of Minas Gerais and alert managers to the substantial socioeconomic impact of hospitalizations.

Keywords: hospitalization; hospital information systems; length of stay; hospital costs; epidemiology, descriptive; aged.

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INTRODUCTION

The growing number of older adults in Brazil has been a determining factor in the sharp demographic transition that the country has been experiencing in recent decades. Parallel to this phenomenon is a notable change in the population's health profile and its significant impact on socio-economic demands and the availability of resources[1]. It is estimated that around 700,000 new older people are added to the Brazilian population each year and this estimate suggests that by 2030 older adults will represent 18.6% of the total population or around 40 million individuals[2,3]. Although these figures indicate positive changes in living conditions in general, they also imply major challenges, mainly related to the increase in the prevalence of chronic health conditions that tend to have a high burden on health systems, the older adults themselves, and society in general[2,3].

One of the main factors impacting public health in the context of population aging is hospitalizations and their negative outcomes. In a cross-sectional study with a representative sample of the Brazilian older adult population (≥60 years, n=4,922), living in 70 municipalities in the five geographic regions, 11.6% of the participants reported at least one hospitalization in the last 12 months[4]. Adjusted analyses revealed that older age (≥80 years), living in a rural area, and clinical diagnosis of chronic conditions such as hypertension and diabetes were factors associated with the occurrence of hospitalization[4]. Recently, a national coverage study based on data from the Hospital Information System (SIH/SUS) showed that, between 2009-2015, 29.0% (~18 million) of total hospitalizations and 39.0% of the corresponding government reimbursement came from hospitalizations in the older adults, with the predominant cause being chronic non-communicable diseases[5]. In addition, the hospital mortality rate for this population increased from 9.8% to 11.2% in the period evaluated[5]. Thus, the high number of hospitalizations confronts the current prospects for the health of older adults in Brazil. From admission to bed stay to hospital discharge, there is a range of events that must be investigated and monitored to reduce the epidemiological, clinical, and socioeconomic burden associated with hospitalizations.

The scarcity of population surveys outside the major centers, coupled with the high operational cost of conducting representative studies, justifies the use of national health information systems since the availability of local data makes it possible to investigate unknown associations and produce epidemiological information that can guide the decision-making of municipal managers. Knowledge of the epidemiological profile of hospitalizations among older adults can provide essential input for the planning, distribution, and monitoring of government resources earmarked for the health of the older adult population.

Thus, the primary objective of this study was to estimate the prevalence and incidence of hospitalizations, and to investigate associated factors, in older adult people in Zona da Mata of Minas Gerais, Brazil, in the 2016-2018 triennium. Secondly, to provide a more comprehensive epidemiological overview of hospitalizations, the following were estimated: monthly hospitalization rate; hospital mortality rate; frequency of hospitalizations according to diagnosis, hospitalizations for ambulatory care sensitive conditions (*internações por condições sensíveis à atenção primária* - ICSAP) and hospital death; and hospital costs.

METHODS

This is an ecological, descriptive-analytical study based on secondary data from the SIH/SUS. The variables were obtained using the electronic tabulation program TabWin version 4.1.5 from the Department of Informatics of the Unified Health System[6]. SIH/SUS is the main national database on hospital production from public, private, and philanthropic institutions, and is used to quantify the number of hospitalizations according to various sociodemographic (e.g., gender, age, and race) and clinical (e.g., diagnosis, stay and death) aspects[7]. The data for this study was obtained via monthly reduced files generated by the movement of Hospital Admission Authorizations (HAA)[8], referring only to hospitalizations in the public health sector. The study's target population was older adult individuals aged ≥60 years, who had HAAs issued in three Health Regions of the Zona da Mata: Juiz de Fora, Ubá, and Leopoldina, during the 2016-2018 triennium. The municipalities that make up each Health Region are described in Table 1.

The Zona da Mata mesoregion, located in the southeast of Minas Gerais, corresponds to approximately 6.1% of the state's total area and is made up of 142 municipalities, subdivided into seven geographic microregions, with a current population of 2,311,547 inhabitants (404,754 aged ≥60 years)[9]. It has important economic activity in which the services, industry, and agriculture sectors stand out[10]. The municipality of Juiz de Fora is its regional capital, with high rates of urbanization, human development, aging, and quality of life[10]. The estimated proportion of older adults and the aging index for the Zona da Mata are, respectively, 17.5% (i.e., around 18 individuals aged ≥60 years for every 100 inhabitants) and 97.4% (i.e., for every 100 inhabitants under the age of 15, there are around 97 individuals aged ≥60 years)[9].

Descriptive data on hospitalizations according to age (≥60 years), in 2016, 2017, and 2018, Health Region (Juiz de Fora/Ubá/Leopoldina), diagnosis (ICD-10 Chapters), SIH/SUS "procedure subgroup" (clinical treatments/oncology treatments/other surgeries...), ICSAP (Brazilian list)[11] and in-hospital death (ICD-10 Chapters) were presented using absolute (n) and relative (%) frequencies. The hospital mortality rate was calculated by dividing the number of deaths in hospitalized patients by the number of patients who left the hospital (e.g., discharge, transfer, or evasion)[12]. Hospital death was considered as described in the 2017

Table 1: Municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (n=83).

Juiz de Fora (n=37)	Ubá (n=31)	Leopoldina (n=15)
Andrelândia	Antônio Prado de Minas	Além Paraíba
Aracitaba	Barão de Monte Alto	Argirita
Arantina	Brás Pires	Astolfo Dutra
Belmiro Braga	Coimbra	Cataguases
Bias Fortes	Divinésia	Dona Eusébia
Bicas	Dores do Turvo	Estrela Dalva
Bocaina de Minas	Ervália	Itamarati de Minas
Bom Jardim de Minas	Eugenópolis	Laranjal
Chácara	Guarani	Leopoldina
Chiador	Guidoval	Palma
Coronel Pacheco	Guiricema	Pirapetinga
Descoberto	Mercês	Recreio
Ewbank da Câmara	Miradouro	Santana de Cataguases
Goianá	Miraí	Santo Antônio do Aventureiro
Guarará	Muriaé	Volta Grande
Juiz de Fora	Patrocínio do Muriaé	
Liberdade	Piraúba	
Lima Duarte	Presidente Bernardes	
Mar de Espanha	Rio Pomba	
Maripá de Minas	Rodeiro	
Matias Barbosa	Rosário da Limeira	
Olaria	São Francisco do Glória	
Oliveira Fortes	São Geraldo	
Passa-Vinte	São Sebastião da Vargem Alegre	
Pedro Teixeira	Senador Firmino	
Pequeri	Silveirânia	
Piau	Tabuleiro	
Rio Novo	Tocantins	
Rio Preto	Ubá	
Rochedo de Minas	Vieiras	
Santa Bárbara do Monte Verde	Visconde do Rio Branco	
Santa Rita de Jacutinga		
Santana do Deserto		
Santos Dumont		
São João Nepomuceno		
Senador Cortes		
Simão Pereira		

Source : www.saude.mg.gov.br/sobre/institucional/superintendencias-regionais-de-saude-e-gerencias-regionais-de-saude

SIH/SUS Technical Operational Manual (i.e., death that occurred after the patient was admitted to hospital, regardless of whether the administrative procedures related to hospitalization had already been conducted or not)[8].

The prevalence of hospitalizations was obtained by dividing the number of hospitalizations in older adults by the total number of hospitalizations, including all age groups, in the three years evaluated. The number of monthly hospitalizations was given as median and minimum maximum. In addition, the monthly hospitalization rate was calculated by dividing the number of monthly hospitalizations in the older adults by the resident older adults in each year (i.e., 2016, 2017, and 2018)[13], in the municipalities belonging to the health Regions evaluated. The rates were expressed per 1,000 person-months. Next, the ratio between hospitalization rates for older adults and adults aged 40-59 was obtained[14]. Finally, the cumulative incidence of hospitalization in the 2016-2018 period was calculated using the total number of hospitalizations in the older adults divided by the older adult residents in that period, in the municipalities belonging to the health Regions evaluated[14].

The factors associated with the number of hospitalizations were investigated using a generalized linear model. Prevalence ratios (PR) and their respective 95% confidence intervals (95% CI) were estimated using negative binomial regression with a logarithmic link function. This regression model was adopted because there was significant dispersion in the data set, indicated by the presence of extreme values in the count of hospitalizations and the large discrepancy between the mean and variance of the distribution[15,16]. The dependent variable was the number of hospitalizations among older adults between 2016 and 2018. The independent variables were operationalized as categorical variables, as follows: sociodemographic: gender (female/male), age group (60-69/70-79/≥80 years) and self-reported race/color (non-white/white); clinical: nature of service (elective/urgent); complexity of procedure (medium/high), type of bed (clinical/surgical), admission to intensive care unit - ICU (yes/no), days spent in hospital (0-14/≥15 days) and death (yes/no).

The association between the dependent and independent variables was assessed using univariate models, obtaining the crude PR. The independent variables that were associated

with the dependent variable (Wald test with p-value <0.20) were inserted into a multivariate model, in which the adjusted PRs were obtained. The estimates of the regression coefficients of the univariate and multivariate models were obtained using the maximum likelihood method[17]. The quality of the fit of the multivariate model was assessed by the chi-square test of the likelihood ratio, Akaike's criterion corrected for the sample, and by graphical analysis of the dispersion of the residuals (standardized deviance residuals vs. predicted values of the response mean).

The cost of hospitalizations was obtained in local currency (Brazilian reais - R$) and included the value per hospital service (e.g., daily rate, food, hygiene, and medication), professional service (i.e., doctor and dental surgeon) and total (i.e., hospital service and professional service)[8]. The total value was compared about the variables year of hospitalization (2016 vs 2017 vs 2018), Health Region (Juiz de Fora vs Ubá vs Leopoldina), and age group (60-69 vs 70-79 vs ≥80 years), using the Kruskal-Wallis test, and the variable gender (female vs male), using the Mann-Whitney test. When a significant difference was detected in the Kruskal-Wallis test, the Mann-Whitney post-hoc test was used for multiple comparisons. The cost data showed a non-normal distribution, which was evidenced by a graphical inspection of the observed and expected values and corroborated by the Shapiro-Wilk test. The cost per total value, according to the "procedure subgroup" of the SIH/SUS and the ICSAP, was provided in currency (R$) and percentage (%).

Except for the association analysis of the univariate models, a p-value of <0.05 was inferred as statistically significant for all other statistical analyses. The SPSS program version 22 (SPSS Inc., IBM Corporation, Chicago, Illinois, USA) was used to analyze the data.

RESULTS

Between January 2016 and December 2018, 113,055 hospital admissions were identified in older adult patients aged ≥60 years, aggregating the number of hospitalizations recorded in 83 municipalities belonging to the Juiz de Fora, Ubá, and Leopoldina Health Regions (Figure 1). This figure corresponded to 35.1% (95% CI=34.9-35.3) of all hospitalizations, including all age groups (n=322,128). According to gender, the frequency of hospitalizations was 31.2% (95% CI=31.0-31.4) in women and 39.7% (95% CI=39.5-40.0) in men.

The total distribution of hospitalizations in absolute numbers remained slightly constant over the three years (2106, n=37,357; 2017, n=39,358; 2018, n=36,340). The same distribution pattern was observed in the number of hospitalizations within each Regional Health Department, i.e. Juiz de Fora (2106, n=17,676; 2017, n=18,780; 2018, n=17,479), Ubá (2106, n=14,783; 2017, n=15,621; 2018, n=14,310) and Leopoldina (2106, n=4,898; 2017, n=4,957; 2018, n=4,533) (Figure 1). The number of hospitalizations was higher in the Juiz de Fora Regional Office compared to the Ubá Regional Office (PR=1.21 [95% CI=1.13-1.29]) and Leopoldina Regional Office (PR=3.75 [95% CI=3.52-3.99]).

The median number of hospitalizations per month in absolute terms was 3,198 (minimum-maximum=1,579-3,693) in older adults, 1,536 (minimum-maximum=769-1,858) in women, and 1,664 (minimum-maximum=810-1,921) in men. The monthly hospitalization rate (per 1,000 person-months) was significantly higher in older adults and men when compared to older women and adults aged 40-59. In both age groups, a sharp decline in the hospitalization rate was observed in November and December 2018 (Figure 2). Removing these last two months from the analysis did not change the result of the rates. The cumulative incidence of hospitalization, considering the resident older adults of the 83

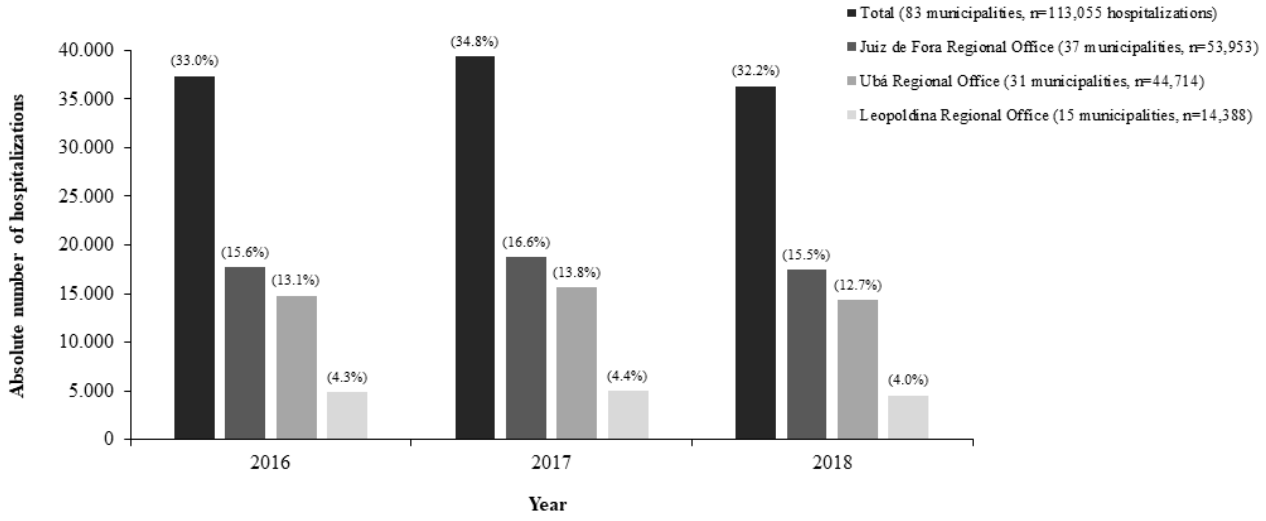

Figure 1: Frequency of hospitalizations in older adults according to year and health region, recorded in 83 municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (n=113,055).

municipalities in the 2016-2018 period, was 144 (95% CI=143-145) per 1,000 older adults, 125 (95% CI=124-126) per 1,000 women and 169 (95% CI=168-170) per 1,000 men.

The frequency of hospitalizations according to diagnosis (ICD-10 Chapters) revealed that the most identified diseases were those of the circulatory system (24.9%), neoplasms (14.9%), diseases of the respiratory system (14.4%), diseases of the digestive system (7.1%) and diseases of the genitourinary system (7.0%). The frequency of hospitalizations according to the SIH/SUS "procedure subgroup" showed that the most performed medical procedures were "clinical treatments" (56.1%), "oncology treatment" (9.0%), "other surgeries" (5.8%), "intermuscular system surgery" (5.1%) and "circulatory system surgery" (4.6%).

The frequency of hospitalizations, according to sociodemographic and clinical variables, was higher in men (51.9%), aged between 60-69 years (42.2%), white race/color (62.6%), emergency care (82.0%), medium complexity procedure (86.9%), clinical bed (71.9%), no ICU stay (81.7%), hospital stay between 0-14 days (89.9%) and no death (88.7%). The univariate analysis showed that the number of hospitalizations was associated ($p<0.20$) with the variables gender, age group, type of care, complexity of the procedure, type of bed, ICU stay, days in hospital, and death (Table 2). The adjusted analysis showed that the factors of male gender (PR=1.52 [95% CI=1.11-2.08]), admission to a surgical bed (PR=1.93 [95% CI=1.05-3.56]), and absence of death (PR=1.94 [95% CI=1.03-3.65]) were positively associated with the number of hospitalizations, while the factor days spent in hospital ≥15 days (PR=0.71 [95% CI=0.54-0.95]) was inversely associated with the number of hospitalizations (Table 3).

The frequency of hospitalizations, according to the ICSAP, was 34.1% (95% CI=33.8-34.4) in the older adults, 34.5% (95% CI=34.1-35.9) in women and 33.4% (95% CI=33.1-33.8) in men. The most frequently identified health conditions were heart failure (21.5%), cerebrovascular diseases (15.6%), angina (13.6%), lung diseases (8.7%) and diabetes mellitus (6.8%).

The cost of hospitalizations by total value in the older adults was R$220.8 million. This value corresponded to 44.6% (95% CI=44.6-44.7) of the overall cost, including all age groups. The cost per total value was significantly higher in the Juiz de Fora Health Region, in males and the 60-69 age group (Figure 3), with an average of R$ 201,700 per day and R$ 1,953 per hospitalization. There was no significant difference in the cost per total value between the years evaluated. The procedures with the highest cost per total value, according to the SIH/SUS "procedure subgroup", were "clinical treatments" (40.7%), "circulatory system surgery" (16.3%), "other surgeries" (16.1%), "oncology treatment" (5.1%) and "musculoskeletal system surgery" (4.9%). The cost per total value due to ICSAPs was R$64.5 million and corresponded to 29.2% (95% CI=29.2-29.2) of the total cost. The costs of hospitalizations in older adults by the value of hospital service and professional service maintained the same distribution behavior as the cost per total value (data not shown).

The frequency of hospital deaths was 11.3% (95% CI=11.1-11.5) in older adults, 11.2% (95% CI=10.9-11.4) in women, and 11.3% (95% CI=11.1-11.6) in men. The most common causes of death (ICD-10 Chapters) were diseases of the respiratory system (21.5%), diseases of the circulatory system (20.4%), neoplasms (16.9%), some infectious and parasitic diseases (14.0%) and diseases of the genitourinary system (5.8%). The hospital mortality rate in the 2016-2018 period was 12.7% (95% CI=12.5-12.9) in older adults, 12.7% (95% CI=12.4-13.0) in women and 12.8% (95% CI=12.5-13.1) in men.

DISCUSSION

This study showed that hospital admissions among older adults accounted for 35.1% of all hospitalizations recorded in three Health Districts in the Zona da Mata region in the 2016-2018 period. This figure is above the national average (27.0%) when compared with data obtained from recent descriptive studies on

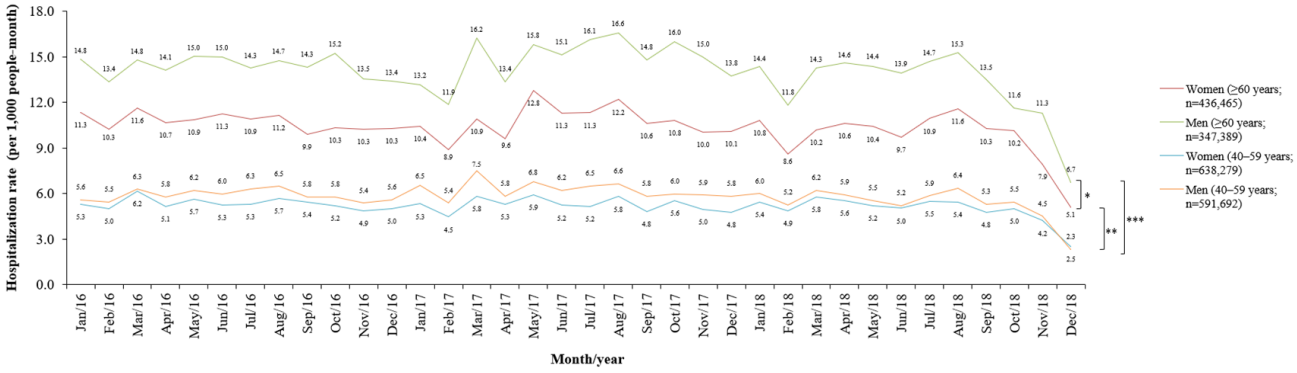

Figure 2: Monthly hospitalization rate in older adults (≥60 years) and adults (40-59 years), registered in 83 municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (n=2,013,825). The rate ratios were: *older men vs. older women=1.35 (95% CI=1.27-1.43); **older women vs. adult women=2.01 (95% CI=1.89-2.13); ***older men vs. adult men=2.42 (95% CI=2.26-2.58).

Table 2: Frequency of hospitalizations in older adults and crude prevalence ratio, according to sociodemographic and clinical variables, recorded in 83 municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (n=113,055).

Variable	Frequency % (95% CI)	PR_{bruta} (95% CI)	p
Sex			
Female	48.1 (47.8–48.4)	1	
Male	51.9 (51.6–52.2)	1.33 (1.09–1.62)	0.005*
Age group			
60-69 years	42.2 (41.9–42.5)	1	
70-79 years	31.8 (31.5–32.1)	0.91 (0.72–1.15)	0.430
≥80 years	26.0 (25.8–26.3)	0.74 (0.58–0.95)	0.018*
Self-reported race/color †			
Not white ‡	37.4 (37.1–37.7)	1	
White	62.6 (62.3–62.9)	1.13 (0.92–1.38)	0.245
Service Character			
Elective	18.0 (17.8–18.2)	1	
Urgency	82.0 (81.8–82.2)	1.74 (1.36–2.24)	<0.001*
Complexity of the procedure			
Average	86.9 (86.7–87.1)	1	
High	13.1 (12.9–13.3)	0.38 (0.29–0.49)	<0.001*
Type of bed			
Clinical	71.9 (71.6–72.1)	1	
Surgical	28.1 (27.9–28.4)	0.83 (0.66–1.04)	0.106*
ICU admission			
Yes	18.3 (18.1–18.5)	1	
No	81.7 (81.5–82.0)	1.65 (1.29–2.11)	<0.001*
Days hospitalized			
0-14 days	89.9 (89.7–90.1)	1	
≥15 days	10.1 (9.9–10.3)	0.67 (0.48–0.93)	0.018*
Death			
Yes	11.3 (11.1–11.5)	1	
No	88.7 (88.5–89.9)	2.99 (2.27–3.94)	<0.001*

95% CI=95% confidence interval; PR=prevalence ratio; ICU=intensive care unit.
*p<0.20.
† The analysis was conducted excluding data with no information on self-reported race/color (n=15,539).
‡ Black (n=12,181), brown (n=23,388), yellow (n=918) and Indigenous (n=5).

hospital admissions in older adults Brazilians[18], including the municipality of Belo Horizonte[19]. This difference can be explained by the influence of sociodemographic characteristics on the profile of current hospitalizations by age group, given that the Zona da Mata mesoregion has a higher proportion of older adults (17.5%) compared to the national estimate (16.1%)[18].

The vast majority of hospitalizations resulted from emergency care, which can be explained by the decompensation of a chronic disease or acute conditions complicated by the simultaneous presence of morbidities that commonly affect older adults (e.g. hypertension, diabetes, and cancer)[2,4]. In addition, medium-complexity procedures, hospitalization in a clinical bed, non-use of an ICU, and length of hospital stay of less than 15 days were variables significantly associated with the number of hospitalizations, which corroborates the findings of a previous study using data from the southeastern region of Brazil[19,20].

The frequency of hospitalizations predominated in the 60-69 age group. This age group, which marks the transition from middle age to old age, as well as encompassing a larger number of individuals, increases the risk of developing health conditions and their negative outcomes4. Similar frequencies of hospitalizations in this age group were previously observed in the studies by Castro et al.[21] and Pagotto et al.[22] in older adults in the states of Paraná (43.0%) and Goiás (51.1%), respectively.

According to gender, older adult men had a significantly higher number of hospitalizations compared to older adult women and

Table 3: Prevalence ratio adjusted according to sociodemographic and clinical variables, referring to hospitalizations in the older adults, registered in 83 municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (n=113,055).

Variable	$RP_{adjusted}$ (IC 95%)	p
Sex		
Female	1	
Male	1.52 (1.11–2.08)	0.009*
Age group		
60-69 years	1	
70-79 years	1.26 (0.93–1.69)	0.132
≥80 years	0.96 (0.47–1.97)	0.909
Self-reported race/color †		
Not white ‡	1	
White	1.09 (0.44–2.70)	0.852
Service Character		
Elective	1	
Urgency	0.58 (0.29–1.16)	0.121
Complexity of the procedure		
Average	1	
High	1.93 (1.05–3.56)	0.035*
Type of bed		
Clinical	1	
Surgical	0.93 (0.39–2.24)	0.876
ICU admission		
Yes	1	
No	0.71 (0.54–0.95)	0.020*
Days hospitalized		
0-14 days	1	
≥15 days	1.94 (1.03–3.65)	0.041*

95% CI=95% confidence interval; PR=prevalence ratio; ICU=intensive care unit . Multivariate model adjusted for gender, age group, type of care, the complexity of the procedure, type of bed, intensive care unit stay, days spent in hospital, and death.
Quality of the final model: likelihood ratio=57.590 (p<0.001); Akaike criterion=1620.335; dispersion of residuals between -1.00-1.00.
*p<0.05.

middle-aged adult men, a higher risk of hospitalization, and higher hospital costs. The male culture of seeking medical attention late and the undervaluing of signs/symptoms partially explain this difference between the sexes[20,21,23]. In this scenario, the National Men's Health Care Policy (Política Nacional de Atenção à Saúde do Homem - PNAISH) has become a fundamental strategy in changing the attitude of the older adult male population and health professionals towards men's health care, with the potential to reduce the worsening of pre-existing conditions and the incidence of new diseases, which also ends up reducing the number of hospitalizations in this population[23].

Diseases of the circulatory system and neoplasms stood out as the main causes of hospitalization in older adults. This is a trend that has already been seen in various regions of Brazil, but which is not homogeneous, as can be seen in a study of hospitalizations among older adults in the city of Goiânia between 2008 and 2015[24], and a 10-year historical series (2005-2015) with data from Brazil's five geographic regions[25]. Conditions such as coronary artery disease acute myocardial infarction, and breast and lung cancers, are increasingly showing an emerging incidence pattern in the older adult population, not only in Brazil[5] but also in the United States and Europe[26,27], which justifies the high burden of these morbidities on the epidemiological distribution of hospitalizations.

ICSAPs accounted for one in three hospitalizations in older adults, similar to what was found in other regions of Brazil between 2008 and 2016 (31.0-41.0%)[28,29]. Among the main causes of ICSAP are heart failure and cerebrovascular diseases, serious conditions that often accompany the aging process, evolve unfavorably and increase the demand for hospitalizations[4,5,26,28]. Entre as principais causas de ICSAP estão a insuficiência cardíaca e as doenças cerebrovasculares, condições graves que frequentemente acompanham o processo de envelhecimento, evoluem de forma desfavorável e aumentam a demanda por hospitalizações[5,18]. In addition, hospitalizations in older adults due to diseases of the circulatory system generally require the attention of specialists, greater technological complexity, and longer care, which potentially contributes to the high consumption of hospital resources in this population[30].

The median coverage of the Family Health Strategy (Estratégia de Saúde da Família - ESF) in the mesoregion and in the period on which this study was based was 78.0%, ranging from 58.0% in the Juiz de Fora Health Region to 91.8% in the Leopoldina Health Region[31]. This wide variation may be related to the significant frequency of ICSAPs since the Juiz de Fora Health Region had the highest number of hospitalizations among the health Regions evaluated. As has been reported in previous studies, greater FHS coverage implies a lower frequency of ICSAPs[28,32]. As the main causes of hospitalization in older adults belong to the group of chronic non-communicable diseases, this emphasizes the need for effective primary care in health promotion and disease prevention, focused on encouraging healthy lifestyle habits, controlling cardiovascular risks, and screening for suspicious signs/symptoms for early diagnosis and intervention[3].

About the frequency of hospital deaths and the hospital mortality rate, the estimates were consistent with those of other recent studies of the Brazilian older adult population. Paz et al.[33] and Parente et al.34 found a frequency of hospital deaths ranging from 9.7 to 12.9% in the period 2015-2018. Dias and Barros[5] and Cordeiro and Martins[20] found a hospital mortality rate ranging from 11.1 to 14.4% between 2011 and 2015. Diseases of the circulatory and respiratory systems were the main causes of death, a trend that has already been shown both nationally and internationally[5,26,27]. In particular, Brazil is among the Portuguese-speaking countries

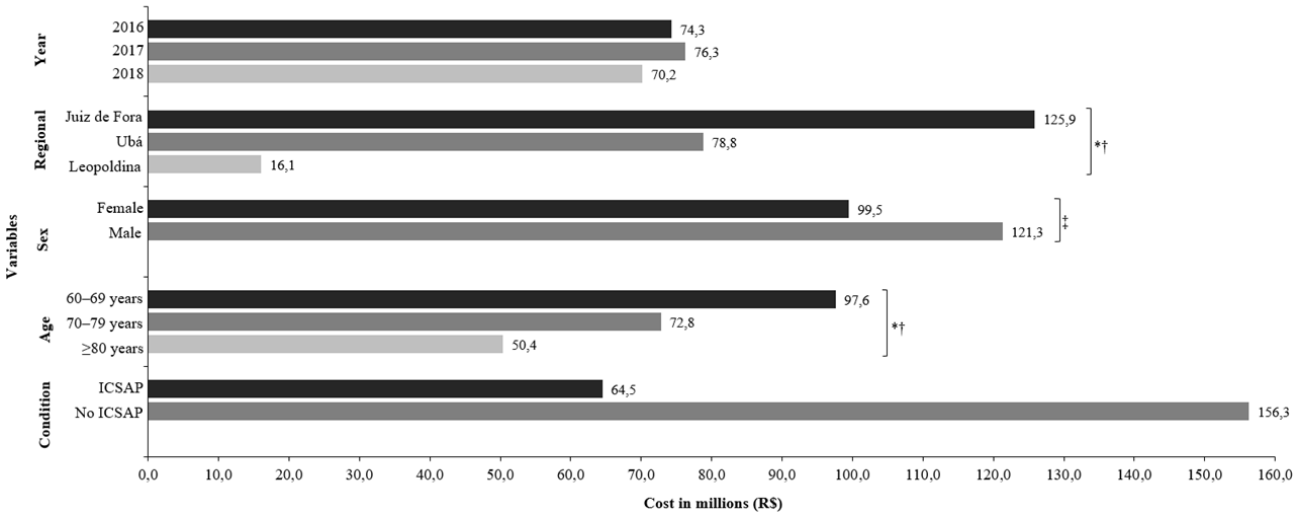

Figure 3: Cost of hospitalizations in older adults by total value, recorded in 83 municipalities belonging to the Health Regions of Juiz de Fora, Ubá and Leopoldina, Zona da Mata, Minas Gerais, Brazil, 2016-2018 (R$ 220.8 million). *Kruskal-Wallis test: Juiz de Fora vs Ubá vs Leopoldina and 60-69 vs 70-79 vs ≥80 ($p<0.001$); † Mann-Whitney post-hoc test: Juiz de Fora vs Ubá, Juiz de Fora vs Leopoldina, Ubá vs Leopoldina, 60-69 vs 70-79, 60-69 vs ≥80 and 70-79 vs ≥80 ($p<0.001$); ‡ Mann-Whitney test: female vs male ($p<0.001$).

with the highest mortality from cardiovascular diseases, according to a recent study by the Global Burden of Disease[35]. The adoption of preventive measures as well as the early identification and treatment of cardiovascular conditions should be constantly encouraged to reduce this high mortality burden in the older adult population. On the other hand, diseases of the respiratory system have been responsible for a growing number of deaths in older adults, mainly due to increased life expectancy and the presence of chronic respiratory diseases[5,21,32]. Added to this is the fact that older adults are more susceptible to respiratory tract infections such as influenza, pneumonia, and tuberculosis, as a result of their declining immune capacities[36].

Finally, the use of a secondary database imposes some limitations on this study. Misunderstandings when filling in the HAA, the possibility of more than one HAA being issued for the same patient (e.g., readmissions or transfers) and missing and/or incomplete data are all dilemmas worth mentioning. It should also be mentioned that the study was limited to analyzing data from the public health system for a brief period (three years) and did not include hospitalizations from the private system. Despite this, the wide availability of information from the SIH-SUS, which covers up to 80.0% of hospitalizations throughout Brazil[7], the need to fill out medical records correctly to authorize payments and the ease with which data can be obtained and handled are factors that strongly encourage the use of this database for epidemiological investigations.

Conclusion

The prevalence and incidence of hospitalizations among older adults in the Zona da Mata are high. The high burden of hospitalizations related to males, cardiovascular diseases, ICSAPs, and the enormous financial cost of hospitalizations, the total value of which was more than R$200,000 per day, is noteworthy. These findings highlight the need to strengthen primary health care policies and actions focused on the prevention and clinical management of morbidities, especially cardiovascular diseases, to reduce avoidable hospitalizations and the excessive costs associated with hospitalizations among older adults in this region of Minas Gerais.

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