● **Original article**

TRENDS IN HOSPITALIZATION FOR DIABETES MELLITUS AND SYSTEMIC ARTERIAL HYPERTENSION IN THE ELDERLY

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ABSTRACT: The present study aimed to assess trend in hospitalizationfor hypertension and diabetes among elderly individuals from the State of Paraná, in the 2001-2013 period. Ecological time-series study based on secondary data from the Information System of Brazil's Unified Health System (SUS) concerning the rates of hospitalization for hypertension and diabetes in the elderly, collected in April 2014and analyzed using descriptive statistics and polynomial regression.There were 59,481 hospitalizations for diabetes and 39,637for hypertension. The trend in hospitalization for diabetes was increasing among men (r2=0.85; p<0.001), at age groups 60-69 years and over 80 years (r2=0.66; p<0.042 and r2=0.69; p<0.002 respectively).Regarding hypertension, there was a decreasing trend for men and women (r2=0.91; p<0.001 andr2=0.82; p<0.001 respectively). The results were similar to those from other studies, stressing the need for information systems as a source for the planning of health actions targeted to elderly individuals.
DESCRIPTORS: Elderly; Chronic disease; Hospitalization; Hypertension; Diabetes Mellitus.

TENDÊNCIA DAS INTERNAÇÕES POR DIABETES MELLITUS E HIPERTENSÃO ARTERIAL SISTÊMICA EM IDOSOS

RESUMO: Objetivou-se analisar a tendência temporal das internações por hipertensão arterial e diabetes entre idosos residentes no Estado do Paraná, no período de 2001 a 2013. Estudo ecológico, de séries temporais com dados secundários do Sistema de Informação do Sistema Único de Saúde, referentes às taxas de hospitalizações por hipertensão e diabetes em idosos, coletados em abril de 2014 e analisados segundo estatística descritiva e regressão polinomial. Foram registradas 59.481 internações por diabetes e 39.637 por hipertensão. A tendência de internação por diabetes foi crescente para homens (r2=0,85; p<0,001), nas faixas etárias de 60 a 69 e maiores de 80 anos (r2=0,66; p<0,042 e r2=0,69; p<0,002 respectivamente). Para hipertensão, a tendência foi decrescente entre mulheres e homens (r2=0,91; p<0,001 e r2=0,82; p<0,001 respectivamente). Os resultados mostraram-se similares a outros estudos, reforçando a necessidade do uso de sistemas de informação como fonte no planejamento das ações em saúde voltadas a população idosa.
DESCRITORES: Idoso; Doença crônica; Hospitalização; Hipertensão; Diabetes Mellitus.

TENDENCIA DE LAS INTERNACIONES POR DIABETES MELLITUS Y HIPERTENSIÓN ARTERIAL SISTÉMICA EN ANCIANOS

RESUMEN: Estudio cuya finalidad fue analizar la tendencia temporal de las internaciones por hipertensión arterial y diabetes entre ancianos que viven en Estado de Paraná, en el periodo de 2001 a 2013. Fue un estudio ecológico, de series temporales con datos secundários, obtenidos en abril de 2014, por el Sistema de Información del Sistema Único de Salud, los cuales se referían a las tajas de hospitalización por hipertensión y diabetes en ancianos. Las informaciones fueron analizadas de acuerdo a estadística descriptiva y regresión polinomial. Se registraron 59.481 internaciones por diabetes y 39.637 por hipertensión. La tendencia de internación por diabetes fue creciente para hombres (r2=0,85; p<0,001), en edades de 60 a 69 y mayores de 80 años (r2=0,66; p<0,042 y r2=0,69; p<0,002 respectivamente). Para hipertensión, la tendencia fue decreciente entre mujeres y hombres (r2=0,91; p<0,001 y r2=0,82; p<0,001 respectivamente). Los resultados fueron similares a los de otros estudios, destacándose la necesidad del uso de sistemas de información como fuente en el planeamiento de las acciones en salud para la población anciana.
DESCRIPTORES: Anciano; Enfermedad crónica; Hospitalización; Hipertensión; Diabetes Mellitus.

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● INTRODUCTION

Systemic Arterial Hypertension(SAH) and Diabetes Mellitus (DM) are major public health issues in Brazil due to their high prevalence rates and acute and chronic complications.

SAH is one of the most significant cardiovascular risk factors[1], and has high prevalence and low rates of control. According to some studies, the world prevalence of SAHis estimated in one billion individuals, resulting in approximately 7.1 million deaths. In Brazil, its prevalence ranges from 22% to 44% for adults, reaching more than 50% for individuals aged 60-69 years and 75% in individuals aged over 70 years[2].

Data from the Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL), of 2013, showed that the self-reported prevalence of DM in the Brazilian population over 18 years increased from 5.5% to 6.9%, between 2006 and 2013: prevalence was 6.5%in women and 7.2% in men, in 2013[3]. In both genders, the diagnosis of DM is an age-prevalent disease and is more prevalent in individuals aged 45 and above. Also, according to data from VIGITEL, more than one fifth of the population aged 65 or above reported a medical diagnosis of DM [3].

SAH and DM are non-communicable or chronic diseases (NCD) and have become more serious due to the fast demographic transition, and elderly are considered a risk group. The percentage of individuals aged 65 years or over has doubled in the country over the past decades: from 2.7% in 1960 to 5.4 % in 2000, and is estimated to reach 19% in 2050, exceeding the number of young individuals [4]. SAH and DM are, thus, diseases commonto aging adults, and their control has become a challenge to the Public Health System.

Epidemiological studies are essential for the monitoring of SAH and DM, as they aim to design control and prevention measures targeted to early detection of the conditions and better allocation ofhuman and financial resources to ensure proper treatment and control [5].

In addition to providing an outlook of the behavior of these disorders, contributing to their monitoring, analysis of hospitalizations for conditions such as SAH and DM also provide valuable information on the effectiveness of Primary Health Care (PHC) actions, which are responsible for early detection of disorders, aiming to prevent complications and hospitalizations. Therefore, hospitalizations have been used as an indicator of the quality of PHC, since when appropriate primary care is provided, hospitalizations for PHC-sensitive conditions can be avoided[6].

The monitoring of hospitalizations for SAH and DM are hence a key component in the planning of healthcare actions by primary health care managers and professionals. Thus, the present study aimed to analyze the trend of hospitalizations for SAH and DM over time among elderly individuals from the state of Paraná, Brazil.

● METHOD

Ecological time-series study that analyzed the trend of hospitalizations for SAH and DM among elderly individuals from the State of Paraná, Brazil, in the 2001-2013 period.The reason for temporal delimitation of the study is the implementation of the Plan for Reorganization of Care to Hypertension and DM by Brazil's Ministry or Health and State and Municipal Departments of Health, in 2001, as a strategy to increase prevention, diagnosis, treatment and control of the referred chronic conditions.

Figure 1 shows the data collection diagram. The records of hospital admissions were obtained from the Hospital Information System of Brazil's Unified Health System (SIH/SUS), based on Authorizations for Hospitalizations (AIHs) compiled at theSIH-SUS, and the estimates of the elderly population living in the state were obtained at the Brazilian Institute of Geography and Statistics (IBGE). The data were collected in April 2014, according to gender and age group and classified into three age groups: 60-69 years; 70-79 years and 80 years and over.

Codes E10, E11, E12, E13 and E14 were adopted for hospitalizations for DMand codes I10 and I11 of the classification provided by the 10th edition of the International Classification of Diseases (ICD)
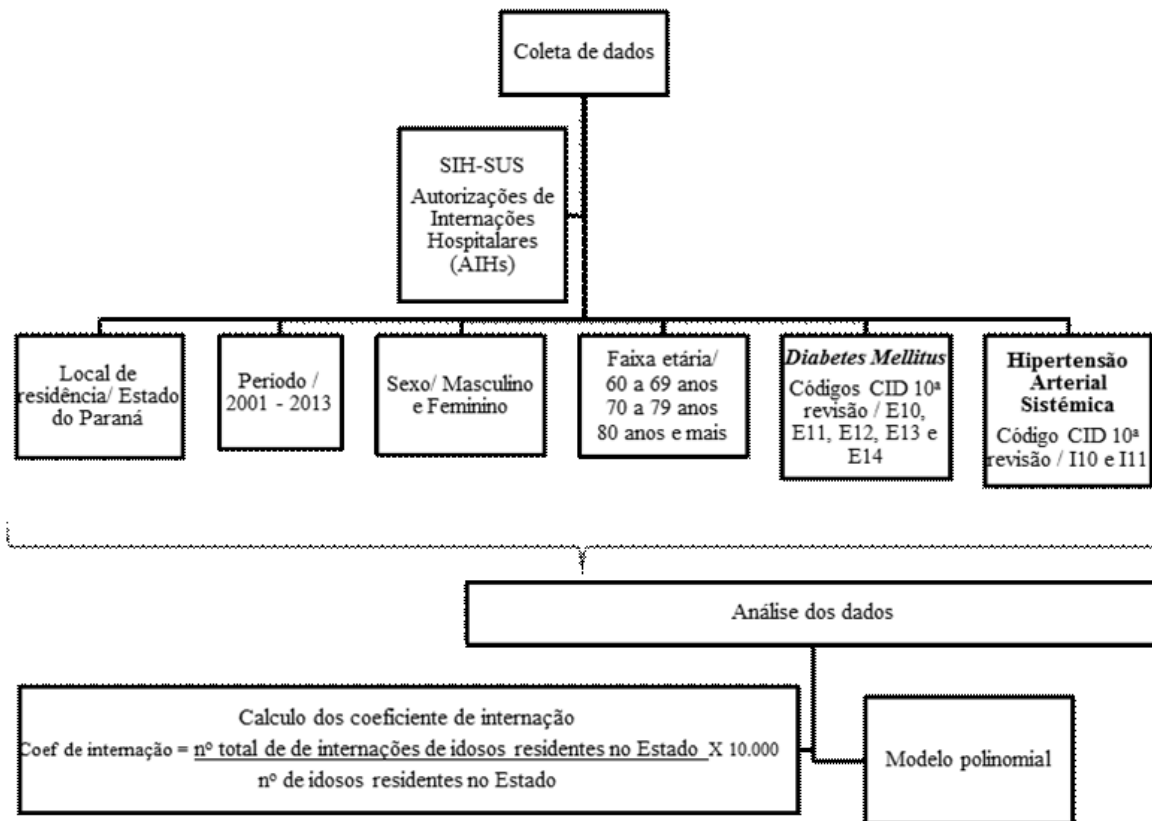
Figure 1 – Diagram of data collection and analysis. Maringá, PR, Brazil, 2014

was used for HAS. The coefficients of hospitalization were calculated by dividingthe total number of hospitalizations of elderly individuals living in the State by the number of elderly individuals living in the State, and then by multiplying the number obtained by 10,000, according to gender and age group, for the study period.

The trend in hospitalizations for SAH and DM was analyzedby means of diagrams of dispersion displaying the relationship betweenthecoefficients of hospitalization and calendar years of schooling for the selection of the order of an approximate polynomial model for analysis[7].

Polynomial model was used in the analysis of regression trends wherethe rates of hospitalization for DM and SAH were considered dependent variables (Y) and calendar years of schooling as an independent variable (X). To avoid autocorrelation between the terms of the regression equation, the variable year was transformed into the variable centralized-year (X minus midpoint of the historic series) [7].

The coefficient of determination for estimated models (r2) was considered as precision measurement. Adherence of data to normal distribution was verified by Kolmogorov-Smirnov test, and all the series had normal distribution. Residual analysis confirmed homoscedasticity of the model [7].

First, a simple linear regression model was tested ($Y = \beta_0 + \beta_1 X$) followed by a linear regression model with a second variable($Y = \beta_0 + \beta_1 X + \beta_2 X$), and a third variable ($Y = \beta_0 + \beta_1 X + \beta_2 X + \beta_3 X$). When two models were similar from a statistical point of view, the simplest model, i.e., with lower order terms was selected. A trend was considered significant if thep value was <0.05. In these models, β_0 is the average annual coefficient, β_1, the coefficient of linear effect (speed) and β_2,the coefficient of quadratic effect (acceleration). The year of 2007 was considered as the midpoint of the historical series [7].

The calculations of hospitalization rates and historical series were performed with Microsoft Office Excel 2007 spreadsheets, and trend analyzes were performed with SPSS software (version 18.0).

Since secondary data available as public domainwas used in this study, and considering the privacy and confidentiality of information associated to human subjects, the present study is exempt from appreciation and approval by the Research Ethics Committee.

● RESULTS

In the State of Paraná, in the 2001-2013 period, there were 117,428 hospitalizations for DM and hypertension, as follows: 59,623 hospitalizations for DM and 57,806 for hypertension in individuals over 60 years of age. Classification according to gender showed 21,663 hospitalizations of men and 37,960 hospitalizations of women for DM, and 23,615 hospitalizations for hypertension of men and 34,190 of women.

There was a decline in the rates of hospitalization for diabetes in the elderly female population living in the state of Paraná and increase among the male population, for the age groups 60-69 years and 80 years and over (Figures 2 and 3).

There was a decreasing trend in hospitalization rates for DM for women of 0.787 hospitalizations per 10,000 inhabitants/year (p<0.011). For men, in contrast, there was an average annual increase of 0.776 hospitalizations per year. The trends according to age groups showed that, for both genders, the greater the longevity of the age group, the higher the annual increase in hospitalization rates. Among women, the hospitalization rate remained stable in the age group of 80 years and over. For men, in turn, hospitalization rates for DM increased in the age groups 60-69 years and 80 years and over (Table 1).
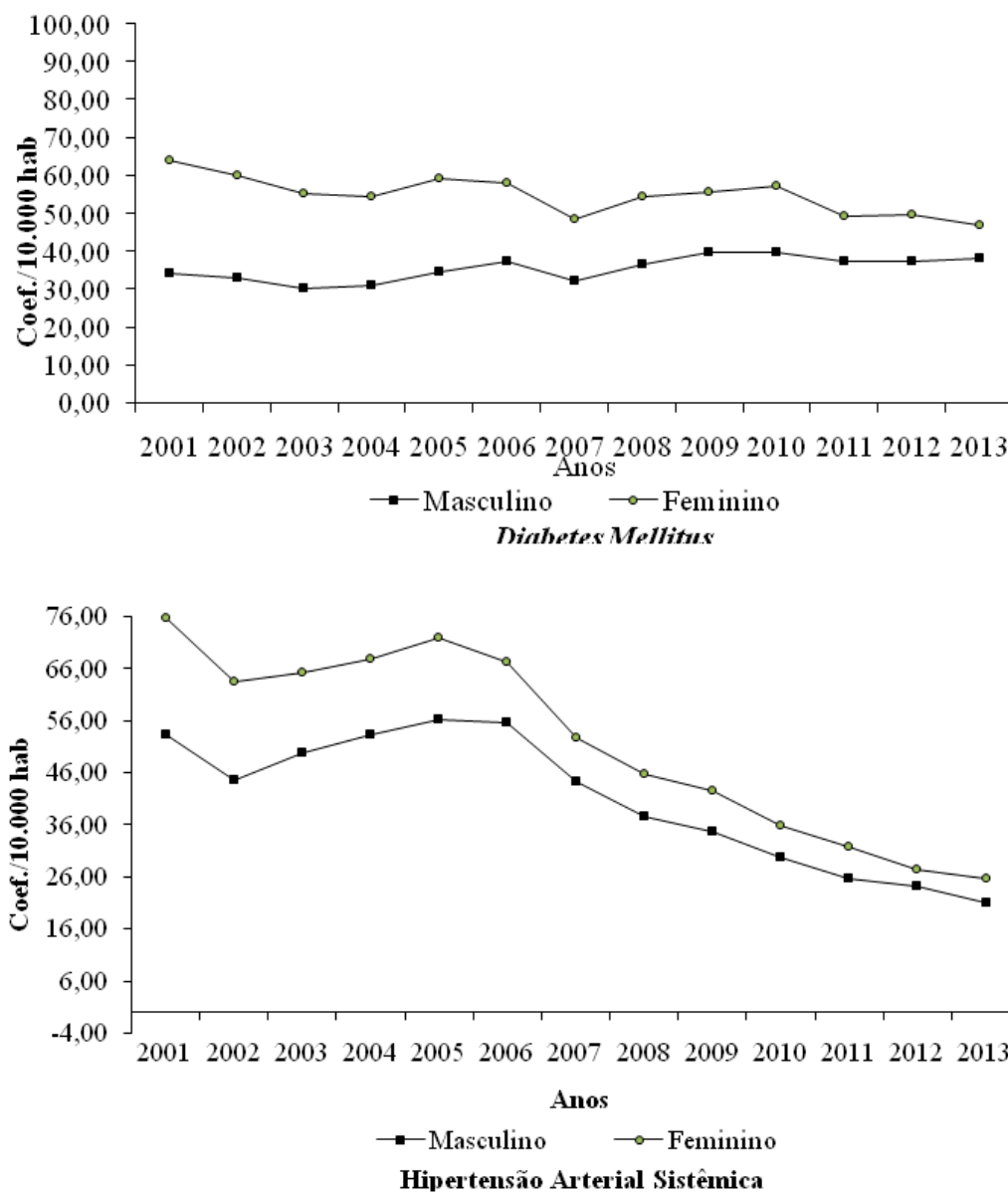

Figure 2 – Time series of hospitalization rates (per 10,000 inhabitants) for Diabetes Mellitus and Systemic Arterial Hypertension, according to gender. Paraná, 2001- 2013. Maringá, PR, Brazil, 2014
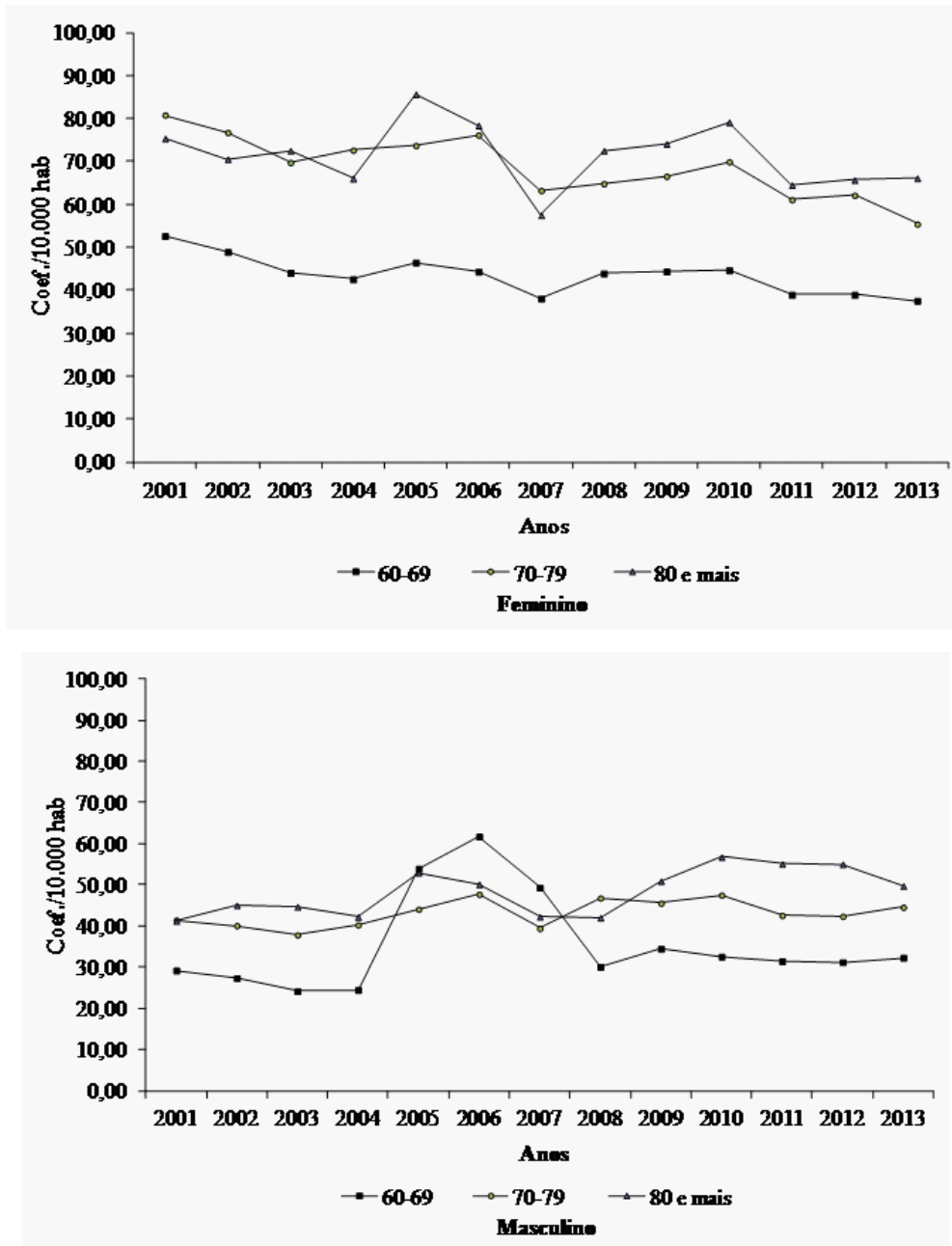
Figure 3 – Time series of hospitalization rates (per 10,000 inhabitants) for Diabetes Mellitus, according to gender and age group. Paraná, 2001- 2013. Maringá, PR, Brazil, 2014

The rates of hospitalization for SAH decreased both for women and men, in both age groups, during the study period (Figures 2 and 4). For women, there was an annual decrease of 4.569 hospitalizations per each 10,000 inhabitants, and for men, a decrease of 3,112. The trends in rates of hospitalization for SAH according to gender showed a greater steady decline for the female population. In both genders, individuals aged 80 years and over have a significant average annual rate of hospitalizations ($\beta 0$) (Table 2).

Table 1 – Trend in hospitalizations for Diabetes Mellitus, according to gender and age group. Paraná, 2001-2013. Maringá, PR, Brazil, 2014

| Gender	Model	r^2	P	Trend
Female				
60- 69 years	$Y=43.335-0.671x$	0.74	0.001	Decreasing
70-79 years	$Y=68.779-1.405x$	0.89	0.0001	Decreasing
80 years and over	$Y=71.724-0.470x$	0.20	0.163	Stable
Total	$Y=88.473-0.787x$	0.77	0.001	Decreasing
Male				
60-69 years	$Y=43.869-2.426x-0.731x^2+0.136x^3$	0.66	0.042	Increasing
70-79 years	$Y=44.638+0.497x-0.139x^2$	0.83	0.001	Decreasing
80 years and over	$Y=48.585+1.065x$	0.69	0.002	Increasing
Total	$Y=35.854+0.776x$	0.85	0.001	Increasing
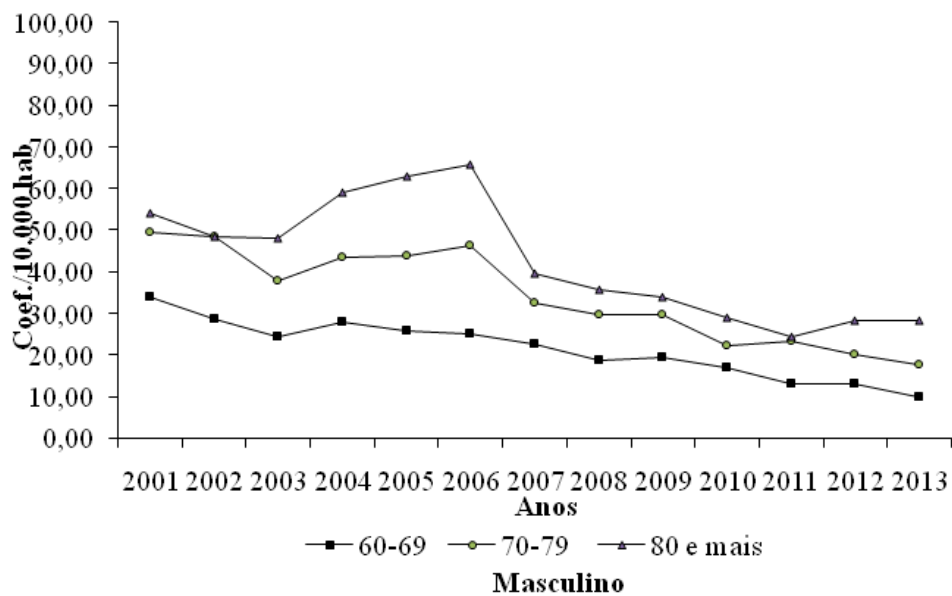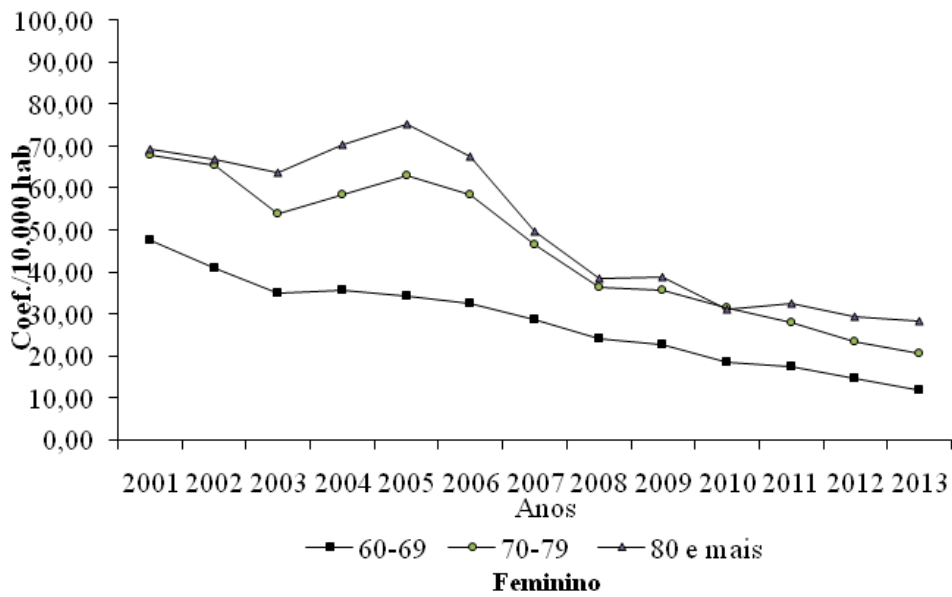
Figure 4 – Time series of hospitalization rates (per 10,000 inhabitants) for Systemic Arterial Hypertension, according to gender and age group. Paraná, 2001-2013. Maringá, PR, Brazil, 2014

Table 2 – Trend in hospitalizations for Systemic Arterial Hypertension, according to gender and age group. Paraná, 2001-2013. Maringá, PR, Brazil, 2014

Gender	Model	r²	P	Trend
Female				
60-69 years	Y=27.827-2.651x	0.99	0.0001	Decreasing
70-79 years	Y=45.458-4.246x	0.94	0.0001	Decreasing
80 years and over	Y=51.332-4.774x	0.88	0.0001	Decreasing
Total	Y=52.278-4.569x	0.91	0.001	Decreasing
Male				
60-69 years	Y=21.475-1.683x	0.97	0.001	Decreasing
70 -79 years	Y=34.267-2.775x	0.94	0.001	Decreasing
80 years and over	Y=43.401-3.429x	0.75	0.001	Decreasing
Total	Y=41.527-3.112x	0.82	0.001	Decreasing

● **DISCUSSION**

The present study showed different trends in hospitalizations for SAH and DM, according to gender and age group, in the state of Paraná, in the 2001- 2013 period. For women, there was a decrease in the hospitalization trend both for SAH and DM, at all age groups. Such decrease can be related to the fact that womenseek primary health services more regularly than men, and also show greater adherence to drug treatment, improving prevention care and health promotion [1].

An increasing trend in hospitalizations for DM was observed among men, specifically at age groups 60-69 years and 80 years and over. One explanation concerns the fact that men are less likely to seek health services targeted to health promotionand disease prevention[9]. Therefore, when men experience serious disorders they seek hospital care, being referred to hospital facilities of high complexity [10].

The adoption of habits such as drinking and smoking,lack of physical activity and unhealthy diets added to late search for medical assistance[10] can also contribute to high rates of hospitalization for DM and lower life expectancy of men compared to women. This can be relate to the higher annual increase in hospitalization rates among women after 80 years of age, both for DM and SAH.

Considering trends in hospitalizations for diabetes according to age range, it can be seen that the greater the longevity of the age group, the higher the annual increase in hospitalization rates.Similar results were obtained in a study conducted in the state of Ceará, from 2001 to 2012 with adult and elderly individuals. This can be explained by the physiological changes related to aging, or else, can result from complications related to the duration of the disease [11].

Considering the rates of hospitalization for SAH,a decreasing trend was observed in all age groups and in both genders. Two studies, the first one related to hospitalizations for PHC sensitive conditions at SUS conducted in the 1998-2009 period [12], and the second one related to hospitalizations for essential arterial hypertension in the 2008-2012 period show a decrease in hospitalizations for hypertension in the studied periods, corroborating the results of the present study [13].

The decrease in hospitalizations for SAH in Paraná can be related to easier access to effective care provided, on a timely basis at the PHC [14], which leads to improvement of preventive care, reducing the rate of hospitalizations. Therefore, considering the increase in the population monitored and treated at the PHC, the rates of hospitalization for SAH tend to decrease [15].

Greater and more effective monitoring of blood pressure, wide availability of free or low-cost drugs and extensive financial incentivesto programs for the controlof hypertension to be implemented by the municipalities can also have a positive impact on the reduction of hospitalizations for SAH. Moreover, other diseases with hypertension as a risk factor (e.g. CVA) can be reduced by these measures in PHC[16].

Despite the decreasing trend in hospitalizations, national and international studies report increase in the prevalence of SAH for all age groups [17-19]. Poor diet, lack of physical activity, smoking, obesity, excess salt and alcohol consumptionare directly related to such increase and high prevalence of SAH worldwide[2].

According to a study carried out by VIGITEL in 2013, the average self-reported prevalence of SAH in the population over 18 years was 24.1%, as follows: 26.3% among women and 21.5% among men. The frequency of SAH increased with aging reachingapproximately 60.4% for the age group of 65 years or over[3]. This was observed in the present study where the average annual coefficient (β0) tended to increase in the older age groups.

Therefore, monitoring and control of SAH and DM by Primary Care services are needed, since these are important measures to control or prevent the worsening of these diseasesand the onset of complications, such as cardiovascular diseases, hospitalizations and mortality [5].

One limitation in the analysis of the results is associated with the data source used (the SIH/SUS: in addition to considering hospitalization as one observation unit, and thus the same individual can be hospitalized more than once, only hospital admissions under the SUS are considered, excluding the individuals who have health insurance. Also, a recent literature review on the methods used in the assessment of information systems reveals inconsistencies in SIH/SUS databases. However, it is believed that the impactof errors in the estimates of trends decreases over time [20].

Another limitation of the present study is that only the primary diagnosis of SIH/SUS is referred. Estimates based exclusively on the primary diagnosis do not allow determining the magnitude of the impact of DM and SAH on Brazilian public health, since both conditions are risk factors for several diseases.

● **CONCLUSION**

There was a greater number of hospitalizations of women for both DM and SAH compared to men. However, there was a decreasing trend in hospitalization rates among women, in contrast with the increasing trend in hospitalization rates for DM among men, in the study period. Concerning SAH, the trends in hospitalization were decreasing for both genders and all age groups.

The results obtained are similar to those obtained in other Brazilian studies, reinforcing the importance of using information systems as source for the planning of health actions targeted to the elderly population.

Further studies that provide a more accurate assessment of the magnitude and impact of DM and SAH on Brazilian public health, not exclusively based on primary diagnosis, and which consider these conditions as risk factors, are needed to contribute to the improvement of preventive health actions.

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