

# Trend in hospitalizations for diabetes *mellitus*: implications for health care

Tendência de hospitalizações por diabetes *mellitus*:  
implicações para o cuidado em saúde

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## Abstract

**Objective:** To analyze the trend in hospitalizations for diabetes *mellitus* in a period of 15 years, according to gender and age group.

**Methods:** Descriptive study, with time series data from hospitalization for diabetes *mellitus* in individuals of both genders, aged 20 or more, data obtained in the information system of the unified health system and analyzed according to descriptive statistics and polynomial regression.

**Results:** A total of 117,717 hospitalizations were registered, 61.6% were women. The general trend was stable, although it has been increasing for men ( $r^2=0.83$ ;  $p<0.001$ ) and stable for women. Age group 50 - 59 and older than 80 years ( $r^2=0.78$ ;  $p<0.001$  for both) showed increasing trend for men, while for all ages it was stable or it was declining for women.

**Conclusion:** The trend in hospitalization for diabetes *mellitus* stratified by gender and age was increasing just for men in the age group of 50 - 59 years and older than 80 years.

## Resumo

**Objetivo:** Analisar a tendência de hospitalizações por diabetes *mellitus* em um período de 15 anos, segundo sexo e faixa etária.

**Métodos:** Estudo descritivo, de séries temporais com dados de hospitalização por diabetes *mellitus* em indivíduos de ambos os sexos, com 20 ou mais anos, obtidos no sistema de informações do sistema único de saúde e analisados segundo estatística descritiva e regressão polinomial.

**Resultados:** Foram registradas 117.717 hospitalizações, sendo 61,6% de mulheres. A tendência geral foi de estabilidade, embora tenha sido crescente para os homens ( $r^2=0,83$ ;  $p<0,001$ ) e estável para mulheres. As faixas etárias de 50 a 59 e maiores de 80 anos ( $r^2=0,78$ ;  $p<0,001$  ambos) apresentaram tendência crescente para homens, enquanto para todas as idades houve estabilidade ou em declínio para mulheres.

**Conclusão:** A tendência de hospitalização por diabetes *mellitus* estratificada por sexo e idade, foi crescente apenas para homens entre 50 a 59 anos e maiores de 80 anos.

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## Introduction

Diabetes *Mellitus* is a chronic disease of high prevalence, characterized as cardiovascular and cerebrovascular risk factor. It also represents serious public health problem, due to high rates of hospitalization due to decompensated charts and/or its complications, which demand high social costs to health services.<sup>(1)</sup> Most people with diabetes are living in developing countries, where the increase will be even more significant over the next 19 years, reaching an increase of 69% among adults.<sup>(2)</sup> Among these countries Brazil is one of them, which presents one of the highest rates of all Latin America, with prevalence of 6.0% in 2010 and estimate to reach 7.8% in 2030, reaching more than 12.7 million people with the disease.<sup>(3)</sup>

Despite the availability of effective treatments to prevent or delay acute and chronic complications, diabetes *mellitus* still implies a huge burden to patients and health systems, leading to a further increase in demand for health care.<sup>(4)</sup> Study found that 23.9% of individuals with diabetes *mellitus* have been hospitalized at least once due to disease, increasing from two to six times the likelihood of hospitalization because of its complications.<sup>(5)</sup> It is estimated that, on average, diabetes is responsible for an excess of over 12,000 hospitalizations per 100,000 people per year.<sup>(5)</sup>

These data demonstrate the magnitude and increase of this condition in the profile of morbidity of the population and show the need for qualification of the health care provided. Thus, studies are associating the quality of diabetes management in outpatient level to reduce hospitalizations at emergency services<sup>(6)</sup> and hospitalizations due to diabetes *mellitus* and its complications.<sup>(7)</sup> In this sense the study of evolution of hospitalizations for diabetes *mellitus* may also mean an indicator of effectiveness of outpatient care, as well as interventions implemented.

The qualification of health actions in outpatient level is one of the foundations for the

proper functioning of the health system and consequently to effectiveness of care for people with diabetes because it is considered an outpatient care-sensitive condition, and there are still hospitalizations due to it, classified as preventable.<sup>(8)</sup> Thus, the number of hospitalizations by these conditions may be indicative of the quality of outpatient care with respect to the diseases whose diagnosis and early treatment are effective in preventing complications and consequently hospitalizations.<sup>(9)</sup>

Therefore, this study is justified considering the prognostic and behavior of hospitalizations caused by diabetes *mellitus* throughout a specific period, making it possible to improve health surveillance actions and evaluate the quality and appropriateness of interventions carried out until then. Thus, this study aimed to analyze the trend in hospitalizations for diabetes *mellitus* in a period of 15 years, according to gender and age group.

## Methods

Descriptive study of ecological type, which analyzed the historical series of hospitalizations for diabetes *mellitus* in adults residing in the State of Parana, in the period from 1998 to 2012. We obtained the data in August 2013 in the hospital information system of the Unified Health System (SUS) that brings together approximately 80% of the hospitalizations of the country.

The main diagnosis of hospitalization related to diabetes *mellitus* is encoded according to norms of the international classification of diseases, 10<sup>th</sup> revision chapter IV, on the E10 to E14 category. The variables analyzed were: age, gender and hospitalization rate. The age groups organized were "20-29", "30-39", "40-49", "50-59", "60-69", "70-79" and "≥80" years.

The selected hospitalizations had main diagnosis of diabetes *mellitus* and took the survey authorizations for hospitalization of type 1 and

with data from population estimates, both provided by the Department of Informatics of the Unified Health System of Brazil. Crude rates of hospitalization were calculated by the ratio between the total number of hospitalizations for diabetes *mellitus* of residents of 20 years or more and the population resident in Parana State, in the same year, by gender and age group, multiplied by 10,000.

Trend analysis was performed using the polynomial regression model considering the rates of hospitalization as the dependent variable (Y) and the years as independent variable (X). To avoid collinearity between the terms of the regression equation, the variable was centralized, so 2005 was the midpoint. Scatter diagrams were constructed between the rate of hospitalization and the years, in order to identify the function to express the relationship between them, and with that, the polynomial order and the polynomial regression models were chosen for the analysis. As a measure of accuracy of the models, we used the coefficient of determination ( $r^2$ ). It should be noted that the data showed normal distribution observed by using the Kolmogorov-Smirnov test, and that the residual analysis confirmed the assumption of heteroscedasticity of the models. The trend was considered significant when the estimated model obtained  $p < 0.05$ .

Initially, we tested the simple linear regression model ( $Y = \beta_0 + \beta_1 X$ ) and later, we tested the models of second degree ( $Y = \beta_0 + \beta_1 X + \beta_2 X^2$ ) and third degree ( $Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3$ ). It was considered as the best model that showed the highest statistical significance, greater precision and residual measurement without vices. When two models were similar to the same variable, from the statistical point of view, we opted for the simpler one, attending the principle of parsimony.

The series were softened through moving average centered on three successive averages. The calculations of coefficients of hospitalization and figure, containing the historical series were prepared in Microsoft Excel® spreadsheets, and for trend analysis, the software Statistical Package for the Social Sciences (SPSS) 20.0 was used.

The development of this study attended national and international standards of ethics in research involving human subjects.

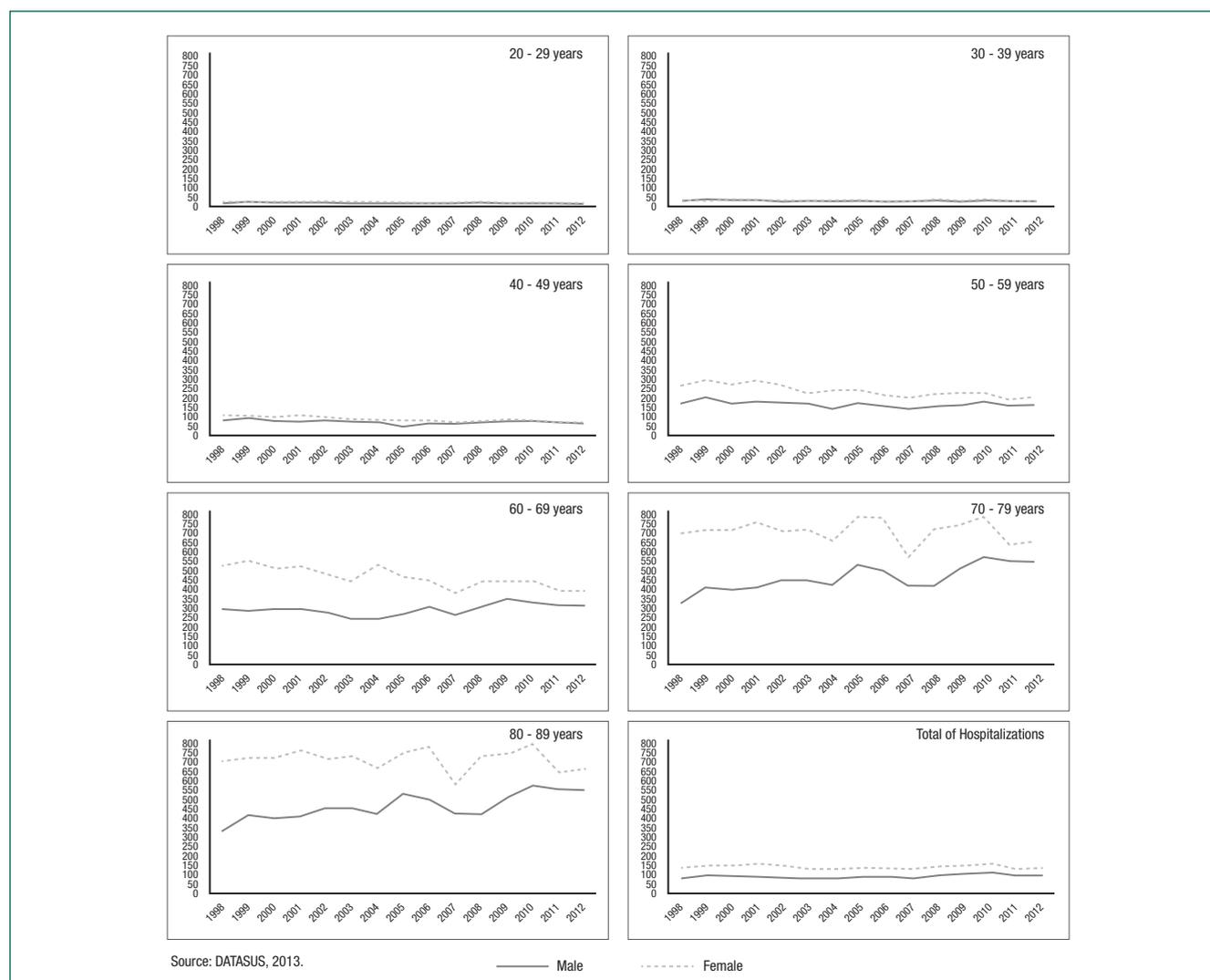
## Results

Over the 15 years analyzed 117,717 hospitalizations for diabetes *mellitus* patients occurred, they were all residents in the State of Parana aged 20 years or more, of both genders, 61.6% were female. With respect to the behavior of the rates, for both genders, there was small oscillations over the years, these being more pronounced for females, and in the older age groups (Figure 1).

It was possible to estimate statistically significant regression models for almost all age groups except 30 - 39 years ( $p = 0.271$ ), 80 years or more ( $p = 0.571$ ), and in the total of hospitalizations for females ( $p = 0.360$ ); as well as those aged 40 - 49 years ( $p = 0.084$ ) and 70 - 79 years ( $p = 0.081$ ) for males, in addition to the overall total of hospitalization ( $p = 0.360$ ), which proved to be stable during the period.

It was identified, for both genders, that the greater the age, the greater the average coefficient of the period ( $\beta_0$ ), reaching at double another age group among men, and tripling among women, especially from the 40 years. This coefficient was also higher for women in all age groups, reflecting the higher rates of hospitalization in this group.

Through the annual increment, it is possible to affirm that the overall coefficient of hospitalization for males showed increasing trend. However, the analysis by age group shows that only those of 50 - 59 years and 80 years or more showed positive acceleration ( $r^2 = 0.78$ ;  $p < \text{both } 0.001$ ), with average increase of 0.5 and 11.6 cases per year, respectively. The rates declined for all other age groups or were stable as noted on age groups of 40 - 49 years ( $r^2 = 0.24$ ;  $p = 0.084$ ) and 70 - 79 years ( $r^2 = 0.25$ ;  $p = 0.081$ ). Annual increments observed in the female models show that the greater the age, the smaller the number of cases, presenting at least 10.9 cases per year in women over 70 years ( $r^2 = 0.81$ ;  $p < 0.001$ ) (Table 1).



**Figure 1.** Rates of hospitalization for diabetes *mellitus* residents of Paraná, according to age, gender and year of occurrence

**Table 1.** Trend analysis of hospitalization rates for diabetes *mellitus* by gender and age group

Age group	Gender	$\beta_0$	$\beta_1$	$\beta_2$	$\beta_3$	p-value	r <sup>2</sup>	Trend
20-29	Male	16.24	-0.45			0.003	0.57	Decreasing
	Female	22.79	-0.55			<0.001	0.86	Decreasing
30-39	Male	26.93	0.13	0.14	-0.019	<0.001	0.84	Decreasing
	Female	32.05	-0.02			0.271	0.11	Stable
40-49	Male	67.84	-0.96			0.084	0.24	Stable
	Female	83.37	-2.62			<0.001	0.82	Decreasing
50-59	Male	157.3	-1.66	0.51		<0.001	0.78	Increasing
	Female	237.57	-6.63			<0.001	0.87	Decreasing
60-69	Male	271.6	7.71	1.20	-0.16	0.001	0.78	Decreasing
	Female	463.3	-9.9			<0.001	0.88	Decreasing
70-79	Male	414.97	4.27			0.081	0.25	Stable
	Female	710.4	-10.9			<0.001	0.81	Decreasing
≥80	Male	462.8	11.57			<0.001	0.78	Increasing
	Female	721.2	-1.11			0.572	0.03	Stable
Total	Male	208.2	3.07	1.06		<0.001	0.83	Increasing
	Female	343.9	-0.63			0.66	0.02	Stable

r<sup>2</sup> - Coefficient of determination

## Discussion

The study presents some limitations such as the use of secondary data, in which diagnostic coding errors are possible and still not possible to identify the re-hospitalization cases, in addition to not having been considered the change in the provision of beds and hospitalizations due to comorbidities, particularly in older individuals. However, the results are valid as they may indicate the importance of the implementation of actions in the framework of outpatient assistance, which aimed at greater resolution and prevention of complications of diabetes on the part of health professionals, and greater investments in this direction on the part of managers.

The epidemiological pattern of diabetes *mellitus* in the world, especially for type 2, has been modified over the past decades and these changes have been attributed to alterations in life habits, urbanization and ageing of the population.<sup>(10)</sup> The increasing number of individuals diagnosed with diabetes *mellitus* and the frequency of complications associated with this disease, has resulted in an increase in the number of hospitalizations.<sup>(10)</sup>

The economic impact of diabetes is expressive, and hospitalizations consume an important piece of public health resources, representing 55% of the cost with disease in Europe,<sup>(11)</sup> 44% in the United States and 10% in Latin America.<sup>(12)</sup> Meta-analysis investigated the extent of the complications and expenses caused by the disease found that in the year 2010, when diabetes *mellitus* was responsible for 278,778 potential years of life lost per 100,000 people and that in 2013 around 7% of people with the disease had had one or more complications that led to hospitalization. The annual direct cost with diabetes *mellitus* was estimated at 3,952 million dollars in the year 2000.<sup>(13)</sup>

People with diabetes have an increased risk of hospitalization and re-hospitalizations compared to those without diabetes, which negatively affects the quality of life of the individual as well as increase the burden on health services.<sup>(14)</sup> The findings of this study show that, in general, the trend in hospitalization for diabetes *mellitus* in adults were decreased, although the rates have behaved differently between the genders.

The analysis showed significant decline among female, with greater fall speed with the advancing age, except for the age groups from 30-39 and 70-79 years, which remained stable. In males, on the other hand, we observed significant increase in the coefficients of hospitalization relating only to the ages of 50-59 and 80 years or more, with decline or stability in other age groups. Despite reaching several age groups, older people have higher rates of hospitalization. Studies investigating the prevalence of diabetes *mellitus* are unanimous to show that this is much bigger in people aged over 40 years.<sup>(3,15)</sup>

When analyzed separately by gender, it is observed that the rates for women remained higher

throughout the period studied, confirming findings of another study<sup>(15)</sup> that investigated the hospitalizations for diabetes *mellitus*, which also found female prevalence. The prevalence of women hospitalizations reflects the higher prevalence of the disease in this gender.<sup>(11,12)</sup> Furthermore, studies show that cardiovascular risk associated with diabetes *mellitus* are considerably higher in women, leading to more cases of hospitalization.<sup>(16)</sup>

However, the coefficient of female hospitalization presented significant decline in almost all age groups. This fact can be associated with the demand for health services in outpatient assistance, composed mostly for programs that benefit women health care in different cycles of life, and that they promote and reflect in the increased demand and use of health services, especially for older women.<sup>(17)</sup> This may be a consequence of the predominance use of health services, which corroborates the results of randomized clinical trial,<sup>(18)</sup> whose women had 1.4 times more chances of using the health service when compared with men.

It is believed that the increase trend in men hospitalizations may be associated with their reduced pursue for health services, the resistance in performing self-care, associated with neglect under the preventive actions, especially those that are focused on diseases of chronic degenerative nature, often seeking the health service, when hospitalization is already necessary.<sup>(19)</sup> Thus, our findings are considered of great importance, mainly for health professionals, in order to encourage a reflection on the health of men who encompasses numerous risk factors and behaviors, in addition to social determinants that influence the demand for health service.

Specifically, a study on self-care behavior in men with diabetes *mellitus* type 2, showed that most of them did not know the symptoms of decompensation and complications of the disease, showed absence of adequate adherence to treatment and frequent monitoring of glycemic levels, plus body mass index, waist-hip ratio and glucose with averages above the recommended in healthy individuals.<sup>(20)</sup> The sum of these factors may be associated to increased hospitalization in this group.

It is suggested, then, that the use of health services within the outpatient assistance appears as a key agent for early diagnosis of the disease, better glycemic control, monitoring of possible complications and hence prevention of aggravations and hospitalizations.<sup>(21)</sup> It is a fact that this demand increases with advancing age, probably due to other health needs that result in increased attendance in services, facilitating the control of the disease and leading to reduction of hospitalizations as shown in polynomial models in female.

Thus, the provision of efficient care aiming at maintenance and proper control of glucose rates in people with diabetes *mellitus* in primary health care, takes the reduction of acute and chronic complications inherent to the disease and consequently a reduction of hospitalizations for this cause.<sup>(22)</sup> Likewise, the provision of continuing and qualified care, which prioritizes the effective communication with the patient with diabetes and the development of health education focusing on self-care, promotes the control of disease, consequently reducing complications and hospitalizations.<sup>(21)</sup>

A broad review of worldwide research on characteristics of outpatient assistance associated with the risk of hospitalization for susceptible conditions shows, with increasing consistency, the inverse correlation between access to outpatient services and hospitalization for sensitive conditions. Thus, the increase of the coefficients in hospitalization for diabetes *mellitus* is impacted by unhealthy lifestyles, overcoming the benefits provided by quality outpatient assistance, still associated to the fact that this is a chronic degenerative disease which demand a longer period of treatment to obtain the desired effects.<sup>(13)</sup>

Furthermore, it is necessary to consider that in the State of Parana, the Family Health Strategy program is following the national pattern of population coverage prognostic, having increased 22.4% coverage in 2000 to 63.1% in 2013. The impact of this coverage and the quality of the assistance provided by the teams, may be associated with lower rates of hospitalization for diseases considered sensitive to this service.<sup>(8)</sup>

In this sense, primary health care professionals are responsible for offering the best possible assistance, through information about the disease and

associated self-care actions especially on healthy eating, daily physical activity practice and proper use of antidiabetic medications, in addition to warn about the possible complications and empower the patient to appropriate self-care.<sup>(20)</sup>

Maintaining continuous surveillance of trends of avoidable hospitalizations and health programs aimed at the male population, especially regarding the chronic non-communicable diseases, configures itself as a useful tool to monitor the performance of the outpatient assistance work. It highlights, therefore, the need for qualification of the service, favoring search, monitoring, care and assistance in diabetes *mellitus*, aiming at improving the control of the disease and prevent complications.

## Conclusion

The trend in hospitalization for diabetes *mellitus* stratified by gender and age was increasing just for men between 50-59 years and older than 80 years.

## Collaborations

Santos AL and Teston EF contributed with the project design, implementing the research and analyzing database, study writing and approval of the final version. Latorre MRDO and Mathias TAF collaborated with the critical review of relevant intellectual content and final approval of the version to be published. Marcon SS contributed with the study writing, critical review of relevant intellectual content and approval of the final version to be published.

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