Original Article

Hospital admissions due to Diabetes *Mellitus* and characteristics of the places of residence

Internações hospitalares por Diabetes *Mellitus* e características dos locais de moradia

Internaciones hospitalarias por diabetes *mellitus* y características del lugar de residencia

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Abstract

Objective: Analyze the occurrence of hospitalizations for diabetes *mellitus* by residential neighborhoods in a large urban center.

Methods: cross-sectional ecological study, which considered the set of hospitalizations caused by diabetes *mellitus*, in the 160 neighborhoods of the city of Rio de Janeiro. To investigate the relationship between hospitalizations for diabetes *mellitus* and the living conditions of the population living in these neighborhoods, some demographic and socioeconomic indicators were calculated from 2010 to 2015. The regions were compared using analysis of variance (ANOVA) and the bivariate associations using F statistics.

Results: the average hospitalization rate for *diabetes mellitus* in the period was 20.5 admissions per 10 thousand inhabitants. The occurrences were higher among male patients (23.0 per 10 thousand) compared to female patients (18.4 per 10 thousand), a trend that was observed in all regions of the city. The Center presents more situations of vulnerability and higher hospitalization rates compared to the others. The variance indicated differences between the regions regarding sociodemographic and environmental characteristics related to living and health conditions.

Conclusion: The regional differences identified in the hospitalization rates and their relationship with greater vulnerability of social indicators point to complications in the management of diabetes *mellitus* and that these result in hospitalizations for diabetes *mellitus*.

Resumo

Objetivo: Analisar a ocorrência de internações por diabetes *mellitus* segundo bairros residenciais de um grande centro urbano.

Métodos: Estudo transversal, do tipo ecológico, que considerou o conjunto de internações hospitalares causadas por diabetes *mellitus*, nos 160 bairros do município do Rio de Janeiro. Para investigar a relação entre internações por diabetes *mellitus* e as condições de vida da população residente nestes bairros, calcularam-se alguns indicadores demográficos e socioeconômicos, no período de 2010 a 2015. As regiões foram comparadas através da análise de variância (ANOVA) e as associações bivariadas mediante estatística F.

Resultados: A taxa média de internação por diabetes *mellitus* no período foi de 20,5 internações por 10 mil habitantes. As ocorrências foram mais elevadas entre pacientes do sexo masculino (23,0 por 10 mil) em comparação ao feminino (18,4 por 10 mil), tendência que se observou em todas as regiões do município. A região do Centro apresenta mais situações de vulnerabilidades e maior taxa de internação na comparação com as demais. A variância indicou diferenças entre as regiões no que se refere as características sociodemográficas e ambientais ligadas as condições de vida e saúde.

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Conflicts of interest: nothing to declare.

Conclusão: As diferenças regionais identificadas nas taxas de internação e sua relação com maior vulnerabilidade dos indicadores sociais apontam para complicações no manejo do diabetes *mellitus* e que estas resultam em internações pela doença.

Resumen

Objetivo: Analizar los casos de internaciones por diabetes *mellitus* según barrios residenciales de un gran centro urbano.

Métodos: Estudio transversal, tipo ecológico, que consideró el conjunto de internaciones hospitalarias causadas por diabetes *mellitus*, en los 160 barrios del municipio de Rio de Janeiro. Para investigar la relación entre las internaciones por diabetes *mellitus* y las condiciones de vida de la población residente en estos barrios, se calcularon algunos indicadores demográficos y socioeconómicos, durante el período de 2010 a 2015. Las regiones fueron comparadas mediante el análisis de varianza (ANOVA) y las relaciones bivariadas mediante estadística F.

Resultados: El índice promedio de internación por diabetes *mellitus* fue de 20,5 internaciones por 10.000 habitantes durante el período. Hubo más episodios entre pacientes del sexo masculino (23,0 por 10.000), comparado con el femenino (18,4 por 10.000), tendencia que se observó en todas las regiones del municipio. La región del Centro presenta más situaciones de vulnerabilidad y un mayor índice de internación al compararse con las demás zonas. La varianza indicó diferencias entre las regiones respecto a las características sociodemográficas y ambientales con relación a las condiciones de vida y salud.

Conclusión: Las diferencias regionales identificadas en los índices de internación y su relación con una mayor vulnerabilidad de los indicadores sociales señalan complicaciones en el manejo de la diabetes *mellitus*, que tienen como resultado internaciones por diabetes *mellitus*.

Introduction

Diabetes *mellitus* (DM) is a chronic, systemic disease caused by numerous factors, ranging from hereditary predispositions to gradual and long exposures to various habits and risk behaviors. Being a condition related to multicausal factors and affecting populations around the world, coping with the disease is a complex challenge in recent times.[1,2]

In the context of epidemiological analyses, the prevalence of DM has been related to living and health conditions at the individual level, as the impacts of the disease can be measured in the productivity and survival of people, and at the collective level, when morbidity and mortality rates are associated and vary according to the socioeconomic aspects presented for the various population groups.[2,3]

Acute or chronic complications are common when related to inappropriate metabolic control, and often result in hospitalizations due to decompensations or effects of the pathogenesis of the continuous hyperglycemic condition. In people with type 2 diabetes, which account for 90% of DM cases, the main chronic complications are cardiovascular and cerebrovascular diseases, nephropathy and neuropathies, leading to limb amputations.[2]

International studies on health costs point out that there is a difference of 70% in expenditures when compared to individuals with and without diabetes. The generators of this impact are related to hospitalization and medications, and this may represent half of the expenditures on health costs in the treatment of this chronic condition.[4-6] Brazilian research on hospitalizations due to conditions sensitive to primary care indicates diabetes as one of the diseases that permits evaluating the quality of primary care offered to the population.[6-8]

The coexistence of biological and socioeconomic determinants in the occurrence of DM requires effective interventions to slow complications and possible hospitalizations.[1,2] Continuous monitoring, health education for lifestyle modification and strategies that value the relationship between individuals and health teams are effective to maintain quality of life, delaying the onset of complications with consequent reduction of hospitalizations.[3,4,8]

The complications arising from chronic conditions, such as diabetes *mellitus*, have an unequal effect on the population and the severity of the health condition with the socioeconomic disparities. Population characteristics such as income, education, race, ethnicity and housing locations are related to the access to health services, especially in urban centers. In order for public policies for the prevention of diseases to include the diversity of population groups, actions to reduce social and economic inequalities should be considered.[7,9,10]

With the increase in the burden of chronic non-communicable diseases, their complications reflect both the quality of life of the population, with an increase in permanent disabilities, and in the performance of the health system, with the increase in spending on hospitalizations and complex procedures.[4,5] Thus, data regarding hospital admis-

sions caused by diabetes have been widely used to monitor, analyze and evaluate the evolution of this phenomenon, especially with regard to the performance of the public health system.[6]

In general, national surveys that seek to identify the occurrence of chronic diseases are restricted to global indicators for large urban centers. For methodological reasons, it is not possible to verify specific aspects related to the expression of diseases in different places of the same city.[11] In the case of the capital of Rio de Janeiro, the socio-spatial inequalities are noticeable with highly socially organized locations, alongside others with very precarious conditions, evidencing true "social abysses", which tend to perpetuate the inequalities of life that directly impact the health of its residents.[12,13] The objective of this study is to analyze the occurrence of hospitalizations for diabetes *mellitus* according to residential neighborhoods of a large urban center.

Methods

Cross-sectional ecological study, which analyzed the occurrence of hospital admissions for DM of residents of the city of Rio de Janeiro between 2010 and 2015. The city was divided into six different regions, based on the clustering of 160 neighborhoods, consistent with the proximity and division of its planning areas.

The data were provided by the Coordination of Care Lines for Chronic Non-Communicable Diseases, of the Municipal Health Department of Rio de Janeiro, based on the information collected in the hospital admission authorization notes (AIH). We selected exclusively those cases in which Diabetes *Mellitus* was the reason for hospitalization according to the International Classification of Diseases number 10 (ICD 10) and which occurred in health facilities in the city of Rio de Janeiro between 2010 and 2015 (n = 9,820). The patients were characterized according to gender (male and female), age groups (18 to 39 years; 40 to 59 years and 60 years and older) and living neighborhoods and later in regions (Center, South, Grande Tijuca, North, West 1 and West 2).

The population living in the neighborhoods of the city was characterized based on data from the 2010 Demographic Census.[14]

The relationship between hospitalizations for DM and the living conditions of the population was calculated based on some socioeconomic and demographic indicators, which allude to living conditions (Chart 1).

Chart 1. Indicators considered to characterize the neighborhoods

n	Description of the indicator(s)
1	Dependency ratio
2	Aging rate
3	Illiteracy rate
4	Income: no income - Proportion of people who had no income; Income ≥ 1 and < 5 minimum wages - Proportion of people who declared income between 1 and less than 5 minimum wages; Income ≥ 5 minimum wages - Proportion of people who declared income of at least 5 minimum wages.
5	Color or race: "White" population-proportion of people of "white" color or race; Mulatto population - Proportion of people of "mulatto" color or race; "Black" population - Proportion of people of "black" color or race"
6	Basic sanitation: piped and treated water, sewage and garbage collection
7	Surroundings: identification of the address, street lighting, paving and open-air sewage

The hospitalization rates were calculated using the ratio between the number of hospitalizations of people with diabetes *mellitus* aged ≥ 18 years and the population over 18 years living in the neighborhoods of the city of Rio de Janeiro, multiplied by 10,000 inhabitants.

The hospitalization rates for DM were calculated for both genders according to age groups in the period analyzed. The denominators were estimated from weighting factors used for specific population growth projections for males (factor = 0.7%) and females (factor = 0.8%).

The analyses were conducted based on the clustering of neighborhoods that constitute regions of the city that are relatively homogeneous in terms of socioeconomic conditions. The 160 neighborhoods are grouped into six regions: Center (n = 15 neighborhoods); South (n = 18); Grande Tijuca (n = 7); North (n = 80); West 1 (n = 19) and West 2 (n = 21). The variance test (ANOVA) was applied to verify the difference between the mean indicators, which informs on the intergroup variation based on Fischer's F-distribution and the respective statistical significance levels. The results were obtained using *Statistical Package for the Social Sciences* – SPSS ver-

sion 23.0 and the map was generated in TerraView 4.2.2.[15]

The study complied with the formal requirements in the regulatory standards for research involving human beings. Regarding the ethical aspects, this study was conducted exclusively with secondary data, in which there was no identification of individuals, but it was evaluated by the Ethics Committees for Research involving Human Beings at Anna Nery School of Nursing (UFRJ) and the Municipal Department of Health (SMS/RJ), obtaining approval registered in opinions 2.253.783 and 2.011.917, respectively.

Results

We analyzed 9,820 hospitalizations for DM of people aged 18 years and over. In every city, there were, on average, 1,600 hospitalizations for DM per year (standard deviation = 313.4), 50.7% being male patients and 54.1% aged 60 years or older.

Most of the hospitalized persons lived in neighborhoods located in the North and West 2 (71.7%), and only 3.7% of the hospitalizations came from the South. Although these regions present high population densities, the frequency of hospitalizations was not proportional to the contingent of their inhabitants. The average hospitalization rate for DM in the city of Rio de Janeiro in the analyzed period was 20.5 admissions per 10 thousand inhabitants, ranging from 6.9/10 thousand in the neighborhoods of the South to 33.9/10 thousand in the Center region.

As observed, the hospitalization rate for DM was higher among male patients (23.0 per 10 thousand) when compared to female patients (18.4 per 10 thousand), a trend that was observed in all regions of the city (Table 1). The rates increased with the patients' age, with 56.5 admissions for every 10,000 people aged 60 years and older. For this age group, it was observed that the occurrence of hospitalizations among residents of the city center exceeded by seven times that observed for the South (98.4/10 thousand vs. 13.1/10 thousand) (Table 1).

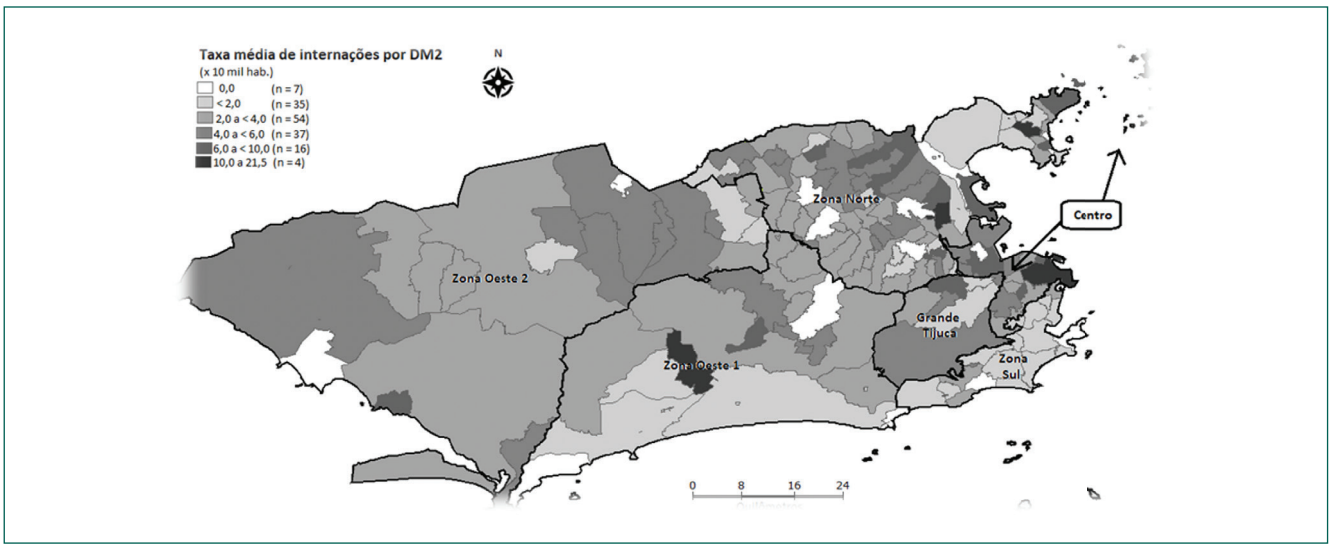
The hospitalization rates among men and women were more expressive for those aged 40-59 years, being about 15% higher among men (35.8% - 2010 and 18.7% - 2015) than among women (22.1% - 2010 and 13.1% - 2014). The pattern was reversed in mid-2014, when hospitalizations caused by DM had a greater impact on women aged 40 to 59 years (30.8%). For the age group over 60 years, in both sexes, the hospitalization rates are similar (51.1% among men and 45.0% among women), while in the last two years analyzed, the hospitalization rates corresponded to 45.1% and 43.5%, respectively.

In relation to the regions of the city, in those regions where the living conditions are more favorable (South and Grande Tijuca), the rates were lower than 10 hospitalizations/10 thousand inhabitants. The highest average hospitalization rates were recorded in the neighborhoods of the North, reaching 18.6/10,000 inhabitants in Jardim Carioca and 21.3/10.000 inhab. in Bonsucesso (Figure 1).

The neighborhoods of the South and West 1 presented the lowest hospitalization rates throughout the period, which should be considered with caution because, as shown in the map in Figure 1, in these regions, there are neighborhoods with high average hospitalization rates, such as "Camorim", where the average rate of 14.9 hospitalizations for every 10 thousand people ≥ 18 years was recorded. This rate was 20 times higher than the average rate observed in Barra da Tijuca (0.5/10,000 people aged ≥18) (Figure 1).

The neighborhoods of the central region presented the highest occurrences of hospitalizations for DM, as well as the highest situations of vulnerability. In addition to the central region, in terms of indicators, the neighborhoods of West 1 presented a similar pattern with the highest proportions of households without basic sanitation (Table 1).

In the central region, the indicators with the highest rates were the dependency ratio with 43.9%, and 4.0% of illiterate people. With regard to the population, the neighborhoods in this region presented 36.6% of mulatto and 14.2% of black individuals. Compared to the other regions, it is the second lowest frequency of whites (49.1%) and



Source: 2010 Demographic Census. Characteristics of the population and households: results of the universe. Rio de Janeiro: IBGE, 2011. Available at: http://www.ibge.gov.br/home/estatistica/populacao/censo2010/caracteristicas_da_populacao/resultados_do_universo.pdf[14]

Figure 1. Hospitalization rates due to Diabetes *Mellitus* (non-standardized) according to the neighborhoods of residence grouped in the six regions of Rio de Janeiro City

the highest frequency of self-declared black people (Table 1).

As for income, also in the central region, 32.3% of the population reported having no income during the 2010 Census and 61.4% reported an income between one and five minimum wages. The highest frequency of people without income was found in West 2 with 42.4% and the highest income in the South (Table 1).

Among the basic sanitation and environment indicators, 29% of the households in West 1 do not have a sewage network, against only 2.8% in the central region. The neighborhoods of West 1 also present the highest rates of absence of garbage collection (17.6%), against 22.8% in the Center neighborhoods. Street lighting was inadequately offered in 17% of the neighborhoods in West 1. Water supply is impaired in 11.9% in West 1, followed by Grande Tijuca with 7.2%. In other neighborhoods, this rate was inferior to 2.7% (Table 2).

The relationships between the average hospitalization rates in the period 2010-2015 are shown in Table 2, and the associations indicate that the regions delimited in this study present statistically significant differences in relation to the selected characteristics, with emphasis on indicators that describe living and health conditions.

Table 1. Hospitalization rates and sociodemographic indicators by region of residence

Variables	Center	South	Grande Tijuca	North	West 1	West 2	Total
Hospitalizations for DM (N)	767	365	606	4,115	1,043	2,924	9,820
Hospitalization rates (x 10 thousand inhab.)	33.9	6.9	19.9	22.7	15.1	23.8	20.5
Sex (x 10 thousand inhab.)							
Male	40.5	8.3	23.0	25.4	16.3	26.1	23.0
Female	28.4	5.8	17.6	20.4	14.1	21.9	18.4
Age (x 10 thousand inhab.)							
18 to 39 years	7.4	3.0	8.3	7.7	3.9	6.3	6.3
40 to 59 years	35.7	6.3	18.9	20.4	14.6	21.7	19.0
60 years and over	98.4	13.1	38.1	62.2	48.8	81.7	56.5
Sociodemographic indicators							
Dependency ratio	43.9	42.6	43.7	43.9	40.9	42.6	43.2
Aging rate	11.6	19.7	19.0	12.7	9.3	8.4	12.7
Illiterate persons	4.0	1.7	1.9	2.7	3.8	3.5	2.9
Color or race							
White	49.1	76.6	72.4	51.4	54.3	42.8	54.1
Mulatto	36.6	17.7	20.1	35.7	34.7	43.4	34.0
Black	14.2	5.7	7.5	12.9	11.0	13.8	11.9
Household income							
No Income	32.3	25.7	26.5	34.7	33.0	42.4	33.9
Income ≥ 1 and < 5 MW	61.4	37.9	48.4	56.9	51.5	51.6	53.5
Income ≥ 5 MW	6.3	36.4	25.1	8.5	15.5	6.0	12.6

DM-Diabetes *Mellitus*; MW - minimum wage; inhab. - inhabitants

Table 2. Associations between rates of hospitalizations for Diabetes *Mellitus* and the sociodemographic and environmental characteristics of the population in neighborhood clusters (n = six regions)

Sociodemographic indicators (%)	Mean	Minimum	Maximum	Standard deviation	Comparison among regions (F)
Average hospitalization rate	22.2	0.0	21.4	3.0	3.5**
Hospitalization rate (men ≥ 40 years)	40.3	0.0	196.8	33.1	4.6**
Hospitalization rate (women ≥ 40 years)	31.3	0.0	262.3	32.4	2.7*
Proportion of illiterates	2.9	0.1	14.0	2.0	4.3**
Proportion without income	33.9	18.4	89.5	7.3	18.7**
Proportion income between 1 and 5 MW	53.5	10.3	68.0	10.1	20.9**
Proportion income > 5 MW	12.6	0.0	54.2	12.8	37.1**
Proportion white	54.1	14.0	91.7	15.6	19.7**
Proportion black	11.9	1.6	29.6	5.1	10.8**
Proportion mulatto	34.0	6.7	66.4	11.4	21.3**
Household without water	2.6	0.0	90.9	9.2	5.8**
Household without sewage	9.0	0.1	100.0	14.6	17.7**
Household without garbage collection	15.2	0.0	83.1	14.1	3.5**

* Anova test (p-value < 0.05; ***p-value* < 0.01); MW - minimum wages

Discussion

This research presented the limitations common to ecological studies, regarding the variable quality of information, and the difficulty to identify readmissions. Nevertheless, the results listed may support reflections for the planning and organization of care actions for people with diabetes *mellitus*. Considering that the hospitalizations for this condition and the demographic and socioeconomic indicators of the regions of the city were studied, the goal was to analyze, even indirectly, the association between health inequalities, including access to health services.

Hospitalization for diabetes *mellitus* points to an increasing trend for males, with a greater increase in the age group between 50 and 59 years, although high rates continue as from the age of 60 years.[7,16] In this study, the hospitalization rate was higher among men, with small differences between the sexes, thus contradicting Brazilian studies[6,16] on the subject.

Similarly, the risk of hospitalization among men was higher, as identified in another study conducted in Rio de Janeiro between 2000 and 2010, which analyzed hospitalizations by conditions sensitive to primary care. In people over 70 years, it was identified that chronic diseases account for more than half of the hospitalizations and that men presented the highest risk.[12]

In line with the results of this study, the research conducted in health regions in Paraná between 2000 and 2012 showed a hospitalization rate between 10.4 and 9.3/10,000 inhabitants, with increasing behavior in most of its regions and also a greater trend towards hospitalization among men.[17,18]. In the northeast, it was observed that, in Bahia, the hospitalization rate for DM was 31%, but with a decreasing trend in the five-year period from 2013 to 2017.[19]

These results strengthen the consideration that men seek services in a late stage, which may result in greater complications and the need for frequent hospitalizations. The reasons for this late search are justified by the lack of time to seek health services, because work is prioritized, except in emergency situations, besides the difficulty to get access to primary care services that function at times that do not meet their needs.[20]

In general, there are difficulties related to access to care and self-care actions necessary for those with chronic conditions. Regarding the difficulty for self-care, in a study conducted in southern Brazil, which addressed the difference in lifestyle between genders, men showed a trend towards deficit and difficulty to maintain proper management of self-care.[21] The same occurred in a study developed in Italy, which demonstrated a statistical association between lesser control and self-care among men.[22] These studies confirm that behavioral, social and cultural aspects interfere with this care.

In the approach of the socioeconomic conditions, the neighborhoods of the South that were characterized by better social situations presented low hospitalization rates in contrast with the city center, which presented the highest rates and vulnerability indicators. It is also observed that some neighborhoods in the South did not present cases of hospitalization, perhaps due to the use of private health insurances, which would justify the absence or low number of records in public services.

As, in this study, the hospitalizations refer to the place of residence of people with DM, the hypotheses for the higher hospitalization rates in the Center and West 2 are related to the deficit in the follow-up by the primary health services in the area, which may be inferior to the population needs, or even to the aspect of care/access of residents from other cities in the state seeking care resources in Rio de Janeiro. Another characteristic of the central region is the intense informal trade of people who live in different regions of the metropolis, but spend much of their time in this region, in addition to the large number of male street dwellers.

Studies conducted in France and Japan indicate that, despite universal health coverage, social, economic conditions and place of residence influence the use of health services and the access to tests and specialists. People over 65 years of age, male individuals and gaining middle or low incomes had a higher risk of hospitalization due to macrovascular complications. The socioeconomic conditions associated with factors such as poor nutrition, housing conditions and difficulty in accessing preventive health services are factors that may interfere.[23-25]

In Taiwan, it was also identified that, in neighborhoods with low-income people and in those with a larger number of individuals with lower education levels, the number of hospitalizations was higher.[26] When considering the association between socioeconomic conditions and hospitalization rates of people with DM, it is a fact that the place of residence can influence the worsening of health conditions, which should favor management initiatives aimed at organizing and expanding the access to and the individual and collective monitoring of diabetes *mellitus*.[17]

Considering that the nursing professionals, especially the nurses assist patients with DM in care actions at the primary level of the healthcare network, providing instructions aimed at metabolic control and quality of life, either during nursing consultations, group or home care including the family, the results of this study can contribute to the longitudinal organization of nursing care in the perspective of expanded actions in their professional scope, with differentiated results that may point to better health gains.[27]

By considering the hospitalization profile and the identification of the social conditions of the people under their care, based on scientific evidence, nurses can better organize their actions at the primary care level, as well as actions that fit in an interdisciplinary perspective. DM being a chronic health problem and hospitalization for DM being a cause sensitive to primary health care, care should be based on different multi-professional areas of knowledge, with a view to the excellence of health care.[28]

In this line of action, the case management by primary care nurses, a common practice among nurses working with advanced practices in countries where this specialty is regulated, can favor results aimed at preventing complications, including the reduction of hospitalizations for decompensated Diabetes *Mellitus*.[28,29]

Conclusion

In the city of Rio de Janeiro, excess hospitalizations by Diabetes *Mellitus* were evidenced among men and people over 40 years of age. The higher proportions of hospitalizations occurred among residents in the Central region, who also presented less favorable conditions, along with the demographic, socioeconomic, household and environmental indicators. The regional differences identified in the hospitalization rates and the relationship between these indicators and greater vulnerability indicate difficulties that may entail greater complications and affect the hospitalization rates.

Collaborations

Palasson RR, Paz EPA, Marinho GL and Pinto LF stated that they contributed to the design of the study, analysis and interpretation of the data, writing of the article, relevant critical review of the intellectual content and approval of the final version for publication.

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