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HOSPITAL ADMISSIONS FOR DIABETES MELLITUS IN SERGIPE, NORTHEASTERN BRAZIL, FROM 2008 TO 2017: AN ECOLOGICAL STUDY

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ABSTRACT

Diabetes mellitus is a primary care-sensitive condition characterized by persistently elevated blood glucose levels. The worldwide prevalence is 8.8% and in Brazil, 7.6%. Objective: To describe the evolution of hospitalization rates, length of hospital stay, and expenditures on diabetes mellitus, in the State of Sergipe, Brazil, from 2008 to 2017. Method: A descriptive time series study was carried out in which data were obtained from Hospital Admission Authorizations registered in the Hospital Information System of the Unified Health System. The data were read and analyzed by the statistical program R. Results: Sergipe recorded 608,083 hospitalizations by the Unified Health System in this period, of which 125,497 were hospitalizations for conditions sensitive to Primary Care (20.6%). Diabetes mellitus was responsible for 7.2% of these hospitalizations, being the sixth most frequent cause (the third among individuals over 50 years of age). The overall rate in the period was 4.1/10,000 inhabitants. (3.8 in men and 4.4 in women). The variation was irregular, with a resulting increase in the hospitalization rate. Length of hospital stay increased by 0.12 days per year during the period (95% CI 0.06 to 0.19). The cost of hospitalization increased with length of stay, with an average of $24.4 (95% CI 23.14 to 25.58) per day of hospitalization. Conclusion: Primary Care has a preponderant role in the

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prevention, early diagnosis and treatment of diabetes mellitus to avoid premature hospital admissions. The research showed an irregular behavior in the hospitalization curve in the period, which gives rise to new research for causal determinants. The risk of hospitalization was higher in females, but in the last years of life it was unusually higher in men. The decrease in spending is worrying, especially with the poorest part of the population, since the disease continues to rise and predominates in this group.

Keywords: Diabetes Mellitus. Primary Health Care. Hospitalization. Ecological Study. Health Policy.

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INTRODUCTION

Diabetes Mellitus (DM) is a syndrome characterized by persistently high blood glucose levels. In the last 20 years, its incidence and prevalence have been progressively increasing. An estimate by the International Diabetes Federation (IFD) in 2015 revealed that there were 415 million people with DM in the world, corresponding to a prevalence of 8.8% (IDF, 2019). In Brazil, in 2017, 12.5 million people with DM between 20 and 79 years of age were registered, with an estimate of reaching 31.8 million in 2045 if the trend continues (SBD, 2019). In Aracaju, capital of the state of Sergipe (SE), a study by telephone survey found a prevalence of 6.8% (BRASIL, 2019).

Latin American countries have varied prevalence of Diabetes Mellitus, such as Jamaica 13.4%, Mexico 8.6%, Brazil 7.6%, Colombia 7.3%, Bolivia 7.2%, Uruguay 7%, Paraguay 6.2%, Argentina 5%, Cuba 4.5%, Venezuela 4.4% and Chile 3.9% (LOPEZ-JAMARILLO, SANCHEZ, DIAZ, *et al*, 2014).

In the Global Burden of Disease study, which estimated the Disability-Adjusted Life Years (AVA/*DALY),* DM represented 5% of the burden of disease in Brazil. The Northeast is the second region with the highest global burden of the disease (9.6 VA/1000 inhabitants) and this is mainly due to the mortality component, being the region with the highest rate of Years of Life Lost due to mortality (5.9 AVP/1000 inhabitants) one of the regions with the highest burden of DM (COSTA, FLOR, Campos, 2017). Regarding mortality, considering all ages, the mortality rate due to acute complications of DM in the period from 2006 to 2010 was 2.4/100 thousand inhabitants. in Brazil, 3.4/100,000 inhabitants. in the Northeast and 3.4/100 thousand in Sergipe (KLAFKE, DUNCAN, ROSA *et al*, 2014). In Brazil, the trend of hospital admissions for DM has been increasing and when stratified by sex, there is an increasing trend in males, despite the higher frequency of hospitalizations for this cause in females (ALANA, SANTOS, LIMA *et al*, 2014; GONZAGA, BORGES, 2017).

A sedentary lifestyle and an inadequate diet, combined with the demographic transition, are the immediate culprits of the type II DM epidemic (TUOMI, SANTORO, CAPRI *et al*, 2014). Due to these characteristics, among others, the appropriate place of care for people with DM is Primary Health Care (PHC), with occasional or periodic referrals to specialized care. PHC can avoid or postpone the need for hospitalization, but failures in any aspect of the system at this level of care facilitate the lack of control of the disease and the need for hospitalization of the patient.

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The Unified Health System (SUS) from 2006 onwards, through the National Primary Care Policy (PNAB), developed a series of actions to strengthen PHC, but from 2013 onwards, the political and economic crisis reflected in the environmental, educational and health sectors, which may have impacted the weakening of PHC and hospitalizations for Chronic Non-Communicable Diseases (NCDs) such as diabetes mellitus.

The objective of this study is to verify the behavior of DM hospitalization rates, length of hospital stay, and respective expenditure, in the state of Sergipe, from 2008 to 2017. The choice of the period is due to the possibility of observing the monitoring of the introduction and withdrawal of measures that strengthened and weakened PHC, with consequences for health indicators. The research aims to contribute to filling this gap and point out aspects of health policies that may be associated.

METHODS

The State of Sergipe is the smallest among the 27 states of Brazil, it is located in the Brazilian Northeast, bordered to the south and west by Bahia, to the north by Alagoas and to the east by the Atlantic Ocean (Figure 1). According to the 2010 census carried out by the Brazilian Institute of Geography and Statistics (IBGE), the population of Sergipe had 2,068,017 inhabitants. (IBGE, 2011). The population pyramids of Sergipe and Brazil have similarities, although Sergipe has a slower aging rate than Brazil.

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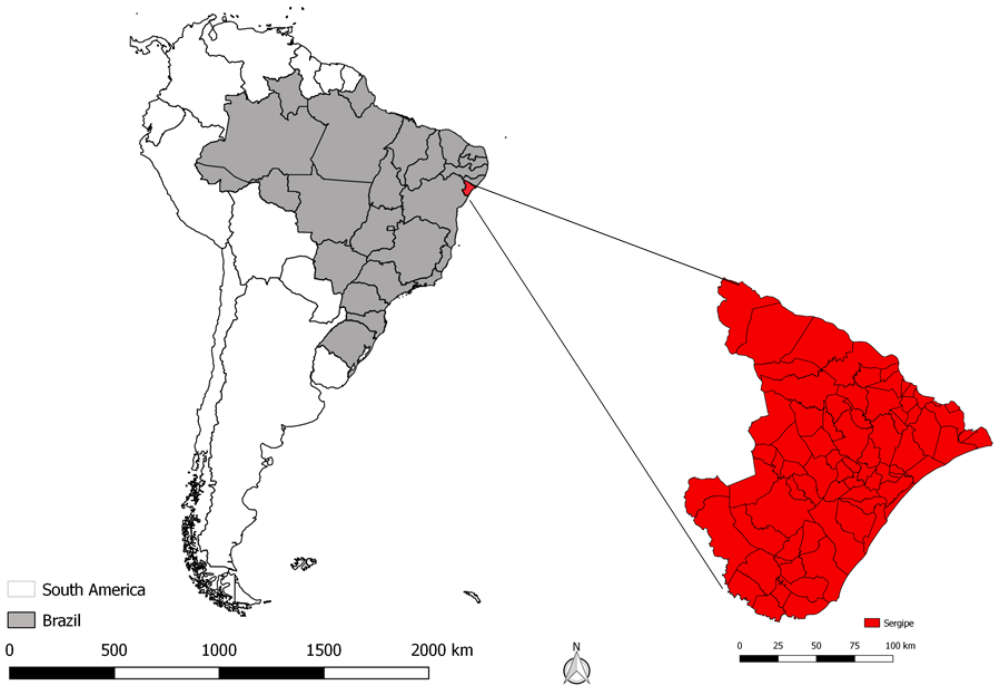
Figure 1: Map of Latin America and Brazil, with emphasis on the state of Sergipe.



An ecological time series study was carried out with data from the SUS Hospital Information System (SIH/SUS). The "reduced files" of the Hospital Admission Authorization (AIH) were used, from which data on hospitalizations for Diabetes Mellitus were obtained. The "AIH files" are made available in files separated by State and month of billing of the hospitalization (called "month of competence"). As the AIH can be billed later, the data files of the State of Sergipe from January 2008 to July 2018 were verified in the research, but only hospitalizations that occurred in the period from 01/01/2008 to 12/31/2017 were selected. Only the cases of citizens residing in Sergipe were also selected. Hospitalizations with the main diagnosis of DM (ICD-10 code between E10 and E14) were used.

The proportions of total hospitalizations and population hospitalization rates for DM per year were calculated, then standardized by sex and age group (0-4, ..., 85-90, 90 and +) by the indirect method (calculation of the Standardized Hospitalization Ratio – RHP). The total cost of hospitalization was expressed in Reais and US Dollars, respectively VAL_TOT and US_TOT. To evaluate the length of hospital stay, a bivariate analysis of the relationship between age and sex and length of stay was performed. In the approach to the cost of hospitalization, a bivariate analysis of age, sex and length of hospitalization was used with cost. For both outcomes: cost and expense, the hypotheses were tested by non-

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parametric methods, observing that linear regression is not parametric, cost was linearized by logarithm. For both outcomes, the hypotheses of difference by sex and age group were tested using a non-parametric method of comparison of means (Kruskal-Wallis test). The interaction between age and sex on length of hospital stay was also tested. Finally, the relationship between hospital expenditure according to length of hospital stay was analyzed using the logarithm, and the variation was analyzed by linear regression.

The data capture on the internet, the reading of the files, classification of hospitalizations, analysis and graphic presentation were carried out in the statistical program R, through the *microdatasus* (SALDANHA, BASTOS, BARCELLOS, 2019) and *read.dbc* (PETRUZALEK, 2016) packages.

The study has limitations since it is an ecological study of time series that does not lend itself to deepening the analysis of causes, but to point out possible associations. It depends on the collection of data entered in the AIH, which may not be as precise, even though the AIH is a validated instrument for research in Brazil.

This research is part of the PhD project: Hospitalizations for Sensitive Conditions to Primary Health Care in Sergipe-Brazil, follows the ethical recommendations of the National Health Council contained in Resolution No. 466, of December 12, 2012, submitted to the Research Ethics Committee of the Federal University of Sergipe and approved under opinion No. 2.232.566 and CAAE: 69111717.5.0000.5546, on August 22, 2017.

RESULTS

Sergipe recorded in the period from 2008 to 2017, 608,083 hospital admissions through the Unified Health System. In the entire period, the frequency of Diabetes Mellitus was 9003 cases, representing 1.5% of hospitalizations, 7.2% of hospitalizations for Ambulatory Care Sensitive Conditions (ACSC), the fifth cause among these and an overall rate of 4.1 cases per ten thousand inhabitants. Table 1 details the distribution of rates by sex and year, in addition to the RHP for the total sexes, while Figure 2 shows the evolution of the standardized rate (RHP) by sex over the period. The rates showed irregular behavior, with an increase at the beginning of the period, a decrease between 2010 and 2013 and a new increase from 2014 onwards. The crude rate observed in 2017 is 36% higher than that observed in 2008, while in the standardized rate this difference is 14%.

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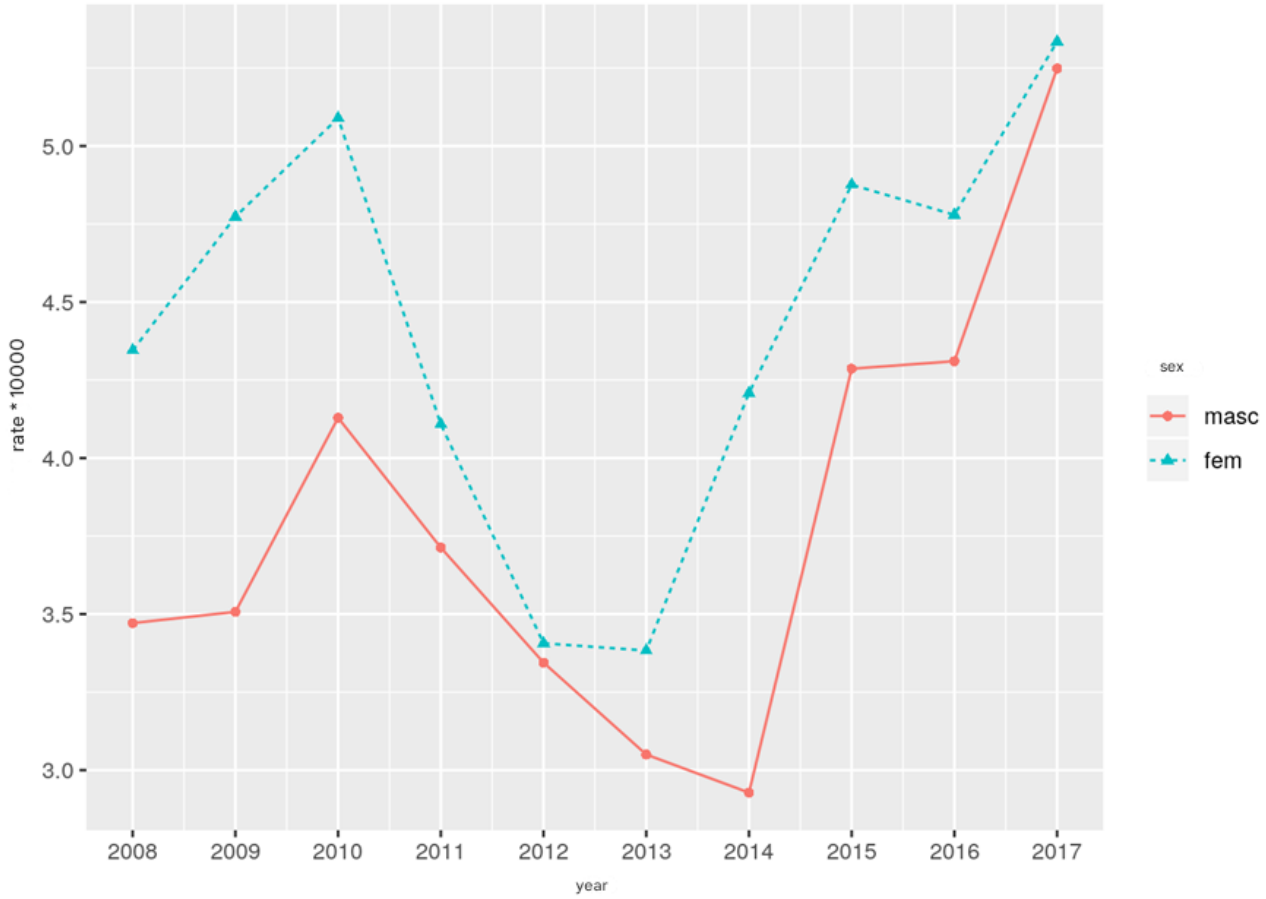
Figure 2: Rate (per 10,000 inhabitants) of hospitalizations due to DM in Sergipe, according to sex from 2008 to 2017.



The proportion of diagnoses among hospitalizations also increased in the period, from 1.3% of hospitalizations and 5.9% of HACSC in 2008 to 2.0% of hospitalizations and 8.1% of HACSC in 2017 (Table 1). The mean age at hospitalization was 59.8 years and remained stable throughout the period. An increase in the frequency of hospitalization for DM is observed with increasing age, with the third most frequent cause being over 50 years of age. The risk of hospitalization was higher in females (4.4/10,000 inhabitants) than in males (3.8/10,000 inhabitants). In the last years of life, the risk of hospitalization for DM in men is higher (Figure 3).

Table 1: Hospitalization for Diabetes Mellitus in Sergipe from 2008 to 2017: cases, proportional distribution over total hospitalizations, total HACSC, rate per ten thousand inhabitants and standardized Hospitalization Ratio.

	Cases	% of Total Hospitalizations	% on HACSC	Gross Rate			RHP*
YEAR		Total	Total	Men.	Five.	Total	
2008	809	1,3	5.89	3.47	4.35	3.92	1.33

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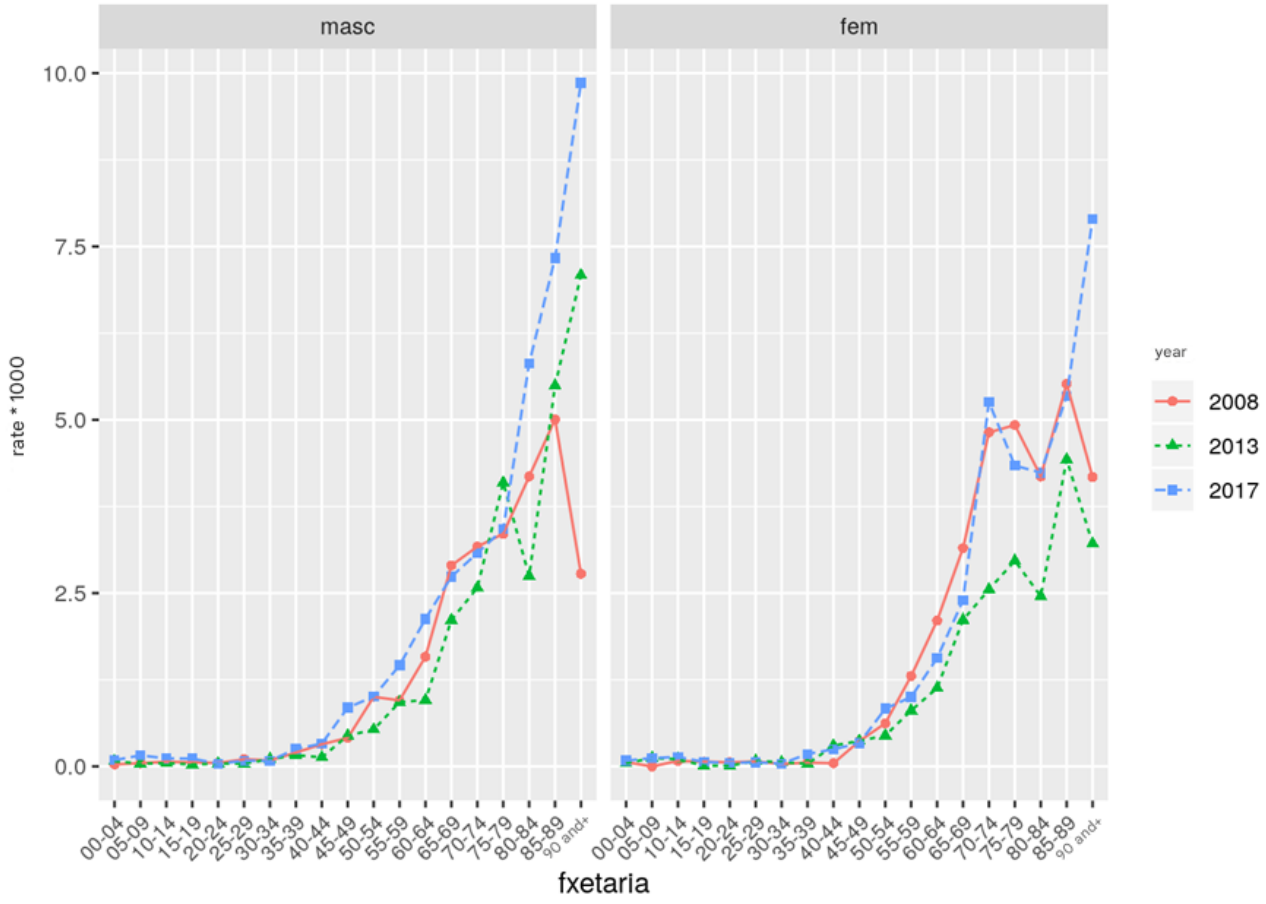
2009	869	1,51	6.74	3.51	4.77	4.15	1.39
2010	979	1,62	7.81	4.13	5.09	4.62	1.52
2011	840	1,41	7.5	3.71	4.11	3.91	1.26
2012	733	1,25	6.31	3.34	3.41	3.38	1.07
2013	707	1,21	6.05	3.05	3.38	3.22	1.00
2014	795	1,33	6.93	2.93	4.21	3.58	1.09
2015	1029	1,6	8.36	4.29	4.88	4.59	1.37
2016	1031	1,58	7.89	4.31	4.78	4.55	1.33
2017	1211	1,95	8.08	5.25	5.33	5.29	1.51
Period	9003	1,48	7,17	3,81	4,36	4,13	--

*RHP: Standardized Hospitalization Ratio

Figure 3: Distribution of DM rate per 1000 inhabitants. according to age group and sex in Sergipe in the years 2008, 2013 and 2017.



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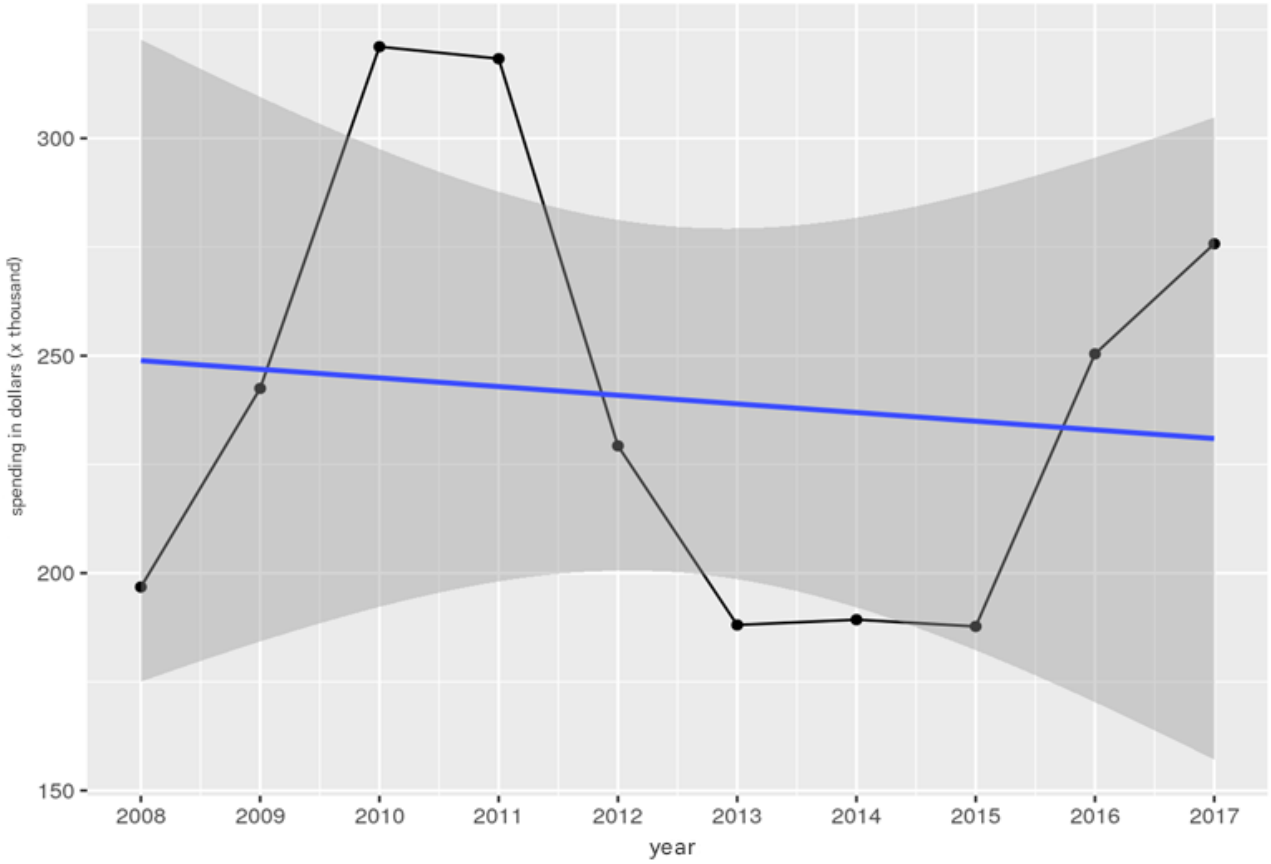
Length of hospital stay increased by 0.12 days per year over the period (95%CI 0.06 - 0.19; p<0.001). A significant but inexpressive interaction between age and gender was observed on length of hospital stay (coeff. = 0.022; p = 0.025). A quarter of hospitalizations lasted up to three days, half lasted up to five days, and a quarter lasted eight days or more. The cost of hospitalization due to DM was irregular over time, with a negative result, i.e., there was a contraction in expenses in the period (Fig. 4). Spending on DM has been decreasing over the years, averaging US$ -13.09 (CI95 -16.91, -9.28) dollars per year (p < 0.001), adjusted for length of hospital stay. Hospitalization expenses increase with length of stay, with an average of $24.36 (CI95 23.14, $25.58) per day of hospitalization.

Figure 4: Distribution of spending in dollars from 2008 to 2017 in Sergipe, with a downward slope.



DISCUSSION

The research showed that during the period studied, the rates of hospitalization for DM fluctuated in the State of Sergipe, increasing from 2014 onwards. The risk of hospitalization for DM was higher in females. The proportion of hospitalizations for DM increased among general hospitalizations and among hospitalizations for Ambulatory Care-Sensitive Conditions. However, the costs of hospitalizations due to DM decreased

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throughout the study period. Half of the hospital admissions had a length of stay of up to five days and little was associated with age and gender. In this study, the length of hospital stay increased significantly over the period and had no significant association with age and gender. In addition, the coefficient of determination, which indicates how much the model explains the variability of the hospitalization rate, was very small, only 0.1%, indicating that it is other variables, probably clinical, that best explain the length of the patient's hospitalization.

The female gender was also predominant in a study carried out in Sergipe in private pharmacies with diabetic people who mostly sought private pharmacies due to the absence or interruptions of medication dispensation, although they had made their DM diagnosis through the SUS (GOIS, LIMA SANTOS *et al*, 2017).

The distribution of DM expenditures was irregular in the period, with a decreasing final result, which we presume to be inadequate and insufficient to meet the needs of the population, since we observed an increase in hospital admissions for this cause. Cross-sectional and descriptive studies on the epidemiological and socioeconomic profile of DM patients in Sergipe report a predominance of females, in a population over 50 years of age (SANTOS, SILVA, LARRÉ *et al,* 2019; OLIVEIRA, LIMA, NUNES *et al*, 2019). The frequencies are higher in people with: low education, low income, and difficulty in acquiring medicines in PHC (GOIS, LIMA, SANTOS *et al*, 2017).

A study of the Social Dimensions of Inequalities Research showed that in the classes of lower socioeconomic status, DM presented about five times more cases than the classes of higher purchasing power. DM, in addition to being associated with obesity with a sedentary lifestyle, systemic arterial hypertension (SAH), and hypercholesterolism and aging, is associated with low income and low education (FLOR, 2017; MALTA, BERNAL, LIMA *et al* 2017).

The role of Primary Health Care (PHC) is fundamental to achieve better results in DM control. Primary and secondary prevention developed in the UBS with educational actions on nutrition, physical activity and encouragement of self-care are fundamental to have a positive impact on DM. One review showed that the more intensive the combined diet and physical activity guidance programs, the more effective the results are in decreasing hospitalizations for complications of DM (BALK, EARLEY, RAMAN *et al*, 2015). The difficulty in obtaining care or excessive delay in scheduling new appointments in PHC in Brazil has been reported by diabetic patients and pointed out as a reason for low

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adherence to treatment, especially by the elderly who are more often carriers of chronic non-communicable diseases (ARTILHEIRO, FRANCO, SCHULZ *et al*, 2014; PEDRAZA, NOBRE, ALBUQUERQUE *et al*, 2018).

The availability of medications is another fundamental factor for the continuity and adherence to treatment of people with DM. In Brazil, this availability is low, a national study found that 59.8% of the interviewed population fully received SUS medicines and 41.8% reported having spent their own money on medicines (ALVARES, GUERRA-JUNIOR, ARAUJO *et al*, 2017). It should be noted that the World Health Organization (WHO) suggests that availability is greater than or equal to 80%, which compromises the effectiveness of PHC (WHO, 2015). The SUS provides intermediate-acting insulin NPH (neutral Protamine Hagedorn), fast-acting insulin (regular insulin), hypoglycemic agents (metformin hydrochloride, glibenclamide and gliclazide) but not with the necessary regularity. A study evaluating data from the second cycle of the Access and Quality Improvement Program (PMAQ) showed that the availability of NPH Insulin and Regular Insulin was 55.5% (95%CI 47.3-63.4) and 50.6% (95%CI 42.4-58.8) respectively in the Northeast region in 2015 In the area of discussion of solutions to increase the dispensation of medicines, the renewal of medical prescriptions is included. Studies have shown that the renewal of medical prescriptions, if carried out properly, following well-defined protocols, can improve adherence and ensure continuity of treatment, in addition to enabling studies of adverse effects and drug interactions (REIS, ALVES, DA CUNHA *et al*, 2018). The guarantee of medication dispensation throughout the UBS's opening hours is part of the necessary reception to improve the effectiveness of the service and user satisfaction (PROTASIO, GOMES, MACHADO, 2017). It is important to emphasize that access to medicines is included in the right to health, guaranteed by Human Rights.

Public policies were adopted to strengthen PHC as well as to address the growing hospitalization for DM, such as the Strategic Action Plan to Combat Chronic Non-Communicable Diseases in Brazil 2021-2030, following WHO guidance (MS, 2021). Since 2006, with the edition of the National Primary Care Policy, a series of actions and events have followed that have strengthened PHC and the Family Health Strategy (ESF), such as the creation of the Family Health Support Center (NASF) in 2008, the creation of the PMAQ, the creation of the Better at Home Program, the creation of the Health Academy Program, Street clinics, Telehealth in 2011, the More Doctor Program in 2013, among others, had a positive impact on the performance of PHC, on the other hand, the crisis that

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took place in Brazil from 2013 onwards, which culminated in the enactment of Constitutional Amendment No. 95 of 2016, which restricted spending ceilings for the next 20 years, affecting health and education, accompanied the increase in hospital admissions due to ACSC in Sergipe and DM alone.

CONCLUSION

Hospital admissions due to DM have been increasing in Sergipe. The curve of hospital admission rates showed irregular behavior, with an increasing result, inversely to the curve of expenses and length of stay. There was a predominance of females up to 80 years of age, when hospitalization for DM is unusually higher in males. The harmful complications of DM, which compromise the possibilities of living of its patients and have great repercussions on the economic and social security aspects of the country, give rise to public policies in each state aimed at the prevention and control of risk factors, early diagnosis and effective treatment. Public policies that strengthen PHC should be resumed so that certain groups of causes, especially chronic non-communicable diseases such as DM, have hospital admissions avoided or postponed.

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