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Temporal and spatial analysis of Hospitalizations for Sensitive Conditions in Primary Care in the elderly

Análise temporal e espacial das Internações por Condições Sensíveis à Atenção Primária em idosos

Análisis temporal y espacial de las Hospitalizaciones por Condiciones Sensibles a la Atención Primaria en ancianos

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ABSTRACT

Objective: To analyze the dynamics and temporal trend of Conditions Sensitive to Primary Care (ICSAP) in the elderly in the state of Sergipe. **Method:** Ecological study, with spatial and temporal trend of ICSAP analysis in the elderly. Data used from the Hospital Information System of the Unified Health System, considering the seven health regions and the 75 cities of Sergipe as units of analysis is during the years 2008 to 2020. **Results:** We have identified the five most common groups of causes: Bacterial Pneumonia, Cerebrovascular Disease, Heart Failure, Hypertension and Diabetes Mellitus. Regions with a growth trend: Itabaiana and Nossa Senhora da Glória (bacterial pneumonia, and cerebrovascular diseases), Nossa Senhora do Socorro (bacterial pneumonia), and Propriá (diabetes mellitus). In the spatial analysis, all rates were very high in the cities of all health regions, with emphasis on Propriá (cause groups) and Estância and Lagarto (for all except Hiper). Clusters with high rates were observed for bacterial pneumonia, cerebrovascular diseases and diabetes mellitus, with a predominance in the central region, and hypertension in eastern Sergipe. Four clusters considered low were identified in four of the five cause groups: Cerebrovascular Diseases in the regional groups of Nossa Senhora da Glória; Heart Failure and Diabetes Mellitus in the regions of Nossa Senhora da Glória, Itabaiana and La; Hypertension in the regions of Itabaiana and Lagarto. **Conclusion:** The study can contribute to health promotion strategies in primary care and in policies aimed at great er comprehensive ness of health actions for theeld erly.

Descriptors: Primary Health Care; Hospital internment; Elderly; Health Information System.

RESUMO

Objetivo: *Analisar a dinâmica espacial e tendência temporal das Internações por Condições Sensíveis à Atenção Primária em idosos no estado de Sergipe.* ***Método:*** *Estudo ecológico, com análise espacial e tendência temporal das internações em idosos. Utilizados dados do Sistema de Informações Hospitalares do Sistema Único de Saúde, considerando como unidades de análise as sete regiões de saúde e os 75 municípios de Sergipe durante os anos de 2008 a 2020.* ***Resultados:*** *Identificamos os cinco grupos de causas mais prevalentes: pneumonias bacterianas, doenças cerebrovasculares, insuficiência cardíaca, hipertensão e diabetes mellitus. Regiões com tendência de crescimento: Itabaiana e Nossa Senhora da Glória (pneumonias bacterianas e doenças cerebrovasculares), Nossa Senhora do Socorro (pneumonias bacterianas) e Propriá (diabetes mellitus). Na análise espacial, foram encontradas taxas muito altas em municípios de todas as regiões de saúde, com destaque para Propriá (em todos os grupos de causas) e Estância e Lagarto (para todos, exceto hipertensão). Clusters com altas taxas foram observados para as pneumonias bacterianas, doenças cerebrovasculares e diabetes mellitus com predominância na região central e, hipertensão no leste Sergipano. Foram identificados quatro clusters considerados baixos em quatro dos cinco grupos de causas: doenças*

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cerebrovasculares nos municípios da regional Nossa Senhora da Glória, insuficiência cardíaca e diabetes mellitus nas regiões de Nossa Senhora da Glória, Itabaiana e Lagarto; hipertensão nas regiões de Itabaiana e Lagarto. ***Conclusão:*** *O estudo pode contribuir para estratégias de promoção à saúde na atenção primária e nas políticas que visem maior integralidade das ações na saúde da pessoa idosa.*

Descritores: Atenção Primária à Saúde; Internação hospitalar; Idoso; Sistema de Informação em Saúde.

RESUMEN

Objetivo: *Analizar la dinámica espacial y tendencia temporal de las Hospitalizaciones por Condiciones Sensibles a la Atención Primaria (HCSAP) en ancianos en el Estado de Sergipe.* ***Método:*** *Estudio ecológico, con análisis espacial y tendencia temporal de las HCSAP en ancianos. Utilizando datos del Sistema de Informaciones Hospitalarias del Sistema Único de Salud, considerando como unidades de análisis las siete regiones de salud y los 75 municipios de Sergipe en los años de 2008 a 2020.* ***Resultados:*** *Identificamos los cinco grupos de causas más prevalentes: Neumonías Bacterianas, enfermedades cerebro-vasculares, Insuficiencia cardíaca, Hipertensión y Diabetes Mellitus. Regiones con tendencia de crecimiento: Itabaiana y Nossa Senhora da Glória (Neumonías Bacterianas y Enfermedades Cerebro-Vasculares), Nossa Senhora do Socorro (Neumonías Bacterianas) y Propriá (Diabetes Mellitus). En el análisis espacial, fueron encontradas tasas muy altas en municipios de todas las regiones de salud, com enfoque en Propriá (en todos los grupos de causas) y Estância y Lagarto (para todos, excepto Hipertensión). Clusters con altas tasas fueron observados para las Neumonías Bacterianas, Enfermedades Cerebro-Vasculares y Diabetes Mellitus con predominância en la región central e, Hipertensión en el leste Sergipano. Fueron identificados cuatro clusters considerados bajos en cuatro de los cinco grupos de causas: Enfermedades Cerebro-Vasculares en los municipios de la regional Nossa Senhora da Glória, Insuficiencia Cardíaca y Diabetes Mellitus en las regiones de Nossa Senhora da Glória, Itabaiana y Lagarto; Hipertensión en las regiones de Itabaiana y Lagarto.* ***Conclusión:*** *El estudio pudo contribuir para estrategias de promoción a la salud en la atención primaria y en las políticas que buscan mayor integralidad de las acciones en la salud del anciano.*

Descriptores: *Atención Primaria de Salud; Hospitalización; Anciano; Sistema de Información en Salud.*

INTRODUCTION

In Brazil, health care is provided mainly through the Primary Health Care (*Atenção Primária à Saúde – APS*) gateway, which, through the Family Health Strategy (*Estratégia de Saúde da Família – ESF*) enables a closer relationship between the services provided and the population[1]. APS aims to prevent and monitor the health of the population, contributing to health promotion and reducing the demand for highly complex services, reducing hospitalizations and the overload of hospital services[2].

With the country's aging population, there is a high use and demand rate for health and care systems for the over-60s. However, as a result of the multiple comorbidities that affect this population, there is a trend towards higher costs and frequency of hospital admissions[2,3].

Hospitalizations for Ambulatory Care Sensitive Conditions (*Internações por Condições Sensíveis à Atenção Primária – ICSAP*) are widely used as an important indicator of health access and resolution. The indicator shows the number of people who could be cared for by primary healthcare and who, due to lack of care and/or timely access to basic health systems, are hospitalized[4]. This term was introduced in Brazil by the Ministry of Health in 2008, with a Brazilian list of ICSAP. This list consists of 19 items based on the 10th Revision of the International Classification of Diseases (*Revisão da Classificação Internacional de Doenças – CID-10*)[5].

The elderly face multiple challenges related to access, such as: geographical and architectural barriers, difficulties with transportation and financial resources, the precariousness of service offerings and approaches for this age group, the low resolution and quality of the APS care network, deficits in the transfer and continuity of care to the healthcare system, and non-compliance of elderly policies. These aspects contribute to a greater susceptibility to avoidable causes of hospitalization, making this part of the population a target for ICSAP[6].

In a study about the quality of primary care in Brazilian cities and the number of ICSAP, we can observe that the elderly were six times more affected by ICSAP than those aged between five and 59. The study also identified that sociodemographic characteristics influence the increase in ICSAP, citing that 1% of the increase in the elderly population raised the number of hospitalizations by 8%[7].

Analyses of ICSAP provide an overview of the situation and performance of health systems, showing a broad range of the effectiveness, quality, and resolution of APS in Brazil, in addition to helping health managers formulate health programs and policies aimed at strengthening and solidifying primary care[8]. Thus, analyzing the main causes

of ICSAP affecting the elderly can be an indicator of how public policies aimed at the elderly and health care, especially APS, are being solidified and highlight the increase in coverage of this age group[8].

Based on geographic distribution and the structural dynamics of the interactions between health, society, and the environment, spatial analysis in health enables the study of factors related to health events[9]. Additionally, it allows for the investigation, location, and identification of health services as well as the identification of how sociodemographic factors may obstruct older people's access to services.

Given this, understanding basic health systems requires knowledge and evaluation of ICSAP affecting the elderly. Therefore, the main objective of this study was to analyze the spatial dynamics and trends of the main causes of ICSAP in the elderly in the state of Sergipe.

METHOD

This is an ecological study using temporal and spatial trend analysis on hospitalizations for conditions sensitive to primary care (ICSAP) in the elderly of Sergipe State. The unit of analysis is the seven health regions and 75 cities in the State, using secondary data from 2008 to 2020.

Sergipe is located in the northeast of Brazil, with a territorial area of 21,925.424 km, subdivided into seven health regions: Aracaju, Estância, Itabaiana, Lagarto, Nossa Senhora da Glória, Nossa Senhora do Socorro and Própria. It has a density of 94.36 inhabitants/km² and an estimated population of 2,318,822 people, with 11.32% of the population (262,586) representing the number of the elderly in the state. In comparison to other regions of the country, the Northeast has one of the lowest Human Development Indices (*Índices de Desenvolvimento Humano – IDH*), life expectancy, infrastructure, and social vulnerability. Sergipe ranks 20th with an IDH of 0.66, a low social vulnerability level, and a life expectancy at birth of 71 years[10]. In this study, the elderly were considered to be those aged 60 years or over, according to Law No. 8,842, of January 4, 1994, which provides for the National Policy for the Elderly.

For the years 2008 to 2020, data on ICSAP were collected from the Hospital Information System of the Unified Health System (*Sistema de Informação Hospitalar*/*Sistema Único de Saúde – SIH/SUS*) based on the consolidated data of the Hospital Admission Authorization (*Autorização da Internação Hospitalar – AIH*), available in the electronic database of the Department of Informatics of the SUS (*Departamento de Informática do SUS – DATASUS*). We used the Ministry of Health's Ordinance No. 221 of April 17, 2008, which lists the 19 diagnostic groups according to CID-10, for the collection and definition of ICSAP. These include: group 1 - diseases preventable by immunization and sensitive conditions; group 2 - infectious gastroenteritis and complications; group 3 - anemia; group 4 - nutritional deficiencies; group 5 - ear, nose and throat infections; group 6 - bacterial pneumonias; group 7 - asthma; group 8 - lung diseases; group 9 - hypertension; group 10 - angina; group 11 - heart failure; group 12 - cerebrovascular diseases; group 13 - diabetes mellitus; group 14 - epilepsies; group 15 - kidney and urinary tract infection; group 16 - skin and subcutaneous tissue infection; group 17 - inflammatory disease of the female pelvic organs; group 18 - gastrointestinal ulcer; group 19 - diseases related to prenatal care and childbirth. Group 19 was excluded from the analysis because it was not the subject of this study, and group 10 was excluded because no results were found.

All groups of causes classified according to the ICD-10 were considered, as well as the health regions of Sergipe, the age group over the age of 60 and the year of processing for data collection.

The data were collected and grouped in Microsoft Excel spreadsheets according to each CID-10 group. The percentage of ICSAP causes for each year was calculated by health region (total number of each cause group for ICSAP according to year and health region/estimated population for the year x 1000 inhabitants), as were the total coefficients for each year by all health regions (total number of ICSAP according to year/population for each year x 1000 inhabitants). After analyzing ICSAP in the elderly in the State of Sergipe, the five main groups of causes were listed, and the percentage of hospitalizations (total hospitalizations per group of causes/total ICSAP) and prevalence (average ICSAP per year according to health region/population in 2014 x 1000 inhabitants) were calculated. Population data was sourced from the 2010 census and annual estimates provided by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística – IBGE*). The year 2014 was selected as the average year of the period analyzed and used to represent the population during this time. Consequently, the temporal and spatial trend analysis was conducted using the five primary ICSAP groups.

The temporal trend analysis covered the period from 2008 to 2020 and utilized Join Point Regression software version 4.5.0.1 (Statistical Methodology and Applications Branch, Surveillance Research Program of the National Cancer Institute, Bethesda, MD, USA, June 2017) to examine the trends of the top five cause groups per health region. The regression model of the five main ICSAP groups allowed the calculation of the average annual percentage change (APC) using the linear model and the Monte Carlo permutation test. In this way, it was possible to measure the

segments over time and to classify the trends as follows: decreasing; increasing; and stationary. The 95% reliability index (95% CI) and Student's t-test were used to evaluate the means.

To analyze the APC, junctions or inflection points were observed. Based on the statistical allocation of the minimum and maximum number of junctions established, it is possible to analyze and test whether the composition of multiple segments, starting on a straight line, is more significant than the minimum number of segments[11].

Spatial analysis was performed with the distribution of prevalence by city and the analysis of association by city for the five main conditions. TerraView 4.2.2 software (Informer Technologies, São José dos Campos, São Paulo, Brazil) and QGIS2.18.3 software (Creative Commons - Attribution - Share Alike License 3.0, CC BY-SA, Las Palmas, California, USA) were used for the respective spatial analyses.

The cartographic base of the State of Sergipe was used, with a projection corresponding to the Universal Coordinate System (*Sistema Universal de Coordenadas*) SIRGAS 2000. Spatial autocorrelation was analyzed using the Global Moran's Index (I), which identifies clusters of areas with similar risks for the expected outcome. Its values vary between minus one and plus one, with values between 0 and +1 indicating a positive correlation and between -1 and 0 a negative correlation.

The Local Indicator of Spatial Association (*Indicador Local de Associação Espacial – LISA*) presented regions with significant local spatial correlation ($p < 0.05$), identifying clusters and outliers[12]. Moran's scatter diagram investigates the behavior of spatial variability by comparing its values with the average of its neighbors. It constructed a two-dimensional graph divided into four quadrants, in which Q1 and Q2 indicate points of positive association and Q3 and Q4 indicate points of negative association, and the descriptions "High-High", "Low-Low", "High-Low" and "Low-High" indicate the Q1, Q2, Q3 and Q4 quadrants respectively. The correlation coefficient ranges from -1 to +1, where values between 0 and +1 suggest a positive correlation and values between -1 and 0 indicate a negative correlation.

Because it was based on secondary data from a public system, this study was not submitted to the ethics committee, as recommended by Health Council Resolution 510 of April 7, 2016. However, the study adhered to ethical rules for human research. The presented data is not personally identifiable and was exclusively collected for this study's specific objectives.

RESULTS

ICSAP rates were calculated according to all CID-10 cause groups, by year and region, excluding groups 10 and 19. The highest rates were found in the health regions of Propriá, throughout the period from 2008 to 2020 (except in 2010), Lagarto, Estância and Nossa Senhora do Socorro. The lowest rates were found in the health regions of Itabaiana, Nossa Senhora da Glória and Aracaju (Table I).

Table I. Rates of ICSAP in the elderly resident population of the health regions of Sergipe, per 1000 inhabitants, by year, 2008-2020

Health Region	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Aracaju	23.00	21.91	17.68	17.23	14.22	12.78	11.14	14.80	17.77	16.40	15.25	15.19	11.62
Estância	27.82	32.48	26.77	26.54	22.54	26.39	23.55	22.57	22.40	25.34	24.26	23.79	19.99
Itabaiana	16.16	15.96	13.86	13.71	11.11	12.95	10.98	14.02	17.96	17.75	16.31	20.40	16.79
Lagarto	39.94	35.48	36.01	22.67	19.76	23.63	24.45	27.28	27.70	19.81	16.84	17.73	11.42
Nossa Senhora da Glória	20.91	18.69	14.57	13.31	15.14	11.15	12.63	12.60	13.51	12.13	9.80	16.03	11.56
Nossa Senhora do Socorro	27.71	23.69	22.64	22.24	25.38	26.22	25.00	29.83	30.42	32.01	29.23	22.88	20.72
Propriá	47.52	38.32	32.70	31.46	30.67	36.72	37.09	40.88	30.68	34.96	35.51	35.32	32.07
Sergipe	**27.55**	**25.58**	**22.36**	**19.98**	**18.14**	**19.06**	**17.97**	**20.79**	**21.78**	**20.88**	**19.30**	**19.46**	**15.61**

Source: Ministry of Health. SUS Hospital Information System (SIH-SUS).

From 2008 to 2020, a total of 57,280 hospitalizations of the elderly population were reported in the State of Sergipe. Among these, the five principal groups of causes of ICSAP have been identified (Table II).

Table II. Main groups of causes of ICSAP in the elderly population of Sergipe from 2008 to 2020.

Causes group	Morbidity list – CID 10	Total number of hospitalizations	Proportion of hospital admissions
Grupo 6	Pneumonias bacterianas	10.589	18.48%
Grupo 12	Doenças cerebrovasculares	9.811	17.12%
Grupo 11	Insuficiência cardíaca	7.624	13.31%
Grupo 13	Diabetes mellitus	7.143	12.47%
Grupo 9	Hipertensão	4.469	7.80%
Total de ICSAP	**-**	**57.280**	**69.18%**

Source: Ministry of Health. SUS Hospital Information System (SIH-SUS).

Regarding the prevalence of the main ICSAP in the elderly by health region during the years analyzed, there was a higher prevalence of: hypertension, diabetes mellitus and bacterial pneumonia in the Propriá health region; bacterial pneumonia in the Estância region; and cerebrovascular diseases in the Lagarto health region, all with rates higher than the state average. The Nossa Senhora da Glória region had the lowest rates of bacterial pneumonia and cerebrovascular diseases, and the Itabaiana region had the lowest rates of heart failure, diabetes mellitus, and hypertension (Table III).

Table III. Prevalence of ICSAP in the elderly by the main groups of causes in the resident population of the health regions of Sergipe, per 1000 inhabitants, 2008-2020.

Health Region	Group 6	Group 12	Group 11	Group 13	Group 9
Aracaju	2.70	2.86	2.25	1.96	1.05
Estância	5.44	3.82	3.71	3.71	1.13
Itabaiana	4.24	3.45	1.65	1.23	0.65
Lagarto	4.29	5.27	3.36	2.96	0.90
Nossa Senhora da Glória	2.69	2.47	1.79	1.48	0.71
Nossa Senhora do Socorro	5.19	3.80	3.52	3.30	2.39
Propriá	4.33	3.97	4.23	5.33	7.47
Sergipe	3.81	3.53	2.74	2.57	1.61

Source: Ministry of Health. SUS Hospital Information System (SIH-SUS).

Table IV presents the time trend by the main groups of causes. Distinct variations were observed among the health areas, regions, and cause groups. The most significant trends were found in Itabaiana and Nossa Senhora da Glória, with bacterial pneumonia and cerebrovascular diseases being the leading causes, followed by Nossa Senhora do Socorro with bacterial pneumonia and Propriá with diabetes mellitus. A trend of reduction was observed in the regions of Aracaju, Estância, and Lagarto among the groups that obtained significant results. There is a focus on the state capital region, which is the only one to show a progressive reduction among the top five identified cause groups.

It is noteworthy that the APC could not be found in the analysis of the Itabaiana health region for hypertension causes due to the lack of data in the electronic database, resulting in a zero response.

Table IV. Temporal trend of ICSAP in the elderly by the main groups of causes, by health region of the state of Sergipe, 2008-2020.

Causes group	Health Region	Percentage change per year (APC)*	IC (95%)	Trends
Group 6 Pneumomies	Aracaju	2008-2013: -12.0*	-19.4; -3.9	Decreasing
		2013-2016: 30.2	-16.2; 102.4	Increasing
		2016-2020: -11.7*	-20.2; -2.3	Decreasing
	Estância	2008- 2020: 2.4	-0.2; 5.1	Increasing
	Itabaiana	2008-2020: 9.7*	5.7; 13.7	Increasing
	Lagarto	2008-2020: 1.1	-4.8; 7.3	Stationary
	Nossa Senhora da Glória	2008-2020: 6.9*	1.1; 12.9	Increasing
	Nossa Senhora do Socorro	2008-2020: 5.0*	1.9; 8.3	Increasing
	Propriá	2008-2020: 1.6	-1.8; 5	Increasing
Group 12 Cerebrovascular diseases	Aracaju	2008-2020: - 1.5	-3.1; 0.2	Decreasing
	Estância	2008-2020: -0.6	-3.1; 2	Decreasing
	Itabaiana	2008-2020: 9.6*	5.5; 13.8	Increasing
	Lagarto	2008-2020: -3.1	-7.7; 1.8	Decreasing
	Nossa Senhora da Glória	2008-2020: 3.3*	1; 5.6	Increasing
	Nossa Senhora do Socorro	2008-2020: 0.9	-1.9; 3.8	Stationary
	Propriá	2008-2020: -0.9	-3.9; 2.3	Decreasing
Cardiac insufficiency	Aracaju	2008-2013: -17.7*	-24.6; - 10.1	Decreasing
		2013-2017: 10.2	-10.8; 36.1	Increasing
		2017-2020: -22.2*	-38.2; -2.1	Decreasing
	Estância	2008-2020: -9.6*	-12; -7	Decreasing
	Itabaiana	2008-2020: 2.8	-1; 6.8	Stationary
	Lagarto	2008-2020: -14.1*	-18.3; -9.7	Decreasing
	Nossa Senhora da Glória	2008-2020: -6.4*	-9.7; -2.9	Decreasing
	Nossa Senhora do Socorro	2008-2018: 2.2	-1.4; 5.9	Increasing
		2018-2020: -34.1	-61.1; 11.7	Decreasing
	Propriá	2008-2020: -13.5*	16.1; - 10.7	Decreasing
Group 13 Diabetes mellitus	Aracaju	2008-2013:-11.7*	-19.2; -3.5	Decreasing
		2013-2016: 20.1	- 19.3; 78.7	Increasing
		2016-2020: -6	-15.5; 4.5	Stationary
	Estância	2008-2015: -6.4	-16.1; 4.4	Stationary
		2015-2018: 35.8	-33.2; 176;1	Increasing
		2018-2020: -27.9	-62.5; 38.7	Decreasing
	Itabaiana	2008-2020: -4.5*	-7.6; -1.2	Decreasing
	Lagarto	2008-2020: -10.2*	-15.4; -4.7	Decreasing
	Nossa Senhora da Glória	2008-2020: -6.7*	-11.5; -1.7	Decreasing
	Nossa Senhora do Socorro	2008-2020: 0.1	-3.6; 3.9	Stationary
	Propriá	2008-2020: 3.6*	0.4; 6.9	Increasing
Group 9 Hipertensão	Aracaju	2008-2020: - 9.33*		Decreasing
	Estância	2008-2020: -11.39*		Decreasing
	Itabaiana	2008-2020: -		-
	Lagarto	2008-2020: -0.09		Decreasing
	Nossa Senhora da Glória	2008-2020:-20.33*		Decreasing
	Nossa Senhora do Socorro	2008-2020: -2.03		Decreasing
	Propriá	2008-2020: -0.01		Decreasing

*Significant value: p< 0.05.
Source: Elaborated by the researchers.

The characterization of the State of Sergipe and the geographical location of the seven health regions is shown in Figure 1. Figures 1A, 1C, 1E, 1G and 1I show the spatial distribution of the prevalence of the main causes in the 75 cities of Sergipe. The maps were classified into five categories based on prevalence, with darker colors indicating higher prevalence. High rates were found in cities in all health regions, especially in Propriá, which showed these results for all groups of causes. Estância and Lagarto did not show very high rates in the hypertension group. It can be observed that in the regional areas of Lagarto and Estância, the city itself has the highest prevalence rates in all five groups analyzed. In the highlands of Sergipe, Canindé de São Francisco, located in the Glória region, has high rates of three groups of causes: heart failure, diabetes mellitus, and hypertension.

The analysis of association was performed using Moran's index and showed significant autocorrelations in two groups of causes of ICSAP: cerebrovascular diseases (I=0.2391; p-value=0.01) and diabetes mellitus (I=0.1749; p-value=0.02), with positive values of direct autocorrelations. This means that cities with similar rates are closer to each other.

By constructing a Moran's map, it was possible to visualize the regions with spatial dependence. Four clusters marked as "Q1" were observed in relation to bacterial pneumonia (1B), cerebrovascular diseases (1D), diabetes mellitus (1H) with a predominance in the central region and, hypertension (1J) in eastern of Sergipe, indicating a high prevalence both in the municipality and its neighbors. Four clusters considered low (Q2) were identified in four of the five cause groups: cerebrovascular diseases (1D) in the cities of Nossa Senhora da Glória; heart failure (1F) and diabetes mellitus (2H) in the regions of Nossa Senhora da Glória, Itabaiana, and Lagarto; and hypertension (1J) in the regions of Itabaiana and Lagarto.

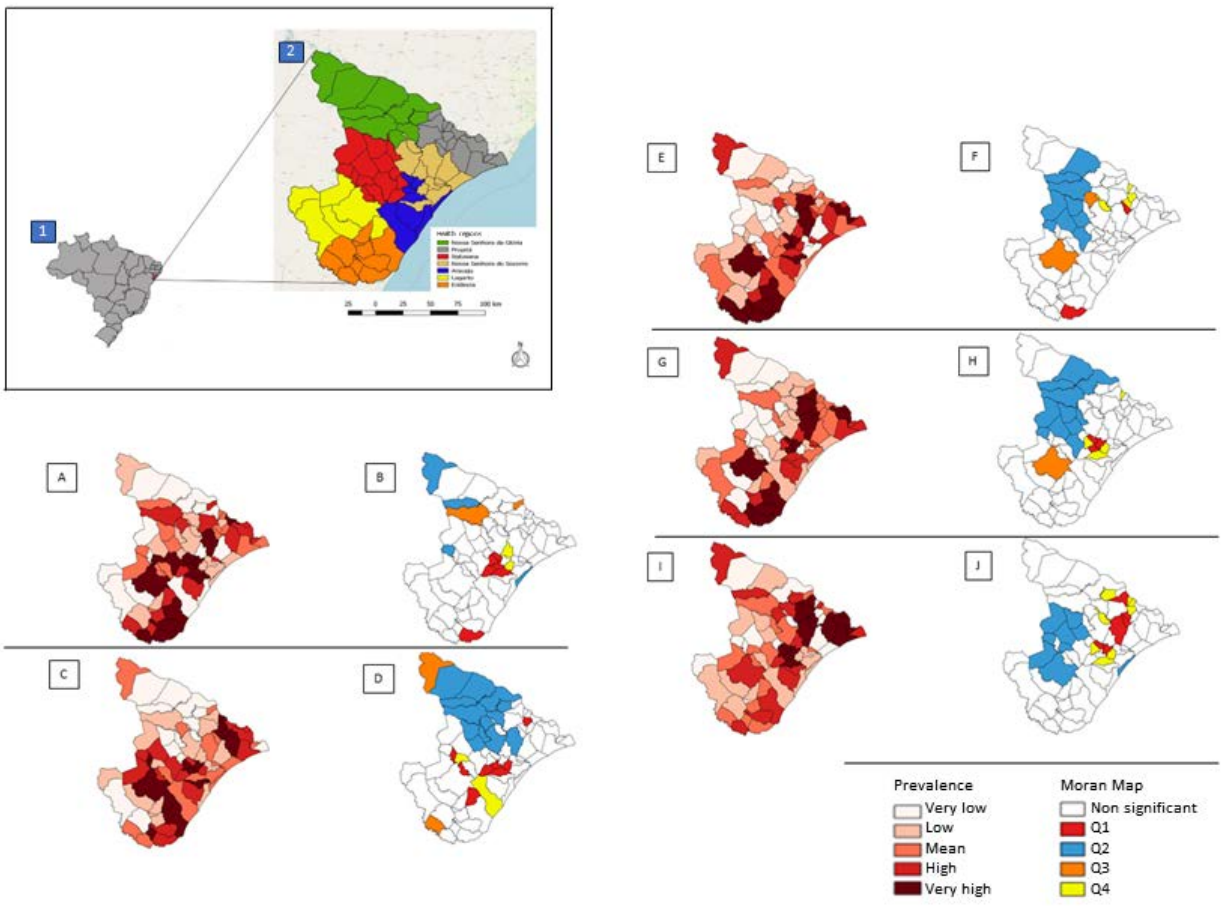

Figure 1 - Location map of the state of Sergipe divided into health regions. 1A.1C.1E.1G.1I. Spatial distribution of prevalence rates for the five main groups of causes by city, Sergipe, 2008-2020. 1B.1D.1F.1H.1J. Spatial autocorrelation and clusters of prevalence rates by the five main groups of causes by city, Sergipe, 2008-2020. AB. Group 6: bacterial pneumonia; CD. Group 12: cerebrovascular diseases; EF. Group 11: heart failure; GH. Group 13: diabetes mellitus; IJ. Group 9: hypertension.

Source: Elaborated by the researchers.

DISCUSSION

This study made it possible to evaluate ICSAP in the elderly over time and space, considering the trend of the main causes identified in the State of Sergipe, with variations in increases and decreases between regions and main groups of causes. It also allowed the spatial evaluation and analysis of the health regions with the highest incidence of these conditions, in order to provide information on the behavior of ICSAP in the elderly population in Sergipe.

The results mentioned here reaffirm the importance of incentive policies to promote the health of the elderly, minimizing ICSAP in the State of Sergipe. Although Sergipe showed a "U-shaped" trend in ICSAP cases between 2008 and 2017, with a decrease in total registrations until mid-2011 and a subsequent increase until 2017(13), this is consistent with the present study. This was related to the economic crisis experienced by the country and the context of PEC55/2016[13]. Other factors have also been identified, such as the implementation of the National Health Promotion Policy (*Política Nacional de Promoção da Saúde – PNPS*) since 2006, higher per capita investment in APS in the State of Sergipe during 2019, and the relationship with the More Doctors Program (*Programa Mais Médicos*) for regions with a lower IDH in the state, between 2014 and 2015[13,14]. These actions have an impact on the behavior and dynamics of the ICSAP and on the effectiveness of APS itself, favoring incentive policies aimed at reducing hospitalizations among the elderly in the State of Sergipe.

Scientific evidence has also shown that there is a relationship between percentage reductions in ICSAP rates and increased coverage and strengthening of the ESF (4). In Sergipe, ESF coverage was 84.65% in 2008 and is estimated to reach 86.63% by 2020[15].

In the analysis of the health regions in Sergipe, the region of Propriá had the highest rate of ICSAP per year, even if the population had 99% ESF coverage in 2020. A descriptive study of ICSAP in Rondônia showed that small communities had a high proportion of hospitalizations for sensitive conditions[16]. Another study that examined the quality of primary care and its relationship with the number of ICSAP in Brazilian cities found a significant correlation between the two[7].

Similarly, considering the relationship between the decrease and increase in rates between health regions calls into question the inherent characteristics of each region. Factors related to social determinants of health, sociodemographics, structure, use and distribution of health services and financial resources, population estimates, and culture can directly influence the proportion of ICSAP. In terms of access to and resolution of APS problems, the elderly face other factors related to the lack of continuity of care and transfer within the care network, which influence the rate of hospitalization[4,14,17].

The five main groups of causes identified (bacterial pneumonia, cerebrovascular diseases, heart failure, diabetes mellitus and hypertension) accounted for 69.18% of all ICSAP in the population over 60. These conditions are included in the classification of chronic non-communicable diseases (*Doenças Crônicas Não Trasmissíveis – DNCT*) and represent a serious public health problem[18]. This is consistent with a study conducted in Rio de Janeiro, in which the percentage of chronic conditions accounted for more than half of all cause groups in the elderly population[19]. Similar results regarding the higher prevalence of ICSAP by health condition have been found in other studies[19,20], such as cerebrovascular diseases, followed by heart failure.

The most common ICSAP in the elderly in the State of Sergipe are consistent with findings in other Brazilian states. In a study carried out in Rio Grande do Norte on ICSAP in the elderly, the main groups of causes were bacterial pneumonia, which was the index that most concentrated the proportion of elderly people, and cerebrovascular diseases[21]. Another study added that heart failure, diabetes mellitus and hypertension were the most common diseases[17].

Cerebrovascular disease and heart failure (*insuficiência cardíaca – IC*), together with the worsening of arterial hypertension and diabetes mellitus, are important causes of cardiovascular disease (*doenças cardiovasculares – DCV*) in Brazil. Scientific research shows that an aging population is a relevant factor in the onset of these conditions, due to the intrinsic factors of this age group and the risk factors associated with it[22].

This is a Brazilian population-based study that identified the risk of cardiovascular disease and showed that the risk increases with age, especially in those with higher blood pressure and lower levels of education[17]. Another study also found that the incidence of cerebrovascular accident (*acidente vascular cerebral – AVC*) increases in people over the age of 60, with an upward trend every decade[23].

The incentive programs and public policies in place to control these diseases, in terms of preventive factors and health promotion in the APS sphere, such as the National Program for Hypertension and Diabetes Mellitus (*Programa Nacional da Hipertensão Arterial e Diabetes Mellitus – HIPERDIA*), pharmaceutical distribution and drug dispensing, in addition to the strategic actions for the control of chronic non-communicable diseases (*Doenças Crônicas Não*

Trasnsmissíveis – DNCT) established by the Ministry of Health[17, 22,25], contribute to ensuring comprehensive care by expanding access, support and care for the elderly. This provides longitudinal care for the elderly by implementing the recommended National Policy for the Health of the Elderly (*Políticas Nacionais de Saúde da Pessoa Idosa – PNSPI*)[16].

It was noted that, despite a decreasing or stable trend in the main groups of causes over the years analyzed, the literature shows the high prevalence of these causes (bacterial pneumonia, cerebrovascular disease, heart failure) in the mortality of the elderly in Brazil, with higher costs and longer hospitalization periods[2,3,26]. This highlights the need for public policies targeted at this population, as well as targeted approaches to minimize these effects on the impact of functionality on the health of the elderly.

On the other hand, the significant growth trends were greater in the bacterial pneumonia cause group in the regions of Itabaiana (representing the greatest trend of all groups), Nossa Senhora da Glória and Nossa Senhora do Socorro. In the literature, pneumonia represents the highest rate of hospitalization in the elderly, encouraging health actions aimed at this cause, even if they are incipient in the context of APS in these regions, and reaffirming the need for greater attention aimed at comprehensive health care for the elderly[21].

Other increasing trends were also observed, such as the group of cerebrovascular diseases, represented in the regions of Itabaiana and Nossa Senhora da Glória, and the group of diabetes mellitus, in the region of Propriá. The increase in these diseases suggests the possibility of real health incentives to provide better care for the elderly in these regions, since these causes influence the mortality of the elderly in Brazil[13].

Other increasing trends were also observed, such as the group of cerebrovascular diseases, represented in the regions of Itabaiana and Nossa Senhora da Glória, and the group of diabetes mellitus, in the region of Propriá. Since these causes influence the mortality of the elderly in Brazil, the increase in these diseases suggests the possibility of real health incentives to provide better care for the elderly in these regions[13].

It is well known that hospitalization has a direct impact on the independence and autonomy of older adults, as the length of hospitalization affects their functionality and can have an impact on their deterioration and likelihood of readmission. It is also known that when 100 older people were hospitalized, one-third showed a decline in Basic Activities of Daily Living (*Atividades Básicas de Vida Diária – ABVD'S*) functionality at the time of discharge, and 28% had not returned to their previous level of health after 30 days in the hospital[27].

When analyzing the spatial distribution and association of the five main groups of causes in the elderly in the 75 cities of Sergipe, it was possible to identify significant spatial autocorrelations for the risk of ICSAP. It should be noted that in the regions with the highest rates, such as the regions of Nossa Senhora do Socorro and Propriá (located in the east and northeast of the state), this may be related to the social determinants of health, which, as seen in[28], the economic and social indicators represented a significant correlation, both with life expectancy and with the provision of health services. We believe that indicators such as illiteracy among the elderly have a direct impact on access to services and health conditions, identifying the lowest rates in the Propriá region and thus impacting existing inequalities.

Although the metropolitan area has the highest percentage of elderly residents, the average percentage remains low compared to other regions. This may be related to better income indicators and better access to and distribution of health services for the elderly[28].

With variations in the downward trend and few significant clusters, it should be noted that in the Lagartop region this may reflect the growing incentives for health actions and services, such as the installation of the Federal University of Sergipe, a reference health campus, in 2011. Then, in 2017, the Multiprofessional Residency Program in the Family Health Strategy (*Programa de Residência Multiprofissional em Estratégia da Saúde da Família*) was offered in the APS sphere, which allowed the expansion of care delivery and the accessibility and availability of services to the population.

Estância and Itabaiana, despite having rates that are similar to each other in terms of spatial autocorrelation compared to other regions, have different prevalence values for bacterial pneumonia, cerebrovascular disease and diabetes mellitus. The social determinants in these regions, such as income and access to health services, are important indicators when considering more effective conditions for access to health services for the elderly[28].

Similarly, when analyzing the factors related to the occurrence of ICSAP among the elderly in the state of Minas Gerais, they found that the provision of services, such as ESF coverage and the availability of SUS beds, had an inverse effect on rates. That is, while a 10% increase in ESF coverage led to a 4.2% decrease in ICSAP, the provision of one bed/1,000 inhabitants increased rates by 2.5%[28].Other factors have also been studied, such as the influence of the per capita income of the cities studied, with a negative relationship with the occurrence of ICSAP in the state. That is, cities with lower income had a higher risk of hospitalization[15, 27]. These data provide evidence of a wide range of factors related to the occurrence of ICSAP in the State of Sergipe.

In addition to socioeconomic factors, others have been identified as determinants, such as the external characteristics of APS, the functioning and delivery of health services, and policies targeting the elderly themselves[15, 29]. In addition, other issues, such as those related to the elderly themselves, are mentioned in the literature, according to which the elderly population is more vulnerable, both physically and financially, and has little knowledge of primary care, which affects the underutilization of primary health care systems[19].

The results presented here suggest that factors related to income and the intrinsic characteristics of each region have a direct influence on the proportion and risk of the elderly affected by ICSAP with the State of Sergipe having a heterogeneous distribution of rates in the health regions described. This underlines the importance of actions aimed at the over-60s in the reformulation of policies and compliance with them, in order to guarantee continuity of care that allows comprehensive care. The limitations of the study, based on secondary data, are also reported. These include errors related to the non-discrimination of readmissions for the same cause, which could lead to a duplication of the data analyzed here and influence the rates described. In addition, in order to conduct studies that support global analysis with optimized analysis and low cost, it is necessary to improve the reach and availability of public data.

CONCLUSION

The State of Sergipe showed a reduction in the proportion of ICSAP in the elderly over the 12-year period under study, but this was not linear between the health regions under study. It was also possible to associate the inequalities between regions in terms of spatial distribution and how these factors can influence access to services and better expansion of APS, with repercussions on the reduction of ICSAP rates in the elderly.

The findings described here serve as a basis for reformulating public policies aimed at providing comprehensive health care to the population studied, creating a potential space for understanding the main causes affecting the health of the elderly in the state. In addition, the spatial autocorrelation between the regions analyzed makes it possible to understand and visualize the areas most affected by the conditions, to implement health policies that are resolutive and have better access to services. Thus, this has a direct impact on the functionality and quality of life of this population.

Therefore, to better understand the factors associated with these hospitalizations among the elderly, their demographic profile, health regions, and associated determinants, more studies analyzing ICSAP are needed.

CONFLICTS OF INTEREST

There are no conflicts of interest reported by the authors.

CONTRIBUTIONS

Larissa Amanda Araújo Santos and **Shirley Verônica Melo Almeida Lima** contributed to the acquisition, analysis and interpretation of data and writing and revising the manuscript. **Júlia Guimarães Reis da Costa** contributed to writing and revising the manuscript. **Andrezza Marques Duque** contributed to the preparation and design of the study, the acquisition, analysis and interpretation of data and the writing and revision of the manuscript.

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