Trends of hospitalizations for ambulatory care-sensitive cardiovascular conditions in the municipality of Senador Canedo, Goiás, Brazil, 2001-2016*

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Abstract

Objective: to analyze trends of hospitalization for ambulatory care-sensitive cardiovascular conditions (ACSCC). **Methods:** this was an ecological study of time series of rates of hospitalization for ACSCC in the municipality of Senador Canedo, GO, Brazil, 2001-2016; we used data from the Hospital Information System and population estimates provided by the Inter-Agency Health Information Network (RIPSA) and the Brazilian Institute of Geography and Statistics (IBGE); the Prais-Winsten method was used to analyze trends. **Results:** we used data on 3,244 hospitalizations for ACSCC; there was decreasing trend in the rate of hospitalizations for ACSCC (annual increase rate [AIR] = -8.14 – 95%CI -11.78;-4.35) and in the heart failure rate (AIR = -12.07 – 95%CI -14.75;-9.30); hospitalization rate time trends for hypertension, angina and cerebrovascular diseases were stationary. **Conclusion:** rates of hospitalization for ACSCC and heart failure decreased, however rates for hypertension, angina and cerebrovascular diseases remained constant.

Keywords: Cardiovascular Diseases; Primary Health Care; Hospitalization; Health Services Research; Time Series Studies.

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Introduction

Ambulatory care-sensitive conditions (ACSC) are health conditions the morbidity and mortality of which can be reduced through timely and effective primary health care.[1,2] An indicator much used to evaluate the extent to which primary health care is resolutive is the rate of hospitalizations for ambulatory care-sensitive conditions (HACSC).[3] High HACSC rates can be related to shortcomings in primary health care, both with regard to preventing the development of ACSC and also in relation to their management.[1,4,5] Promotion, prevention, cure and rehabilitation actions on the primary health care level are capable, in the short and medium term, of achieving a reduction in the number of HACSC.[6]

Measuring HACSC rates is important in the sense of analyzing the effectiveness of primary health care provided by the Brazilian National Health System (SUS), in addition to guiding the development of actions to regulate access to hospital admissions. Standing out among the morbidities found on the Brazilian List of Ambulatory Care-Sensitive Conditions are systemic arterial hypertension (ICD: I10 and I11) and related outcomes, such as angina (I20), cerebrovascular diseases (I63-I67; I69; G45 and G46) and heart failure (I50 and J81).[6-8] Individuals who have these conditions are more prone to hospitalization, owing to the greater risk of functional impairment, drug-related adverse events and the occurrence of comorbidities having exclusive and relevant impact from the socio-economic point of view, both for the patient and for Public Health.[9]

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Cardiovascular diseases are the leading causes of morbidity and mortality worldwide. Their impact can be direct, through their ability to cause functional impairment, or indirect, owing to adverse effects of treatment, leading to people being more dependent on the health system.[9,10] This results in great financial onus for the State, as was made evident in 2016 when there were 1,125,944 SUS hospitalizations owing to circulatory system diseases, at a cost of R$2,734,129,065.96 for the health system.[11]

In Florianópolis, capital of the state of Santa Catarina, a study analzying HACSC between 2001 and 2011 showed that cerebrovascular diseases and heart failure came in 2nd and 3rd place on the list of HACSC. In a health region in the state of São Paulo, there were 26,759 HACSC between 2008 and 2010, 41.5% of which related to circulatory system diseases.[7,12]

There are still few studies on hospitalization rates for ambulatory care-sensitive cardiovascular diseases (ACSCC); in particular there are no data on these rates in Senador Canedo, in the state of Goiás (GO). As it is a medium-sized municipality located in the metropolitan region of the state capital Goiânia, according to the "inverse care law", Senador Canedo could have a greater trend towards higher hospitalization rates.[13] The need therefore exists to evaluate access to primary health care and its effectiveness by means of systematized studies of HACSC.[3]

The objective of this study was to analyze trends in the rates of SUS hospitalizations attributed to ACSCC in the municipality of Senador Canedo, GO, between January 2001 and December 2016.

Methods

This is an ecological study of the time series of SUS hospitalization rates arising from ambulatory care-sensitive cardiovascular conditions (ACSCC), involving patients resident in the municipality of Senador Canedo between January 2001 and December 2016. This period was selected in order to obtain a sufficient number of data to perform the time series analysis, but without excessive historical information interfering with the extrapolation current results. The study's population was comprised of individuals aged 30-69 years old who used SUS services and were resident in the municipality in the study period.

Senador Canedo is located in the middle of the state of Goiás and forms part of the metropolitan region of the state capital Goiânia. According to estimates made by the Brazilian Institute of Geography and Statistics (IBGE), in 2016 the municipality had 102,947 inhabitants and population density of 420.63 inhab./km². Its human development index (HDI) was 0.701 which is considered to be high. According to data provided by the Health Ministry's Primary Health Care

Department, Senador Canedo has 100% Family Health Strategy (FHS) coverage comprised of 34 teams, a Urgency and Emergency Health Center, a Psychosocial Care Center, a Family Health Support Hub, a Mobile Urgency Care Unit, a Medical and Dental Specialties Center and a Municipal Maternity Hospital.[14,15]

The hospitalization rates (HR) among the general population were calculated taking the municipality's resident population[16] as the denominator and applying the following formula:

$$HR = \frac{\text{No. of ambulatory care-sensitive cardiovascular condition hospitalizations}}{\text{Resident population}} \times 10,000$$

This calculation was performed for each of the causes studied based on time series. All the data collected refer to people aged 30-69.

We considered ambulatory care-sensitive cardiovascular condition hospitalizations to be those having as their main diagnosis one of the following codes of the International Statistical Classification of Diseases and Health Related Problems - Tenth Revision (ICD-10): arterial hypertension (I10 and I11); angina (I20); heart failure (I50 and J81); and cerebrovascular diseases (I63-I67; I69; G45 and G46). These conditions are found on the Brazilian List of Ambulatory Care-Sensitive Conditions created by Health Ministry Ordinance No. MS/SAS 221, dated April 17th 2008. Hospitalization records were retrieved from the SUS Hospital Information System (SIH/SUS) and tabulated using the Tabwin application.

Data on the resident population were retrieved from population estimates provided by the Inter-Agency Health Information Network (RIPSA) and the Brazilian Institute of Geography and Statistics (IBGE), which can be accessed on the SUS Information Technology Department (DATASUS) website. Only population data for the year 2016 were not available and were therefore estimated by projecting the annual average population growth rate for the other years. These tabulations were performed using the TabNet application.

After being tabulated, the data were organized and the rates were calculated using Microsoft Excel. We estimated the annual and overall percentage variation of the rates. We performed the statistical analyses using the Stata statistical package, version 13.0.

We used the Prais-Winsten generalized linear regression method to analyze the hospitalization rate trends. We preferred this measurement to simple linear regression as it is a generalized linear regression procedure especially designed for data which may be influenced by serial autocorrelation, as frequently happens with population data measurements. The dependent variable logarithm is used to carry out the Prais-Winsten method.[17] We built models in which the hospitalization rate logarithm was added as a dependent variable and the year of hospitalization as an independent variable.

By using Prais-Winsten regression we were able to obtain the β value for the slope of the straight line. Statistical significance was found by making a comparison between the p value given by the standard normal curve (t), taking a 95% confidence interval.

The coefficient of determination (R^2) was used to measure the fit of the linear model in relation to the hospitalization rate values found. R^2 varies between 0 and 1, indicating in percentage terms the extent to which the model explains the values found.

The mean annual percentage increase rate (AIR) was calculated using the following formula:

$$\text{Annual increase rate} = \alpha + 10^{\beta}$$

Where:

α corresponds to the hospitalization rate in the first year of the series (intersection between the X and Y axes); and
β corresponds to the coefficient of the slope of the straight line formed during regression.

The 95% confidence interval (95%CI) of the mean annual percentage increase rate in the period was calculated based on the following formula:

$$95\%CI = -1 + 10^{(\beta \pm t * EP)}$$

Where:

t is the value at which Student's t distribution has 15 degrees of freedom at a two-tailed 95%CI; and
EP is the estimated standard error of β, provided by the regression analysis.

We adopted a 5% significance level for all the statistical tests we used. P-values≤0.05 were therefore considered to be significant.

It was not necessary to submit the study project to the Federal University of Goiás Human Research Ethics Committee, since the research was performed on secondary data in which participants are not identified, as per National Health Council (CNS) Resolution No. 466, dated December 12th 2012, and CNS Resolution No. 510, dated April 7th 2016. The latter Resolution provides for research that uses public domain information not needing to be submitted to a Research Ethics Committee.

Results

We used data on 3,244 SUS ACSCC hospitalizations relating to patients aged 30-69 and resident in Senador Canedo between January 2001 and December 2016. Heart failure was the most diagnosed condition, found in 1,147 (33.35%) hospitalizations, followed by hypertension, in 1,066 (32.86%), cerebrovascular diseases, in 576 (17.76%) and angina, in 455 (14.03%). Figure 1 shows hospitalization rate magnitude and trend for each of these causes.

Table 1 shows the ACSCC hospitalization rates in Senador Canedo and respective percentage variations (annual and total) in the period studied. There was a total reduction of 62.08% in the hypertension hospitalization rate, a 51.11% reduction for angina and an 87.56% reduction for heart failure; as well as a 74.48% reduction in total percentage variation. Only the cerebrovascular diseases hospitalization rate increased, by 5.68%.

Heart failure hospitalizations are predominant in almost all the period, with a peak of 147.23 hospitalizations/10,000 inhabitants in 2012. There were peaks in the angina and hypertension hospitalization rates

in 2005 and 2007, respectively, followed by periods of falling trends in both rates. The cerebrovascular diseases hospitalization rate remained below all the other rates and its magnitude was stationary throughout the period.

Table 2 shows the analysis of the hospitalization rates trend for each cause studied among the population aged 30-69. The heart failure hospitalization rate decreased (AIR = -12.07 – 95%CI -14.75;-9.30); hospitalizations analyzed for the remaining cardiovascular conditions showed a stationary trend over the period. Taking all ACSCC hospitalizations as a whole we found a decreasing trend (AIR = -8.14 – 95%CI -11.78;-4.35).

Discussion

We found a decreasing tend trend in the ACSCC hospitalization rate in the municipality of Senador Canedo between January 2001 and December 2016. Heart failure diagnosis stood out among these hospitalizations and showed a decreasing time trend, while the time trends for the hospitalization rates of systemic arterial hypertension, angina and cerebrovascular diseases were stationary.
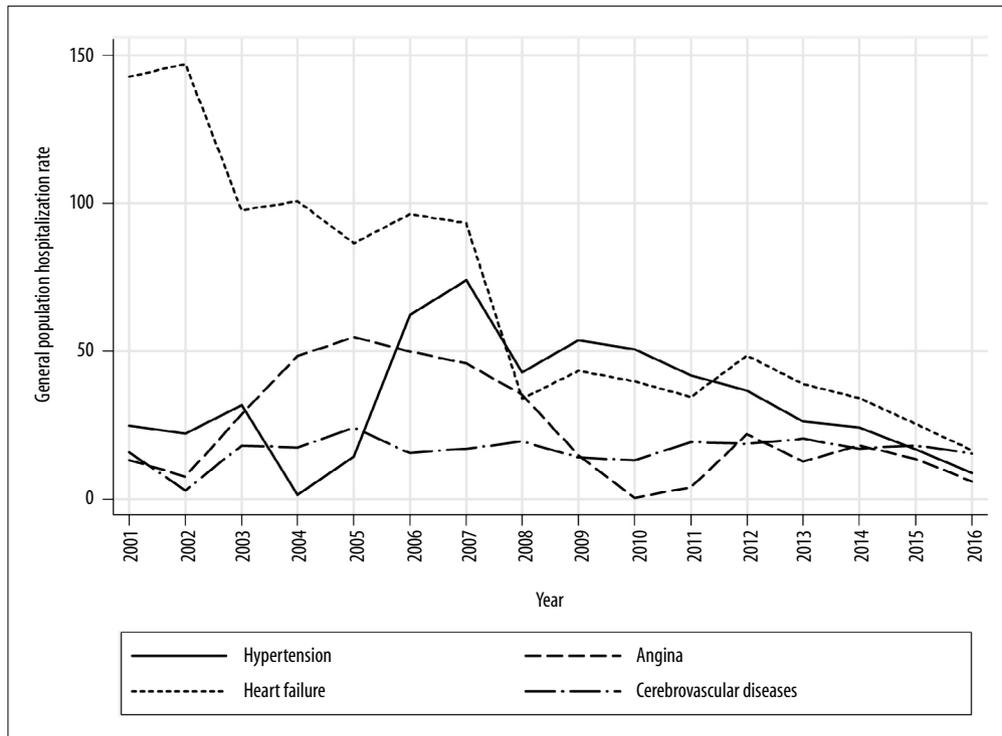

Figure 1 – Ambulatory care-sensitive cardiovascular condition hospitalizations per 10,000 inhabitants aged 30-69 years, in Senador Canedo, Goiás, 2001-2016

The substantial reduction in ACSCC hospitalizations in Senador Canedo coincides with data in the literature. Boing et al. (2012) found substantial HACSC reduction and pointed to heart failure as the second leading cause amongst hospitalizations recorded between 1998 and 2009 in Brazil as a whole.[8] Batista et al. (2012) found an increasing trend for ACSCC hospitalizations in municipalities in the state of Goiás between 2000 and 2008 and the leading causes of HACSC identified by them in a population aged over 40 were chronic

Table 1 – Ambulatory care-sensitive cardiovascular condition hospitalization rates and respective percentage variations (annual and total), in Senador Canedo, Goiás, 2001-2016

Year	Hypertension hospitalization rate	Percentage variation (%)	Angina hospitalization rate	Percentage variation (%)	Heart failure hospitalization rate	Percentage variation (%)	Cerebrovascular disease hospitalization rate	Percentage variation (%)	ACSCC hospitalization rate[a]	Percentage variation (%)
2001	25.70		13.64		148.45		16.26		204.05	
2002	23.01	-10.47	7.83	-42.56	153.25	3.24	2.94	-81.93	187.03	-8.34
2003	32.87	42.84	29.67	278.80	101.35	-33.87	18.72	537.16	182.62	-2.36
2004	1.29	-96.08	50.32	69.56	104.93	3.53	18.06	-3.50	174.60	-4.39
2005	14.97	1,060.19	57.04	13.37	90.21	-14.03	25.08	38.86	187.31	7.28
2006	65.26	335.98	52.21	-8.47	100.96	11.91	16.12	-35.72	234.55	25.22
2007	77.91	19.39	48.28	-7.51	98.40	-2.54	17.92	11.17	242.52	3.40
2008	45.37	-41.77	37.34	-22.66	35.95	-63.47	20.59	14.88	139.25	-42.58
2009	57.06	25.76	15.59	-58.25	46.11	28.27	14.93	-27.51	133.68	-4.00
2010	53.95	-5.44	0.32	-97.98	42.28	-8.31	13.88	-7.00	110.43	-17.40
2011	44.91	-16.76	4.25	1,246.43	37.02	-12.44	20.63	48.63	106.81	-3.28
2012	39.93	-11.09	23.78	459.77	52.84	42.75	20.26	-1.83	136.81	28.08
2013	29.20	-26.86	14.03	-41.01	43.23	-18.19	22.62	11.65	109.08	-20.27
2014	27.14	-7.05	20.22	44.13	38.22	-11.58	19.11	-15.50	104.69	-4.02
2015	18.82	-30.65	15.11	-25.26	28.37	-25.78	20.15	5.43	82.45	-21.24
2016	9.75	-48.23	6.67	-55.87	18.47	-34.91	17.18	-14.72	52.06	-36.86
Total variation (2001-2016)		-62.08		-51.11		-87.56		5.68		-74.48

a) ACSCC: ambulatory care-sensitive cardiovascular conditions.

Table 2 – Analysis of the trend of ambulatory care-sensitive cardiovascular condition hospitalizations per 10,000 inhabitants aged 30-69 years, in Senador Canedo, Goiás, 2001-2016

ACSCC hospitalization rates[a]	AIR[b] (%)	95%CI[c] Lower limit	95%CI[c] Upper limit	R2[d]	Trend
Hypertension	0.13	-13.66	16.13	0.45	Stationary
Angina	-7.47	-23.97	12.62	0.69	Stationary
Heart failure	-12.07	-14.75	-9.30	0.87	Decreasing
Cerebrovascular diseases	3.63	-0.99	8.46	0.23	Stationary
Total	-8.14	-11.78	-4.35	0.91	**Decreasing**

a) ACSCC: ambulatory care-sensitive cardiovascular conditions.
b) AIR: average annual percentage increase rate.
c) 95%CI: 95% confidence interval.
d) R2: coefficient of determination.

diseases, especially angina and heart failure.[13] According to DATASUS data, in Goiânia between 2001 and 2016 there was a decreasing trend in heart failure hospitalizations, with a 72% reduction in the number of hospitalizations, while in Senador Canedo there was a 87,56% reduction.[18,19] In a study in which the author assessed all places in Brazil with ACSCC hospitalizations (5,565 municipalities) between 2008 and 2014, an overall decreasing trend was found in ACSCC hospitalization rates in both sexes and all age ranges.[20]

The high rates of heart failure hospitalization, as well as its decreasing trend, are in keeping with the literature: chronic diseases are the leading causes of hospitalizations among older people. The outstanding success in reducing heart failure hospitalization rates in Senador Canedo may be explained by the increase in the coverage of the Family Health Strategy – FHS. Between July 2007 and December 2016 on average FHS coverage was 41% in Goiânia and 85% in Senador Canedo, thus promoting greater effectiveness of the principle of first access and the resolutive capacity of SUS Primary Care.[11] In addition, the great progress made with heart failure treatment, through the use of beta-blockers (ßBlock), angiotensin-converting enzyme inhibitors (ACEI), aldosterone inhibitors and implantable cardioverter defibrillators/cardiac resynchronization therapy, as well as greater medical adherence to treatment guidelines, may have contributed to the large reduction (around 88%) in the hospitalization rate.[21] Despite the considerable reduction, the high heart failure hospitalization rates indicate that the problem still deserves attention.

In the study conducted by Rezende,[20] cerebrovascular disease hospitalization rates show increasing rates in the municipalities studied and are higher in medium and large-sized municipalities, in contrast to the stationary statistical trend for cerebrovascular diseases found in Senador Canedo.

It is important to emphasize that population characteristics, such as socio-economic and cultural factors, the presence or otherwise of risk factors for the development of cardiovascular conditions, in addition to doing physical exercise and having healthy eating habits, may give rise to discrepancies when comparing figures between the country's administrative divisions and regions.[22] Nevertheless, we did not find major differences between the heart failure, systemic arterial hypertension and cerebrovascular disease hospitalization rates for Senador Canedo and data contained in the literature, indicating that there was nothing unusual in the rates found for that city.[3]

Generally speaking, the data indicate a decreasing time trend, stationary in some cases, for ACSCC hospitalizations, both at the national level and in the analysis of the administrative regions in isolation. These reductions have occurred in a manner dependent or otherwise on increased primary health care coverage.[5] The findings for Senador Canedo are similar to those of studies conducted in the state of Paraná, which propose that improved management of risk factors is the origin of the trends found, reinforcing the idea of a probable relationship between reduced hospitalization rates and high Primary Care coverage (100%) and high community health agent coverage (100%) in the city throughout the entire study period; as well as FHS coverage being 85% on average between July 2007 and December 2016.[9,13] The results indicate that the municipality's health services have good resolutive capacity. Even so, the stationary rates found for angina, systemic arterial hypertension and cerebrovascular disease hospitalizations in Senador Canedo, with hospitalization rates higher than those found in Brazil's Midwest region, show that measures aimed at health promotion, prevention, early diagnosis and longitudinal treatment monitoring still need to be enhanced.

One of the main limitations of this study lies in the use of secondary data retrieved from the SUS Hospital Information System (SIH/SUS). That system is geared to billing SUS funded hospitalizations, so that in order to avoid rejection of a Hospital Admission Authorization (AIH-SUS) and non-payment of the related hospitalization, some health establishments may be led to input diagnosis codes based on their compatibility with the code of the procedure performed. Nevertheless, analysis of the quality of diagnosis information held on SIH/SUS showed good validity, with 70.1 to 81.9% specificity and 88.4 and 95.2% specificity.[23] It is important to highlight that as the design of this article is that of an ecological study, we cannot assert that there is a relationship of causality between the negative trend found and increased Family Health Strategy coverage: when analysis is performed for the city, individual cases and their peculiarities are not taken into consideration,

thus making evident the impossibility of controlling confounding factors.[24]

In conclusion, the time trends of ACSCC hospitalizations in Senador Canedo were found to be similar to the overall situation in Brazil as a whole: decreasing trends denote improved primary health care coverage and, consequently, improved effectiveness of its actions. The data we have presented can help with evaluating access to and quality of primary health care in Senador Canedo, apart from the analysis of geographic variations and the indication of the need to enhance these services in the municipality.

Author's contributions

Aquino EC and Neto OLM contributed to the conception and design of the study, results analysis and interpretation, as well as writing and critically reviewing the contents of the manuscript. Silva MVM, Oliveira VS, Araújo-Pinto PM, Razia PFS and Caixeta ACL contributed to data analysis and interpretation, as well as writing and critically reviewing the contents of the manuscript. All the authors have approved the final version of the manuscript and are responsible for all its aspects, including the guarantee of its accuracy and integrity.

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