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Admissions due to ambulatory care-sensitive conditions (ACSC): an analysis based on socio-demographic characteristics, Brazil and regions, 2010 to 2019

Internações por condições sensíveis à atenção primária (ICSAP): uma análise segundo características sociodemográficas, Brasil e regiões, 2010 a 2019

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ABSTRACT: *Objective:* To analyze the temporal trend of hospital admissions due to Ambulatory Care-Sensitive Conditions (ACSC) in Brazil per sex, region, cause and age group, from 2010 to 2019. *Methods:* This is an ecological study based on the temporal trend of ACSC rates. Standardized rates were analyzed in a simple linear regression and a generalized linear model (GLM) Gamma. The percentage change was also checked over three periods: 2010–2014, 2015–2019 and 2010–2019. *Results:* There was a reduction in hospital admission rates between 2010 and 2019 for Brazil: 124.3/10,000 inhab. to 88.2/10,000 inhab. among women (-29.0%) and 119.0/10,000 inhab. to 88.2/10,000 inhab. (-25.9%) among men in all regions. The decrease was more prominent between 2010–2014 (-17.7%) and (-17.8%) than between 2015–2019 (-.2%) and (-5.9%) for females and males, respectively. The milder decline in the period from 2015 to 2019 was more noticeable among age groups 0–4y and 5–19y in all regions. As for the causes, most ICD-10 diseases had a downward trend, the more expressive ones being gastroenteritis (-60%); however, an increase was seen in cerebrovascular diseases among women (11.2%) and men (17.1%), and angina (15% %) and skin infections (56.1%) among men. *Conclusion:* There was a significant drop in ACSC rates in the period analyzed, especially for age groups 0-4y and 5-19y. The rates had a milder drop from 2015 to 2019, a period of austerity and economic crisis.

Keywords: Primary health care. Quality of health care. Hospitalizations. Family health.

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RESUMO: *Objetivo:* Analisar a tendência temporal das internações por condições sensíveis à atenção primária (ICSAP) no Brasil, por sexo, regiões, causas e faixas etárias, no período de 2010 a 2019. *Métodos:* Trata-se de estudo ecológico baseado na tendência temporal das taxas de ICSAP. Foram analisadas as taxas padronizadas segundo regressão linear simples e modelo linear generalizado (MLG) gama. Observou-se também a variação percentual em três períodos: 2010–2014, 2015–2019 e 2010–2019. *Resultados:* Ocorreu redução nas taxas de internação entre 2010 e 2019 para Brasil: 124,3 / 10.000 hab. para 88,2 / 10.000 hab. em mulheres (-29,0%) e 119,0 / 10.000 hab. para 88,2 / 10.000 hab. (-25,9%) em homens, em todas as regiões. A queda foi maior entre 2010 e 2014 (-17,7% e -17,8%) do que entre 2015 e 2019 (-9,2% e -5,9%) — valores para sexo feminino e masculino, respectivamente. Esse declínio menor no período de 2015 a 2019 foi mais perceptível entre as faixas de zero a quatro anos e de cinco a 19 anos em todas as regiões. Quanto às causas, foi verificada redução para maioria dos códigos da Classificação Internacional de Doenças (CID-10), mais expressiva para gastroenterites (-60%), entretanto tiveram aumento doenças cerebrovasculares entre mulheres (11,2%) e homens (17,1%) e angina (15%%) e infecções da pele (56,1%) entre homens. *Conclusão:* Ocorreu importante queda das taxas de ICSAP no período analisado, especialmente para as faixas etárias de zero a quatro e de cinco a 19. As taxas tiveram menor queda entre 2015 e 2019, período de austeridade e crise econômica.

Palavras-chave: Atenção primária à saúde. Qualidade da assistência à saúde. Hospitalizações. Saúde da família.

INTRODUCTION

Primary Health Care (PHC) is the core gateway to the Unified Health System (SUS) in Brazil[1]. The political decision of PHC was the result of the historical process of consolidation of SUS and of the understanding that its strengthening improves the performance of indicators, and reduces both health inequalities and costs[2].

PHC has expanded greatly throughout the national territory since the creation of the Family Health Strategy (FHS) in 1994. Data from the National Household Sample Survey (PNAD) estimated a PHC populational coverage of 50.9% in 2008; data from the 2013 National Health Survey (PNS) estimated the coverage in 53.4% and from 2019, in 60%[3,4]. In addition to the expansion of PHC, it is necessary to assess its quality and ability to produce changes. Assessing health services is a major challenge given the diversity of methodologies available, databases and the importance of considering the perspective of different actors involved in the process: workers, managers and users[5].

Hospital admissions for Ambulatory Care-Sensitive Conditions (ACSC) have been used internationally as an outcome indicator to evaluate PHC. In Brazil, with the creation of the national list of ACSCs in 2008[6], this indicator started to be used to assess hospital admissions and their association with the FHS team.

ACSCs refer to hospital admissions for diseases that would be impacted by adequate care[7,8]. Different countries have listed these diseases in an attempt to develop a measurable indicator. These lists differ from country to country, which makes it hard to compare them; however, they have been widely used to assess PHC and health systems as to effectiveness in impacting hospital admissions[9,10].

ACSC rates in Brazil and regions tended to decline between 1999 and 2007, along with the expansion of FHS coverage across the country[11]. Several analyses of this evolution have been carried out to better understand what can impact these rates in general, looking a correlation with such hospital admission rates[12-14].

ACSCs have been used as an indicator of the effectiveness of health systems[15,16], so it is important to analyze the behavior and evolution of these rates in more recent years—including periods of economic crisis[17]—as to monitor health inequalities and any possible worsening in indicators.

Further national studies stratified by causes and age group are also important to understand how ACSCs can be better used[12].

This study aimed to analyze the temporal trend of ACSCs in Brazil according to sex, regions, causes, and age groups from 2010 to 2019.

METHODS

This is a temporal trend ecological study, in which the rates of hospital admission for ACSC in Brazil and regions from 2010 to 2019 were analyzed.

The data come from the Hospital Information System (SIH) available at the Information Technology Department of the Unified Health System (DATASUS, www.datasus.gov.br). The selection of groups of the International Classification of Diseases in its tenth chapter (ICD-10) was made based on the national list of ACSCs published by the Ministry of Health in 2008[6], composed of 20 diagnostic groups divided into 120 ICD-10 groups, except the ones related to childbirth (ICD-10 O-80 to O-84), as these are the natural outcome of pregnancy, not a disease. People aged 80 years and older were also excluded because they had a higher risk of being admitted to a hospital regardless of the quality of the health service, as recommended by the ACSC-Brasil Project[11].

The rates of hospital admissions for ACSC were calculated by dividing the number of admissions for diseases of the groups described in the Brazilian List of ACSCs[6] by the estimated population, according to the Brazilian Institute of Geography and Statistics (IBGE) in respective years; then, the result was multiplied by 10,000. This procedure was performed by sex, region, and age groups. Rates were also standardized per age distribution of the Brazilian population at the period midpoint (2014), enabling comparisons between years[11]. Rates by cause were also calculated by the number of admissions divided by the estimated population; however, standardization and age distribution were not performed.

The rates of admissions for ACSC were considered a response variable and the year-to-year distribution was considered an explanatory variable. Stratified analyses were performed by region, sex, age group, and causes of hospitalization. To verify the distribution of these rates, the Shapiro-Wilk test was applied. In the analysis groups with normal distribution over the years, a simple linear regression model was applied[18]. In the others, it was assumed that they had a gamma distribution and the Generalized Linear Model (GLM) for the Gamma distribution was applied[19].

The regression coefficient β, which is the degree of association between test variables, was presented both in the linear regression and in the GLM gamma analyses: positive β means a correlation of upward rates over the years; negative β indicates a downward trend. The significance of this association ($p<0.05$) and the extent to which the variation in rates of hospital admissions for ACSC can be explained by the evolution of the years (R^2)—that is, the accuracy of the model—were also shown. Descriptive analyzes were also carried out to verify the percentage changes in rates between the beginning (2010) and the end (2019) of the series, as well as to compare the differences in rates between two different periods: 2010 and 2014, 2015 and 2019.

Data from SIH/DATASUS were tabulated and extracted by means of the Tabwin software version 3.6. The database was exported for statistical analysis in the Statistical Package for the Social Sciences (SPSS) software version 20.0.

The study was carried out in accordance with Resolution No. 466 of the National Health Council (CNS) dated back from December 12, 2012. The SIH information is available on the DATASUS website without patients' identification, therefore, they are freely accessible.

RESULTS

In Brazil and in all regions, both the standardized rates and rates by age group and sex of hospital admission for ACSCs had a statistically significant reduction in the period studied (Table 1).

The biggest drop for both sexes was identified in the Midwest region: -40.87% among women and -35.22% among men. The smallest rate variations in the period were found in the Southeast region, with -22.37% among women and -21.7% among men, followed by the South region, with -26.54% among women and -24.29% among men. In all situations, the difference between 2010 and 2014 was greater than between 2015 and 2019, falling to half the reduction among women and a third among men (Table 1).

The highest standardized rates in 2010 were identified in the North region, with 178.97 hospital admissions per 10,000 inhabitants (178.97/10,000 inhab.) among females and 147.59/10,000 inhab. among males. In 2019, the highest rate for females was reported in the North region (117.70/10,000 inhab.) and, for males, in the South region (102.55/10,000 inhab.) (Table 1).

The rates of hospital admissions for ACSC by age group and regions for males, observed in Table 2, decreased from 2010 to 2019. In the age groups 0-4 years, 5-19 years and 20-59 years, the rhythm of rate decline was slower when the period 2010-2014 was compared with the period 2015- 2019. In some cases, there was an increase from 2015 to 2019, such as in the Midwest region, in the age groups 0-4 years and 5-19 years, and in the Southeast region, in the age group of 0-4 years (Table 2 and Supplementary material — Table 1S).

The biggest drop in rates was reported in the North region for the age groups 0-4 years (-34.34%) and 5-19 years (-37.33%), and in the Midwest region for the age groups 20-59 year (-37.29%) and 60-79 years (-39.08%). In the age group 0-4 years, however, this decrease was noticed only in the first period (2010 to 2014), with little variation in the second period, and with an increase by 9.57% in the Midwest region between 2015 and 2019 (Table 2 and Supplementary material — Table 1S).

The highest hospital admission rates in the age group 0-4 years were found in the North region in 2010 (465.69/10,000 inhab.) and in 2019 (305.79/10,000 inhab.). In the age group 5-19 years, the highest hospitalization rates were reported in the North region in 2010 (73.02/10,000 inhab.) and in the Northeast region in 2019 (48.53/10,000 inhab.). The rhythm of decline in rates also decelerated in 2015 to 2019 and, even though it grew by 3.0% in the Midwest region (Table 2 and Supplementary material — Table 1S).

In the age group 20-59 years, the highest rates were found in the North region in 2010 (88.14/10,000 inhab.) and in the South region in 2019 (64/10,000 inhab.), also with a reduction in the percentage of decline from 2015 to 2019. For the age group 60-79 years, the highest rates were seen in the South region, with approximately 560.8/10,000 inhab. in 2010 and almost 409.2/10,000 inhab. in 2019, with a reported reduction in the downward trend from 2015 to 2019. The correlation of hospital admissions with the years showed an

Table 1. Trends in standardized rates of hospital admissions for ambulatory care sensitive conditions per 10,000 inhabitants according to sex, and percentage changes in 2010–2019, 2010–2014, 2015–2019. Brazil and regions, Hospital Information System, 2010 to 2019.

Region	Sex	2010	2014	2015	2019	Coefficient	p	R^2	Variation 2010–19	Variation 2010–2014	Variation 2014–2019
Brazil	F	124.34	102.30	97.17	88.22	-3.92	<0.01	0.94	-29.06	-17.73	-9.21
	M	119.02	97.74	93.79	88.24	-3.34	<0.01	0.90	-25.86	-17.88	-5.92
Midwest	F	159.44	114.35	106.05	94.28	-7.06	<0.01	0.91	-40.87	-28.28	-11.10
	M	137.33	102.17	96.57	88.96	-5.28	<0.01	0.90	-35.22	-25.60	-7.87
Northeast	F	141.27	113.71	108.65	95.97	-4.93	<0.01	0.93	-32.07	-19.51	-11.67
	M	128.57	105.62	101.74	94.91	-3.64	<0.01	0.89	-26.18	-17.85	-6.71
North	F	178.97	148.34	129.37	117.70	-7.06	<0.01	0.93	-34.23	-17.11	-9.02
	M	147.59	124.15	111.04	101.95	-5.35	<0.01	0.94	-30.92	-15.88	-8.18
Southeast	F	91.02	78.39	75.99	70.65	-2.30	<0.01	0.93	-22.37	-13.87	-7.03
	M	96.21	80.98	78.92	75.34	-2.37	<0.01	0.89	-21.70	-15.83	-4.54
South	F	142.10	119.39	115.50	104.39	-3.65	<0.01	0.91	-26.54	-15.98	-9.62
	M	135.45	110.87	108.27	102.55	-3.11	<0.01	0.83	-24.29	-18.15	-5.28

*p-value<0.001; β coefficient; p-value coefficient; R^2: % of variation in hospital admission rates explained by temporal trend; percentage change.

Table 2. Trends in hospitalization rates for ambulatory care-sensitive conditions per 10,000 inhabitants for the male gender according to age group, and percentage changes in 2010–2019, 2010–2014, 2015–2019, Brazil and regions, Hospital Information System, 2010 to 2019.

Age group	Region	2010	2014	2015	2019	β Coefficient	2010–2019 (%)	2010–2014 (%)	2015–2019 (%)
0-4 years	Brazil*	345.6	268.7	251.2	253.0	-0.03†	-26.8	-22.2	0.7
	Midwest	365.1	258.9	243.3	266.6	-10.64†	-27	-29.1	9.6
	Northeast*	409.4	313.6	287.4	288.8	-0.03†	-29.5	-23.4	0.5
	North	465.7	357.6	317.6	305.8	-16.47†	-34.3	-23.2	-3.7
	Southeast*	259.1	215	208.7	212	-0.02†	-18.2	-17	1.6
	South*	330.5	260.5	247.6	247.1	-0.03†	-25.2	-21.2	-0.2
5-19 years	Brazil	51.9	41.9	39.1	37.7	-1.46†	-27.4	-19.4	-3.6
	Midwest	59.5	42.1	39.7	40.9	-1.92†	-31.3	-29.3	3
	Northeast*	67.2	54.1	49.7	48.5	-0.03†	-27.7	-19.5	-2.4
	North	73.0	59.8	50.6	45.8	-3.11†	-37.3	-18.1	-9.5
	Southeast	34.1	28.7	28.1	27	-0.73†	-20.6	-15.6	-3.6
	South*	48.2	37.1	36.9	35.6	-0.03†	-26.1	-22.9	-3.5
20-59 years	Brazil	70.9	59.0	56.8	52.7	-2.1†	-25.6	-16.7	-7.2
	Midwest	80.1	60.4	57.1	50.2	-3.36†	-37.3	-24.5	-12
	Northeast	75.6	62.2	60.6	54.1	-2.54†	-28.4	-17.7	-10.7
	North	88.1	73.2	65.1	59.3	-3.39†	-32.7	-17	-9
	Southeast	60.2	51.2	49.4	47.2	-1.61†	-21.6	-14.8	-4.5
	South	80.0	67.6	66.9	64.0	-1.47†	-20.1	-15.5	-4.4
60-79 years	Brazil	420.4	354.2	347.2	315.3	-11.81†	-25	-15.7	-9.2
	Midwest	522.9	399.8	379.5	318.6	-22.16†	-39.1	-23.6	-16.1
	Northeast	401.9	350.3	351.4	320.2	-9.88†	-20.3	-12.8	-8.9
	North	467.2	430.2	396.1	357.3	-14.82†	-23.5	-7.9	-9.8
	Southeast	359.7	301.5	297.3	273.0	-10†	-24.1	-16.2	-8.2
	South	560.8	460.6	448.2	409.2	-14.69†	-27	-17.9	-8.7

ACSC: ambulatory care sensitive conditions; %: percentage change. *generalized linear gamma model was used, not linear regression; †p<0.01 of the coefficient.

association and a decrease in the period, which can be verified by β coefficients (-0.02 to -22.16) and with p-value<0.001 in all years (Table 2). The R² calculation also suggests that variable hospitalization rate can be explained over the years (0.60 to 0.96) (Supplementary material — Table 1S).

In Table 2, the rates of hospital admission for ACSC by age group and regions among females also decreased from 2010 to 2014. Between 2015 and 2019, the drop in rates was less marked, while the increase by 6.4% in hospitalization rates in the age group 0-4 years was identified in the Midwest region (Table 3 and Supplementary material — Table 2S).

The greatest reduction in rates among females in the age group 0-4 years old (-35.5%) was found in the North region between 2010 and 2019. In the age groups 5-19 years (-30.7%), 20-59 years (-41.2%) and 60-79 years (-49.1%), the most prominent reductions were identified in the Midwest region (Table 2).

The highest hospitalization rates were found in extreme age groups: 0-4 and 60-79 years. Among children in the first age range, the highest rates were observed in the North region in 2010 (433.8/10,000 inhab.) and in 2019 (279.8/10,000 inhab.). As for the elderly of the second age range, the highest rates were found in the Midwest in 2010 (488.9/10,000 inhab.) and in the South in 2019 (303.7/10,000 inhab.). The correlation of hospitalization rates with the years showed an association and decrease also among females. The β coefficients ranged from -0.03 to -25.57 with p-value <0.001 in all years (Table 3). R² suggests that the variable hospitalization rate can be explained over the years (0, 63 to 0.96) (Supplementary material — Table 2S).

When checking the causes of hospitalization among females in Brazil, the three most frequent in 2010 were: infectious gastroenteritis and complications (29.06/10,000 inhab.), kidney and urinary tract infection (18.31/10,000 inhab. inhab.) and heart failure (13.83/10,000 inhab.). In 2019, the causes were kidney and urinary tract infection (17.40/10,000 inhab.), infectious gastroenteritis and complications (11.75/10,000 inhab.) and cerebrovascular diseases (10.0/10,000 inhab.). The most prominent drops in the period were related to infectious gastroenteritis and complications (-59.6%), asthma (-58.7%) and hypertension (-49.2%). In addition, there was an increase in rate for some causes such as cerebrovascular diseases (11.2%) (Table 4).

Among males, the main causes of hospitalization in 2010 were: infectious gastroenteritis and complications (28.0/10,000 inhab.), heart failure (14.9/10,000 inhab.), and pulmonary diseases (11.2/10,000 inhab.). In 2019, the main causes of hospitalization were cerebrovascular diseases (11.9/10,000 inhab.), infectious gastroenteritis and complications (11.1/10,000 inhab.), and heart failure (10.7/10,000 inhab.). The most marked drops were due to asthma (-61.3%), infectious gastroenteritis and complications (-60.4%), and heart failure (-27.7%). There were also increases in some rates in the period and, among the ten main causes of hospitalization among males, the rates related to skin and subcutaneous tissue infection increased (56.1%), as well as hospital admissions due to cerebrovascular diseases (17.1%) (Table 5).

Table 3. Trends in hospital admission rates for ambulatory care-sensitive conditions per 10,000 inhabitants for the female gender by age group, Brazil and regions, and percentage changes in 2010–2019, 2010–2014, 2015–2019. Hospital Information System, 2010 to 2019.

Age Group	Região	2010	2014	2015	2019	β Coefficient	2010–2019 (%)	2010–2014 (%)	2015–2019 (%)
						Hospital admissions for ACSC among females			
0–4 years	Brazil*	308.6	244.5	227.4	229.1	-0.03†	-25.8	-20.8	0.7
	Midwest	335	242.6	223.5	237.9	-9.91†	-29	-27.6	6.4
	Northeast*	364.1	283.7	259.4	262.9	-0.03†	-27.8	-22.1	1.3
	North	433.8	326.6	286	279.8	-15.3†	-35.5	-24.7	-2.2
	Southeast*	229.3	196.5	190.4	193.7	-3.16†	-15.5	-14.3	1.7
	South*	282.3	232.5	221.3	215.5	-0.03†	-23.7	-17.7	-2.6
5–19 years	Brazil	65.5	59.4	55.7	51.3	-1.5†	-21.7	-9.3	-7.9
	Midwest	81.5	67.4	60.9	56.4	-2.78†	-30.7	-17.3	-7.4
	Northeast	78.2	68.2	63.4	59.6	-1.82†	-23.8	-12.8	-6
	North	96.7	85.4	74.6	68.8	-3.13†	-28.9	-11.6	-7.8
	Southeast	43.7	42.8	41.7	37.6	-0.72†	-13.9	-2	-9.8
	South	66.4	61.7	60.4	54.8	-1.12†	-17.5	-7	-9.3
20–59 years	Brazil	87.2	72.1	68.7	61.9	-2.83†	-29	-17.3	-10
	Midwest	112.1	81.8	76.2	65.8	-5.13†	-41.2	-27	-13.6
	Northeast	99.3	78.7	75.8	65	-3.88†	-34.6	-20.7	-14.2
	North	138.4	113.2	97.7	88.6	-5.73†	-36	-18.3	-9.4
	Southeast	62.6	54.2	52.7	49.1	-1.6†	-21.7	-13.4	-6.9
	South	99.8	85.9	83.7	76.4	-2.17†	-23.4	-13.9	-8.7
60–79 years	Brazil	348.7	279.1	268.4	230.6	-13.18†	-33.9	-20	-14.1
	Midwest	488.9	322.8	302	248.8	-25.57†	-49.1	-34	-17.6
	Northeast	378.2	305.5	300.1	246.3	-15.26†	-34.9	-19.2	-17.9
	North	435.9	379.1	334.8	292.1	-18.4†	-33	-13	-12.8
	Southeast	268.1	219.1	211.4	188.1	-9.15†	-29.8	-18.3	-11
	South	459.5	365.6	351.6	303.7	-15.62†	-33.9	-20.4	-13.6

ACSC: ambulatory care-sensitive conditions; %: percentage change; *generalized linear gamma model was used, not linear regression; †p<0.01 of the coefficient.

Table 4. Ten major causes, in 2010, of hospital admissions for ambulatory care-sensitive conditions among females and respective rates per 10,000 inhabitants, percentage changes in the 2010–2019, 2010–2014, 2015–2019, Brazil and regions, Hospital Information System.

ACSC among women	2010	2014	2015	2019	Variation 2010-2019	Variation 2010–2014	Variation 2015–2019
Infectious gastroenteritis and complications	29.06	19.36	18.39	11.75	-59.6	-33.4	-36.1
Asthma	9.87	6.50	5.75	4.08	-58.7	-34.1	-29.1
Hypertension	6.81	5.14	4.98	3.46	-49.2	-24.6	-30.6
Heart failure	13.83	11.76	11.36	9.90	-28.4	-15.0	-12.8
Diabetes mellitus	8.57	7.46	7.39	6.37	-25.7	-13.0	-13.9
Lung diseases	8.80	8.23	7.79	7.71	-12.4	-6.5	-1.1
Kidney and urinary tract infection	18.31	17.33	18.21	17.40	-5.0	-5.4	-4.5
Bacterial pneumonia	7.80	6.75	6.88	7.64	-2.1	-13.5	11.1
Angina	4.53	4.76	5.04	4.58	1.1	5.0	-9.1
Cerebrovascular diseases	9.00	9.23	9.45	10.00	11.2	2.6	5.9

ACSC: ambulatory care-sensitive conditions

Table 5. Ten major causes, in 2010, of hospital admissions for ambulatory care-sensitive conditions among males and respective rates per 10,000 inhabitants, percentage changes in 2010–2019, 2010–2014, 2015–2019, Brazil and regions, Hospital Information System.

ACSC among men	2010	2014	2015	2019	Variation 2010–2019	Variation 2010–2014	Variation 2015–2019
Asthma	10.07	5.77	5.70	3.89	-61.3	-42.7	-31.7
Infectious gastroenteritis and complications	28.04	17.66	14.38	11.09	-60.4	-37.0	-22.8
Heart failure	14.91	12.24	11.98	10.79	-27.7	-17.9	-10.0
Lung diseases	11.23	9.62	9.89	9.45	-15.8	-14.3	-4.5
Diabetes mellitus	6.70	6.39	6.44	6.70	-0.01	-4.8	4.1
Bacterial pneumonia	9.06	7.91	7.75	9.14	0.9	-12.7	17.9
Kidney and urinary tract infection	8.75	8.61	8.76	9.41	7.5	-1.7	7.4
Angina	6.29	7.34	7.15	7.24	15.0	16.7	1.3
Cerebrovascular diseases	10.13	10.68	11.02	11.86	17.1	5.4	7.6
Infection of the skin and subcutaneous tissue	5.24	6.44	6.80	8.18	56.1	22.8	20.4

ACSC: ambulatory care-sensitive conditions

DISCUSSION

The study of temporal trends in hospital admissions from 2010 to 2019, using the ACSCs list, found a reduction in hospitalization rates in Brazil and across regions; however, the drop reported from 2010 to 2014 was greater than the one reported from 2015 to 2019. Among children aged zero to four years and five to 19 years old there was an increase or reduction in rhythm of decrease in rates from 2015 to 2019. Most causes showed a downward trend, while cerebrovascular diseases increased among women and men, as well as angina and skin infections among men.

The decrease observed in this study is consistent with the reduction reported in studies carried out by the ACSC-Brasil Project from 1999 to 2007 in Brazil and regions[11]. A literature review with the theme of ACSC among children under five years of age found a reduction[13].

When data were analyzed by age group, higher rates were found in the elderly aged 60 to 79 years and in children aged zero to four years of both sexes, which can be explained by the greater vulnerability in the extremes of life, which also have higher mortality rates[20]. For both sexes, the greatest reduction in the age group 0-4 years was found in the North region and, in the age group 60-79 years old, in the Midwest region. In a study carried out by Amorim et al. in Brazil and regions, in which the period from 2003 to 2012 was analyzed, better results were also found for the Midwest region, especially in the age range 60 years and over. One hypothesis would be the great economic development of this region of the country in the period, driven by agribusiness, which had a positive impact on indicators in several areas, including the health of the population[21].

The proportion of drops was similar in all age groups and in the standardized rates for the entire population, varying from 20 to 40% in the period analyzed, as also reported by studies on previous periods, carried out in several cities and states[15,22,23]. This decline may reflect the continued expansion of PHC in the period, the investments in improvement programs and in PHC, namely the Program for Improving Access and Quality of Primary Care (PMAQ-AB)[24,25], the National Policy of Primary Care of 2012[26] and the program "more physicians"[27]. For the age groups 0-4 and 5-19 years, this drop occurred mostly from 2010 to 2014. Between 2015 and 2019, there was a decrease in the rhythm of decline, which has also been described in studies on infant mortality in Brazil, which increased after 2015[28,29].

Some authors have related the increase in infant mortality between 2015 and 2016 with the Zika virus[28], others with austerity policies such as Constitutional Amendment 95 (EC95), which froze the increase in public spendings for 20 years[29]. The findings in the age group from zero to four years old are consistent with research that even project an increase in mortality in children under five years of age by 2030 in Brazil if the crisis and austerity policies are maintained[30].

The relation between crisis, reduced spending on social policies, and the consequent worsening of health indicators has been reported in studies from European countries, especially countries with less robust health systems and higher proportions of vulnerable populations[17].

Another finding of the study was that, in general, higher rates of hospitalization were found in the North region among females. In the Southeast region, lower rates were found for all age groups, in all years. Among males, the highest rates were also found in the North region, except for the 60-79 age group, whose higher rates were identified in the South region. The lowest rates, for all age groups, were also found in the Southeast region. Regional differences have also been described in some editions of PNS, showing worse indicators in the northern region of the country[3]. This can be explained by the lower socioeconomic development in this region and the care gaps, with a lower supply of health services[31].

The main causes of hospitalization found in Brazil among females were infectious gastroenteritis and complications, kidney and urinary tract infections, heart failure, cerebrovascular diseases, and asthma; among males, data were similar, but less expressive when it came to urinary tract and skin infections. Similar results were obtained in a study carried out in Pernambuco between 2008 and 2012[23], with significant drops in hospitalizations for infectious gastroenteritis (60%). This was also described by Macinko et al., who observed the most marked declines in rates of hospital admissions for gastroenteritis and asthma in the age groups up to 20 years old from 1999 to 2007 in Brazil[22]. These results dialogue with those of studies carried out in the North region, in a temporal trend from 2008 to 2017[32], and others conducted with children under one year of age, showing a reduction in hospital admissions for gastroenteritis[33]. These significant drops can be explained by general improvements in living conditions, better sanitation, improvements in water supply, and in access to health services, especially PHC[32].

Pinto Junior et al., in 2020[33], pointed out that the ACSC list has room for some adjustments considering different types of disease by age, such as the Brazilian List of Preventable Causes of Deaths from Interventions of the Unified Health System. This list considers a group of causes for people aged zero to four years and other ICD-10 causes specific for the age group 5-74 years, but not the same ICD-10 in all age groups.

The Unified Health System Performance Index (IDSUS), created in 2012, uses 24 indicators to provide an overview of SUS coverage in the national territory. Hospitalization for causes sensitive to primary care, an IDSUS indicator, do not take into account in their calculation hospitalizations for cerebrovascular diseases, diseases related to intestinal ulcers and prenatal care/delivery, as these are conditions in which PHC would not have an important impact on hospital admission, since they would depend on responses at other levels of the system[31]. In our study, significant increases in hospitalizations were observed from 2010 to 2019 for these three causes in both sexes in Brazil. We highlight the importance of further studies on causes defined as preventable in the ACSC list.

The limitations of this study were related to reliability and accuracy of diagnoses recorded in hospital admission authorizations (HAA) due to inadequate filling. Another limitation is data scope, which was restricted to SUS and partnered network. Caution is recommended when making comparisons between rates stratified by causes, as they have not been standardized. Even so, it is noteworthy that HAAs allow important epidemiological analyses on hospital morbidity[11] and, despite potential information biases, the study brings advances in identifying the evolution of rates of hospital admissions due to ACSC by age group and causes.

This study described a significant reduction in hospitalization rates for ACSC in the period analyzed for both sexes, all age groups and regions. Among causes, gastroenteritis showed the most prominent decline. These findings reflect improvements in PHC, but also in general living conditions. However, a reduction in the rhythm of decline in rates from 2015 to 2019 was identified and, in some regions, even an increase, especially in the age group of 0-4 years. These findings may echo the economic crisis after 2015, as well as the austerity policies implemented in that period. PHC has been experiencing setbacks since 2016, including the dismantling of PMAQ-AB, cuts in specific fundings for the Family Health Support Center (NASF), and the weakening of the "more physicians" Program, added to the resource freezing resulting from EC95, which increases health inequities.

Further analyses of health outcomes and indicators in the coming years are needed so we can understand how these policies will behave. Knowing the trends in hospitalization rates can guide public policies aimed for investments in PHC, which is essential for improving the quality of life and health of the country population.

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REFERENCES

1. Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. Milkbank Q 2005; 83(3): 457-502. https://doi.org/10.1111/j.1468-0009.2005.00409.x

2. Brasil. Ministério da Saúde. Gabinete do Ministro. Portaria nº 2.436, de 21 de setembro de 2017. Aprova a Política Nacional de Atenção Básica, estabelecendo a revisão de diretrizes para a organização da Atenção Básica, no âmbito do Sistema Único de Saúde (SUS). Diário Oficial da União; 2017. [cited on Apr 18, 2022]. Available at: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2017/prt2436_22_09_2017.html

3. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde. Tabelas 2019. Informações sobre domicílios e acesso e utilização dos serviços de saúde. Tabelas Completas Módulos A e B [Internet]. 2020 [cited on Feb 27, 2020]. Available at: https://www.ibge.gov.br/estatisticas/sociais/saude/9160-pesquisa-nacional-de-saude.html?edicao=28655&t=resultados

4. Malta DC, Santos MAS, Stopa SR, Vieira JEB, Melo EA, Reis AAC. A cobertura da estratégia de saúde da família (ESF) no Brasil, segundo a pesquisa nacional de saúde, 2013. Ciên Saúde Colet 2016; 21(2): 327-38. https://doi.org/10.1590/1413-81232015212.23602015

5. Contandriopoulos AP, Champagne F, Denis JL, Pineault R. Avaliação na área da saúde: conceitos e métodos. In: Hartz ZMA (org.). Avaliação em saúde: dos modelos conceituais à prática na análise de implantação de programas. Rio de Janeiro: Editora Fiocruz; 1997. p. 29-47.

6. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Portaria nº 221, de 17 de abril de 2008. Aprova a Política Nacional de Atenção Básica, determinando que a Secretaria de Atenção à Saúde, do Ministério da Saúde, publicará os manuais e guias com detalhamento operacional e orientações específicas dessa Política. Diário Oficial da União; 2008. [cited on Apr 18, 2022]. Available at: https://bvsms.saude.gov.br/bvs/saudelegis/sas/2008/prt0221_17_04_2008.html

7. Alfradique ME, Bonolo PF, Dourado I, Lima-Costa MF, Macinko J, Mendonça CS, et al. Internações por condições sensíveis à atenção primária: a construção da lista brasileira como ferramenta para medir o desempenho do sistema de saúde (Projeto ICSAP-Brasil). Cad Saúde Pública 2009; 25(6): 1337-49. https://doi.org/10.1590/s0102-311X2009000600016

8. Mendonça CS, Nedel FB, Batista SR, Medina MG. A utilização do indicador internações por condições sensíveis à atenção primária no Brasil. In: Mendonça MHM, Matta GC, Gondin R, Giovanella L (orgs). Atenção primária à saúde no Brasil: conceitos, prática e pesquisa. Rio de Janeiro: Editora Fiocruz; 2018. p. 527-68.

9. Caminal Homar J, Casanova Matutano C. La evaluación de la atención primaria y las hospitalizaciones por ambulatory care sensitive conditions. Marco conceptual. Atención Primaria 2003; 31(1): 61-5. https://doi.org/10.1016/s0212-6567(03)70662-3

10. Fernandes VBL, Caldeira AP, Faria AA, Rodrigues Neto JF. Internações sensíveis na atenção primária como indicador de avaliação da estratégia de saúde da família. Rev Saúde Pública 2009; 43(6): 928-36. https://doi.org/10.1590/S0034-89102009005000080

11. Turci MA, Lima e Costa MFF, Bonolo PF, Oliveira VB. Avaliação do impacto das ações do programa de saúde da família na redução das internações hospitalares por condições sensíveis à atenção básica em adultos e idosos. Relatório final de pesquisa. Belo Horizonte: Universidade Federal de Minas Gerais; 2012. Available at: https://www.nescon.medicina.ufmg.br/biblioteca/imagem/3261.pdf

12. Malvezzi E. Internações por condições sensíveis à atenção primária: revisão qualitativa da literatura científica brasileira. Saúde em Redes 2018; 4(4): 119-34. https://doi.org/10.18310/2446-4813.2018v4n4p%25p

13. Pedraza DF, Araújo EMN. Internações das crianças brasileiras menores de cinco anos: revisão sistemática da literatura. Epidemiol Serv Saúde 2017; 26(1): 169-82. https://doi.org/10.5123/S1679-49742017000100018

14. Costa JSD, Pattussi MP, Morimoto M, Arruda JS, Bratkowski GR, Sopelsa M, et al. Tendência das internações por condição sensível à atenção primária e fatores associados em Porto Alegre, RS, Brasil. Ciênc Saúde Colet 2016; 21(4): 1289-96. Available at: https://doi.org/10.1590/1413-81232015214.15042015

15. Mendonça MHM, Gondim R, Matta GC, Giovanella L. Os desafios urgentes e atuais da atenção primária à saúde. In: Mendonça MHM, Matta GC, Gondim R, Giovanella L. Atenção primária à saúde no Brasil: conceitos, práticas e pesquisa. Rio de Janeiro: Editora Fiocruz; 2018. p. 329.

16. Gérvas J, Homar JC. Hospitalizations by ambulatory care sensitive conditions (ACSC) from the general practioner/family physician1's point of view. Rev Esp Salud Publica 2007; 81(1): 7-13. https://doi.org/10.1590/s1135-57272007000100002

17. Schramm JMA, Paes-Sousa R, Mendes LVP. Políticas de austeridade e seus impactos na saúde: um debate em tempos de crises. Rio de Janeiro: Fiocruz; 2018. Available at: https://www.arca.fiocruz.br/bitstream/icict/28240/2/Joyce_Mendes_et_al_politicas_de_austeridade.pdf

18. Shapiro SS, Wilk MB. An analysis of variance test for normality (complete samples). Biometrika 1965; 52(3/4): 591-611. https://doi.org/10.2307/2333709

19. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika 1986; 73(1): 13-22. https://doi.org/10.1093/biomet/73.1.13

20. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Análise em Saúde e Vigilância de Doenças não Transmissíveis. Saúde Brasil 2019 uma análise da situação de saúde com enfoque nas doenças imunopreveníveis e na imunização. Brasília: Ministério da Saúde; 2019. Available at: https://bvsms.saude.gov.br/bvs/publicacoes/saude_brasil_2019_analise_situacao.pdf

21. Amorim DNP, Chiarello MD, Vianna LG, Moraes CF, Vilaça KHC. Internações por condições sensíveis à atenção primária de idosos no Brasil, 2003 a 2012. Rev Enferm UFPE 2017; 11(2): 576-83. https://doi.org/10.5205/1981-8963-v11i2a11976p576-583-2017

22. Macinko J, Dourado I, Aquino R, Bonolo PF, Lima-Costa MF, Medina MG, et al. Major expansion of primary care in Brazil linked to decline in unnecessary hospitalization. Health Aff (Millwood) 2010; 29(12): 2149-60. https://doi.org/10.1377/hlthaff.2010.0251

23. Mendonça SS, Albuquerque EC. Perfil das internações por condições sensíveis à atenção primária em Pernambuco 2008 a 2012. Epidemiol Serv Saúde 2014; 23(3): 463-74. https://doi.org/10.5123/S1679-49742014000300009

24. Russo LX, Powell-Jackson T, Barreto JOM, Borghi J, Kovacs R, Gurgel Junior GD, et al. Pay for performance in primary care: the contribution of the Program for Improving Access and Quality of Primary Care (PMAQ) on avoidable hospitalisations in Brazil, 2009-2018. BMJ Global Health 2021; 6(7): e005429. https://doi.org/10.1136/bmjgh-2021-005429

25. Soares C, Ramos M. Uma avaliação dos efeitos do PMAQ-AB nas internações por condições sensíveis à atenção básica. Saúde Debate 2020; 44(126): 708-24. https://doi.org/10.1590/0103-1104202012609

26. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Política Nacional de Atenção Básica / Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Brasília: Ministério da Saúde; 2012. Disponível: http://189.28.128.100/dab/docs/publicacoes/geral/pnab.pdf

27. Brasil. Ministério da Saúde. Gabinete do Ministro. Portaria Interministerial nº 1.369, de 8 de julho de 2013. Dispõe sobre a implementação do Projeto Mais Médicos para o Brasil. Diário Oficial da União; 2013. Available at: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2013/pri1369_08_07_2013.html#:~:text=Disp%C3%B5e%20sobre%20a%20implementa%C3%A7%C3%A3o%20do%20Projeto%20Mais%20M%C3%A9dicos%20para%20o%20Brasil.&text=DISPOSI%C3%87%C3%95-ES%20GERAIS-,Art.,Mais%20M%C3%A9dicos%20para%20o%20Brasil.

28. Brasil. Ministério da Saúde. Departamento de Análise em Saúde e Vigilância das Doenças não Transmissíveis. Painéis saúde Brasil: mortalidade na infância e componentes. Available at: http://svs.aids.gov.br/dantps/centrais-de-conteudos/paineis-de-monitoramento/saude-brasil/mortalidade-na-infancia

29. Reis AAC. O que será do Brasil e do SUS? Reciis Ver Eletron Comum Inf Inov Saúde 2018; 12(2): 119-24. https://doi.org/10.29397/reciis.v12i2.1551

30. Rasella D, Basu S, Hone T, Paes-Sousa R, Ocké-Reis CO, Millett C. Child morbidity and mortality associated with alternative policy responses to the economic crisis in Brazil: a nationwide microsimulation study. PLoS Med 2018; 15(5): e1002570. https://doi.org/10.1371/journal.pmed.1002570

31. Instituto de Comunicação e Informação Científica e Tecnológica em Saúde. IDSUS: um ranking para a saúde [cited on Dec 11, 2021]. Available at: https://www.icict.fiocruz.br/content/idsus-um-ranking-para-a-sa%C3%BAde. 2017.

32. Freitas JLG, Silva PP, Moreira KFA, Cavalcante DFB, Souza MHN, Alves JC. Internações por condições sensíveis à atenção primária em crianças em Rondônia de 2008 a 2017. Cogitare Enferm 2020; 25: e71904. http://doi.org/10.5380/ce.v25i0.71904

33. Pinto Junior EP, Aquino R, Dourado I, Costa LQ, Silva MGC. Internações por condições sensíveis à atenção primária à saúde em crianças menores de 1 ano no Brasil. Ciên Saúde Coletiva 2020; 25(7): 2883-90. https://doi.org/10.1590/1413-81232020257.25002018

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