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RESEARCH

DISTRIBUTION TRENDS IN HOSPITALIZATIONS FOR PRIMARY CARE-SENSITIVE CONDITIONS RELATED TO CHRONIC NONCOMMUNICABLE DISEASES

TENDÊNCIAS DE DISTRIBUIÇÃO DAS INTERNAÇÕES POR CONDIÇÕES SENSÍVEIS À ATENÇÃO PRIMÁRIA RELACIONADAS A DOENÇAS CRÔNICAS NÃO TRANSMISSÍVEIS

TENDENCIAS DE DISTRIBUCIÓN DE LAS HOSPITALIZACIONES POR CONDICIONES SENSIBLES A LA ATENCIÓN PRIMARIA RELACIONADAS CON ENFERMEDADES CRÓNICAS NO TRANSMISIBLES

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ABSTRACT

Objetivo: to analyze trends and distribution patterns in hospitalizations for ambulatory care-sensitive conditions (ACSCs) related to noncommunicable diseases (NCDs) from 2016 to 2022 in São Paulo State. **Methods**: an ecological study using secondary data on NCD-related ACSC hospitalizations available through DATASUS. Descriptive analyses, spatial autocorrelation analysis using Moran's I, and temporal trend analysis through Joinpoint regression were performed. **Results**: two inflection points were observed, with reduced proportions of NCD-related ACSC hospitalizations during the second half of 2017 and between 2020 and 2022. Analysis of clusters identified through univariate local Moran's I revealed slight positive spatial autocorrelation among NCD-related ACSC hospitalization rates, indicating that their spatial distribution was not random. The highest NCD-related ACSC hospitalization rates were recorded in the Administrative Regions of Santos, Marília, São Paulo, and Campinas, whereas the lowest rates were observed in the Administrative Regions of Barretos, São José do Rio Preto, and Bauru. **Conclusion**: NCD-related ACSC hospitalizations showed positive spatial autocorrelation, with specific reductions in 2017 and from 2020 to 2022, revealing distinct hospitalization patterns across São Paulo State regions.

Keywords: Spatial Analysis; Primary Health Care; Ambulatory Care Sensitive Conditions; Health Inequities; Noncommunicable Diseases.

RESUMO

Objetivo*: analisar a tendência e a distribuição das internações por condições sensíveis à atenção primária (ICSAP) relacionadas às doenças crônicas não transmissíveis (DCNT), no período de 2016 a 2022, no estado de São Paulo.* ***Métodos****: estudo ecológico, com dados secundários de internações por condições sensíveis à atenção primária relacionadas às doenças crônicas não transmissíveis, disponibilizados pelo DATASUS. Foram realizadas análises descritivas, de autocorrelação espacial, por meio do Índice de Moran, e de tendência temporal, por regressão Joinpoint.* ***Resultados****: observaram-se dois pontos de inflexão, com redução das proporções de ICSAP relacionadas às DCNT no segundo semestre de 2017 e entre 2020 e 2022. A análise dos clusters formados pelo Índice de Moran local univariado revelou autocorrelação espacial positiva leve entre as taxas de ICSAP relacionadas às DCNT, indicando que a distribuição espacial das internações não é aleatória. As maiores taxas de ICSAP relacionadas às DCNT foram registradas nas Regiões Administrativas de Santos, Marília, São Paulo e Campinas, enquanto as menores foram observadas nas Regiões Administrativas de Barretos, São José do Rio Preto e Bauru.* ***Conclusão****: houve autocorrelação espacial positiva das ICSAP por DCNT, com redução pontual em 2017 e no período de 2020 a 2022, evidenciando padrões de internação distintos nas diferentes regiões do estado de São Paulo.*

Palavras-chave*: Análise Espacial; Atenção Primária à Saúde; Condições Sensíveis à Atenção Primária; Desigualdades de Saúde; Doenças não Transmissíveis.*

RESUMEN

Objetivo*: analizar la tendencia y la distribución de las hospitalizaciones por condiciones sensibles a la atención primaria (ICSAP) relacionadas con las enfermedades crónicas no transmisibles (ECNT), en el período de 2016 a 2022, en el estado de São Paulo.* ***Métodos****: estudio ecológico, con datos secundarios de hospitalizaciones por condiciones sensibles a la atención primaria relacionadas con las ECNT, proporcionados por DATASUS. Se realizaron análisis descriptivos, de autocorrelación espacial mediante el índice de Moran, y de tendencia temporal mediante regresión Joinpoint.* ***Resultados****: se observaron dos puntos de inflexión, con una reducción de las proporciones de ICSAP relacionadas con las ECNT en el segundo semestre de 2017 y entre 2020 y 2022. El análisis de los conglomerados formados por el índice de Moran local univariado reveló una autocorrelación espacial positiva leve entre las tasas de ICSAP relacionadas con las ECNT, lo que indica que la distribución espacial de las hospitalizaciones no es aleatoria. Las tasas más altas de ICSAP relacionadas con las ECNT se registraron en las Regiones Administrativas de Santos, Marília, São Paulo y Campinas, mientras que las más bajas se observaron en las Regiones Administrativas de Barretos, São José do Rio Preto y Bauru.* ***Conclusión****: se observó una autocorrelación espacial positiva de las ICSAP por ECNT, con una reducción puntual en 2017 y en el período de 2020 a 2022, evidenciando patrones de hospitalización distintos en las diferentes regiones del estado de São Paulo.*

Palabras clave: *Análisis Espacial; Atención Primária de Salud; Condiciones Sensibles a la Atención Ambulatoria; Inequidades en Salud; Enfermedades no Transmisibles.*

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INTRODUCTION

Hospitalizations for Ambulatory Care Sensitive Conditions (ACSCs) have been widely employed internationally as a performance indicator when evaluating Primary Health Care (PHC) services[1]. ACSC hospitalizations are considered avoidable admissions arising from health problems that could be addressed within PHC, thereby preventing complications and the need for care at more complex levels. Therefore, high ACSC hospitalization rates may indicate difficulties within PHC in ensuring effective care for users and may also be associated with insufficient coverage at this level and/or a lack of integration among services within the healthcare network[2].

In Brazil, following implementation of the Brazilian List of Ambulatory Care Sensitive Conditions in 2008, this indicator began to be employed to analyze hospitalization profiles and their relationship with Primary Health Care performance[1,3]. The list comprises 19 groups of hospitalization causes and diagnoses, among which Noncommunicable Diseases (NCDs) are particularly relevant, representing a significant challenge to the healthcare system due to their prevalence and economic impact. NCDs include cardiovascular diseases, chronic respiratory diseases, obesity, neoplasms, and diabetes.

NCDs constitute one of the leading causes of morbidity and mortality in Brazil and are influenced by social and individual factors associated with lifestyle habits, including unhealthy dietary intake, physical inactivity, smoking, excess weight, high blood pressure, and metabolic changes. Between 1990 and 2021, despite declining NCD mortality rates in the country, national estimates indicate a persistently high burden involving mortality, years of life lost, and disability, with a risk that the target to reduce premature NCD mortality by one third by 2030 will not be achieved[4].

Within the context of ACSC hospitalizations, a multicenter analysis conducted in Latin American countries between 2015 and 2019 found that NCDs accounted for 50.6% of hospitalizations for Ambulatory Care Sensitive Conditions, constituting the main group responsible for these admissions[5]. Given the magnitude of NCDs and their contribution to ACSC hospitalizations, this indicator helps monitor PHC access, quality, and effectiveness, supporting the identification of potentially avoidable admissions and informing healthcare service planning and management[6,7].

NCDs more frequently affect low-income populations, which are more vulnerable and exposed to risk factors, in addition to facing greater barriers to accessing healthcare services and health promotion and disease prevention initiatives[8]. Moreover, poverty among these individuals tends to be aggravated by household expenses related to treatment for these diseases. Social determinants, such as educational attainment, occupation, income, gender, and ethnicity, play a significant role in increasing NCD prevalence and morbidity and mortality rates[9,10].

Given this scenario, although studies have explored ACSC hospitalization rates within national and regional contexts[1,2,11], gaps remain in the literature regarding trends in NCD-related ACSC hospitalizations over time. This gap hinders the development of effective health management strategies, particularly in regions marked by substantial socioeconomic disparities. Considering the relevance of ACSC hospitalizations as an indirect indicator of PHC access, continuity of care, and effectiveness, understanding how NCD-related hospitalizations were distributed temporally and spatially across São Paulo State is necessary. Therefore, this study seeks to answer the following question: what were the temporal and spatial patterns of NCD-related ACSC hospitalizations in São Paulo State between 2016 and 2022? In this context, this study aimed to analyze trends and distribution patterns in NCD-related ACSC hospitalizations from 2016 to 2022 in São Paulo State.

METHOD

This descriptive ecological study was conducted using secondary data concerning NCD-related ACSC hospitalizations in São Paulo State from January 2016 to December 2022. This study was reported in accordance with guidelines from the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative.

According to data from the 2022 Census, São Paulo State has a total population of 44,411,238 inhabitants and a population density of 178.92 inhabitants per square kilometer[12]. Regarding administrative organization, the state is divided into 16 Administrative Regions (ARs), namely: Araçatuba, Barretos, Bauru, Campinas, Central, Franca, Itapeva, Marília, Presidente Prudente, Registro, Ribeirão Preto, Santos, São José do Rio Preto, São José dos Campos, São Paulo, and Sorocaba[13]. This territorial division served as the basis for the analyses conducted in this study. Notably, São Paulo State ARs exhibit substantial socioeconomic diversity, varying in population size, municipality count, and economic characteristics, such as industrialization level, tertiary sector development, unemployment rates, and income levels.

All hospitalizations among São Paulo State residents recorded in the Brazilian Unified Health System (*Sistema Único de Saúde*, SUS) Hospital Information System were included when their primary admission diagnosis was listed in the Brazilian List of Ambulatory Care Sensitive Conditions, established by Ordinance No. 221 of April 17, 2008, and classified as NCD-related[3]. Hospitalizations involving patients residing in other federative units and records lacking information on municipality of residence were excluded.

Microdata were obtained from reduced files containing Hospital Admission Authorization records from the Brazilian Unified Health System Hospital Information System, available on the official webpage maintained by the Brazilian Unified Health System Department of Information and Informatics (DATASUS). Microdata extraction covered hospitalization records from January 2016 to December 2022, considering each patient's municipality of residence. After file retrieval, data were tabulated and organized in an Excel spreadsheet, and the inclusion and exclusion criteria were applied. The final database included NCD-related ACSC hospitalization records aggregated by admission month and year, municipality of residence, and AR.

NCD-related ACSC hospitalizations were identified based on diagnostic groups and their corresponding codes from the International Classification of Diseases, Tenth Revision, according to the Brazilian List of Ambulatory Care Sensitive Conditions: asthma (J45-J46), chronic pulmonary diseases (J20-J21, J40-J44, J47), arterial hypertension (I10-I11), angina (I20), heart failure (I50, J81), cerebrovascular diseases (I63-I67, I69, G45-G46), and diabetes mellitus (E10-E14).

The variables analyzed were admission year and month, gender, age group, primary admission diagnosis, admission type, hospital outcome, municipality of residence, and AR. For the descriptive analyses, absolute and relative frequencies corresponding to NCD-related ACSC hospitalizations were estimated according to the variables examined. The proportion of ACSC hospitalizations relative to total hospitalizations and the proportion of NCD-related ACSC hospitalizations relative to all ACSC hospitalizations were also calculated and expressed per 100 hospitalizations. Accordingly, in this study, the term "proportion" was employed for indicators whose denominator corresponded to total hospitalizations or all ACSC hospitalizations, avoiding the term "incidence" when no population denominator was available.

For the temporal analysis, monthly proportions of NCD-related ACSC hospitalizations relative to all ACSC hospitalizations were employed from January 2016 to December 2022. Monthly variations were analyzed using Joinpoint regression based on a Poisson regression model. The model enabled identification of inflection points in the temporal trend and estimation of monthly percent change, mean monthly percent change over the entire period, corresponding 95% confidence intervals (95% CIs), and p-values. The number of joinpoints was determined using the Monte Carlo permutation test, considering a 5% significance level. The Joinpoint Regression Program (v. 4.9.1.0) was employed for this analysis.

Univariate Global Moran's I was calculated to assess spatial autocorrelation among the variables examined. Moran's I is a statistical test that produces a single coefficient employed to measure spatial association across a dataset. Its null hypothesis assumes spatial independence, with an expected value of zero. Positive values ranging from 0 to +1 indicate direct correlation, whereas negative values ranging from 0 to −1 suggest inverse correlation[14]. Following the global analysis, local indicators of spatial association were estimated using Local Moran's I to identify spatial clusters comprising municipalities with similar or divergent NCD-related ACSC hospitalization patterns. Clusters were classified as follows: areas with high variable frequencies and neighboring areas with high frequencies (high-high); areas with low variable frequencies and neighboring areas with low frequencies (low-low); areas with low variable frequencies and neighboring areas with high frequencies (low-high); areas with high variable frequencies and neighboring areas with low frequencies (high-low); and areas not included in any cluster due to lack of statistical significance (not significant). Furthermore, Ilhabela could not be assessed because it has no neighboring municipalities sharing a border.

Spatial analyses were performed using GeoDa software (v. 1.20.0.10), whereas maps and frequency distributions were prepared using QGIS (v. 3.26.0). Only secondary, publicly available data without nominal identifiers were employed. The study complied with the ethical principles established in Resolutions No. 466/2012 and No. 510/2016 issued by the Brazilian National Health Council. Because it employed secondary, public data without individual identification, available through official health information systems, the study was exempt from Research Ethics Committee review.

RESULTS

From 2016 to 2022, 16,705,572 total hospitalizations were recorded in São Paulo State, among which 1,273,838

were ACSC hospitalizations, representing a mean proportion of 7.6% over the period. The highest proportion of ACSC hospitalizations relative to total hospitalizations occurred in 2016, with 196,403 records among 2,381,799 total admissions (8.24%). Conversely, the lowest proportion was observed in 2021, when ACSC hospitalizations accounted for 158,967 among 2,324,225 recorded admissions (6.83%). In 2022, this proportion increased, with 187,682 ACSC hospitalizations among 2,376,816 total admissions (7.89%) (Table 1).

Most NCD-related ACSC hospitalizations were recorded among males in every year analyzed, with a mean proportion of 52.8%, and hospitalizations were most frequent in the 60 to 69-year age group. During the period analyzed, deaths increased between 2019 and 2021, with the highest numbers recorded in 2020 and 2021, followed by a reduction in 2022. The highest proportions of NCD-related ACSC hospitalizations were recorded in the ARs of Santos, Marília, São Paulo, and Campinas. Conversely, the lowest proportions were recorded in the ARs of Barretos, São José do Rio Preto, and Bauru (Table 2).

Table 1 – Comparison between total hospitalizations and ACSC hospitalizations. São Paulo, 2016–2022.

Year	Total hospitalizations	ACSC hospitalizations relative to total hospitalizations n (%)
2016	2381799	196403 (8.24)
2017	2423728	172626 (7.12)
2018	2464481	196500 (7.97)
2019	2527777	201038 (7.95)
2020	2206746	160622 (7.27)
2021	2324225	158967 (6.83)
2022	2376816	187682 (7.89)

Legend: ACSC hospitalizations: hospitalizations for Ambulatory Care Sensitive Conditions; n: absolute frequency; %: relative frequency.
Source: Prepared by the authors based on DATASUS data

Joinpoint analysis examining the monthly trend in NCD-related ACSC hospitalizations in São Paulo State identified five joinpoints, comprising six temporal segments. Two segments showed statistically significant reductions: from August 2017 to February 2018, with a monthly percent change of -5.1% (95% CI: -7.4; -2.7; $p < 0.01$), and from June 2020 to December 2022, with a monthly percent change of -0.3% (95% CI: -0.5; -0.1; $p < 0.01$). The remaining segments were not statistically significant. Over the entire period, the mean monthly percent change was 0.2% (95% CI: -0.4; 0.7), indicating a stable overall trend during the period analyzed (Table 3).

Global spatial autocorrelation analysis showed positive univariate Global Moran's I values in every year analyzed, ranging from 0.063 in 2018 to 0.119 in 2022, with statistical significance across all years ($p < 0.001$). Although these values indicate positive spatial autocorrelation, their magnitude was low because they were close to zero, suggesting weak yet nonrandom spatial clustering among NCD-related ACSC hospitalizations in São Paulo State (Table 4).

Analysis of clusters formed through univariate Local Moran's I revealed slight positive spatial autocorrelation among NCD-related ACSC hospitalization rates throughout the study period. In other words, Global Moran's I values indicated direct correlation because they were positive and slight correlation because they were close to zero. Statistical significance was observed in every year, indicating that the spatial distribution of hospitalizations was not random. High-high clusters predominated from 2016 to 2022 in the ARs of Marília, Presidente Prudente, Itapeva, Sorocaba, Campinas, São Paulo, and Santos, indicating areas with high NCD-related ACSC hospitalization rates and similar patterns in surrounding municipalities. High-high clustering increased in Campinas, Registro, Sorocaba, Itapeva, São Paulo, and Santos in 2017, followed by a decrease through 2019, an increase in 2020, a decrease in 2021, and another increase in 2022. Low-low clusters predominated from 2016 to 2022 in the ARs of Presidente Prudente, Araçatuba, São José do Rio Preto, Barretos, and Franca. Low-low clustering decreased in the Presidente Prudente AR in 2022, when only high-high and low-high clusters were identified (Figure 1).

DISCUSSION

The analysis of temporal trends and distribution patterns in NCD-related ACSC hospitalizations in São Paulo State between 2016 and 2022 revealed important temporal and territorial patterns. The overall trend remained stable during the period analyzed, although Joinpoint regression identified inflection points, with statistically significant reductions between August 2017 and February 2018 and between June 2020 and December 2022. Furthermore, regional differences persisted in the proportion of NCD-related hospitalizations among all ACSC hospitalizations, along with slight positive spatial autocorrelation, indicating that these admissions were not randomly distributed across São Paulo State.

Table 2 – Proportion of NCD-related ACSC hospitalizations by AR. São Paulo, 2016–2022.

Administrative Region	ACSC hospitalizations not related to NCDs	NCD-related ACSC hospitalizations relative to total ACSC hospitalizations		Total
		n(%)	95% CI	
Araçatuba	19056	13052 (40.65)	40.0–41.4	32108
Barretos	13292	6100 (31.46)	30.7–32.3	19392
Bauru	26449	17257 (39.48)	38.9–40.1	43706
Campinas	93849	77832 (45.33)	45.0–45.7	171681
Central	22432	17719 (44.23)	43.5–44.8	40151
Franca	17761	11321 (38.93)	38.2–39.7	29082
Itapeva	14909	11796 (44.17)	43.4–45.0	26705
Marília	22403	20384 (47.64)	47.0–48.3	42787
Presidente Prudente	31832	23211 (42.17)	41.6–42.7	55043
Registro	4759	3395 (41.63)	40.2–43.1	8154
Ribeirão Preto	27611	18436 (40.04)	39.5–40.6	46047
Santos	21182	19346 (47.73)	47.1–48.4	40528
São José do Rio Preto	49637	27351 (35.52)	35.1–35.9	76988
São José dos Campos	39887	29902 (42.84)	42.4–43.3	69789
São Paulo	267354	240298 (47.33)	47.1–47.5	507652
Sorocaba	36121	27904 (43.58)	43.1–44.1	64025
Estado de São Paulo	708534	565304 (44.4)	44.3–44.5	1273838

Note: ACSC hospitalizations: hospitalizations for Ambulatory Care Sensitive Conditions; NCDs: Noncommunicable Diseases; n: absolute frequency; %: relative frequency; CI: confidence interval.
Source: Prepared by the authors based on DATASUS data.

Table 3 – Joinpoint analysis examining the monthly trend in NCD-related ACSC hospitalizations. São Paulo, 2016-2022.

Segment	Period	MPC (%)	95% CI	p-value
1	jan/2016–may/2017	0.3	-0.1; 0.8	0.13
2	may/2017–aug/2017	10.8	-0.8; 23.7	0.07
3	aug/2017–feb/2018	-5.1	-7.4; -2.7	<0.01
4	fen/2018–feb/2020	-0.1	-0.4; 0.1	0.36
5	feb/2020–jun/2020	5.0	-1.0; 11.3	0.10
6	jun/2020–dec/2022	-0.3	-0.5; -0.1	<0.01
Entire period	jan/2016–dec/2022	AMPC = 0.2	-0.4; 0.7	-

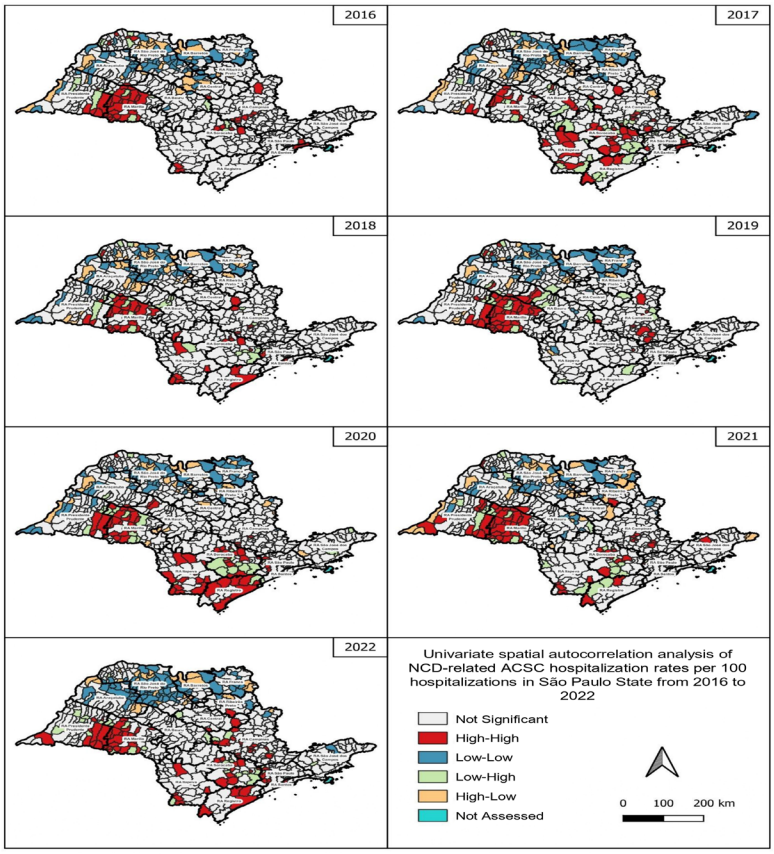
Note: ACSC hospitalizations: hospitalizations for Ambulatory Care Sensitive Conditions; NCDs: Noncommunicable Diseases; MPC: monthly percent change; AMPC: mean monthly percent change; 95% CI: 95% confidence interval.
Source: Prepared by the authors based on DATASUS data.

Table 4 – Univariate Global Moran's I for NCD-related ACSC hospitalizations. São Paulo, 2016–2022.

Year	Univariate Global Moran's I	p-value
2016	0.070	<0.001
2017	0.066	<0.001
2018	0.063	<0.001
2019	0.071	<0.001
2020	0.085	<0.001
2021	0.073	<0.001
2022	0.119	<0.001

Note: ACSC hospitalizations: hospitalizations for Ambulatory Care Sensitive Conditions; NCDs: Noncommunicable Diseases. Positive Global Moran's I values indicate positive spatial autocorrelation.
Source: Prepared by the authors based on DATASUS data.

Figure 1 – Univariate spatial autocorrelation analysis examining NCD-related ACSC hospitalization rates per 100 hospitalizations across the ARs. São Paulo, 2016–2022.



Note: ACSC hospitalizations: hospitalizations for Ambulatory Care Sensitive Conditions; NCDs: Noncommunicable Diseases.
Source: Prepared by the authors based on DATASUS data.

Although the overall trend remained stable, Joinpoint analysis identified specific segments showing statistically significant reductions between August 2017 and February 2018 and between June 2020 and December 2022. These inflection points suggest changes in temporal patterns involving NCD-related ACSC hospitalizations, which may reflect changes in service organization, access to the healthcare network, and healthcare service utilization patterns. However, such variations should be interpreted considering the political, institutional, and public health context during the period, as well as the multifactorial nature of avoidable hospitalizations. In this regard, overall stability across the series does not diminish the relevance of the identified change segments but indicates that variations occurred at specific points and should be analyzed within their respective contexts.

In 2016, São Paulo State experienced a period marked by significantly increased healthcare expenditures and reduced budgetary resources, while the country faced a recession and declining gross domestic product[3]. The PHC funding floor was frozen and subjected to budgetary constraints under the new fiscal regime established through Constitutional Amendment No. 95/2016, which limited growth in public spending to inflation over the following 20 years. Municipalities with lower tax revenues or no counterpart funding from the state government may have been more vulnerable to these restrictions, with potential repercussions for PHC effectiveness. Notably, this fiscal regime remained in effect until 2023, when it was repealed through Complementary Law No. 200/2023[15,16]. Therefore, the significant reduction observed between August 2017 and February 2018 should be interpreted with caution, as it may reflect fluctuations in temporal hospitalization patterns, changes in care pathways, or variations in hospital service utilization and recording rather than necessarily representing the direct effect of a single factor.

Furthermore, the National Primary Care Policy, issued in 2017 under Ordinance No. 2,436/2017, also forms part of the context surrounding changes in PHC organization during the period analyzed. This new policy did not establish minimum staffing requirements for primary care teams and also recognized other PHC strategies as transitional arrangements. These changes gave managers greater autonomy but may have weakened the PHC model guided by the Family Health Strategy (FHS), as they made population coverage requirements more flexible and reduced the minimum number of community health workers per team from the previous six workers to only one[17]. Thus, provisions established under this new PHC policy may have affected the quality of ties between teams and communities, as well as initiatives developed within service catchment areas[18].

Conversely, the reduction in NCD-related ACSC hospitalizations observed between 2020 and 2022 may be understood in light of the profound effects that the COVID-19 pandemic had on health systems, particularly PHC. During the first pandemic year, PHC services in Brazil experienced significant disruption, with a marked decline in the provision of medical consultations, outpatient procedures, and follow-up for chronic conditions such as hypertension, diabetes, and respiratory diseases, while hospital beds were prioritized for COVID-19 cases[19]. Therefore, the reduction identified in this segment should not necessarily be interpreted as improved NCD control or PHC effectiveness but as a potential reflection of changes in healthcare access, provision, and utilization during the public health emergency.

Redirection of healthcare teams' efforts toward addressing COVID-19, combined with suspended elective activities and the population's reluctance to seek PHC services, contributed to interruptions in continuity of care for people with NCDs. During this period, PHC services across many São Paulo State municipalities partially interrupted follow-up for people with NCDs. This discontinuity may have had implications for chronic complications and mortality, in addition to burdening the health system through accumulated deferred care[19]. This scenario may have led to long-term clinical decompensation across many such conditions, generating unmet demand that became more apparent toward the end of the public health emergency. Thus, the proportional reduction in NCD-related ACSC hospitalizations during the pandemic may have coexisted with worsening longitudinal follow-up for these conditions, particularly when fewer people sought care, access was restricted, and the hospital network was reorganized.

In São Paulo State, as in other Brazilian regions, social and territorial inequalities may contribute to ACSC hospitalizations, exerting a greater impact on regions with lower Family Health Strategy coverage and higher population density, such as metropolitan areas. In these areas, overburdened health services and complex care pathways hinder care coordination and continuity, particularly when managing NCDs[18]. This aspect is relevant to understanding the persistence of regional differences observed in this study, since greater healthcare infrastructure in certain territories does not necessarily ensure timely access, longitudinal continuity, and adequate chronic condition follow-up.

The predominance of high-high clusters in regions such as Marília, Campinas, São Paulo, and Santos suggests persistent pockets of vulnerability that, even in settings with more developed healthcare infrastructure, face limitations in care organization and primary care capacity to respond. In São Paulo State, the traditional PHC model predominates across medium-sized and large municipalities, where services do not follow the FHS model. This traditional model follows a fragmented approach to care, often centered on unscheduled demand, with lower care planning capacity and limited adoption of management tools based on local health indicators[20]. The absence of strategies to reorganize work processes based on service delivery data and territorial analysis may compromise PHC performance and reduce its effectiveness in preventing hospitalizations.

A previous study revealed a declining trend in ACSC hospitalizations between 2010 and 2019 in regions such as Araçatuba, whereas regions such as São Paulo and Ribeirão Preto showed an increase, reinforcing the relevant role played by PHC coverage and organization in the observed patterns[10]. Furthermore, the potential association between increased ACSC hospitalizations and greater social inequality should be considered, since São Paulo State contains pockets of poverty even in regions with a high Human Development Index. In 2021, during the pandemic, the state reached its highest recorded proportion of extreme poverty, with more than 2 million people living below the extreme poverty line, primarily concentrated in the São Paulo Metropolitan Region[21]. Social vulnerability and income inequality are critical factors contributing to greater barriers to healthcare access, leading to worsening diseases that could be managed within PHC[22].

Conversely, low-low clusters concentrated in the ARs of Presidente Prudente, Araçatuba, São José do Rio Preto, Barretos, and Franca may indicate areas where PHC performs more favorably. Notably, the ARs of Presidente

Prudente, Araçatuba, and São José do Rio Preto had high Family Health Strategy team coverage, reaching 85.97%, 85.82%, and 71.99%, respectively, in 2018. Barretos and Franca had Family Health Strategy team coverage reaching 58.81% and 46.17% among their respective populations[23]. These regions, mostly comprising municipalities with low population density and higher Family Health Strategy coverage, may benefit from PHC organization that is more closely aligned with territorially oriented care principles, enabling greater care continuity and early detection of health problems, thereby preventing hospitalizations, premature deaths, and disabilities.

These findings reinforce the need to strengthen PHC as a central strategy for addressing NCDs and reducing ACSC hospitalizations. Public policies guided by health surveillance, territorial planning, and care regionalization are essential to mitigate inequalities and expand primary care access and quality in São Paulo State.

It is important to emphasize that this study has limitations related to its reliance on the quality of secondary data obtained through DATASUS, which includes only hospitalization data from SUS providers. Because this is an ecological study, the findings should be interpreted as aggregate temporal and spatial distribution patterns involving NCD-related ACSC hospitalizations. Therefore, direct causal relationships cannot be established between the observed variations and specific events. Nevertheless, the results support relevant hypotheses regarding factors that may influence NCD-related ACSC hospitalization distribution, such as regional PHC organization, FHS coverage, socioeconomic and territorial inequalities, access pathways through the healthcare network, and changes in healthcare service utilization during the COVID-19 pandemic.

CONCLUSION

The study revealed overall stability in the trend of NCD-related ACSC hospitalizations in São Paulo State between 2016 and 2022, although inflection points were identified, with statistically significant reductions during specific segments of the period analyzed. Geographical disparities were also observed, with higher proportions of NCD-related ACSC hospitalizations in the ARs of Santos, Marília, São Paulo, and Campinas, and lower proportions in Barretos, São José do Rio Preto, and Bauru.

These findings underscore the importance of public health policies targeting NCD prevention, early diagnosis, and appropriate management, particularly in contexts marked by economic inequality and during public health emergencies, such as the COVID-19 pandemic. Therefore, continuous improvement in PHC is essential to reduce avoidable hospitalizations and promote population health.

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