

TEMPORAL ANALYSIS OF THE CAUSES OF HOSPITALIZATIONS FOR AMBULATORY CARE-SENSITIVE CONDITIONS IN CHILDREN UNDER 1 YEAR OF AGE IN THE STATE OF BAHIA, 2009 TO 2019



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Márcia Reis Rocha Rosa¹, Tamires Pereira dos Santos², Jessica Suzarte Carvalho de Souza³, Aloísio Machado da Silva Filho⁴ and Carlos Alberto Lima da Silva⁵.

ABSTRACT

Primary health care (PHC) is considered by the Ministry of Health to be the gateway to the Unified Health System (SUS), with the purpose of organizing the flow of health actions and services from low complexity to high complexity. This is designated as the set of individual and collective care aimed at the promotion, protection of diseases, diagnosis, treatment, rehabilitation and harm reduction, obeying the principles of universality, accessibility, integrality, equity and decentralization of services. It is believed that this has great relevance with regard to the resolvability of health problems, with the purpose of minimizing hospital admissions that would be prevented by PHC actions. It is necessary to analyze the trends in the causes of Hospitalizations for Ambulatory Care-Sensitive Conditions (ACSC) in children under 1 year of age in the state of Bahia, Brazil, from 2009 to 2019. Simple linear regression analysis with Prais-Winsten correction, significance 5%, was performed through an ecological time series study, in which the information was collected from the database of the Hospital Information System of the Unified Health System (SIH/SUS). Of the ten main causes of hospitalizations among children under one year of age, three showed a trend towards a reduction in their rates, but five showed an increase. A new profile of the causes of HACSC was established in 2017, when pulmonary diseases

¹ Dr. in Public Health

State University of Feira de Santana-Bahia, Brazil

E-mail: marciareisrosa@yahoo.com.br

Orcid: 0000-0003-1962-3964

² Master in Collective Health

State University of Feira de Santana-Bahia, Brazil

E-mail: tammy.saantos@gmail.com

Orcid: 0000-0003-0606-9984

³ Master of Science in Environmental Sciences

State University of Feira de Santana

Feira de Santana- Bahia, Brazil

Email: jeusuzarte@yahoo.com.br

Orcid: 0009-00094151-6509

⁴ Dr. in Computational Modeling and

Industrial Technology

State University of Feira de Santana

Feira de Santana-Bahia, Brazil

E-mail: aloisioestatistico@uefs.br

Orcid: 0000-0001-8250-1527

⁵ Dr. in Public Health

State University of Feira de Santana

E-mail: calsilva@uefs.br

Orcid: 0000-0003-3221-265X

began to predominate. The results infer that the high population coefficient of avoidable hospitalizations in children under one year of age and the recent change in the order of causes may be related to the determinants of health/disease and/or the practices and work processes involved with child health at the level of Primary Care.

Keywords: Primary Health Care. Child Health. Hospitalization. Time Series Studies.

INTRODUCTION

Free access to comprehensive Primary Health Care (PHC) should be able to prevent the occurrence or minimize the consequences of diseases frequently related to this level of care, so that it never needs or almost never resorts to other levels of care (secondary or tertiary), much less that these diseases evolve into deaths. In this sense, it is believed that 75% to 80% of a population's health problems would be solvable in PHC (FRERRER *et al*, 2014).

Despite the great expansion of PHC in Brazil, the evaluation of its effectiveness has not evolved at the same speed and faces many challenges to occur regularly (GIOVANELLA, 2018). One of the indicators recommended by the Ministry of Health to evaluate PHC and encourage the production of studies that allow comparability between the various regions of the country is hospitalizations for Ambulatory Care-Sensitive Conditions (HACSC). Once elected by each national health system, Primary Care-Sensitive Conditions (ACSC) are considered avoidable by PHC actions, so they should not lead to hospital admissions or, if they occur, that they should be at small rates. Brazil defined its list through Ordinance SAS/MS No. 221, of April 17, 2008, since then, studies with the Brazilian population have been taking place increasingly.

The inverse association of HACSC rates with the expansion of the Family Health Strategy has been demonstrated in Piauí, Pernambuco, Minas Gerais, and Bahia. Studies of temporal trends have revealed different magnitudes of HACSC rates, with most showing a general downward trend and the main group of causes being Infectious Gastroenteritis and its complications (BARRETO *et al*, 2012; CARVALHO *et al*, 2015; SANTOS *et al*, 2015; PINTO *et al*, 2018; AMARAL *et al*, 2020 and COSTA; PINTO and SILVA, 2017). A literature review identified the North and Northeast regions with the lowest number of studies and with the highest rates in children, justifying a continuation and deepening of investigations in the child population of these regions (PERREIRA; SILVA and LIMA, 2014).

The age group of children under one year of age and the association of HACSC with the coverage of the Family Health Strategy was studied in the state of Bahia from 2000 to 2012. The authors identified a 52.2% reduction in avoidable hospitalizations and a rate in 2012 of 46/1000 live births (PINTO *et al*, 2018). In the same year, a rate of 20.6/1000 was found in live births in the same age group in the state of Ceará (COSTA; PINTO and SILVA, 2017). The occurrence of different prevalences in two states in the Northeast region instigates and justifies our investigation on HACSC in the state of Bahia.

According to the World Health Organization (WHO), primary health care aimed at the group of children, especially those under one year of age, reflects economic, sociocultural and political conditions of the country and its communities. A better understanding of this indicator and its behavior over time can lead to interventions in the organizational aspects of PHC, as well as in the social determinants of health. Thus, the objective of this study was to analyze the trends in the causes of hospitalizations for Ambulatory Care-Sensitive Conditions in children under 1 year of age in the state of Bahia, 2009 to 2019.

METHODOLOGY

TYPE OF STUDY

This is an ecological epidemiological study of time series referring to the period from 2009 to 2019, which focused on an aggregate of children under 1 year old residing in a state of the Brazilian federation (Bahia).

DATA COLLECTION

The database was built from secondary information in the public domain. The largest volume of data on HACSC was obtained through consultation with the Department of Informatics of the Unified Health System (DATASUS), which uses the source of the Hospital Information System of the Unified Health System (SIH/SUS). The data extraction took place through the Tab software, for Windows – TabWin. Data from the Information System on Live Births (SINASC) were also used to calculate the annual population rates presented in the study.

DATA ANALYSIS

Only paid Type 1 Hospital Admission Authorizations (AIH) were selected to avoid computing readmissions for the same reason as the first hospitalization. Therefore, type 5 AIHs that are the extension of a long-stay stay for the same person were excluded. The population of the complete study included all children under five years of age living in Bahia, however the results presented here refer only to the population of children under 1 year of age, disaggregated into neonatal period (0 to 27 days), post-neonatal period (28 days to 11 months and 29 days) hospitalized for ACSC in any health units that are part of the SUS, residents in the state of Bahia, included in the SIH/SUS at the time of data

collection (June 2021). The identification of ACSC occurred according to the Brazilian HACSC List published in Ordinance MS/GM No. 221, of April 17, 2008. This ordinance contains an annex that lists all diseases considered not to generate hospitalizations if PHC were effective, classified into 19 groups and identified by the International Classification of Diseases – Tenth Revision – ICD-10. This ICD-10 breakdown allowed the exact count of HACSC in the study population and the calculation of the annual rate of HACSC (per 10,000 inhabitants) for each age component and group of causes, with the count of hospitalizations for each group of causes as the numerator and the population of live births in the state of Bahia for each year as the denominator.

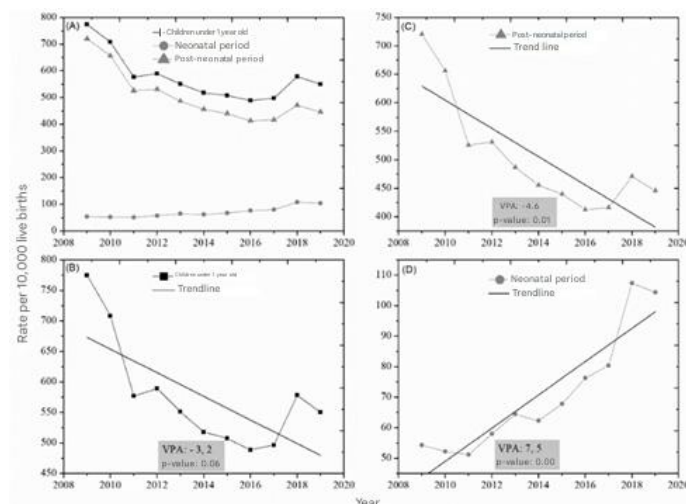
The temporal trends of HACSC rates were estimated in the computational and statistical language called R (R CORE, 2020). In this analysis, a simple linear regression model was used with correction by the Prais-Winsten method (PRAIS and WINSTEN, 1954) with 95% confidence.

RESULTS

A total of 131,566 children under 1 year of age (29.77% of children under five years of age) were hospitalized for ambulatory care-sensitive conditions in the period between 2009 and 2019 in the state of Bahia, 16,018 (3.62%) in the neonatal period (0 to 27 days of life) and 115,548 (26.14%) in the post-neonatal period (28 days to 11 months). The mean rate among children under 1 year of age was 576.45/10,000 live births, with 505.65/10,000 live births in the post-neonatal period and 70.79/10,000 live births in the neonatal period.

Figure 1A shows the behavior of crude rates in the eleven-year time series, and Figures 1B, C and D show trends for children under 1 year of age and their neonatal and post-neonatal components. Figure 1B shows a decreasing trend that is not statistically significant for HACSC in children under 1 year of age. However, in the analysis of the neonatal (Figure 1D) and post-neonatal (Figure 1C) components, the trends of the rates respectively increasing and decreasing are observed, with statistically significant Annual Percentage Variations (APC).

Figure 1 - Time series of crude rates and trends in HACSC in children under 1 year of age, Bahia, Brazil, 2009 to 2019.



Source of raw data: SIH/SUS/DATASUS, SINASC/SUS/DATASUS. Note: VPA: Annual percentage change. HFSC=Hospitalizations for Ambulatory Care-Sensitive Conditions.

Table 1 describes the statistical behavior of the rates of all groups of causes of HACSC in children under 1 year of age in the state of Bahia in the period between 2009 and 2019. The ten causes that had the highest mean rates in the group of children under 1 year of age, in descending order, were infectious gastroenteritis and complications; lung diseases; bacterial pneumonias; asthma; diseases related to prenatal care and childbirth; kidney and urinary tract infections; skin and subcutaneous tissue infections; ear, nose and throat infections; nutritional deficiencies; and heart failure.

Table 1 – Descriptive statistics of the groups of causes of HACSC in children under 1 year of age, Bahia, Brazil, 2009 to 2019.

Cause Groups ^s	Rates per 10 thousand live births			
	Average	DP	CV(%)	Asymmetry
Group 1: Immunization-preventable diseases and sensitive conditions	6,89	4,47	64,94	1,47
Group 2: Infectious gastroenteritis and complications	164,75	89,66	54,42	1,07
Group 3: Anemia	0,95	0,23	24,49	0,44
Group 4: Nutritional deficiencies	15,13	4,40	29,13	0,82
Group 5: Ear, nose and throat infections	15,52	6,01	38,74	0,71
Group 6: Bacterial pneumonias	86,63	22,44	25,90	0,75
Group 7: Asthma	80,20	32,83	40,94	0,35
Group 8: Lung diseases	96,94	32,37	33,39	0,39
Group 9: Hypertension	0,60	0,27	45,25	-0,23
Group 10: Angina	0,10	0,09	90,87	0,35
Group 11: Heart failure	10,48	3,77	36,05	1,31
Group 12: Cerebrovascular diseases	0,29	0,19	65,46	1,54
Group 13: Diabetes mellitus	1,22	0,32	26,33	-0,19
Group 14: Epilepsies	9,83	3,06	31,12	0,73
Group 15: Kidney and urinary tract infections	30,06	5,48	18,23	0,91

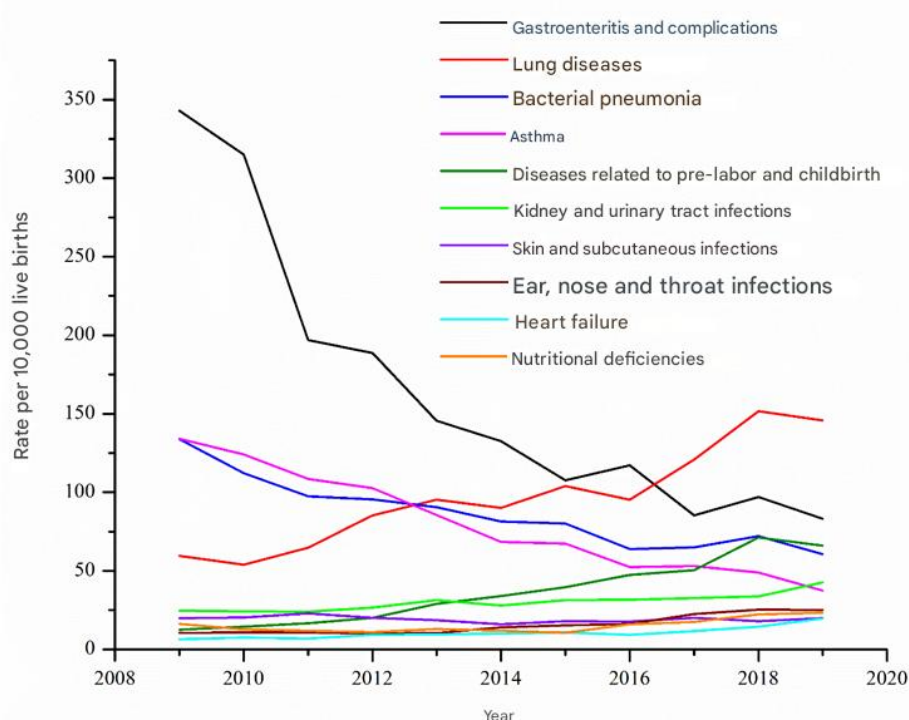
Group 16: Skin and subcutaneous tissue infections	19,22	1,84	9,61	0,13
Group 17: Inflammatory disease female pelvic organs	0,09	0,04	51,96	0,69
Group 18: Gastroduodenal ulcer	0,97	0,24	24,75	0,60
Group 19: Diseases related to prenatal care and childbirth	36,49	20,49	56,14	0,42

Source of raw data: SIH/SUS/DATASUS, SINASC/SUS/DATASUS.

Note: § According to the annex of Ordinance No. 221, of April 17, 2008, which has the International Code of Diseases 10 as a reference; SD=standard deviation; CV=coefficient of variation.

However, it can be seen in Figure 2 that there were changes in the magnitude of the crude rates of the six main causes of HACSC throughout the series, which culminated in the modification of the ranking of causes in the last year of the historical series. The pulmonary diseases that make up the group (acute bronchitis, unspecified bronchitis, simple and mucopurulent chronic bronchitis, unspecified chronic bronchitis, emphysema, bronchiectasis, other chronic obstructive pulmonary diseases) take first place as a reason for hospitalization for ambulatory care-sensitive conditions from the year 2017 onwards, remaining until the last year of the study. Diseases related to prenatal care and childbirth appear in children under 1 year of age since the beginning of the series, as the fifth most frequent cause and, as of 2018, they become the third most frequent cause of HACSC.

Figure 2 – Time series of the ten leading causes of hospitalizations for ambulatory care-sensitive conditions in children under 1 year of age in the state of Bahia, Brazil, 2009 to 2019



Source of raw data: SIH/SUS/DATASUS, SINASC/SUS/DATASUS.

The ranking of the ten main groups of causes in 2019 and the trends in the population of children under 1 year of age can be identified in table 2. It is observed that five groups of causes showed an upward trend, drawing attention to diseases related to prenatal care and childbirth and pulmonary diseases, whose large increase of 20.2% and 10.3% per year, respectively, changed the order of causes in the last year of the study. Other important increases, around 10% per year, have been presenting upper airway infections and heart failure, but without impact on the ordering of the causes, due to lower rates. Concomitantly, two groups of causes suffered drastic reductions: infectious gastroenteritis and asthma, reducing respectively 13.2% and 11.8% per year, also with an impact on the order of causes.

Table 2 – Planning and trend of the ten main causes of HACSC in children under 1 year of age, Bahia, Brazil, 2009 to 2019.

Order of causes &	Rate 2009*	2019 Rate**	VPA#	95%CI	Tendency
1-Lung diseases	059,50	145,78	10,3	7,8/12,8	Increase
2-Gastroenteritis and comp.	342,92	83,110	-13,2	-16,3/-10,0	Reduction
3-Prenatal diseases and childbirth	012,54	66,120	20,2	18,0/22,4	Increase
4-Pneumonias, Bacterial	133,83	60,700	-6,9	-8,5/-5,3	Reduction
5-Inf. kidney and urinary tract	024,63	42,640	4,8	3,7/6,0	Increase
6-Asthma	134,01	37,420	-11,8	-12,7/-10,9	Reduction
7-Inf. ear, nose and gar.	010,57	25,050	10,0	5,4/14,8	Increase
8-Def. Nutritional	016,26	23,380	4,5	-2,6/12,1	Stability
9-Inf. skin and subcutaneous	019,99	19,780	-0,9	-3,3/1,5	Stability
10-Heart failure	006,48	19,570	9,9	6,2/13,7	Increase

Source of raw data: SIH/SUS/DATASUS, SINASC/SUS/DATASUS

Notes: & descending order in 2019 (last year of the series). * per 10 thousand live births/first year of the series. ** per 10 thousand live births/last year of the series. # Annual Percentage Change (%).

DISCUSSION

Based on the results observed, it was possible to obtain rates of the HACSC indicator in children under one year of age, in a Federation Unit: Bahia, Brazil, in the period of eleven years (2009 to 2019), compare them with other states of the Brazilian federation, in addition to monitoring the movement of their causes.

This research found, for the state of Bahia, a high population coefficient of this indicator (average rate of 57.6/1000 live births, rate in 2015 was 50.77/1000 live births), while a nationwide study found a rate for Brazil of 48.14/1,000 live births in 2015 (PINTO *et al*, 2020). Other studies in the state of Bahia confirm these high rates, which were justified by the authors due to the large territorial extension and higher population density of Bahia

among the northeastern states, which may hinder the coverage of PHC services (RIBEIRO; ARAÚJO AND ROCHA, 2019).

However, between 2013 (the last year of the series studied by the aforementioned authors) and 2019, coverage by the Family Health Strategy (FHS) increased from 66.39% to 75.84% and Primary Care coverage went from 72.42% to 81.03% (BRASIL, 2021). In view of relatively high coverage quantities, there is possibly a lack of quality in the health care model(s) implemented in Bahia, similar to what was reported in a study in the city of Manaus (SILVA; GARNELO and GIOVANELLA, 210). However, it is considered that the health/disease process involves many other conditioning factors and social determinants that go beyond the quantity and quality of the primary care offered to the population (BUSS and PELLEGRINI, 2007). Thus, the occurrence of avoidable hospitalizations in the child population can be minimized by more actions to qualify PHC, however, it is emphasized that health care also needs to be enhanced by policies that act on the macroeconomy; in the strengthening of social relations; in intersectoral actions that involve living and working conditions and act on the health/disease of the child population.

The increasing trend of HACSC in the subgroup of children under 28 days of age found here confirmed the findings of other authors in the state of Ceará (COSTA; PINTO and SILVA, 2017) and in Brazil (PINTO *et al*, 2020). The authors justified the result by the increase in the rate of Congenital Syphilis in the group of causes "Diseases related to Prenatal Care and Childbirth". In this study, it is plausible to be the same reason, given that this group of causes showed a growth of around 20% per year and the incidence rate of Congenital Syphilis in Bahia went from 2.7 per 1 thousand live births in 2012 to 6.7 per 1 thousand live births in 2020 (SESAB, 2020; SESAB, 2021).

As of 2017, this study detected that lung diseases, gastroenteritis, and diseases related to prenatal care and childbirth accounted for approximately half of HACSC in children under one year of age in Bahia. The graphical visualization of the time series of the causes of HACSC in children under 1 year of age (Figure 2) showed the rise of pulmonary diseases (PAD) being intercepted at different points (2013 and 2017) by the descending lines of bacterial pneumonia, asthma, and gastroenteritis, thus, PD began to take the first place among the causes of HACSC in children under one year of age. Diseases related to prenatal care and childbirth followed almost parallel to lung diseases or vice versa.

The group of pulmonary diseases is composed of acute bronchitis, bronchiolitis, unspecified bronchitis, simple and mucopurulent chronic bronchitis, unspecified chronic bronchitis, emphysema, bronchiectasis, and other chronic obstructive pulmonary diseases, however, this study did not reach the necessary detail to define how many and which affected the population studied. A study of the trend of HACSC in children under one year of age in Brazil between 2000 and 2015 reported a result with a rate of lung diseases exceeding the rate of gastroenteritis and bacterial pneumonia in 2012 in the neonatal (7.9/10 thousand live births) and post-neonatal (130.5/10 thousand live births) population (PINTO *et al*, 2020), being higher than that found in the present study (85.36/10,000 live births), pointing out a possible change in the profile of causes in children under 1 year old also at the national level. Researchers reported lung diseases with a predominance in children under one year of age when grouped in the state of São Paulo between 2008 and 2014 (LOBO *et al*, 2019), but did not disclose the number of the rate. In an analysis of the causes of HACSC in all states of the Brazilian Northeast between 2004 and 2013, this change in profile was not detected. Gastroenteritis was also detected with the highest rates among the causes of HACSC (RIBEIRO; ARAUJO and ROCHA, 2019).

The change in the profile of causes of HACSC in children under 1 year of age also demands changes in the structure and work process of PHC to increase the problem-solving capacity on the diseases that generate these avoidable hospitalizations. Once the change in the profile of the causes is identified, action should be taken on the causes with higher rates and/or growth trends. Of the ten main causes among children under one year of age in Bahia, three showed a trend of reduction in their rates, but five showed growth. Although there are rates of lower magnitude, nosological groups with significant growth (lung diseases; diseases related to prenatal care and childbirth; kidney and urinary tract infections; ear, nose, and throat infections; heart failure) should be the target of early epidemiological recognition to allow the planning of policies, programs, and actions, as well as nosological groups of greater magnitude or prevalence. The anticipation function is the best use of time series analysis "which allows us to predict future scenarios of the distribution of diseases in the population and the factors capable of modifying this distribution for better or worse" (ANTUNES and CARDOSO, 2015).

Until then, the group of infectious gastroenteritis and complications has been identified in Brazil, especially in the Northeast, as the main cause of HACSC (RIBEIRO; ARAUJO and ROCHA, 2019; MOURA *et al*, 2010). Although the occurrence of

gastroenteritis is related to lack of sanitation, hospitalization indicates late management due to failure of Primary Health Care (KONSTANTYNER; MAIS and TADDEI, 2015). Thus, successful efforts over the last decades have been made to train teams in the management of diarrhea, which avoids complications and, consequently, avoids hospitalizations. However, the management of diseases of the respiratory system, in general, demands more structure of services and new skills of primary care health professionals (CUNHA, 2002).

Some limitations of this study need to be reported for critical evaluation of the results. The hospitalizations computed here refer to the records of the database of the Unified Health System, which, although they represent the majority, do not include the total count of the outcome of HACSC. As these are secondary data, arising from the completion of the AIH, it is subject to filling errors. The comparison of the results with other states in Brazil can be made as long as they have population and socioeconomic characteristics similar to those of the state of Bahia. However, respecting the limitations of ecological studies, the results cannot be applied at the individual level (LOPES, 2018).

Despite the limitations, this study brought to the discussion evidence of hospital morbidity that can help managers of the areas involved in the elaboration of public policies and in the planning of actions that result in a better problem-solving capacity of primary care. The large number of hospitalizations, the ease of access to data (as it is a database in the public domain), and the validation of data regarding the reliability of diagnoses of Ambulatory Care-Sensitive Conditions add value to this indicator for use in the qualification of municipal, state, and federal health systems (ABAID; NEDEL and ALCAVAGA, 2014; CAVALCANTE; OLIVEIRA and REHEN, 2012).

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