

Time trends in hospitalizations for Ambulatory Care Sensitive Conditions among children under five years old in Ceará, Brazil, 2000-2012

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Lillian de Queiroz Costa¹

Elzo Pereira Pinto Júnior²

Marcelo Gurgel Carlos da Silva¹

¹Universidade Estadual do Ceará, Programa de Pós-Graduação em Saúde Coletiva, Fortaleza-CE, Brasil

²Universidade Federal da Bahia, Instituto de Saúde Coletiva, Salvador-BA, Brasil

Abstract

Objective: to analyze time trends and describe the causes of hospitalizations for Ambulatory Care Sensitive Conditions (ACSC) in children under five years old in Ceará, Brazil, 2000-2012. **Methods:** this is an ecological time series study using data from the National Hospital Information System; trends were analyzed using Prais-Winsten regression. **Results:** from 2000 and 2016 ACSC hospitalization rates fell from 32.5 to 11.2/1,000 inhabitants under five years old (annual variation of -16.8%; 95%CI -20.6;-10.9); the cause groups with the largest reductions were nutritional deficiencies (-94.7%), infectious gastroenteritis (-52.6%), asthma (-59.0%) and bacterial pneumonias (-8.9%); the greatest reduction was found in the post-neonatal component (-22.4%); the hospitalization rate for prenatal and childbirth-related diseases increased 15 times among children under one year old. **Conclusion:** despite reduced ACSC hospitalization rates, preventable conditions were found that may reflect gaps in Primary Health Care.

Key words: Primary Health Care; Child Health; Hospitalization; Time Series Studies; Ecological Studies.

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Correspondence:

Lillian de Queiroz Costa – Av. Santos Dumont, No. 6915, Apto. 501, Fortaleza-CE, Brasil. CEP: 60175-057

E-mail: lillianqueiroz@hotmail.com

Introduction

Health indicators represent essential assessment and monitoring tools of health services. One of these indicators, the Hospitalizations for Ambulatory Care Sensitive Conditions (ASCS), correspond to health problems which are closely related to primary health care; good quality primary health care services can reduce the risk of hospitalizations due to these preventable causes.¹

Hospitalizations for ASCS, also known as preventable hospitalizations, represent an important tool to verify, indirectly, the effectiveness and effectiveness of the assistance given by the first level of health care.² In this sense, monitoring these hospitalizations is essential for supporting decisions which aim to reduce the high number of preventable hospitalizations.³

There seems to be an agreement in international literature in which preventable hospitalizations are markers of Primary Health Care effectiveness, associated to difficulties in the access to quality services, especially among vulnerable populations.

These unnecessary hospitalizations possibly reflect gaps in the health care system related to provide qualified access to Primary Health Care, since the group of diseases responsible for such hospitalizations should be early detected. Actions timely and effectively offered in the first care level of the health system can reduce diseases' severity, avoiding complications and the need for hospitalization.⁴

The first studies on hospitalizations for ASCS were developed in the United States of America and pointed to the elimination of access barriers to health services as a decreasing factor of preventable hospitalizations.⁵ From those studies, many other studies have been developed under this theme, in various countries and contexts, participants and diverse methodologies. In spite of the plurality of methodologies and research scenarios, there seems to be an agreement in international literature in which preventable hospitalizations are markers of Primary Health Care effectiveness, associated to difficulties in the access to quality services, especially among vulnerable populations.⁶⁻⁹

In 2008, the Brazilian Health Ministry launched the Brazilian list of hospitalizations for ASCS.¹⁰ This list,

which is a result of a validation work performed by many Public Health specialists of the country, covers 19 groups of diagnoses considered sensitive to Primary Health Care and classified according to the International Statistical Classification of Diseases and Related Health Problems - 10th Revision (ICD-10).¹

With regard to hospitalizations for ASCS among children under five years old and respective age subgroups (0 to 27 days; 28 days to 11 months; 1-4 years), which is a group of the population that frequently uses the primary health care services offered by the Family Health Strategy (FHS) in Brazil, many studies have been developed aiming to understand the magnitude, context and characteristics of those hospitalizations.^{3,11,12} Those studies show the high prevalence of acute conditions in pediatric hospitalizations, such as diseases of the respiratory tract and gastroenteritis,^{11,13,14} and that the reduction of hospitalizations for ASCS is closely related to the improvement in the offer and effectiveness of primary actions in health, mostly when developed by FHS teams.¹⁵⁻¹⁸

Despite the increasing number of studies dedicated to hospitalizations for ASCS in children, researches on the specific causes of hospitalizations in neonatal and post-neonatal period, among children under one year, those from one to four years and under five years are still scarce. This study aimed to analyze time trends and to describe the causes of Hospitalizations for Ambulatory Care Sensitive Conditions – ASCS – in children under five years old in Ceará, Brazil, from 2000 to 2012.

Methods

This is an ecological time series study on ASCS hospitalization rates in the state of Ceará, Brazil, in the period from 2000 to 2012.

The information sources to the research were the National Hospital Information System (SIH/SUS) and the Information System on Live Births (Sinasc), besides demographic data provided by the Brazilian Institute of Geography and Statistics (IBGE). All of these data are secondary, of public domain, and were accessed at SUS IT Department website (www.datasus.gov.br). The software Tab for Windows – TabWin version 3.6b – was used for data extraction.

All hospitalizations of children under five years old that occurred between January 2000 and December 2012 at SUS or its associated network of hospitals were included, for all the municipalities of the state of Ceará.

ASCS hospitalization rates, according to the most frequent hospitalization causes due to sensitive conditions, were calculated considering the disease groups described in the Brazilian list of hospitalizations for ASCS.¹⁰ The hospitalization rates of the seven main ASCS causes were calculated, for the following age groups: from 0 to 27 days (neonatal); from 28 days to 11 months (post-neonatal); under 1 year; from 1 to 4 years; and under 5 years.

In the groups of children from 0 to 27 days, 28 days to 11 months and under 1 year, rates were calculated by dividing the number of hospitalizations for ASCS, in each age group, by the total of live births in the given year (Sinasc), and then multiplied by 1,000. ASCS hospitalization rates for children from 1 to 4 years were calculated by dividing the total of hospitalizations in this group by the number of children in the same age group in each year (IBGE), multiplying the result by 1,000. For children under five, the rates corresponded to the ratio between the total hospitalizations for this age and the number of children in this age group, for each year, multiplied by 1,000.

After calculating these indicators, for the descriptions of hospitalizations for ASCS, we chose to present the municipalities' medians in the tables, to avoid data dispersion that could compromise the average. The rates percentage variation in the time series was calculated by comparing the values of the last to those of the first year. To calculate this percentage variation, the value of the rate of the last year was deducted from the value of the rate of the first year, and this difference was divided by the rate value for the first year.

Besides describing the variation of ASCS hospitalization rates, according to the main causes by age group, we estimated the time trends of hospitalization rates of total ASCS. For this, we used preventable hospitalization rates for each municipality of Ceará, per year. It should be highlighted that the total ASCS for each age group represents all 19 groups of causes of the Brazilian list, not only the most frequent causes. Prais-Winsten general linear regression was used for time trends analysis, to estimate *beta 1* (*b'*) coefficients; and then, the annual percentage change was estimated and its respective 95% confidence intervals (95%CI), for each age group analyzed. The analyses were performed using Stata software version 12.

Despite using free access secondary data, available in public sources, without personal identification of the

hospitalized children, the study's project was submitted and approved by the Ethics Research Committee of Ceará State University, under the Report No. 923.491, in December 11, 2014.

Results

In Ceará, 388,973 hospitalizations for ASCS were registered in children under five years old, from 2000 to 2012, with reduction from 35,989 to 17,358 between the first and the last years of the period. ASCS hospitalization rate in children under five years ranged from 32.5/1,000 inhabitants in 2000 to 11.2/1,000 inhabitants in 2012, which corresponds to a 65.5% reduction in 13 years.

With regard to hospitalization rates in children from 0 to 27 days of life, a reduction in hospitalizations due to bacterial pneumonias (-58.5%), gastroenteritis (-51.1%) and asthma (-36.7%) was observed; however, there was an increase for other causes. A 21-time increase in hospitalization rates for prenatal and childbirth-related diseases was observed, and those became the main hospitalization causes in this age group in 2012. Even though there has been a considerable decline in hospitalizations due to gastroenteritis, this cause represented the second higher hospitalization rate in the last year of the studied period. The time trends analysis revealed annual percentage increase of 17.5% (95%CI: 7.2;28.8) in ASCS hospitalization rate for the neonatal group (Table 1).

In children from 28 days to 11 months, there has been a reduction in hospitalization rates for nutritional deficiencies (92.3%), infectious gastroenteritis (78%), asthma (68.2%) and bacterial pneumonias (27.6%). On the other hand, there has been an increase in hospitalization rates for kidney infections (170.0%) and pulmonary diseases (94.0%). Although the considerable reduction presented, infectious gastroenteritis had remained as the main specific cause of preventable hospitalization for that age group, between 2000 and 2012. Time trends analysis has showed an annual percentage reduction of 22.4% (95%CI: -22.2; -16.8) in ASCS hospitalization rate for the post-neonatal group (Table 2).

The analysis of specific hospitalization rates per group of sensitive causes in children under 5 years old revealed a reduction in hospitalizations due to nutritional deficiencies (90.0%), infectious

Table 1 – Rates of hospitalizations for Ambulatory Care Sensitive Conditions (ASCS) among children from 0 to 27 days (per 1,000 live births), according to most frequent causes, Ceará, 2000-2012

ASCS Diagnoses	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ% ^a	Annual percentage variation ^b (95%CI ^c)
Infectious gastroenteritis and complications	1.31	1.18	1.5	1.24	1.11	1.24	2.96	2.10	1.92	1.02	0.87	0.60	0.64	-51.1	-
Bacterial pneumonias	1.06	0.63	0.71	0.6	0.62	0.53	0.83	0.92	0.97	1.29	0.97	1.18	0.44	-58.5	-
Asthma	0.30	0.33	0.26	0.2	0.23	0.36	0.52	0.59	0.48	0.21	0.14	0.12	0.19	-36.7	-
Prenatal and childbirth-related diseases	0.15	0.30	0.30	0.49	1.56	1.73	2.16	2.13	2.43	2.43	2.94	3.45	3.30	2,100.0	-
Pulmonary diseases	0.11	0.22	0.13	0.12	0.27	0.38	0.23	0.23	0.29	0.69	0.22	0.49	0.29	163.6	-
Kidney and urinary tract infections	0.07	0.07	0.08	0.10	0.17	0.16	0.14	0.12	0.25	0.17	0.39	0.33	0.35	400.0	-
Skin and subcutaneous tissue infections	0.04	0.04	0.01	0.03	0.05	0.03	0.05	0.05	0.17	0.31	0.36	0.38	0.30	640.3	-
ASCS total in children aged from 0 to 27 days	2.07	1.66	2.55	2.30	2.52	3.04	5.31	3.99	4.97	3.09	4.70	3.74	3.92	91.5	17.5 (7.2;28.8)

a) Δ% = percentage variation in the period
b) Calculated using Prais-Winsten regression
c) 95%CI:95% confidence interval

Table 2 – Rates of hospitalizations for Ambulatory Care Sensitive Conditions (ASCS) in children from 28 days to 11 months (per 1,000 live births), according to most frequent causes, Ceará, 2000-2012

ASCS Diagnoses	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ% ^a	Annual percentage variation ^b (95%CI ^c)
Infectious gastroenteritis and complications	62.21	56.42	60.89	52.65	53.02	52.53	46.33	30.36	25.57	26.2	20.35	16.43	13.66	-78.0	-
Asthma	14.78	14.56	13.14	12.91	12.2	7.6	8.15	9.08	6.34	7.31	4.35	6.49	4.70	-68.2	-
Bacterial pneumonias	12.89	8.79	13.91	18.15	17.77	11.73	13.91	13.76	14.73	18.35	10.81	15.41	9.32	-27.6	-
Pulmonary diseases	3.51	3.47	2.56	3.00	7.32	10.17	7.12	7.56	6.19	10.36	6.10	11.28	6.82	94.0	-
Nutritional deficiencies	2.76	2.74	2.59	2.24	1.93	0.98	0.75	0.64	0.42	0.46	0.26	0.28	0.21	-92.3	-
Kidney and urinary tract infections	0.63	0.72	0.68	0.94	0.92	1.34	1.10	1.30	1.35	1.64	2.20	1.46	1.69	170.0	-
Epilepsy	0.45	0.54	0.50	0.54	0.49	0.75	0.64	0.55	0.35	0.51	0.59	0.63	0.52	14.8	-
ASCS total in children aged from 28 days to 11 months	74.80	67.50	78.80	69.50	71.20	71.70	63.10	45.40	38.00	40.00	29.50	31.80	14.70	-80.4	-22.4 (-29.2;-16.8)

a) Δ% = percentage variation in the period
b) Calculated using Prais-Winsten regression
c) 95%CI:95% confidence interval

gastroenteritis (77.5%), asthma (67.6%) and bacterial pneumonias (30%), and an increase in hospitalizations due to other causes, and a 15-time increase in hospitalization rates due to prenatal and childbirth-related diseases. Concerning the increase of hospitalizations due to kidney infections, this cause remains as one with the lowest magnitude in the group of hospitalizations for ASCS. The time trends analysis has showed an annual percentage reduction of 20.6% (95%CI -25.9;-14.9) in ASCS hospitalization rate for children under one year (Table 3).

In the group of children aged from 1 to 4 years, the most frequent preventable hospitalization causes also presented infectious gastroenteritis, asthma and bacterial pneumonias. The decrease in hospitalization rates due to nutritional deficiencies (97.8%), asthma (55.1%) and gastroenteritis (27.1%) should be highlighted; despite the fact that the latter remains as the most frequent cause for all the studied years. Unlike what has happened in other age groups, in this preschooler range, the hospitalization rates due to bacterial diseases basically remained stable. The time trends analysis has shown an annual percentage decrease of 12.9% (95%CI -18.7;-6.7) in the ASCS hospitalization rate for children aged from 1 to 4 years (Table 4).

The analysis of hospitalizations for ASCS in children under five years old has shown that infectious gastroenteritis, asthma and bacterial pneumonias remain as the main hospitalization reasons in the group of preventable causes, a profile similar to the other analyses per age group. In this broader age group, the 94.7% reduction in hospitalizations due to nutritional deficiencies stand out, making it no longer the fourth, but the last among the seven main causes of hospitalizations for ASCS; besides reductions above 50% in hospitalizations due to gastroenteritis and asthma. The time trends analysis has revealed an annual percentage reduction of 16.8% (95%CI -20.6;-10.9) in ASCS hospitalizations rate for children under five years (Table 5).

Discussion

In Ceará, from 2000 to 2012, there has been a significant decrease in the occurrence of hospitalizations for ASCS among children under five years old and in their age subgroups. The reductions in

the hospitalization rates due to nutritional deficiencies, infectious gastroenteritis, asthma and bacterial pneumonias, in the various age groups have stood out. This reduction in the group of preventable causes, and hospitalizations due to prenatal and childbirth-related diseases presented a high magnitude increase in the group of children up to 27 days of life. We should also highlight the reduction trend of hospitalizations for ASCS in almost all age groups, except for neonatal group, in which we observed a discrete increasing trend over the historic series.

This study's results support evidences of other studies conducted in Brazil which have also presented ASCS hospitalization rate's reduction in children.^{3,10,13,19} The differences in the characteristics of those hospitalizations result from various factors, such as socioeconomic characteristics of the population, epidemiological conditions, health services' characteristics and other peculiarities, inherent to each Brazilian region, state or municipality.¹¹

The highest ASCS hospitalization rates were found in the group of children under one year old, and the post-neonatal group was the main responsible for those hospitalizations and also for the most expressive decreasing rates. A study conducted in a public hospital in the state of Paraná, which aimed to understand the causes of hospitalizations in children under five years old, has verified, similarly, a predominance of hospitalizations in children under one year old, showing that 42% of hospital admissions have occurred in this age group.²⁰

The high occurrence of hospitalizations among children under one year old may be related to immunological immaturity, particular of this age group, putting them into a higher risk of diseases, whilst the most significant decreases in this age range may have suffered strong influence of the improvement in the offer and quality of health services, especially those related to primary health care, offered by FHS teams.

The analysis of the main diseases groups that lead to hospitalizations for ASCS has concluded, about almost every age group, that the most frequent causes of hospitalizations were infectious gastroenteritis and complications, asthma and bacterial pneumonias. The historic series description has evidenced that the higher reductions occurred in those ASCS hospitalization rates related to infectious gastroenteritis, notwithstanding

Table 3 – Rates of hospitalizations for Ambulatory Care Sensitive Conditions (ASCS) in children under one year old (per 1,000 live births), according to most frequent causes, Ceará, 2000-2012

ASCS Diagnoses	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ% ^a	Annual percentage variation ^b (95%CI) ^c
Infectious gastroenteritis and complications	63.52	57.6	62.39	53.9	54.12	53.77	49.29	32.46	27.49	27.22	21.22	17.03	14.30	-77.5	-
Asthma	15.08	14.89	13.4	13.11	12.44	7.96	8.67	9.67	6.82	7.52	4.49	6.61	4.89	-67.6	-
Bacterial pneumonias	13.95	9.43	14.62	18.75	18.39	12.27	14.74	14.68	15.7	19.64	11.78	16.59	9.76	-30.0	-
Pulmonary diseases	3.62	3.7	2.69	3.13	7.59	10.55	7.35	7.8	6.47	11.05	6.32	11.77	7.11	96.4	-
Nutritional deficiencies	2.85	2.83	2.81	2.37	2.1	1.11	0.86	0.69	0.47	0.50	0.35	0.34	0.28	-90.0	-
Kidney and urinary tract infections	0.70	0.79	0.76	1.04	1.09	1.50	1.24	1.42	1.61	1.80	2.59	1.79	2.04	189.8	-
Prenatal and childbirth-related diseases	0.21	0.36	0.34	0.51	1.59	1.80	2.43	2.35	2.60	2.51	3.03	3.50	3.41	1531.3	-
ASCS total in children aged under 1 year old	78.80	70.20	81.80	72.10	73.50	75.30	71.50	49.40	42.20	43.70	32.30	36.40	20.60	-73.9	-20.4 (-25.9;-14.9)

a) Δ% = percentage variation in the period
b) Calculated using Prais-Winsten regression
c) 95%CI: 95% confidence interval

Table 4 – Rates of hospitalizations for Ambulatory Care Sensitive Conditions (ASCS) in children from 1 to 4 years old (per 1,000 live births), according to most frequent causes, Ceará, 2000-2012

ASCS Diagnoses	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ% ^a	Annual percentage variation ^b (95%CI) ^c
Infectious gastroenteritis and complications	13.72	15.53	14.84	14.54	15.37	16.87	15.51	13.39	11.79	11.49	13.95	11.41	10.00	-27.1	-
Asthma	11.36	11.33	10.98	8.83	8.74	8.45	6.92	8.25	4.94	5.48	5.80	6.58	5.00	-55.1	-
Bacterial pneumonias	4.06	3.97	5.54	6.52	6.47	4.74	4.59	5.18	5.50	5.71	5.36	5.63	4.29	5.7	-
Nutritional deficiencies	1.09	0.87	0.75	0.66	0.58	0.23	0.16	0.17	0.10	0.06	0.07	0.05	0.02	-97.9	-
Pulmonary diseases	0.73	0.77	0.36	0.33	0.50	0.61	0.38	0.62	1.02	1.27	1.45	1.60	1.16	57.3	-
Kidney and urinary tract infections	0.72	0.86	0.40	0.41	0.45	0.50	0.42	0.48	0.48	0.66	0.81	0.77	0.77	5.8	-
Skin and subcutaneous tissue infections	0.19	0.15	0.06	0.14	0.19	0.20	0.25	0.27	0.36	0.63	0.90	0.88	0.57	204.4	-
ASCS total in children aged from 1 to 4 years old	22.50	22.90	24.40	20.80	23.10	23.60	21.60	18.70	13.30	15.50	15.90	15.60	9.00	-60.0	-12.9 (-18.7;-6.7)

a) Δ% = percentage variation in the period
b) Calculated using Prais-Winsten regression
c) 95%CI: 95% confidence interval

Table 5 – Rates of hospitalizations for Ambulatory Care Sensitive Conditions (ASCS) in children under 5 years old (per 1,000 live births), according to most frequent causes, Ceará, 2000-2012

ASCS Diagnoses	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Δ% ^a	Annual percentage variation ^b (95%CI ^c)
Infectious gastroenteritis and complications	22.44	23.08	22.80	20.76	21.18	22.24	20.03	16.19	14.12	13.81	15.47	12.33	10.62	-52.6	–
Asthma	11.88	11.88	11.20	9.33	9.08	8.10	6.92	8.25	5.12	5.67	5.57	6.48	4.88	-59.0	–
Bacterial pneumonias	5.77	4.93	7.01	8.40	8.21	5.79	5.95	6.61	7.08	7.89	6.67	7.70	5.26	-8.9	–
Nutritional deficiencies	1.39	1.22	1.09	0.93	0.81	0.36	0.26	0.25	0.16	0.13	0.13	0.11	0.07	-94.7	–
Pulmonary diseases	1.24	1.30	0.76	0.79	1.63	2.18	1.42	1.80	1.92	2.88	2.43	3.58	2.28	84.0	–
Kidney and urinary tract infections	0.71	0.84	0.46	0.50	0.54	0.64	0.53	0.62	0.66	0.83	1.17	0.96	1.00	40.1	–
Skin and subcutaneous tissue infections	0.20	0.15	0.06	0.15	0.20	0.20	0.28	0.28	0.40	0.69	0.98	0.93	0.61	210.9	–
ASCS total in children aged under 5 years old	32.50	31.00	34.70	29.20	31.80	32.00	28.80	23.40	17.80	18.70	20.50	17.70	11.20	-65.5	-16.8 (-20.6;-10.9)

a) Δ% = percentage variation in the period

b) Calculated using Prais-Winsten regression

c) 95%CI: 95% confidence interval

those diseases have remained as the major determinant group of hospitalizations, whereas asthma and bacterial pneumonias took turns in second and third places.

A study on the most frequent hospitalization causes in children from zero to four years old in Brazil pointed to a prevalence of gastroenteritis in the North and Northeast regions, and to a smaller proportion in the Southeast region, considered the most developed region in the country. With regard to respiratory diseases, there have been hospitalizations prevalence in the South and Midwest regions, and a smaller rate in the North region, confirming climate influence over those diseases' etiology and Brazilian regional inequalities, related both to health services accessibility and professionals and to the population's life conditions in each region.¹⁴

Concerning the most frequent causes of hospitalizations for ASCS, other studies conducted in states located in the Northeast region – Piauí and Pernambuco – presented findings similar to the present study. In Piauí, among children under five years old, there was a more evident reduction in hospitalizations due to infectious and parasitic diseases.³ In Pernambuco, the main diagnostic groups were gastroenteritis and complications, asthma, bacterial pneumonias and pulmonary diseases, which, altogether, were responsible for 89.1% of hospitalizations.¹⁷

In Brazil, the deepest reductions in infant mortality due to specific causes were observed for diarrhea

and respiratory infections, which have decreased 92% and 82%, respectively.²¹ Although these advances and the reduction in hospitalization rates and mortality due to infectious gastroenteritis, this evolution had not occurred homogeneously among Brazilian macroregions, and gastroenteritis is still responsible for the increasing number of hospitalizations, especially among children under five years.¹¹

Some analyses conducted in municipal level pointed that the Family Health Program (FHP) brought positive results over infant mortality,^{22,23} especially on the reduction of mortality due to diarrhea and pneumonias.^{24,25} In the Northeast region, children under five years old would be twice likely to be hospitalized due to diarrhea if they lived in areas not covered by FHP.²⁶

In this study, an increase in pulmonary diseases for almost every age group investigated over the historic series has been observed. In the case of bacterial pneumonia, there was an initial panorama of increasing rates, mostly among children under one year, especially those aged from 28 days to 11 months. Pediatric beds offer over the years can explain, in part, the increase of these clinical hospital admissions due to bacterial pneumonias.

A research that aimed to evaluate the effect FHP over hospitalization rates due to pneumonia in children under five years who lived in Brazilian municipalities, between 1999 and 2009, found a positive association between

the increase in FHP coverage and rates of pneumonia in age groups of children under one year and under two months. According to that research, that was a desirable effect, since clinical recommendation for the treatment of pneumonias in this age group occurs in hospital level, once they are considered severe cases.²⁷

Other interesting aspect concerns to the exponential increase (2,100.00%) observed in hospitalizations due to prenatal and childbirth-related diseases in the age group from 0 to 27 days. Congenital syphilis is believed to be the main responsible for this increase of cases in Ceará – which is alarming, since this is considered a preventable disease, capable of causing serious damages in affected children.

In Ceará, congenital syphilis rate has increased considerably. From 2000 to 2009, it rose from 0.56 to 49.32 per 10 thousand live births. This increase in the number of cases can represent an improvement in notifications, as well as an evidence of the need to develop effective actions to control this disease. We can infer that the issue of congenital syphilis is closely related to the access and to low quality of prenatal care, which can be considered a marker of quality and maternal-infant assistance.²⁸

This study has also shown an important reduction in the number of hospitalizations due to nutritional deficiencies, probably associated to the improvement of the families' socioeconomic status, maternal schooling improvement, expansion of health services access and sanitation, besides a growth in the population's purchasing power over the years.²⁹ In this sense, cash transfer programs, such as *Bolsa Família* Program, especially when directed to families in extreme poverty, can reflect in improvement in social status and, consequently, in the reduction of food insecurity and hunger among this population.³⁰

The decreasing trend of hospitalizations for ASCS in most of the age groups, especially in post-natal care group, keeps strict relation with potential impacts of public policies, such as Family Health Strategy and *Bolsa Família* Program.^{29,30} In turn, the observed trend of discreet increase of ASCS hospitalization rates in the neonatal group can reveal deficiencies in hospital care to newborns, especially in places with bad socioeconomic indicators.

This study presents as limitation the fact that the analysis has considered Ceará as a level of

data aggregation, which may have hidden certain hospitalizations patterns, since some municipalities in Ceará are in extreme poverty conditions. These municipalities' socioeconomic differences could reveal more serious scenarios, increasing or maintaining high levels of preventable hospitalizations, mostly where there is little infrastructure of primary public services, such as health services. In any case, we must highlight the importance of this research and its pioneering action in drawing an overview of hospitalizations due to preventable conditions in children under five years old, in a state of the Northeast region of Brazil.

All in all, this present study has revealed a reduction in hospitalizations for the main preventable condition groups, and a reduction in the magnitude of hospitalizations due to causes that once had been more common among children, as gastroenteritis, asthma and bacterial pneumonias. Significant decrease was also noticed in hospitalizations linked to nutritional deficiencies, a sign of improvement in life conditions and of decrease of extreme poverty.

However, high rates of hospitalizations for ASCS in Ceará still persist, indicating the need for effective and timely actions in health services, mainly in Primary Health Care. This study has revealed that the evaluation of health services offered to the population is extremely relevant, through the use of indicators able to establish a situational diagnosis and to serve as support for building and directing public policies whose objective would be to improve the services performance and quality.

Despite the advantages provided by the use of information systems in health on researches of Hospitalizations for Ambulatory Care Sensitive Conditions –ASCs –, it is imperative that new primary studies on this group of causes are developed with the purpose of better identifying the profile of hospitalized children and these hospitalizations determinants.

Authors' contributions

All the authors contributed to the conception and design of the study, analysis and interpretation of results, drafting and relevant critical review of its intellectual content. They approved the manuscript's final version and declared to be responsible for all aspects of the study, ensuring its accuracy and integrity.

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