

## Characteristics and factors associated with hospitalization in early childhood: 2004 Pelotas (Brazil) birth cohort

Características e fatores associados à hospitalização nos primeiros anos de vida: coorte de nascimentos de Pelotas 2004, Rio Grande do Sul, Brasil

Características y factores asociados a la hospitalización durante los primeros años de vida: cohorte de nacimientos de Pelotas 2004, Rio Grande do Sul, Brasil

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### Abstract

Hospitalization is a frequent event in early childhood. In Brazil, the National Household Sample Survey of 2008 showed a 9% hospitalization rate among children in the first four years of life. The study aimed to describe the characteristics of hospitalization in the first six years of life and analyze the early factors associated with hospitalization in a birth cohort in southern Brazil. A zero-inflated Poisson model was used to simultaneously examine the effects of co-variables for the occurrence of a given event and to count events. The frequency of at least one episode of hospitalization during the study period was 33.4% (95%CI: 31.8-34.9), and was highest in the first year (19.1%; 95%CI: 17.9-20.4), remaining stable at approximately 10% between the first and fourth years, decreasing to 8.4% (95%CI: 7.6-9.4) between the fourth and sixth years. diseases of the respiratory system were among the leading causes of hospitalization, followed by infectious and parasitic diseases. History of prior hospitalization was one of the most important predictors of odds of hospitalization and risk of multiple hospitalizations. In early childhood, birth weight, gestational age, Apgar score, sex, and type of pregnancy were inversely associated with hospitalization, and environmental characteristics such as maternal smoking in pregnancy, mother's skin color, and low family income were associated statistically with number of hospitalizations. The results point to the importance of focusing efforts on reducing hospitalizations from diseases of the respiratory system, especially in children under one year.

Hospitalization; Infant; Cohort Studies

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## Introduction

Hospitalization is defined as the admission and stay in a hospital establishment for more than 24 hours in the attempt to recover the individual's health <sup>1</sup>. Worldwide, hospitalizations account for nearly half of public spending in health <sup>2</sup>. Costs are related to the characteristics of the diseases that caused the hospitalization and the patient's age <sup>2,3,4,5</sup>. Diseases with high incidence can lead to the hospitalization of a high number of individuals, which entails higher costs <sup>2,3,4</sup>. In addition, costs tend to be higher in extreme age groups, in rare diseases, and in diseases whose treatment requires highly specialized technology <sup>2,3,4</sup>.

Hospitalization is a frequent event in early childhood and preschool age <sup>5</sup>. In Brazil, the *National Household Sample Survey* (PNAD 2008) showed an 8.9% hospitalization rate among children from zero to four years of age. Among hospitalized children, 54.7% were males and 80.7% had been hospitalized only once <sup>6</sup>.

Respiratory diseases are the most frequent causes of morbidity and mortality in children under five years worldwide, especially in high-income countries <sup>7,8</sup>. In medium and low-income countries, infectious diseases are still important causes of hospitalization, despite the decline in hospitalizations from acute diarrhea since the advent of oral rehydration therapy and such interventions as maternal breastfeeding and immunizations <sup>7,8,9</sup>.

In Brazil, respiratory diseases are the leading cause of hospitalization in children under five years, followed by infectious intestinal diseases <sup>5,10</sup>. Hospitalizations from these causes are distributed unequally across the regions of Brazil. In the South, Southeast, and Central, hospitalizations from respiratory diseases are more common, while admissions for infectious and parasitic diseases predominate in the North and Northeast <sup>6,10,11</sup>.

In the South of Brazil, Matijasevich et al. <sup>12</sup> evaluated hospitalizations during childhood in three longitudinal population-based studies. All-cause hospitalization at least once in the first year of life remained constant from 1982 to 2004 (19.6% in 1982; 18.1% in 1993; and 19.2% in 2004;  $p = 0.7$ ). However, there was a sharp reduction in hospitalizations from diarrhea during the same period (6.3% in 1982; 3.2% in 1993; and 1.0% in 2004;  $p < 0.001$ ).

The current study aims to describe the characteristics of hospitalization in the first six years of life and analyze early factors associated with odds of hospitalization and risk of multiple hospitalizations in a birth cohort in southern Brazil.

## Methods

### Study site

Pelotas is a medium-sized municipality, predominantly urban, located in Rio Grande do Sul State, Brazil. The population in 2004 was estimated at 340,000. At the time, Pelotas was an impoverished municipality, with a per capita Gross Domestic Product (GDP) below the mean for Brazil and Rio Grande do Sul (Instituto Brasileiro de Geografia e Estatística. Censo Demográfico 2000. [http://www.ibge.gov.br/home/estatistica/populacao/censo2000/universo.php?tipo=31o/tabela13\\_1.shtm&paginaatual=1&uf=43&letra=P](http://www.ibge.gov.br/home/estatistica/populacao/censo2000/universo.php?tipo=31o/tabela13_1.shtm&paginaatual=1&uf=43&letra=P), accessed on 28/Jul/2016).

### Study population and design

From January 1 to December 31, 2004, all the hospitals in the city were visited daily to identify births. Postpartum women were interviewed on their socioeconomic, demographic, reproductive, and healthcare characteristics during pregnancy and childbirth. The newborns were examined by trained field researchers. The original cohort consisted of 4,231 live newborns, corresponding to 99.2% of the births in Pelotas in the year 2004.

Children participating in the study were followed at one, two, four, and six years of life. At each follow-up, the mothers were interviewed and the children were measured and weighed by trained field researchers. The follow-up rate at all visits exceeded 90% <sup>13</sup>. All the follow-up waves of the 2004

Birth Cohort were approved by the Institutional Review Board of the School of Medicine, Pelotas Federal University.

### **Variables and statistical analyses**

The study focused on the rate, number, and causes of hospitalization in early childhood, considering hospitalizations that occurred after hospital discharge following birth.

Information on hospitalization in the first year of life was collected at 12 months using the following question: “Has your child been admitted to hospital since birth and until now?”. Hospitalization between 1 and 2 years, 2 and 4, and 4 and 6 years was collected using the previous question but referring to the respective period at the 2, 4, and 6-year follow-up visits, respectively. We calculated the rate of at least one hospitalization in the period from one to six years (sometime in life) and in the following periods: in the first year, between the first and second year, between the second and fourth year, and between the fourth and sixth year of life. To calculate the lifetime hospitalization rate, we only included children with information on hospitalization at all the follow-up visits. The hospitalization rate in each period was collected as discrete, and for the analysis it was categorized: none, one, two, three, four, and five or more times. Causes of hospitalization were collected with an open question: “Why was <the child> hospitalized?” or “Why was he/she admitted to hospital?” Answers were coded according to the International Classification of Diseases, 10<sup>th</sup> edition (ICD-10). Later, the ten leading causes of hospitalization were listed for each follow-up wave according to the ICD-10 groups.

The early factors were collected in the perinatal study. Birth weight was classified in four groups (< 2,500g, 2,500g-2,999g, 3,000g-3,499g, and ≥ 3,500g). Gestational age was categorized as ≥ 37 weeks (term) and < 37 weeks (preterm). Family income was divided into quintiles, with the first quintile including the poorest 20% and the fifth quintile the wealthiest 20%. The monthly income quintile cutoffs were: BRL 0-≤ 240 (Q1); 241-≤ 400 (Q2); 401-≤ 600 (Q3); 601-≤ 1,000 (Q4); and 1,001-≤ 22,000 (Q5).

Parity was categorized as < 2 or ≥ 2 children, and 5-minute Apgar score as ≥ 7 or < 7 points. The mother’s and child’s skin color were observed by the interviewer and categorized as white, black, or brown.

The other variables, such as sex (male/female), type of delivery (vaginal/cesarean), and maternal smoking (yes/no) were analyzed the same way as collected. Alcohol consumption during the pregnancy was assessed through a question addressed to the mother and analyzed dichotomously (yes/no).

Early factors associated with hospitalization were evaluated with the Zero-Inflated Poisson model (ZIP)<sup>14</sup>, which allows simultaneously examining the effects of co-variables on the binomial and counting components. Thus, the early factors that affect the odds of hospitalization were estimated simultaneously with the factors that affect the number of hospitalizations in the children. The estimated measures of association were odds ratio of hospitalization and relative risk for the number of hospitalizations. Wald’s chi-square test was used to assess whether the models’ estimates were statistically different from zero.

The crude and adjusted analyses were limited to children with information for the outcome and predictors. In the adjusted model, for each study period, we included the mother’s and child’s characteristics with significance < 0.20 in the crude analysis. The variables were included only once in the equation and were then removed one by one until the best predictors were identified (backward elimination strategy). The variables included in the final model varied according to the child’s age.

Interactions with the sex variable were tested, and no significant interactions were observed. Colinearity was seen between the variables. The correlation matrix did not show highly correlated variables.

The ZIP model was compared to the traditional Poisson model using the Vuong test<sup>15</sup>, and in all cases ZIP was more adequate for the data analysis. The statistical analyses used Stata 13.1 (StataCorp LP, College Station, USA).

## Results

Of the 4,231 newborns that entered the 2004 Pelotas cohort, 3,907, 3,869, 3,799, and 3,722 children were followed at two, four, and six years of age, respectively (with rates greater than 90% at each follow-up). At one, two, four, and six years of age, there was information on hospitalization for 3,907 (100%), 3,868 (99%), 3,799 (100%), and 3,646 (98%) children, respectively.

Among the children studied, 51.9% were males, 28.9% had black or brown skin color, 45.2% were delivered by cesarean, 10.9% with birth weight < 2500g, 11.6% with gestational age < 37 weeks, and 2.1% with 5-minute Apgar < 7. As for maternal characteristics, 72.8% of the mothers were white, 60.7% had two or more children, 21.1% smoked, and 3.3% had consumed alcohol during the pregnancy.

The rate of at least one lifetime hospitalization from birth to six years of age was 33.4% (95%CI: 31.8-34.9). Analyzing hospitalization according to cohort follow-up waves, the hospitalization rate in the first year of life was 19.1% (95%CI: 17.9-20.4), remained stable at 10% from the first to fourth years, and decreased to 8.4% (95%CI: 7.6-9.4) from the fourth to the sixth years of life (Table 1).

At all the follow-up waves, the majority of the children had been hospitalized once. In the first year of life, 15.0% (95%CI: 13.9-16.1) had one hospitalization, decreasing in the second year to 8.2% (95%CI: 7.4-9.1), and then remaining stable throughout the period (7.6% – 2 to 4 years; 6.8% – 4 to 6 years). The proportion of children with two or more hospitalizations varied from 4.2% in the first year of life to 1.7% from the fourth to the sixth year (Table 1).

Table 2 shows the causes of hospitalization according to ICD-10 chapters. Diseases of the Respiratory System (chapter X) were among the leading causes of hospitalization in all the years, with 9.6% in the first year of life, around 5% from one to four years, decreasing to 2.9% from the fourth to the sixth year of life. The second leading cause of hospitalization was Infectious and Parasitic Diseases (chapter I), with proportions around 1%.

As for ranking of the ten leading causes of hospitalization by ICD-10 groups (Table 3), “Influenza and pneumonia” and “Chronic diseases of the lower airways” were among the three leading causes of hospitalization in all the follow-up visits. “Infectious intestinal diseases” such as diarrhea, viral gastroenteritis, and other diarrheas not specified were classified from third to fifth, depending on the age at follow-up. From two to six years of age, surgical causes ranked from second to third.

In the first year of life, according to the crude analysis, birth weight, gestational age, and type of pregnancy were inversely associated with odds of hospitalization (Table 4). In the adjusted analysis, children with gestational age < 37 weeks and those with low birth weight (< 2,500g) showed odds of hospitalization three times higher than term infants and those with birth weight from 3,000g to

**Table 1**

Frequency of at least one hospitalization and number of hospitalizations in the first six years of life, recorded in follow-up visits of the 2004 Birth Cohort, Pelotas, Rio Grande do Sul State, Brazil.

	≤ 1 year (n = 3,907)		1 to 2 years (n = 3,868)		2 to 4 years (n = 3,799)		4 to 6 years (n = 3,646)		Any time in life (n = 3,412)	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI	%	95%CI
Hospitalization	19.1	17.9-20.4	10.0	9.0-10.9	10.2	9.3-11.2	8.4	7.6-9.4	33.4	31.8-34.9
Number of hospitalizations										
None	80.8	79.6-82.1	90.0	89.1-91.0	89.8	88.8-90.7	91.5	90.6-92.4	67.5	65.9-69.1
1	15.0	13.9-16.1	8.2	7.4-9.1	7.6	6.8-8.4	6.8	6.0-7.6	20.2	18.9-21.6
2	2.7	2.2-3.3	1.3	1.0-1.7	1.6	1.2-2.0	1.0	0.8-1.4	7.3	6.6-8.2
3	0.9	0.6-1.2	0.2	0.1-0.4	0.4	0.3-0.7	0.3	0.2-0.5	2.2	1.7-2.7
4	0.3	0.2-0.6	0.2	0.0-0.3	0.3	0.2-0.6	0.1	0.0-0.3	1.3	1.0-1.8
≤ 5	0.3	0.1-0.5	0.1	0.0-0.3	0.3	0.2-0.6	0.3	0.1-0.5	1.5	1.1-1.9

95%CI: 95% confidence interval.

**Table 2**

Causes of hospitalization according to International Classification of Diseases – 10<sup>th</sup> edition (ICD-10) chapters. 2004 Birth Cohort, Pelotas, Rio Grande do Sul State, Brazil.

Chapters	≤ 1 year (n = 3,907)		1 to 2 years (n = 3,868)		2 to 4 years (n = 3,799)		4 to 6 years (n = 3,646)	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI
	I – Certain infectious and parasitic diseases	1.23	0.88-1.57	1.32	0.96-1.68	1.18	0.89-1.53	0.71
II – Neoplasms [tumors]	0.00	0.00-0.00	0.00	0.00-0.00	0.03	0.00-0.19	0.00	0.00-0.00
III – Diseases of the blood and blood-forming organs, and certain disorders involving the immune mechanism	0.38	0.19-0.58	0.28	0.12-0.45	0.18	0.05-0.32	0.03	0.00-0.08
IV – Endocrine, nutritional, and metabolic diseases	0.69	0.43-0.95	0.52	0.29-0.74	0.21	0.06-0.36	0.11	0.00-0.22
V – Mental and behavioral disorders	0.08	0.00-0.16	0.00	0.00-0.00	0.11	0.00-0.21	0.08	0.00-0.18
VI – Diseases of the nervous system	0.23	0.08-0.38	0.05	0.00-0.12	0.21	0.06-0.36	0.11	0.00-0.22
VII – Diseases of the eye and adnexa	0.00	0.00-0.00	0.00	0.00-0.00	0.05	0.00-0.13	0.03	0.00-0.08
VIII – Diseases of the ear and mastoid process	0.10	0.00-0.20	0.21	0.06-0.35	0.18	0.05-0.32	0.16	0.03-0.30
IX – Diseases of the circulatory system	0.08	0.00-0.16	0.00	0.00-0.00	0.11	0.00-0.21	0.08	0.00-0.18
X – Diseases of the respiratory system	9.57	8.65-10.50	5.30	4.59-6.01	4.82	4.14-5.50	2.90	2.36-3.50
XI – Diseases of the digestive system	0.46	0.25-0.67	0.23	0.08-0.38	0.34	0.16-0.53	0.33	0.14-0.51
XII – Diseases of the skin and subcutaneous tissue	0.23	0.08-0.38	0.16	0.03-0.28	0.34	0.16-0.53	0.08	0.00-0.18
XIII – Diseases of the musculoskeletal system and connective tissue	0.00	0.00-0.00	0.00	0.00-0.00	0.03	0.00-0.08	0.03	0.00-1.08
XIV – Diseases of the genitourinary system	0.64	0.39-0.89	0.23	0.08-0.38	0.39	0.20-0.59	0.27	0.10-0.44
XV – Pregnancy, childbirth, and the puerperium	0.00	0.00-0.00	0.00	0.00-0.00	0.00	0.00-0.00	0.00	0.00-0.00
XVI – Certain conditions originating in the perinatal period	0.92	0.62-1.22	0.00	0.00-0.00	0.00	0.00-0.00	0.00	0.00-0.00
XVII – Congenital malformations, deformations, and chromosomal abnormalities	0.13	0.02-0.24	0.03	0.00-0.08	0.18	0.05-0.32	0.03	0.00-0.08
XVIII – Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	1.31	0.95-1.66	0.78	0.50-1.05	0.89	0.60-1.19	0.96	0.64-1.28
XIX – Injury, poisoning, and certain other consequences of external causes	0.08	0.00-0.16	0.47	0.25-0.68	0.37	0.18-0.56	0.55	0.31-0.79
XX – External causes of morbidity and mortality	0.00	0.00-0.00	0.18	0.05-0.31	0.26	0.10-0.43	0.41	0.20-0.62
XXI – Factors influencing health status and contact with health services	1.15	0.82-1.49	0.57	0.33-0.81	1.50	1.11-1.89	2.19	1.72-2.67

95%CI: 95% confidence interval.

3,499g, respectively. Infants with low birth weight (LBW – RR = 1.7; 95%CI: 1.3-2.2) and those from the poorest families showed higher risk of multiple hospitalizations when compared to the reference category. Maternal smoking during pregnancy was associated with increased risk of readmissions (RR = 1.2; 95%CI: 1.0-1.4). Girls showed approximately 20% lower risk of readmission when compared to boys.

From the first to the second year of life (Table 4), in the adjusted analysis, children with LBW and 5-minute Apgar < 7 showed odds of hospitalization twice as high (OR = 2.2; 95%CI: 1.0-4.8) and six times higher (OR 6.1; 95%CI: 1.8-21.1), respectively, than the reference category. Children hospitalized in the first year of life showed nearly three times greater risk of multiple hospitalizations than those not hospitalized in the previous year (RR = 2.9; 95%CI: 2.3-3.8). Children of mothers that had smoked during pregnancy and from families in the poorest quintile showed 40% (RR = 1.4; 95%CI: 1.1-1.8) and 80% (RR = 1.8; 95%CI: 1.3-2.6) higher risk of readmission when compared to children of mothers that had not smoked during pregnancy and those from families in the highest income quintile, respectively.

From two to four years, in the crude analysis, the only factors associated with odds of hospitalization were gestational age, hospitalization from one to two years of life, and maternal smoking

**Table 3**

Ten leading causes of hospitalization in early childhood according to International Classification of Diseases – 10<sup>th</sup> edition (ICD-10) groups. 2004 Birth Cohort, Pelotas, Rio Grande do Sul State, Brazil.

Rank	≤ 1 year	1 to 2 years	2 to 4 years	4 to 6 years
1	Other acute lower respiratory infections *	Influenza (flu) and pneumonia **	Chronic lower respiratory diseases ***	Chronic lower respiratory diseases ***
2	Influenza (flu) and pneumonia **	Chronic lower respiratory diseases ***	Influenza (flu) and pneumonia **	Persons in contact with health services for specific procedures and care #
3	Chronic lower respiratory diseases ***	Infectious intestinal diseases ##	Persons in contact with health services for specific procedures and care #	Influenza (flu) and pneumonia **
4	Infectious intestinal diseases ##	General symptoms and signs ###	General symptoms and signs ###	General symptoms and signs ###
5	General symptoms and signs ###	Persons in contact with health services for specific procedures and care #	Infectious intestinal diseases ##	Infectious intestinal diseases ##
6	Hemorrhagic and hematological disorders of the fetus and the newborn §	Metabolic disorders §§	Acute upper respiratory infections §§§	Acute upper respiratory infections §§§
7	Persons in contact with health services for specific procedures and care #	Nutritional anemias †	Certain other conditions of the skin and connective tissue ††	Certain other diseases of the urinary system †††
8	Certain other diseases of the urinary system †††	Agents of bacterial, viral, and other infections ‡	Certain other diseases of the urinary system †††	Injuries to the shoulder and arm ‡‡
9	Metabolic disorders §§	Poisoning from, drugs, medicaments, and biological substances ‡‡‡	Metabolic disorders §§	Symptoms and signs concerning the digestive system and abdomen †
10	Aplastic anemias and certain other anemias ††	Symptoms and signs concerning the digestive system and abdomen †	Diseases of the middle ear and mastoid †††	Diseases of the outer ear †

\* Acute bronchiolitis, acute bronchitis;

\*\* Flu, pneumonia, influenza, respiratory infection;

\*\*\* Asthma, bronchospasm, asthmatic bronchitis;

# Surgeries, surgical revision;

## Diarrhea, viral gastroenteritis, other diarrheas not otherwise specified;

### Fever of unknown origin, ill-defined signs and symptoms, unspecified convulsions, other symptoms and signs concerning food and liquid intake, cachexia, other general symptoms and signs, pain not otherwise classified;

§ Jaundice;

§§ Lactose intolerance, volume depletion;

§§§ Tonsillitis, pharyngitis, sinusitis;

† Nutritional/iron deficiency anemia;

†† Other and unspecified dermatitis;

††† Cystitis, urinary infection;

‡ Other infectious or parasitic diseases, other infectious and unspecified diseases;

‡‡ Fracture of the arm;

‡‡‡ poisoning by drugs, biological, and food substances;

† Nausea and vomiting, abdominal pain, flatulence and related condition;

†† Anemias;

††† Mastoiditis, otitis media with effusion;

† Otitis, ear pain.

**Table 4**

Zero-Inflated Poisson (ZIP) model to assess early factors associated with odds of hospitalization and number of hospitalizations in children from birth to two years of age. 2004 Birth Cohort, Pelotas, Rio Grande do Sul State, Brazil.

Variables	n	≤ 1 year (n = 3,678)				1 to 2 years (n = 3,690)				
		Hospitalization *		Number of hospitalizations **		Hospitalization *		Number of hospitalizations **		
		OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI) ***	OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI) ***	
Sex [reference: male]										
Female	1,765	1.1 (0.7-1.8)		0.8 (0.6-1.1)	0.8 (0.7-0.9)	1,767	0.9 (0.5-1.6)		1.0 (0.6-1.7)	
Birth weight (g) [reference: 3,000-3,499]										
< 2,500	325	12.3 (2.2-67.4)	2.6 (1.2-5.7)	1.6 (1.2-2.1)	1.7 (1.3-2.2)	332	1.8 (1.0-3.7)	2.2 (1.0-4.8)	1.5 (0.6-3.7)	1.0 (0.4-2.5)
2,500-2,999	918	1.5 (1.0-2.1)	1.1 (0.8-1.6)	1.0 (0.8-1.3)	1.1 (0.9-1.4)	920	0.9 (0.6-1.5)	0.8 (0.6-1.6)	1.5 (1.0-2.3)	1.4 (0.9-2.1)
≥ 3,500	984	0.8 (0.6-1.2)	1.0 (0.7-1.4)	1.2 (0.9-1.6)	1.0 (0.8-1.4)	987	1.0 (0.6-1.7)	1.0 (0.6-1.7)	0.7 (0.5-1.2)	0.8 (0.5-1.3)
Gestational age (weeks) [reference: ≥ 37]										
< 37	505	9.5 (2.2-41.6)	2.7 (1.5-4.6)	1.0 (0.7-1.3)		511	1.9 (0.8-4.5)	1.5 (0.9-2.3)	0.8 (0.4-1.6)	
5-minute Apgar [reference: ≥ 7]										
< 7	59	32.9 (0.0-431.8)		1.3 (0.7-2.2)		58	6.4 (1.9-21.8)	6.1 (1.8-21.1)	6.3 (2.8-13.9)	
Type of delivery [reference: vaginal]										
Cesarean	1,673	1.1 (0.7-1.7)		0.9 (0.7-1.3)		1,682	1.0 (0.5-1.8)		1.0 (0.6-1.7)	
Type of pregnancy [reference: singleton]										
Multiple	77	7.0 (1.1-4.7)	0.3 (0.1-1.8)	1.7 (0.3-9.0)		77	1.3 (0.3-6.6)		1.7 (0.3-9.0)	
Hospitalization in first year of life [reference: no]										
Yes						684	1.6 (0.8-3.3)		2.4 (1.4-4.2)	2.9 (2.3-3.8)
Child's shin color [reference: white]										
Black	392	1.1 (0.7-1.7)		1.4 (1.0-1.9)	1.0 (0.8-1.3)	394	1.7 (1.0-2.7)	1.4 (0.8-2.5)	1.7 (1.1-2.7)	1.4 (0.7-2.5)
Brown	663	0.8 (0.5-1.2)		1.2 (0.8-1.8)	0.9 (0.7-1.2)	674	1.2 (0.6-2.3)	1.4 (0.6-3.1)	1.4 (0.8-2.4)	1.0 (0.6-1.5)

(continues)

Table 4 (continued)

Variables	n	≤ 1 year (n = 3,678)				1 to 2 years (n = 3,690)				
		Hospitalization *		Number of hospitalizations **		Hospitalization *		Number of hospitalizations **		
		OR	OR	RR	RR	OR	OR	RR	RR	
		(95%CI)	(95%CI) ***	(95%CI)	(95%CI) ***	(95%CI)	(95%CI) ***	(95%CI)	(95%CI) ***	
Mother's skin color [reference: white]										
Black	732	1.1 (0.8-1.7)		1.1 (0.8-1.5)		738	1.1 (0.6-1.8)		1.7 (1.1-2.5)	0.9 (0.6-1.5)
Brown	253	1.2 (0.6-2.4)		1.1 (0.7-1.7)		255	0.8 (0.4-1.7)		2.6 (1.2-5.6)	1.6 (1.0-2.5)
Mother's smoking during pregnancy [reference: no]										
Yes	980	0.9 (0.6-1.5)		1.5 (1.1-2.0)	1.2 (1.0-1.4)	995	1.1 (0.6-2.0)		1.6 (0.9-2.7)	1.4 (1.1-1.8)
Mother's alcohol consumption during pregnancy [reference: no]										
Yes	117	1.8 (0.4-8.6)		0.7 (0.3-1.4)		119	1.0 (0.1-9.1)		0.8 (0.1-4.6)	
Parity [reference: < 2]										
≥ 2	2,220	0.9 (0.6-1.5)		1.2 (0.8-1.6)		2,229	1.4 (0.7-2.7)		1.0 (0.6-1.8)	
Family income at child's birth (quintiles) [reference: wealthiest Q5]										
Q1 (poorest)	728	0.9 (0.4-1.9)		2.5 (1.6-4.1)	2.0 (1.5-2.7)	728	0.6 (0.2-1.8)		3.1 (1.8-5.3)	1.8 (1.3-2.6)
Q2	724	1.1 (0.6-2.2)		2.4 (1.6-3.5)	2.1 (1.6-2.7)	734	0.6 (0.2-1.5)		2.5 (1.5-4.2)	1.5 (1.1-2.2)
Q3	735	1.1 (0.6-1.9)		2.1 (1.5-2.9)	1.9 (1.5-2.6)	732	0.7 (0.3-1.5)		1.7 (1.2-2.5)	1.2 (0.9-1.8)
Q4	775	1.0 (0.6-1.6)		1.2 (0.9-1.7)	1.2 (0.9-1.6)	775	0.6 (0.3-1.2)		1.1 (0.8-1.6)	0.9 (0.6-1.4)

95%CI: 95% confidence interval; OR: odds ratio; RR: relative risk.

\* Predictors associated with odds of hospitalization;

\*\* Predictors associated with number of hospitalizations;

\*\*\* Adjusted for mother's and child's characteristics with significance < 0.20 in the crude analysis.

during pregnancy (Table 5). After adjustment, odds of hospitalization were higher in children that had been hospitalized during the previous period (OR = 3.4; 95%CI: 2.0-5.9) and in children of mothers who had smoked during pregnancy (OR = 1.7; 95%CI: 1.0-2.8). Children hospitalized from the first to the second years of life and children of mothers that had smoked during pregnancy showed approximately four and three times greater risk of multiple hospitalizations, respectively, compared to children in the reference categories.

From four to six years, girls showed 30% (OR = 0.7; 95%CI: 0.5-0.9) lower odds of hospitalization than boys. Children of multiple pregnancies showed six times higher odds of hospitalization (OR = 6.3; 95%CI: 1.9-20.9) than those of singleton pregnancies. Children hospitalized from two to four years of life showed five times greater odds of hospitalization (OR = 5.3; 95%CI: 2.9-9.8) than those



**Table 5**

Zero-Inflated Poisson (ZIP) model to assess early factors associated with odds of hospitalization and number of hospitalizations in children from two to six years of age. 2004 Birth Cohort, Pelotas, Rio Grande do Sul State, Brazil

Variables	n	2 to 4 years (n = 3,774)				n	4 to 6 years (n = 3,514)			
		Hospitalization *		Number of hospitalizations **			Hospitalization *		Number of hospitalizations **	
		OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI)		OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI)
Sex [reference: male]										
Female	1,811	0.9 (0.6-1.4)		0.8 (0.4-1.4)		1,685	0.6 (0.4-1.0)	0.7 (0.5-0.9)	1.1 (0.6-1.8)	
Birth weight (g) [reference: 3,000-3,499]										
< 2,500	336	1.3 (0.8-2.3)		1.4 (0.8-2.4)		314	1.4 (0.7-2.8)		1.2 (0.7-1.9)	
2,500-2,999	944	1.2 (0.9-1.7)		1.4 (0.8-2.4)		871	1.1 (0.7-1.6)		1.2 (0.7-2.3)	
≥3.500	1,011	0.9 (0.7-1.3)		1.3 (0.6-2.7)		955	0.8 (0.6-1.3)		1.3 (0.6-2.8)	
Gestational age (weeks) [reference: ≥ 37]										
< 37	521	1.8 (1.0-3.3)	1.2 (0.8-1.7)	1.5 (0.8-2.9)		486	1.4 (0.6-3.4)		1.3 (0.6-3.0)	
5-minute Apgar [reference: ≥ 7]										
< 7	59	1.6 (0.6-3.9)		1.1 (0.5-2.5)		58	231.5 (2.4-2.2)		3.5 (0.6-21.0)	1.4 (0.9-2.1)
Type of delivery [reference: vaginal]										
Cesarean	1,710	0.8 (0.5-1.3)		1.2 (0.7-2.1)		1,605	1.0 (0.6-1.7)		1.4 (0.8-2.2)	
Type of pregnancy [reference: singleton]										
Multiple	77	1.8 (0.7-4.4)		1.8 (0.8-3.7)	1.0 (0.5-2.1)	73	<b>8.9</b> <b>(2.2-4.0)</b>	<b>6.3</b> <b>(1.9-20.9)</b>	<b>6.3</b> <b>(3.1-12.7)</b>	<b>2.8</b> <b>(1.6-4.9)</b>
Hospitalization from 1 <sup>st</sup> to 2 <sup>nd</sup> year of life [reference: no]										
Yes	362	<b>3.7</b> <b>(2.2-6.3)</b>	<b>3.4</b> <b>(2.0-5.9)</b>	<b>2.5</b> <b>(1.4-4.6)</b>	<b>4.5</b> <b>(2.6-7.8)</b>					

(continues)

Table 5 (continued)

Variables	n	2 to 4 years (n = 3,774)				n	4 to 6 years (n = 3,514)			
		Hospitalization *		Number of hospitalizations **			Hospitalization *		Number of hospitalizations **	
		OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI)		OR (95%CI)	OR (95%CI) ***	RR (95%CI)	RR (95%CI)
Hospitalization from 2 <sup>nd</sup> to 4 <sup>th</sup> year of life [reference: no]										
Yes					382	<b>5,3</b> (2,8-9,9)	<b>5,3</b> (2,9-9,8)	<b>2,2</b> (1,3-3,7)	<b>2,2</b> (1,3-3,6)	
Child's skin color [reference: white]										
Black	403	1,0 (0,7-1,5)		1,0 (0,6-1,6)	0,6 (0,4-0,9)	381	1,1 (0,7-1,8)		1,1 (0,6-2,0)	
Brown	684	1,0 (0,6-1,7)		1,7 (0,9-3,3)	1,6 (0,9-2,6)	628	1,1 (0,6-2,1)		1,0 (0,5-1,7)	
Mother's skin color [reference: white]										
Black	853	1,4 (1,0-1,9)	1,1 (0,8-1,6)	1,2 (0,7-2,1)		701	1,1 (0,7-1,7)		1,1 (0,7-1,7)	
Brown	260	1,3 (0,7-2,3)	1,1 (0,7-1,8)	1,2 (0,6-2,3)		240	1,3 (0,6-2,9)		1,2 (0,5-2,5)	
Mother's smoking during pregnancy [reference: no]										
Yes	1.010	<b>1,6</b> (1,0-2,5)	<b>1,7</b> (1,0-2,8)	<b>1,8</b> (1,1-2,9)	<b>2,7</b> (1,7-4,2)	936	1,2 (0,7-2,4)		1,4 (0,7-2,5)	
Mother's alcohol consumption during pregnancy [reference: no]										
Yes	123	2,1 (0,8-6,0)	1,4 (0,7-2,8)	1,8 (0,7-4,2)		113	1,2 (0,4-3,9)		1,0 (0,4-2,6)	
Parity [reference: < 2]										
< 2	2.284	1,2 (0,8-1,9)		0,9 (0,5-1,7)		2.121	0,8 (0,5-1,4)		1,2 (0,7-2,1)	

(continues)

not hospitalized in the previous period. Children hospitalized from two to four years and those born to multiple pregnancies showed twice the odds (RR = 2.2; 95%CI: 1.3-3.6) and three times the odds (RR = 2.8; 95%CI: 1.6-4.9), respectively, of those in the reference categories (Table 5).

Table 5 (continued)

Variables	2 to 4 years (n = 3,774)				4 to 6 years (n = 3,514)					
	n	Hospitalization *		Number of hospitalizations **		n	Hospitalization *		Number of hospitalizations **	
		OR	OR	RR	RR		OR	OR	RR	RR
		(95%CI)	(95%CI) ***	(95%CI)	(95%CI)		(95%CI)	(95%CI) ***	(95%CI)	(95%CI)
Family income at child's birth (quintiles) [reference: wealthiest Q5]										
Q1 (poorest)	753	0.9 (0.5-1.7)		2.0 (1.2-3.3)	1.4 (1.0-2.1)	683	1.7 (0.8-3.6)		1.8 (0.9-3.7)	1.2 (0.8-1.9)
Q2	753	0.8 (0.5-1.5)		2.0 (1.0-4.1)	1.6 (0.9-2.7)	712	1.7 (0.8-3.3)		1.3 (0.7-2.4)	1.0 (0.7-1.5)
Q3	749	1.0 (0.6-1.5)		2.2 (1.2-4.0)	1.5 (0.9;2.5)	694	1.4 (0.8-2.5)		1.3 (0.8-2.2)	1.0 (0.7-1.6)
Q4	788	0.8 (0.5-1.2)		1.2 (0.6-2.3)	1.1 (0.6-2.2)	740	1.5 (0.9-2.4)		0.9 (0.6-1.3)	0.8 (0.6-1.2)

95%CI: 95% confidence interval; OR: odds ratio; RR: relative risk.

\* Predictors associated with odds of hospitalization;

\*\* Predictors associated with number of hospitalizations;

\*\*\* Adjusted for mother's and child's characteristics with significance < 0.20 in the crude analysis.

## Discussion

In the current study, one out of five children required hospitalization in the first year of life. Diseases of the respiratory system were among the leading causes of hospitalization, followed by infectious and parasitic diseases. Early factors that predicted hospitalization and number of hospitalizations were not the same. In the first two years of life, the child's and mother's biological factors such as birth weight, gestational age, Apgar score, sex, and multiple pregnancy were inversely associated with hospitalization, while environmental characteristics such as history of maternal smoking during pregnancy, mother's skin color, and low family income were associated with number of hospitalizations. For each follow-up period analyzed, history of previous hospitalization was one of the most important predictors of hospitalization and number of hospitalizations.

In keeping with previous studies in Pelotas <sup>12,16</sup> with a similar methodology to that used in this study, hospitalization in childhood, especially in the first year of life, has remained high and stable for at least three decades, at around 20%, thus corroborating the current study's findings.

Other Brazilian studies <sup>5,6,11,17</sup> on hospitalization of children found lower hospitalization rates than in the current study. Castro et al. <sup>17</sup>, using data from the PNAD 1998, showed an 11.1% hospitalization rate in children under one year and 6.9% from one to four years. In PNAD 2008 <sup>6</sup>, the hospitalization rate in children under four years of age was 8.4%. Ferrer et al. <sup>5</sup> studied hospitalization of children from birth to nine years of age, from 2002 to 2006, in Brazil and in the city of São Paulo, and used data from the Brazilian Hospital Information System of the Brazilian Unified National Health System (SIH-SUS), showing a hospitalization rate of 17% in Brazil and 16% in São Paulo <sup>5</sup>. The *National Demographic and Health Survey* (PNDS 2006) <sup>11</sup> assessed the morbidity and mortality profile in children less than five years of age in Brazil. In the 12-23-month and 24-35-month age brackets, PNDS 2006 showed higher hospitalization rates than in the current study. Regional inequalities could explain these differences. In PNDS 2006, in the North and Northeast, the hospitalization rates in children under five years were 14.1% and 13.6%, respectively, compared to 10.9% in the South. The hospitalization rates from diarrhea and respiratory diseases were also higher in these age brackets in PNDS 2006 when compared to the current study.

As shown in other studies in different settings in Brazil <sup>5,6,10,16,18</sup>, Diseases of the Respiratory System (ICD-10 – chapter X) were the leading causes of hospitalization from birth to six years of age and ranked from first to third among the ten leading causes of hospitalization.

Most respiratory diseases in childhood are caused by viruses and/or bacteria that develop more readily in humid, cold, closed, and crowded environments. Gonzales et al. <sup>19</sup>, studying the effects of climate on hospitalizations from asthma and pneumonia in preschoolers in Pelotas, found that children born from April to June (autumn) showed higher risk of hospitalization from pneumonia and asthma/bronchitis in the first three years of life than those born from January to March (summer).

Infectious and Parasitic Diseases (ICD-10 – chapter I) were the second leading cause of hospitalization, accounting for 1% of admissions over the study period. Diarrheic diseases, although presenting lower and more stable percentages, are still an important public health problem. Studies have shown that cases of acute, serious diarrhea persist and are associated with one-third of childhood hospitalizations and an estimated 600,000 deaths per year in children worldwide <sup>3,8,9</sup>.

According to Ferrer et al. <sup>5</sup>, Certain Conditions Originating in the Perinatal Period (ICD-10 – chapter XVI) were the second cause of hospitalization in São Paulo and the third in Brazil, accounting for 15.9% and 10.1% of admissions, respectively. In the current study, the proportion of hospitalizations from these causes was low (< 1%). Such differences can be attributed to methodological issues between studies and improvements in some maternal-child indicators in the municipality in recent decades, for example improved perinatal care, longer breastfeeding, and an increase in maternal schooling <sup>5,20</sup>. In the study by Ferrer et al. <sup>5</sup>, calculation of the hospitalization rate included all hospitalizations of children under one year, without excluding readmissions, which may have overestimated the hospitalization rate from these causes. In addition, the authors used the SIH-SUS, fed by the Authorizations for Hospital Admissions (AIHs), which have limitations in the quality of diagnosis at hospital admission <sup>4,21</sup>.

Age at first hospitalization, number of previous hospitalizations, disease severity, and socio-environmental conditions are considered risk factors for re-hospitalization of children <sup>22,23</sup>. Lasmar et al. <sup>22</sup> studied asthma patients under 15 years of age and found that odds of re-hospitalization in children with a history of first hospitalization before 12 months of age were 2.5 times higher when compared to children whose first hospitalization occurred after 24 months of age. Bloomberg et al. <sup>23</sup> studied hospitalizations of children over the course of 10 year and found that after the first hospitalization from asthma, the probability of a second, third, and fourth hospitalization was 30%, 46%, and 59%, respectively. Neuman et al. <sup>24</sup> investigated factors associated with re-hospitalization after a previous admission for pneumonia. Higher number of admissions due to pneumonia (including more prolonged hospitalizations) was associated with re-hospitalization. The authors also reported that children with complicated pneumonia or those with chronic comorbidities such as neurological, digestive, and circulatory diseases were more predisposed to experiencing re-hospitalization from all causes, when compared to children without chronic diseases.

Meanwhile, the high rate of preterm births in the 2004 birth cohort (15% preterm <sup>13</sup> and 10.8% late preterm <sup>25</sup>) could also explain the high odds of re-hospitalization in the study sample. Preterm or late preterm children have higher odds of hospitalization and re-hospitalization than term children <sup>26</sup>. In a retrospective birth cohort in Australia that followed children from birth to 18 years, gestational age was inversely associated with greater risk of re-hospitalization. Nearly 62% of the cohort was re-hospitalized at least once during childhood, and more than 90% of children born with gestational age ≤ 33 weeks were re-hospitalized in the first 18 years of life, compared to 59% in children born with gestational age ≥ 39 weeks <sup>27</sup>.

Finally, repeated hospitalization may lead to social and clinical problems for the family and child, disorganization of family functioning, and consequences for the child's physical and emotional development, in addition to increasing the potential for developing hospital infections, especially in children with chronic comorbidities <sup>28</sup>.

Various perinatal health conditions are associated with hospitalization in early childhood <sup>12,16,18</sup>. In this study, low birth weight, gestational age < 37 weeks, and 5-minute Apgar score < 7 were associated with hospitalization and number of hospitalizations in the first and/or second years of life. These findings are consistent with those of previous studies <sup>12,16,18</sup>. Children with low birth weight are more vulnerable to environmental and social factors and show greater risk of morbidity and mortality in

early childhood<sup>12,18</sup>. Selling et al.<sup>29</sup> assessed the long-term effects of preterm birth and intrauterine growth restriction and found greater risk of hospitalization in adolescence and adulthood among those born small for gestational age, preterm, and those born both preterm and small for gestational age<sup>29</sup>. Matijasevich et al.<sup>12</sup>, in a study on hospitalization over the course of 22 years in three birth cohorts, found that birth weight was one of the factors most closely associated with higher hospitalization rates. Apgar score, the method used to assess the newborn's clinical status at birth, is considered a predictor of neonatal complications and mortality<sup>30</sup>. Low 5-minute Apgar score is associated with increased risk of brain damage<sup>31</sup> and greater risk of hospitalization due to epilepsy in the first 12 years of life<sup>31</sup>.

In this study, male gender was associated with greater odds of hospitalization and more hospitalizations in children under one year and from four to six years. Other studies have shown the predominance of male gender in morbidity and hospitalization from diseases of the respiratory tract in childhood, with an inversion in puberty, when girls show higher incidence of hospitalization<sup>16,17,18</sup>. A possible explanation for this finding relates to the lower caliber of airways and immunological differences in boys during childhood and hormonal changes in girls in puberty<sup>32</sup>.

Children born to multiple pregnancies are at greater risk of preterm birth and/or low birth weight and are more likely to need additional health care<sup>33</sup>. In Henderson et al.<sup>33</sup>, the duration of hospitalization of twin and triplet infants was twice as long and eight times longer, respectively, compared to singleton children.

Various studies have shown racial inequalities in hospitalization rates. Hospitalization rates due to diarrhea were higher in black children under six months of age when compared to white children, and this difference was not modified following introduction of the rotavirus vaccine<sup>34</sup>. African-American children showed greater risk of hospitalization from asthma/wheezing and greater risk of readmission than white children, and this inequality was attributed to differences in access to health care and associated socioeconomic variables<sup>34</sup>.

There is evidence in the literature of the association between maternal smoking during pregnancy and risk of hospitalization in childhood<sup>35,36</sup>. In this study, children of mothers that smoked showed higher hospitalization rates than children born to mothers that did not smoke during pregnancy.

Family income at birth was inversely associated with hospitalization in children under four years. Children of poor families are more prone to be exposed to pathogens and have greater risk of illness and less access to health services and medical treatments<sup>37</sup>. Studies on hospitalization are heavily influenced not only by socioeconomic factors, but also by the health system's characteristics and professional practices<sup>22</sup>.

The study's limitations include the possibility of Berkson's bias, since children of low-income families can be hospitalized more often than children of higher-income families, increasing the hospitalization rate in this group, which already displays higher morbidity and mortality rates<sup>38</sup>.

Another potential limitation is the quality of information on cause of hospitalization, since it was reported retrospectively by the mother without confirmation on the medical record. To deal with this problem, all causes of hospitalization were classified in major groups with similar signs and symptoms, according to ICD-10 chapters.

Changes in Brazil's economy in the last decade were marked by a combination of economic growth and improved income distribution. The improvement was due to access to a public conditional cash transfer policy and growth in the job supply, among other reasons, manifested as better quality of life for families, an improvement that was more pronounced in the poorest areas of the country<sup>39</sup>. There were changes in families' income in the 2004 cohort over the course of the study period, especially in the poorest quintiles, with more stability among the wealthier. Some 62% of the children in the lowest income quintile at birth remained in the lower quintiles at 6 years. Meanwhile, 82% of the children in the highest income quintiles at birth remained in the upper quintiles at 6 years.

Skin color of the mother and child was assessed by the interviewer rather than by self-report. The effect of the chosen data collection procedure on racial classification is controversial, and various researchers have suggested that it has limited validity and reliability<sup>40</sup>. If this type of classification error occurred, it was not differential in relation to the outcome, since the interviewers had no way of knowing who had been hospitalized previously. We would thus expect that any associations would be biased toward nullity (non-association).

Despite these limitations, this was a study with a prospective population-based longitudinal design, with a low percentage of losses to follow-up, in which the children were followed since birth, allowing to study the hospitalization rate and to follow its evolution over time. This deserves emphasis, since there is a relative scarcity of similar studies in middle-income countries like Brazil.

In summary, the study's results confirm that the early childhood hospitalization rate remains quite high in Pelotas, Rio Grande do Sul State, especially in the first year of life, when compared to similar studies in other states of Brazil. Respiratory diseases are still the leading cause of hospitalization in childhood. Previous history of hospitalization was a strong predictor of hospitalization, and various perinatal biological and environmental factors were associated with hospitalization in early childhood. Increasing access to adequate treatments and improving childcare are necessary interventions to reduce childhood hospitalization. These findings are useful for planning health measures for children, thereby contributing to the improvement of health services.

### Contributors

V. L. S. Silva e A. Matijasevich contributed in the writing of the article, conception, and data analysis and interpretation. G. V. A. França collaborated in the conception, analysis, interpretation of data and final revision. I. S. Santos and F. C. Barros collaborated in the approval of the final version for publication. collaborated in the relevant critical revision of the intellectual content; approval of the final version for publication.

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## Resumo

*A hospitalização é um evento frequente nos primeiros anos de vida. No Brasil, a Pesquisa Nacional por Amostra de Domicílios de 2008 registrou uma taxa de hospitalização de 9% entre crianças menores de quatro anos. O estudo objetivou descrever as características da hospitalização nos seis primeiros anos de vida e analisar os fatores precoces associados à hospitalização em uma coorte de nascimentos no sul do Brasil. Foi usado o modelo de Poisson Inflacionado de Zeros para examinar os efeitos de covariáveis simultaneamente para a ocorrência ou não de algum evento e para a contagem de eventos. A frequência de pelo menos um episódio de hospitalização no período foi de 33,4% (IC95%: 31,8-34,9), sendo mais elevada durante o primeiro ano (19,1%; IC95%: 17,9-20,4), permanecendo estável em aproximadamente 10% entre o primeiro e o quarto anos, reduzindo para 8,4% (IC95%: 7,6-9,4) entre os quatro e seis anos. As doenças do aparelho respiratório estiveram entre as principais causas de hospitalização, seguidas pelas doenças infecciosas e parasitárias. A história de hospitalização prévia foi um dos preditores mais importantes para a chance de hospitalização e para o risco de múltiplas hospitalizações. Nos primeiros anos de vida o peso ao nascer, idade gestacional, Apgar, sexo e tipo de gestação mostraram-se inversamente associados à hospitalização, e as características ambientais como fumo materno na gestação, cor da mãe e baixa renda familiar apresentaram associação com o número de hospitalizações. Os resultados apontam para a importância em destinar esforços para a redução das hospitalizações por doenças do aparelho respiratório principalmente em crianças menores de um ano.*

*Hospitalização; Lactente; Estudos de Coortes*

## Resumen

*La hospitalización es un evento frecuente en los primeros años de vida. En Brasil, la Encuesta Nacional por Muestra de Domicilios de 2008 registró una tasa de hospitalización de un 9% entre niños menores de cuatro años. El objetivo del estudio fue describir las características de la hospitalización durante los seis primeros años de vida y analizar factores precoces, asociados a la hospitalización, en una cohorte de nacimientos en el sur de Brasil. Se usó el modelo de Poisson Inflado por Ceros para examinar los efectos de covariables simultáneamente para la ocurrencia o no de algún evento y para el cómputo de eventos. La frecuencia de por lo menos un episodio de hospitalización en el período fue de un 33,4% (IC95% 31,8-34,9%), siendo más elevada durante el primer año (19,1%; IC95% 17,9-20,4%), permaneciendo estable en aproximadamente un 10% entre el primero y el cuarto año, reduciéndose hasta el 8,4% (IC95% 7,6-9,4%) entre los cuatro y seis años. Las enfermedades del aparato respiratorio estuvieron entre las principales causas de hospitalización, seguidas de las enfermedades infecciosas y parasitarias. La historia de hospitalización previa fue uno de los predictores más importantes para la oportunidad de hospitalización y para el riesgo de múltiples hospitalizaciones. Durante los primeros años de vida el peso al nacer, edad gestacional, Apgar, sexo y tipo de gestación se mostraron inversamente asociados a la hospitalización, y las características ambientales como consumo de tabaco por parte de la madre durante la gestación, el color de piel de la madre y baja renta familiar presentaron una asociación con el número de hospitalizaciones. Los resultados apuntan la importancia en destinar esfuerzos para la reducción de las hospitalizaciones por enfermedades del aparato respiratorio, principalmente en niños menores de un año.*

*Hospitalización; Lactante; Estudios de Cohortes*

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