Prevalence of bronchial asthma in patients infected with respiratory syncytial virus: A single-center observational study.

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Abstract

Introduction: Asthma is the most common noncommunicable disease in children. Respiratory syncytial virus (RSV) affects primarily children two years of age and is the leading cause of bronchiolitis in children worldwide. The objective of the present study was to establish the prevalence and relationship between bronchial asthma and RSV in preschool patients.

Methods: A descriptive, analytical, observational, cross-sectional, nonexperimental study was conducted at Dr. Francisco de Icaza Bustamante Hospital in Guayaquil from January 2017 to April 2019. The statistical analysis used the Chi-square test, for which the statistical significance value was <0.005, and InfoStat statistical software.

Results: There were 64 patients. The prevalence was 83% in patients diagnosed with RSV who subsequently developed asthma before six years of age. The comorbidity with the most significant presence in the population was prematurity (20%). There was a predominance of males (63%), as did the 3-year-old group (38%). Family history of asthma (21.88%). Patients were admitted with a classification of triage 2 (20.31%) or triage 1 (6.25%). Maternal age was <18 years (17.1%). The most frequent respiratory complication was unspecified acute bronchiolitis (71.8%), followed by unspecified pneumonia (65.6%). The patients were admitted to the intensive care unit (12.5%) and were hospitalized (7.8%).

Conclusions: There was a relationship between a history of respiratory syncytial virus infection and bronchial asthma. The prevalence of bronchial asthma in RSV-infected patients was high, with a predominance of 3-year-old preschoolers, males, and premature infants. The most common respiratory complication was unspecified acute bronchiolitis.

Keywords: MeSH: Asthma; Bronchiolitis; Observational Study; Child: Respiratory Syncytial Viruses.

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Introduction

The World Health Organization estimates that 235 million people worldwide have asthma. It is the most common noncommunicable disease in children. Deaths from bronchial asthma occur notoriously in countries with low and lower middle incomes; the WHO estimated 383,000 deaths from asthma in 2015 alone [1]. Ocampo, Gaviria, and Sánchez, in a study carried out in Latin America, aimed to compare the epidemiological data provided by the International Study of Asthma and Allergies in Childhood (ISAAC) 2004 study with the data identified in several regional cohort studies through a critical evaluation. These authors highlighted the main similarities and analyzed the differences between these epidemiological data and concluded that in Latin America, the severity of asthma is mild to moderate; however, 20% of patients have severe asthma, the primary phenotype being atopic (60 to 80%), and involving environmental factors such as the maternal history of asthma, cigarette exposure, and low income [2]. In a 2012 prospective cohort study of the development of asthma after respiratory syncytial virus bronchiolitis in Washington, 206 children were evaluated during an initial episode of severe RSV bronchiolitis at 12 months of age, followed by up to 6 years. Approximately 50% of children who experience severe RSV bronchiolitis in childhood have a significantly increased risk of asthma during the first six years of life, and symptoms generally persist as children grow to school age [3]. Another retrospective cohort study conducted in 2019 in the U.S. evaluated 534 babies hospitalized for bronchiolitis, where more than 55% of babies hospitalized for bronchiolitis developed asthma within five years of discharge [4].

Additionally, a prospective study of children <2 years hospitalized for acute respiratory infections between 2012 and 2013 was published in Argentina in 2019; in 2019, 622 children were evaluated, and it was concluded that RSV caused (71.8%) more than half of the cases of life-threatening diseases [5]. It is not known precisely whether RSV is a precursor to asthma or, more importantly, a predisposing marker of childhood asthma. The objective of the study was to focus on the modifiable factors involved in the development of this disease and to prevent recurrent symptoms and asthma attacks that can cause frequent visits to the emergency room until hospitalization.

Materials and methods

Study design

The methodology corresponds to a descriptive, analytical, cross-sectional, and retrospective study.

Study area

This study was conducted in the Infectology and Pneumology Service at the Hospital del Niño Dr. Francisco Icaza Bustamante in Guayaquil-Ecuador from January 2017 to April 2019.

University and Sample

The universal population included all the patients registered at the institution. The sample size was nonprobabilistic and discretionary since all incident cases in the study period were included.

Variables

The variables considered were ages ranging from 2 to 6 years. The other variables that were used were the sex of the patient, the comorbidities presented, the clinical picture, the presence of the respiratory syncytial virus, and the health area where the asthma patients were admitted.

Procedure, techniques, and instruments.

The study sample data were collected through the hospital system from the review of medical records using the information of the qualitative variables expressed as frequencies and percentages. The differential expression analysis and analysis of the relationships between the variables were performed using the chi-square test, for which the statistical significance value was <0.005. The quantitative variables were analyzed

descriptively and are expressed as the mean and standard deviation.

Control of sources of bias.

To avoid bias in the study, the registration of medical records in a Microsoft Excel database, which met the eligibility criteria, was guaranteed.

Statistical analysis

The data collected were recorded in a form designed exclusively for this purpose. They were processed with the Statistical Software InfoStat, where frequency, distribution, and association statistical methods were applied.

Results

Participants

Sixty-four patients were admitted to the study.

General characteristics of the population

The patients admitted for the first time were newborns up to 1 month of life (39.06%); 53.13% were admitted in 2017, and 28.13% were admitted in 2019. Most were three years old (38%), followed by 4-year-old patients (25% currently and 62.50% male) (Table 1).

Most of the patients analyzed were admitted to the emergency room; however, 12.50% were admitted to the intensive care unit, and only 7.81% were in the hospitalization area. A total of 20.31% were admitted with a classification of triage 2, that is, emergency and triage 1 (6.25%), classified as resuscitation. A family history of asthma was noted (21.88%). A total of 17.19% of the patients had adolescent mothers under 18 years of age. The most frequent comorbidity was prematurity, found in 20.31% of the patients. Some patients simultaneously presented more than one comorbidity, such as bacterial sepsis in 9.38% of newborns (Table 2).

Table 1. Sociodemographic and clinical characteristics of patients participating in the study.

Variable (s)	Frequency n = 64	Percentage (%)
Sex		
Female	40	62.50%
Male	24	37.50%
Entry age (months)		
0-1	25	39.06%
2-3	13	20.31%
4-5	11	17.19%
6-7	5	7.81%
8-9	1	1.56%
10-11	2	3.13%
12 or more	7	10.94%
Year of admission		
2017	34	53.13%
2018	12	18.75%
2019	18	28.13%
Current age		
< 1 year	5	7.81%
1	11	17.19%
2	6	9.38%
3	24	38.0%
4	16	25.0%
5	1	1.56%
6	1	1.56%
Type of care		
Hospitalization	5	7.81%
ICU	8	12.50%
Emergencies	51	79.69%
Triage		
1	4	6.25%
2	13	20.31%
3	16	25.00%
4	25	39.06%
5	6	9.38%
Family History of Asthma		
Yes	14	21.88%
No	50	78.13%

Rates were 82.81% for patients diagnosed with RSV who subsequently developed asthma before six years of age. Of the 64 patients, 11 did not develop HELLP syndrome (17.19%). (Figure 1).

Figure 1. Asthma prevalence in RSV patients.

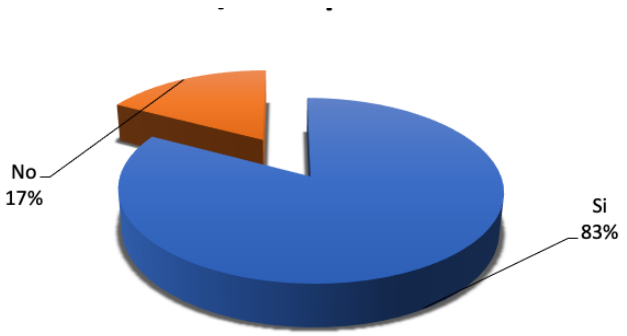

Table 2. Demographic variables of the group studied.

Variable (s)	Frequency n = 64	Percentage (%)
Mother's age		
< 18 years	11	17.19%
18-25	25	39.06%
26-30	16	25.00%
31-35	5	7.81%
Comorbidities		
Rhinitis	5	7.81%
Prematurity	13	20.31%
GERD	2	3.13%
Protein-Calorie Malnutrition	5	7.81%
Bacterial sepsis of the newborn	6	9.38%

Figure 2. Type of respiratory complication.

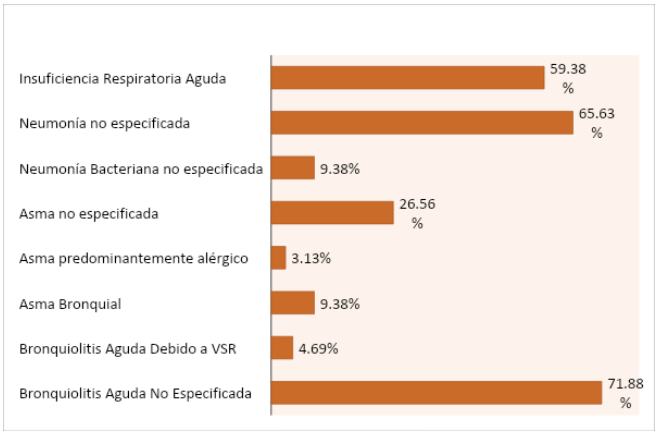

Table 3. Correlation coefficient between the variables.

Development of Asthma n = 48/ Bronchiolitis n= 24 with RSV	Value	gl	*P*
Chi Square Pearson	8	1	0.0047
Coef. Conting. Cramer	0.33		
Coef. Conting. Pearson	0.32		

The most frequent respiratory complication was unspecified acute bronchiolitis (71.88%), followed by unspecified pneumonia (65.63%) and acute respiratory failure (59.38%). Some patients developed **multiple complications** throughout their clinical course (Figure 2). Regarding the analysis of the relationship between the development of respiratory diseases and previous exposure to RSV, the *P*-value of the chi-square test was 0.0047, indicating that there is a relationship between RSV and bronchial asthma as well as bronchiolitis (Table 3).

Discussion

In this study, pediatric patients infected with RSV had bronchial asthma or bronchiolitis up to 6 years of age. Kulaus et al. reported a 15% prevalence of asthma at the age of 7 years and showed that 95% of children with RSV and rhinovirus infections had a significantly greater risk of asthma than did subjects who had never had infections; however, these findings suggest that the most critical risk factor for developing subsequent asthma is the number of acute respiratory episodes rather than the specific viral trigger involved [6]. In addition, another cohort study reported that respiratory tract infections caused by RSV and rhinovirus in the first year of life were associated with wheezing and asthma at the age of 5 years [7]. In the study by Avraham Beigelman and Leonard B. Bacharier, 206 infants admitted with respiratory syncytial virus bronchiolitis were included, and almost 50% of them had been diagnosed with asthma at seven years, which favors the relationship between severe bronchiolitis for RSV and subsequent development of asthma [8]. Severe RSV bronchiolitis has

been associated with an increase in rates of early wheezing, asthma, and possibly allergic sensitization later in life. Wheezing in early childhood after RSV infection has a high prevalence, influences quality of life, and generates significant health care costs [9]. According to Blaken et al., RSV infection is associated with subsequent recurrent wheezing, which is an indication of preexisting pulmonary vulnerability in preterm infants. These findings demonstrated that administering the palivizumab vaccine reduced the number of days with wheezing in preterm infants. The first year of life among late preterm infants [10]. Our findings showed prematurity (20.31%) and wheezing (82.81%) were the most frequent comorbidities. Considering that, in our study, the most common symptom in our patients was dyspnea (96.88%).

Age is related to the severity of asthma, according to epidemiological research, and the sex and age of patients affect the rate of hospitalization for asthma. According to a retrospective study, the admission rate at 0 to 10 years for boys was almost twice that for girls [11].

According to the Global Initiative for Asthma (GINA), in children <5 years old, recurrent wheezing is common, but asthma is more likely to occur if they wheeze or cough with exercise/laugh/cry or in the absence of respiratory infections or if they have a history of eczema or allergic rhinitis [12].

The Spanish guidelines for the management of asthma indicate that among the most studied or associated factors are host factors such as atopy, early menarche, obesity, bronchial hyperresponsiveness, and rhinitis; perinatal factors such as prematurity, breastfeeding, tobacco use during pregnancy, maternal and infant diet, maternal age, preeclampsia, cesarean section, neonatal lung function, and neonatal jaundice. However, environmental factors can act at different ages, including environmental pollution, aeroallergens, occupational allergens, respiratory infections, and tobacco [13].

The respiratory viruses associated with asthma include the same viruses that cause the common cold, wheezing, and bronchiolitis in children. These viruses are the primary triggers of respiratory diseases in adults and schoolchildren, accounting for approximately 85%. Respiratory viruses associated with asthma include respiratory syncytial viruses (RSV), influenza and rhinoviruses, coronaviruses, parainfluenza, adenoviruses, pneumoviruses, and bocaviruses; however, they are less common [14].

Currently, a study revealed that the inhibition of necroptosis, which contributes to the pathogenesis of RSV bronchiolitis through the release of HMGB1 in the first years of life, improved the progression of asthma induced by exposure to viruses or allergens in adulthood; therefore, this inhibition may be a viable strategy for limiting the severity of viral bronchiolitis and disrupting the pathogenesis of asthma [15].

Conclusions

There is a relationship between a history of respiratory syncytial virus infection and bronchial asthma. The prevalence of bronchial asthma in RSV-infected patients was high, with a predominance of 3-year-old preschoolers, males, and premature infants. The most common respiratory complication was unspecified acute bronchiolitis.

Abbreviations

RSV: respiratory syncytial virus.

Supplementary information

No supplementary materials are declared.

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Not declared.

Authors' contributions

Kristell Daniella Franco Loor: Conceptualization, data curation, formal analysis, fundraising, research, writing - original draft.
Eugenia Cevallos Velásquez: Methodology, project management, resources, software, supervision, validation, visualization, writing, revision and editing.
Vanessa Patricia Salazar Choez: Methodology, project management, resources, software, supervision, validation, visualization.
Luis Fernando Arroba: research, resources, writing - original draft.
All the authors read and approved the final version of the manuscript.

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Availability of data and materials
The data were collected from medical files; they are not publicly available due to patient confidentiality but are available through the corresponding author under a justified academic request.

Declarations

Ethics committee approval and consent to participate
The study was approved by the Bioethics Commission of the Faculty of Medical Sciences of the Santiago de Guayaquil Catholic University and the Teaching and Research Commission of the Dr. Francisco de Icaza Bustamante Hospital.

Publication consent
Images, radiographs, and specific patient studies were not available.

Conflicts of interest
The authors declare that they have no conflicts of interest.

Author information
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