

Regional asthma hospitalization rates and global asthma mortality rate in Chilean children

Tasas Regionales de hospitalización y mortalidad por asma infantil en Chile

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What do we know about the subject matter of this study?

Recently, there has been a significant increase in the overall rate of hospitalization due to asthma in children from 3.8 to 7.8 per 10 000 inhabitants.

What does this study contribute to what is already known?

There are some regional differences in hospitalization rates due to asthma in children, in which the Region V has the highest rate. The overall mortality rate due to asthma in children is 0.37 per 100 000 inhabitants.

Abstract

In recent years, there has been a significant increase in asthma hospitalization rates in children, however, regional and mortality rates are yet unknown. **Objective:** To determine regional asthma hospitalization rates in children and the global mortality rate in this age group. **Patients and Method:** We determined asthma hospitalization rates in the 15 regions of the country existing at the time of the study, between 2008 and 2014, based on the number of hospital discharges in each region and the population at risk of hospitalization. The mortality rate was obtained using the ratio between deaths due to asthma in children aged 5 to 15 and the exposed population. **Results:** the 5th region presented the highest hospitalization rate (7.6 per 10,000 inhabitants). Except for 4 regions, the median hospitalization rates of the different regions were similar to those found in the Metropolitan Region. The overall mortality rate due to asthma in 5 to 15-year-old children was 0.37 per 100,000 inhabitants in the analyzed period. **Conclusions:** most regions of the country have similar hospitalization rates to the Metropolitan Region and the 5th region presents the highest hospitalization rate due to asthma. The global mortality rate in children between 5 and 15 years old is 0.37 per 100,000 inhabitants.

Keywords:

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Introduction

Bronchial asthma is a highly prevalent disease worldwide. In Latin America, the prevalence of asthma in children varies between 2.6% and 33.1%, and more than half of the countries in the region present a prevalence higher than 15%¹. Using standardized questionnaires, The International Study of Asthma and Allergies in Childhood (ISAAC) determined that in Chile the prevalence of asthma was 17.9% in the 6-7-year-old group and 15.5% in the 13-14-year-old group².

Hospitalizations due to bronchial asthma represent a serious adverse outcome in patients with severe asthma and difficult-to-treat asthma³. A study published in Chile showed that, since 2001, there has been a significant increase in the hospitalization rate due to asthma in children aged 5 to 15 years which was 3.8 per 10,000 inhabitants to 7.8 per 10,000 inhabitants by 2014⁴. During that period, the most significant increase in hospitalization rates was observed in children aged between 5 and 7 years. The reported lethality was 0.02%⁴.

The objective of this study is to estimate regional rates of asthma hospitalization in children aged 5-15 years, to assess if there are differences between them, and to determine asthma mortality rate in this age group. These data will allow us to identify the regions that have the highest rates of asthma hospitalization and thus design strategies to reduce them.

Patients and Method

Design

Observational study describing the evolution of asthma hospitalization rates from 2008 to 2014 in children aged 5-15 years in the 15 regions of Chile at the time of the study. The evolution of the rates was analyzed globally by region.

Data collection

Data was obtained from hospital discharge records provided by the Department of Statistics and Health Information (DEIS) of the Chilean Ministry of Health⁵. These records include all hospital discharges from both the public and private health systems. We selected the information corresponding to hospital discharges due to asthma (ICD10 codes: J450, J451, J458, J459, and J46), in addition to simple age, sex, length of hospital stay, date of hospitalization, and condition at discharge. The sizes of the population at risk of hospitalization was taken from the demographic projections provided by the National Institute of Statistics of Chile (INE)⁶.

Data analysis

Using a first-order auto-regression linear model (Prais-Winsten), we analyzed the evolution of hos-

pitalization rates and compared them between age ranges and geographical regions through the Poisson regression method, where the comparative measure was the incidence rate ratio (IRR). Since the Metropolitan Region (MR) is the most populated the most stable in terms of population, we decided to consider it as the reference region to compare the hospitalization rates due to asthma with the other regions of the country. The mortality rate was calculated using the quotient between the number of deaths due to asthma in children aged 5 to 15 years and the exposed population, which was obtained from the INE's population projections⁶. The continuous variables were described as median, and interquartile range (IQR), while the qualitative ones were described as frequencies and proportions. The confidence intervals were 95% and the significance of 5%. The data was processed in the statistical software STATA 14.0.

Results

During the study period, there were 29 821 total hospital discharges due to asthma, 10 847 (36.4%) of them were children 5 to 15 years old. The median age was 8 (IQR 6-10) and did not change during the studied period ($p = 0.868$). 78% were children under 10 years. This greater proportion of hospitalization in younger children is present in all regions of the country. Comparing the number of hospital discharges due to asthma in the age range of 11-15 years to the 5-10 years range, adjusted by region, we see that children 5-10 years old have a risk of hospitalization 3 times greater than the older group (IRR = 3.11 95% CI 2.98-3.26 $p < 0.001$). 6 251 (57.6%) patients were male and 4 596 (42.4%) were female. When analyzing hospitalizations by region, there were no significant differences by sex.

The median length of hospital stay was 3 days (IQR 1-5) for both sexes. This median was consistently observed in all regions except Region IV, where the median age was 4 days, a difference that was considered significant ($p < 0.0001$). The median length of hospital stay did not vary in the analyzed period.

The global median hospitalization rate for the 7 years analyzed was 4.5 per 10 000 inhabitants (95% CI, 4.04-4.92) and remained stable over that period ($p = 0.404$). Region V presented the highest median hospitalization rate, 7.6 per 10 000 inhabitants, followed by Region IV and IX Region with 6.0 and 5.9 per 10 000 inhabitants, respectively (Table 1). Region VII had the lowest average hospitalization rates with 1.7 per 10 000 inhabitants, followed by Region XII and Region III with 1.9 and 2.3 per 10 000 inhabitants respectively (Table 1).

Table 1. Mean regional asthma hospitalization rates compared to the mean rate in the Metropolitan Region

Region	Mean regional hospitalization rates per 10 000 inhabitants (2008-2014)	Comparison of the mean regional hospitalization rates with the mean MR rate (XIII) P-value
I	3.9	0.351
II	5.4	0.412
III	2.3	0.005*
IV	6.0	0.125
V	7.6	< 0.001*
VI	3.4	0.131
VII	1.7	0.001*
VIII	5.6	0.269
IX	5.9	0.167
X	4.8	0.906
XI	5.5	0.328
XII	1.9	0.001*
XIV	4.5	0.853
XV	4.0	0.408
XIII	4.7	Reference (Metropolitan Region)

*Statistically significant difference.

When comparing the average hospitalization rates of each region with those of the MR, we observed that regions III, VII, and XII presented significantly lower rates than the MR and Region V presented a significantly higher hospitalization rate than the MR. The average hospitalization rates in the remaining regions did not differ significantly from those of the MR (Table 1).

Hospitalization rates remained constant in all regions throughout the studied period, except for Region I, which presented a decrease of 0.7 hospitalizations per 10 000 inhabitants per year ($p = 0.019$) and Region VIII that had an increase of 0.2 hospitalizations per 10 000 inhabitants per year ($p = 0.016$).

The global asthma mortality rate in children 5 to 15 years old for the analyzed period, was 0.37 per 100 000 inhabitants. Most deaths (5/7) occurred in children older than 10.

Discussion

Hospitalizations due to asthma reflect the greatest spectrum of morbidity and they are an indicator of poor disease control and, to a lesser extent, they represent the intrinsic severity of the disease.

In Chile asthma hospitalization rates in children have doubled, resulting in a major public health problem that we must address as a country⁴. 40% of the total asthma hospitalizations in the country were chil-

dren 5 to 15 years old and almost 80% of them were under 10 years of age.

The high proportion of younger patients hospitalized due to asthma is consistent across all regions of our country. The higher hospitalization rates in younger asthmatic patients has also been reported in other countries such as the United States and Spain^{7,8}. One possible explanation for this observation is that at younger ages maybe we have underdiagnosis of the disease and therefore lack of adequate treatment. Other possibility is the increased exposure of younger children to viral infections, which is known to be the main trigger for asthma exacerbations.

In general, hospitalization rates in the different regions are similar to those in the MR. Despite this, we observed significant differences in 4 regions (III, V, VII, and XII). International literature has also described important differences in asthma hospitalization rates in children from neighboring countries with similar climatic and economic development characteristics such as Finland and Sweden. Thus, Finland reports hospitalization rates of 6.8 per 10,000 inhabitants in 2014, while in Sweden the rate in the same period was 13.6 per 10,000 inhabitants⁹. Regional differences in hospitalization rates of childhood asthma within the same country have also been described, as in the United States where hospitalization rates were lower in the western region of the country, followed by the northeastern, central, and southern regions¹⁰.

The reason for regional differences in asthma hos-

pitalization rates is probably multifactorial in origin. One of these factors could be the different degree of exposure to environmental agents such as viruses, allergens, and environmental pollutants both inside and outside the home. In this sense, environmental pollution could play an important role in the higher rate of asthma hospitalization in Region V of our country, where several thermoelectric plants and oil refineries are located and several environmental alerts have been reported in recent years.

Multiple studies in the international literature show a clear association between the level of environmental pollution in a given place and the number of asthma hospitalizations. The pollutants that can cause problems in asthmatic patients are particulate matter 2.5 (PM_{2.5}), particulate matter 10 (PM₁₀), ozone (O₃), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂). In a meta-analysis published by Zheng in 2015 that included 87 studies, it was shown that short-term exposure to all these pollutants increased the risk of emergency room visits and hospitalizations due to asthma, especially in children and older adults¹¹. Another study, conducted in Taiwan during a one year period, showed a correlation between air pollution levels in different regions of the country and asthma hospitalizations in the same period. It was observed that this association was stronger in those regions with higher levels of pollution while it was weak in regions with low levels¹². Oil refineries are a source of many pollutants especially PM₁₀, SO₂, and NO₂. In a cross-sectional study in Quebec, a city with oil refineries, there was a clear association between SO₂ levels and asthma diagnosis in children living near these refineries, as well as the number of children with uncontrolled asthma¹³. Other factors that may influence regional variations in hospitalization rates are disease severity, disease control, and better or worse outpatient management¹⁴⁻¹⁶.

In a descriptive, prospective multicenter study conducted in Chilean children hospitalized due to asthma crises, we saw that almost 50% of these patients had no established diagnosis of asthma at the time of hospitalization and therefore were not receiving any maintenance treatment. Patients who did have an established diagnosis of asthma presented poor adherence to maintenance treatment¹⁷. These two observations are reflecting poor outpatient management and the impact of that on asthma hospitalizations. Good adherence to the maintenance treatment is fundamental to keep asthma under control and avoid asthmatic attacks. Therefore this is a very important factor to consider in our country if we want to reduce asthma hospitalizations in children.

Asthma mortality rate in the analyzed period was low, comparable with that of developed countries. It is noteworthy that most of the children who died for

asthma in our country were older than 10 years old. This observation contrasts with the fact that this age group had the lowest asthma hospitalization rates, which could lead us to conclude that these patients are probably not under medical supervision, underestimate their symptoms, and are therefore at a greater risk of dying.

Certainly, adolescence is a complicated period of life, in which patients are developing their autonomy and at the same time, moving away from parents and their care. For that reason, it would be important to develop in our country special follow-up programs for this vulnerable group of asthmatic patients.

One strength of our study is to show for the first time in Chile the regional variations of asthma hospitalization rates, as well as the global asthma mortality rate in children. The main weakness is the quality of available records, since we do not have detailed data on hospitalizations, such as asthma severity, presence of comorbidities, adherence to maintenance treatment, or type of therapy received by each patient.

We believe it is very important to identify the main risk factors in the regions with the highest hospitalization rates, in order to implement the necessary measures to reduce them.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors state that the information has been obtained anonymously from previous data, therefore, Research Ethics Committee, in its discretion, has exempted from obtaining an informed consent, which is recorded in the respective form.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

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