

# Factors associated to recurrent visits to the emergency department for asthma exacerbations in children: implications for a health education programme

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## ABSTRACT

*Introduction:* Recurrent emergency department (ED) visits for asthma exacerbations produce anxiety as well as high costs to the health system and the family.

*Objective:* To identify factors associated with recurrent ED visits for asthma exacerbations in children in Bogotá, Colombia.

*Methods:* Data obtained from a survey of parents of 223 patients with asthma (mean  $\pm$  SD: 4.8  $\pm$  3.5 years of age) attending an asthma clinic were analysed. Demographic data and a broad asthma knowledge and attitudes questionnaire were completed by the parents.

*Results:* Of the 223 asthmatic patients enrolled, 60 (26.9 %) had 3 or more visits to the ED for asthma in the last 6 months ("recurrent ED visits"). After controlling by age, educational level of the father, and severity of the disease; parents of children with "recurrent ED visits" were more prone to report that

they attended ED because the asthma exacerbations were severe enough to go to the primary care physician (OR, 2.45; CI 95 %, 1.13-5.30;  $p = 0.02$ ); that asthma medications should be administered only when the children are symptomatic (OR, 3.26; CI 95 %, 1.45-7.36;  $p = 0.004$ ), and conversely they were less prone to have knowledge that asthma exacerbations can be avoided if medications are administered in the asymptomatic periods (OR, 0.31; CI 95 %, 0.14-0.68;  $p = 0.003$ ).

*Conclusions:* An educational programme intended to reduce the recurrent ED visits for asthma exacerbations should consider the inclusion of an explanation about the chronic nature of the disease and the importance of long-term therapy.

**Key words:** Asthma exacerbations. Educational programme. Risk factors. Emergency department. Children.

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## INTRODUCTION

There has been a sharp increase in the global prevalence, morbidity, mortality and burden of childhood asthma over the last 40 years<sup>1</sup> despite the availability of excellent medications for controlling chronic symptoms and treating exacerbations. Asthma exacerbations are a frequent cause of emergency department (ED) visits in children; moreover there is a subgroup of patients who consulted repeatedly.<sup>2</sup> Fur-

thermore, each hospital visit due to asthma produces anxiety, interrupting the children's and parents' rhythm of life, as well as the high costs to the health system and the family.<sup>3</sup> It is hypothesised that if parents and physicians control factors related to the asthma exacerbations, it could alter the process that causes these recurrent ED visits.<sup>4</sup>

An adequate comprehension of these factors is important before applying any programme or actions towards decreasing these recurrent ED visits. Epidemiologic studies have identified several risk factors for ED visits in children i.e. young age, duration of symptoms, high consumption of asthma medication, previous asthma hospitalizations, low parental confidence on efficacy of asthma medication, unknown criteria to decide on the ED visits,<sup>5</sup> low parent educational level, afro-American population, lack of use of a strict treatment plan for asthma,<sup>6</sup> parental attitude towards evaluating the severity of their children's asthma,<sup>7</sup> previous consultations to the ED, high frequency of asthma ambulatory consultations,<sup>8</sup> family history of asthma,<sup>9</sup> poor social assistance, problems to pay social security,<sup>10</sup> allergen exposures, lack of health insurance, lack of adherence to self-treatment plans,<sup>4</sup> low family income, crowding, severity of the crisis, use of asthma medication in the last year,<sup>11</sup> single-parent family,<sup>11,12</sup> and lack of increasing asthma medication doses at the beginning of a cold episode.<sup>13</sup>

Although asthma is considered a public health problem among children in Bogota, Colombia (current prevalence of asthma of 10 % and 8.5 % for children ages 6-7 and 13-14 years, respectively)<sup>14</sup>, there is not enough information about factors related to ED visits. The objective of this study was to identify those factors associated to recurrent visits to ED for asthma exacerbations susceptible of being modified by an educational programme in children.

## METHODS

This study was conducted between May 2004 and October 2006 among those asthmatic children who consecutively participated in our educational asthma programme "A TODO PULMON" at the Clinica Col-sanitas in Bogota, Colombia. Children were eligible for the study if they have the diagnosis of asthma (stringent definition of the Asthma Predictive Index<sup>15</sup> for preschoolers; and NAEPP definition plus spirometry with greater than or equal to a 12 % increase in FEV<sub>1</sub> after bronchodilator medication<sup>16</sup> for older children and adolescents). The data presented in this report correspond to the baseline after the execution of our educational asthma programme.

The parents of the patients fill in a broad questionnaire about knowledge and attitude related to asthma, which was developed and validated previously by our group.<sup>17</sup> This questionnaire has 17 items grouped into three domains: myth and beliefs about asthma treatment (7 items); knowledge on the disease (6 items); and other aspects like physical activity and cigarette smoking (4 items), Appendix 1. For the purpose of the present study we added one multiple choice question asking "What was the most important reason to take their children to the ED due to asthma exacerbation during the last 6 months?" (the six alternatives were: because the ED physicians are better than the rest; because the treatment prescribed at the ED is more effective; because in the ED the treatment starts immediately; because the exacerbations were severe enough to go to the primary care physician; because the ED opens 24 hours; and because of any other reason). Also, demographic and asthma related variables were registered, i.e.: age, gender, highest parental educational level, duration of asthma, "controllers" drug uses, number of visits to the ED due to asthma in the last 6 months, number of oral steroids burst prescribed in the last 6 months, use of written-plan guides for self-management, previous asthma diagnosis made by the physician and parents' belief that their child has asthma.

## Statistical analysis

We divided the population into those children who had 3 or more ED visits in the previous 6 months ("recurrent ED visits") and those with less than 3 ED visits ("non-recurrent ED visits"). The value for child age was dichotomized according to the median value. Differences between continuous variables were analyzed using the unpaired t test or Wilcoxon's signed rank test, whichever appropriate. A bivariate analysis was performed to assess the association between children with recurrent and non-recurrent ED visits using Chi-square test or Fisher's exact test. Predictive variables associated with the outcome variable in the bivariate analysis with a p-value  $\leq 0.20$  were included in the multivariate analysis. The alpha level of 0.20 was chosen to reduce the likelihood of missing important predictors whose bivariate relationship with the outcome may be confounded with other variables.<sup>18</sup> In addition, it was defined a priori to include in the multivariate analysis other variables expected to influence on the number of visits to the ED, such as age of the patients, severity of asthma, and parents' educational level. The goodness-of-fit of the stepwise logistic regression models was as-

essed using the Hosmer-Lemeshow test.<sup>19</sup> All statistical tests were 2-tailed, and the significance level used was 0.05. The data were analysed with Stata 8.0 (Stata Corporation, College Station, TX, USA).

## RESULTS

During the study period, a total of 1050 subjects were screened in the clinic; of these subjects, 225 (21.4 %) met our eligibility criteria, and 223/225 (99.1 %) were enrolled in the study. Two children had uncompleted questionnaire forms and were excluded from the analysis. Of the 223 participants, 134 (60.1 %) were males, and the mean age  $\pm$  SD was  $4.8 \pm 3.5$  years. During the 6 months prior to the survey, 28 (12.6 %) of the children had no ED visits due to asthma exacerbation, 72 (32.3 %) had one, 63 (28.2 %) had two, and 60 (26.9 %) had 3 or more visits ("recurrent ED visits"). Therefore, 163 children were included in the "non-recurrent ED visits" group and 60 children in the "recurrent ED visits" group.

Children with recurrent ED visits were significantly younger than those with non-recurrent ED visits ( $3.5 \pm 2.1$  vs.  $5.3 \pm 3.8$  years,  $p = 0.001$ , respectively). However, there were not significant differences between children with recurrent ED visits and non-recurrent ED visits in terms of gender, maternal educational level, previous medical diagnosis of asthma and parental consideration of asthma in their child (Table I). Children in the recurrent ED visits

were more prone to having mild and severe persistent asthma diagnoses than those in the non-recurrent ED visits. Conversely, there were more mild intermittent asthmatics in the non-recurrent ED visits than in the recurrent ED visits group (Table I). There were no significant differences in the previous asthma diagnosis made by the physician and the parents' belief that their child has asthma (Table I). There were no significant differences in the duration of asthma [ $26.5$  (10.5-41.2) vs.  $27.5$  (12-60),  $p = 0.22$ ], and duration of "controller" therapy use [ $0$  (0-2) vs.  $0$  (0-1),  $p = 0.85$ ]. None of the children have had a written-plan guideline for asthma self-management.

Among all the variables of the "asthma knowledge and attitude" questionnaire, most of the parents recognized the negative effect of tobacco smoking around asthmatic children and recognized that airway inflammation is the main cause of asthma. Parents from children with recurrent ED visits were more prone to consider that *asthma medications should be administered only when the children are symptomatic* (70.0 % vs. 44.2 %, OR: 2.95; 95 % CI: 1.57-5.55,  $p = 0.001$ ); and conversely, less prone to know that *asthma exacerbations can be avoided if medications are taken in the asymptomatic periods* (46.7 % vs. 67.5 %, OR: 0.41; 95 % CI: 0.23-0.76,  $p = 0.004$ ) than parents from children with non-recurrent ED visits. Parents from children with recurrent ED visits were more prone to report that *they attended the ED because asthma exacerbations of*

**Table I**  
Social and demographic characteristics of children with recurrent vs. non-recurrent ED visits due to asthma exacerbations in the previous 6 months

Variables	Recurrent ED visits (n = 60)	Non-recurrent ED visits (n = 163)	OR (95 % CI)	p value
Male gender	35 (58.3 %)	99 (60.7 %)	0.90 (0.49-1.65)	0.74
High school level of the mother	6 (10 %)	25 (15.3)	0.62 (0.24-1.61)	0.32
High school level of the father	5 (8.3 %)	26 (15.9 %)	0.47 (0.17-1.29)	<b>0.19</b>
Asthma severity:				
Mild intermittent	7 (11.7 %)	47 (28.8 %)	0.32 (0.14-0.77)	<b>0.008</b>
Mild persistent	29 (48.3 %)	62 (38 %)	1.52 (0.84-2.77)	<b>0.16</b>
Moderate persistent	7 (11.7 %)	29 (17.8 %)	0.61 (0.25-1.48)	0.27
Severe persistent	17 (28.3 %)	25 (15.3 %)	2.18 (1.08-4.42)	<b>0.02</b>
Previous asthma diagnosis made by a physician	31 (51.7 %)	85 (52.1 %)	0.94 (0.52-1.71)	0.85
Parents who consider their children have asthma	21 (35 %)	46 (28.2 %)	1.32 (0.70-2.50)	0.39
Asthma exacerbations of their children were severe enough to go to the primary care physician*	27 (45.0 %)	30 (18.4 %)	3.43 (1.79-6.57)	<b>&lt; 0.001</b>

\*The most important reason for taking children to the ED due to asthma exacerbation in the previous 6 months.  
ICS: inhaled corticosteroids; LABA: long active beta2 agonist; LTRA: leukotriene receptor antagonists.

their children were severe enough to go the primary care physician (45.0 % vs. 18.4 %, OR: 3.43; 95 % CI: 1.79-6.57,  $p < 0.001$ ), Table II. Other nearly significant differences were that more parents from children with recurrent ED visits considered that *after the asthma exacerbations, once the coughing is over, use of the inhaler and medications should stop* (51.7 % vs. 36.8 %, OR: 1.80, 95 % CI: 0.99-3.28,  $p = 0.053$ ), *considering that the main cause of asthma is airway inflammation* (78.3 % vs. 68.1 %, OR: 1.69; 95 % CI: 0.84-3.40,  $p = 0.14$ ), and *considering that asthma exacerbations can be severe enough to require hospitalization in an ICU or cause death* (85 % vs. 74.8 %, OR: 1.86, 95 % CI: 0.84-4.11,  $p = 0.12$ ) than parents from children with non-recurrent ED visits.

After the multiple logistic regression analysis was performed, the only predictive variables that remained independent as risk factors for recurrent ED visits in the previous 6 months were: to be younger than 4 years of age, to have mild or severe persistent asthma, and the fact that parents considered that *asthma medications should be administered only when the children are symptomatic* (adjusted OR, 2.95; 95 % CI, 1.57-5.55;  $p = 0.001$ ) and the *asthma exacerbations of their children were severe enough to go to the primary care physician* (adjusted OR, 3.43; 95 % CI, 1.79-6.57;  $p < 0.001$ ); conversely, parents of children with recurrent ED visit were less prone to consider that the *asthma exacerbations can be prevented if medications are taken between exacerbations* (adjusted OR, 0.31; 95 % CI, 0.14-0.68;  $p = 0.003$ ), Table III.

**Table II**  
**Knowledge and attitudes on asthma of parents of children with recurrent vs. non-recurrent ED visits due to asthma exacerbations in the previous 6 months.**

Variables	Recurrent ED visits (n = 60)	Non-recurrent ED visits (n = 163)	OR (95 % CI)	p value
<b>Myths and beliefs about asthma treatment:</b>				
Inhalers can lead to dependence or addiction	35 (58.3 %)	88 (54 %)	1.19 (0.66-2.17)	0.56
Inhalers can affect or damage the heart	20 (33.3 %)	46 (28.2 %)	1.27 (0.67-2.40)	0.46
It is not good to use the inhaler for too long	43 (71.7 %)	110 (67.5 %)	1.22 (0.64-2.33)	0.55
After asthma exacerbations, once the coughing is over, use of the inhaler and other medications should stop	31 (51.7 %)	60 (36.8 %)	1.80 (0.99-3.28)	<b>0.053</b>
Asthma medications should be administered only when the children are symptomatic	42 (70.0 %)	72 (44.2 %)	2.95 (1.57-5.55)	<b>0.001</b>
It is better to use inhalers without a holding chamber	6 (10 %)	25 (15.3 %)	0.61 (0.24-1.58)	0.31
It is better to go to ED even if symptoms are mild	40 (66.7 %)	111 (68.1 %)	0.94 (0.50-1.76)	0.84
<b>Knowledge on asthma:</b>				
The main cause of asthma is airway inflammation	47 (78.3 %)	111 (68.1 %)	1.69 (0.84-3.40)	<b>0.14</b>
Asthma exacerbations can be prevented if medications are taken during the asymptomatic periods	28 (46.7 %)	110 (67.5 %)	0.41 (0.23-0.76)	<b>0.004</b>
Viral infections are the main causes or triggers of asthma exacerbations	20 (33.3 %)	64 (39.5 %)	0.77 (0.41-1.43)	0.40
If an asthmatic child gets viral infections, parents should apply inhalers even if there is no cough	13 (21.7 %)	43 (26.4 %)	0.77 (0.38-1.56)	0.47
Asthma exacerbations can be severe enough to require hospitalization in ICU or cause death	51 (85 %)	122 (74.8 %)	1.86 (0.84-4.11)	<b>0.12</b>
Some asthma medications only work when used daily	28 (46.7 %)	73 (44.7 %)	1.05 (0.58-1.91)	0.86
<b>Other aspects of asthma:</b>				
Parents should ask a doctor to tell the school that an asthmatic child should not exercise	6 (10 %)	24 (14.7 %)	0.64 (0.25-1.67)	0.36
Asthmatic children should not participate in sports that make them run too much	11 (18.3 %)	28 (17.2 %)	1.08 (0.50-2.34)	0.84
It is better not to smoke or let anyone else smoke near a child who has asthma	58 (96.7 %)	157 (96.3 %)	1.11 (0.22-5.65)	1.00
If the parents of a child with asthma smoke outside the house, it will not affect the child	14 (23.3 %)	52 (31.9 %)	0.65 (0.33-1.29)	0.21

Table III

**Multivariate analysis of predictors for recurrent ED visits due to asthma exacerbations in the previous 6 months\***

Variables	adjusted OR	95 % CI	p value
Age < 4 years	3.18	1.40-7.21	<b>0.006</b>
High school level of the father	0.41	0.12-1.41	0.16
Mild intermittent asthma	1.00	—	
Mild persistent asthma	3.18	1.17-8.70	<b>0.02</b>
Moderate persistent asthma	1.00	0.26-3.80	0.99
Severe persistent asthma	4.53	1.44-14.33	<b>0.01</b>
Asthma exacerbations of their children were severe enough to go elsewhere**	2.45	1.13-5.30	<b>0.02</b>
After asthma exacerbations, once the coughing is over, use of the inhaler and medications should stop	1.73	0.77-3.90	0.18
Asthma medications should be administered only when the children are symptomatic	3.26	1.45-7.36	<b>0.004</b>
The main cause of asthma is airway inflammation	1.21	0.52-2.86	0.66
Asthma exacerbations can be prevented if medications are taken between exacerbations	0.31	0.14-0.68	<b>0.003</b>
Asthma exacerbations can be severe enough to require hospitalization in an ICU or cause death	1.81	0.68-4.84	0.23

\*Predictive variables associated with the outcome variable in the bivariate analysis with a p-value  $\leq 0.20$  were included in the multivariate analysis.

\*\*The most important reason for taking children to the ED due to asthma exacerbation in the previous 6 months.

## DISCUSSION

In the present study, parents of children who had recurrent ED visits in the previous 6 months were more prone to have the knowledge that the asthma exacerbations of their children were severe enough to go to the primary care physician and that the asthma medications should be administered only when the children are symptomatic; and conversely, they were less prone to consider that asthma exacerbations can be prevented if medications are taken between exacerbations. The latter reflects the lack of knowledge and doubt among the parents about the chronic condition inherent to asthma and the necessity of administering asthma medications for long periods of time, even when symptoms are absent.

One potential explanation of this knowledge among parents could be the fact that the definition of asthma and the understanding of its pathophysiology have changed considerably with time<sup>20</sup> without those changes being transmitted to our patients. Briefly, in the fifties asthma was defined as a disease characterized by a reversible obstruction of the airways, that would resolve spontaneously, or after therapy.<sup>21</sup> In the next decade, it was considered an episodic disease, in which the airway obstruction was caused by bronchial hyper reactivity<sup>22</sup>; therefore, the therapeutic goal was to relieve bronchospasm once it appeared. During the seventies, the concepts of prevention of bronchospasm and treatment of disease progression were used for the first time.<sup>23</sup> However, it was only during the nineties, that the disease was redefined as a chronic inflammatory disease characterised by reversible obstruction of air flow, and bronchial hyper-

reactivity.<sup>24</sup> From that moment on, inflammation and anti-inflammatory treatment were considered as the goal. Therefore, it is probable that the erroneous concept of asthma in the past was responsible, at least in part, for the fact that patients, families, and even physicians still consider asthma as an episodic disease and accept the higher morbidity<sup>24</sup> and manage it exclusively on the symptomatic periods or exacerbations, instead of treating inter-critical periods.<sup>24</sup>

Recently, a survey carried out in Latin America, including Colombia, showed that 40 % of the respondents think that only the symptoms could be treated but not the underlying condition. A small proportion (16 %) of the patients knew that asthma is an inflammatory disease and only 6 % used inhaled corticosteroids; however 91 % claim the necessity for better education on asthma and its treatment.<sup>25</sup> Moreover, studies carried out in other parts of the world using similar methodology, have shown that inhaled corticosteroids were underused according to the international guidelines and this was not related to the severity of the disease.<sup>26</sup> All of this evidence may reflect that many people still have the erroneous concept of asthma being more an episodic than a chronic disease; therefore these patients and/or their families do not understand the chronic nature of asthma and probably do not consider the necessity of prolonged drug administration during the inter-critical periods.<sup>24</sup> As was previously reported, the low adherence to therapy has been associated to a higher use of ED<sup>4,27</sup> and also to considering the ED as the best place to treat the disease,<sup>5</sup> as was found in the present study.

Another factor that could further limit an adequate long term therapy adherence is that some parents do

not know or believe that their children suffer from asthma. Despite the fact that all children included in the present study meet the criteria to be considered asthmatics,<sup>15, 16</sup> only approximately half of the parents reported that their children had been previously diagnosed with asthma by a physician; and moreover, only one third of the parents really suggested that their children had asthma. It has been described that most parents mainly only recognise asthma as a disease with severe symptoms,<sup>28</sup> without believing that this disease can also be present when the symptoms are milder. In the present study, the previous medical diagnosis of asthma in the child and the parental belief that their children suffered from asthma were not significantly associated with recurrent ED visits; in contrast to a previous report that found that children with dispensed asthma medications but lacking an asthma diagnosis have had higher healthcare utilisation than children with a diagnosis of asthma.<sup>29</sup> For all these reasons, we assume that it is probable that if parents accept the diagnosis of asthma in their children (even if with mild symptoms), but more importantly, if they recognise the chronic nature of the disease and the necessity and importance of continuous administration of "control medications", the adherence to the therapy will increase and the morbidity and recurrent ED visits will decrease.

Another risk factor for recurrent ED visits found in the present study was age. Children younger than 4 years old were more prone to have recurrent ED visits than older; similarly to a previous study carried out in a developed country which reports that children under 3 years had worse control of asthma than older ones.<sup>30</sup> Possible explanations for the greater morbidity in preschoolers will be that the current guidelines based on symptom-frequency criteria seem to offer a valid basis for classifying asthma severity especially in children older than 5 years of age but may underclassify youngers,<sup>31</sup> and by the fact that at present asthma treatment in preschoolers seems to be insufficiently adjusted to the severity or phenotype of wheezers.<sup>32</sup> Moreover, in this age group, other diagnoses of wheezing or exacerbation different from asthma could be present, however the use of the Asthma Predictive Index,<sup>15</sup> as in the present study, can help for an early recognition of asthma among preschool children with recurrent wheezing and therefore could facilitate convincing their parents about the chronic condition of the disease and the necessity of administering medications for long periods even when symptoms are absent.

In terms of severity of asthma as a risk factor for recurrent ED visits, at present it is well known that severity of asthma does not mean control of asthma, and patients with mild asthma can have severe exacer-

berations,<sup>33</sup> that would be the explanation as to why in our study either children with mild or severe persistent asthma remain associated with recurrent ED visits. We know that those children who had control of their disease by using regular controller therapy will have less recurrent ED visits, independently of their severity. Despite the demonstrated usefulness of taking a written plan for self-management of asthma,<sup>16</sup> none of the children in the present study had such a plan. The usefulness of asthma education activities directed to patients has been demonstrated, especially when they include written self-treatment plans.<sup>34</sup>

The limitations of the present study are inherent to its design. As a cross-sectional study it is impossible to establish a cause relationship among the study variables and the recurrent ED visits, we are only able to identify their associations. This study only included patients referred to our clinic for an asthma educational programme; therefore our patients would have more severe disease and maybe have higher knowledge of asthma than those in the general population, so the results could not be generalised to other patients with a less severe disease or different knowledge of asthma.

In conclusion, we speculated that a local asthma educational programme intended to reduce the number of ED visits for asthma exacerbations should consider the inclusion of an explanation and discussion about the chronic nature of the disease and the importance of the long-term administration of "asthma controllers" medications, even in asymptomatic periods. Further prospective studies are needed to corroborate this hypothesis.

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## Appendix 1

### Questionnaire about knowledge and attitude on asthma

#### Myths and beliefs about asthma treatment:

1. Inhalers can lead to dependence or addiction
2. Inhalers can affect or damage the heart
3. It is not good to use the inhaler for too long
4. After asthma exacerbations, once the coughing is over, use of the inhaler and other medications should stop
5. Asthma medications should be administered only when the children are symptomatic
6. It is better to use inhalers without a holding chamber
7. It is better to go to ED even if symptoms are mild

#### Knowledge on asthma:

1. The main cause of asthma is airway inflammation
2. Asthma exacerbations can be prevented if medications are taken during the asymptomatic periods
3. Viral infections are the main causes or triggers of asthma exacerbations
4. If an asthmatic child gets viral infections, parents should apply inhalers even if there is no cough
5. Asthma exacerbations can be severe enough to require hospitalization in ICU or cause death
6. Some asthma medications only work when used daily

#### Other aspects of asthma:

1. Parents should ask a doctor to tell the school that an asthmatic child should not exercise
2. Asthmatic children should not participate in sports that make them run too much
3. It is better not to smoke or let anyone else smoke near a child who has asthma
4. If the parents of a child with asthma smoke outside the house, it will not affect the child