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ORIGINAL ARTICLE

Effectiveness of Asthma Education with and Without a Self-Management Plan in Hospitalized Children

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Background. Formal education in primary care can reduce asthma exacerbations. However, there are few studies in hospitalized children, with none originating in Latin America. **Methods.** A prospective randomized study was designed to evaluate whether a full education with self-management plan (ESM) was more effective than an education without self-management plan (E) in reducing asthma hospitalization. Children (5 to 15 years of age) who were hospitalized for an asthma attack were divided in two groups. Children in the E group received general instructions based on a booklet. Those in the ESM group received the same booklet plus a self-management guide and a puzzle game that reinforces the lessons learned in the booklet. Patients were interviewed every 3 months, by telephone, for one year. Interviewers recording the number of hospitalizations, exacerbations, and emergency visits for asthma and oral steroid burst uses. **Results.** From 88 children who met the inclusion criteria, 77 (86%) completed one year of follow-up (41 from E and 36 from ESM group). Overall, after one year, the hospitalization decreased by 66% and the inhaled corticosteroids therapy increased from 36% to 79%. At the end of the study, there was no difference in exacerbations, emergency visits, oral steroid burst uses, or hospitalizations between the two groups. **Conclusions.** Asthma education with or without a self-management plan during asthma hospitalization were effective in reducing exacerbations, emergency visits, oral steroid burst uses, and future rehospitalizations. This evidence supports the importance of providing a complete asthma education plan in any patient who is admitted for asthma exacerbation.

Keywords asthma education program; hospitalized; asthma attack; self-management; Latin America

INTRODUCTION

Asthma is one of the most common chronic diseases in children and has a high correlation to economic burden. The prevalence ranges worldwide, from 6% in the United States to 36% in Costa Rica (1). In Chile, a country in Latin America (a globally poor region), the prevalence is 18% for children 6 to 7 years of age and 15% for 13 to 14 years of age (2). In addition, asthmatic children from a lower socioeconomic status are more prone to have more exacerbations and hospitalizations (40%) than asthmatics from higher socioeconomic status (3). It is well known that poverty is directly related to less education. Moreover, asthma education is a key element for the success in asthma management and to achieve the patient's comprehension of many factors related with the disease. Such factors include nature of the disease, triggers, treatment options, early recognition of exacerbations, and a rescue action plan. A recent study conducted in Colombia, Latin America, reported that when parents believe that asthma must be treated only when the child is ill the emergency department consultation increased by 3.3 times than when the parents believe that asthma must have a regular treatment (4).

Moreover, a Cochrane review showed that if children have an asthma self-management plan their risk of exacerbation is reduced by 27% (5). The education about asthma is usually done by primary care, where most of the patients consult. However, we believe that giving information during hospitalization for asthma attacks could also be effective. This is the time when the parents may see the seriousness of asthma and how the available drugs can be effective. However, there are only few self-management education studies conducted on hospitalized asthmatic patients in children (6); and none took place in Latin America.

We hypothesize that the educational self-management plan during hospitalization is more effective in reducing future exacerbations than traditional education among children from a socioeconomically disadvantaged population in Chile.

METHODS

We conducted a prospective study of children 5 to 15 years of age admitted for asthma attacks at the pediatric section of Dr. Sótero del Río Children's Hospital, Santiago, Chile. This hospital is an inner-city facility that attends a socioeconomically disadvantaged population (around 1 to 5 million). During the enrollment period (May 2006 through April 2007) all the children admitted for asthma attacks who stayed more than 24 hours were invited to participate in the study. A demographic questionnaire about their personal and family backgrounds and characteristics of their asthma

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in the previous 12 months was completed by the parents or guardians at the admissions stage of the study. Asthma in the child was defined if they had received that diagnosis from their physician or if they had had at least two symptoms of asthma (wheezing, tight chest, shortness of breath, or coughing with exercise) in the past year. Allergic rhinitis was defined by the presence of rhinorrhea, nasal itching, and sneezing without having a cold during the past year. Patients were excluded from the study if they had other lung diseases, such as cystic fibrosis, ciliary dyskinesia, chronic lung injury secondary to aspiration, bronchopulmonary dysplasia, foreign body, bronchiolitis obliterans, cardiopulmonary malformations, or neurological alterations.

Each child included in the study was randomized (by a computer program) to receive one of the two education programs, either standard education program (E) or self-management education program (ESM). Children from the E group received a general education about the etiology, triggers, types, severity, and treatment of asthma and the correct use of the inhalers with spacers. That education lasted 30 minutes and was collected by a research nurse. At the end of the session and after a conversation with the patients and their parents or guardians, the nurse distributed a booklet that reinforced those topics. Children in the ESM group received the same general education and booklet including a self-management guideline. This information taught the children and their families how to recognize an asthma exacerbation based on the symptoms stratified in green, yellow, orange, or red lights. The nurse also taught what to do in different scenarios (e.g., series of 2 puffs of salbutamol by metered dose inhaler [MDI] every 10 minutes for one hour plus oral prednisone [1 mg/kg daily, a maximum of 30 mg/d, for 5 days] if the exacerbation is more severe and a visit to the emergency room if needed when management does not improve the symptoms). Moreover, children in the ESM group received a puzzle game to reinforce the educational session with their families at home.

We taught the families of both groups (E and ESM) to register in a card any asthma exacerbations, hospitalizations, emergency visits, and the therapy used in exacerbations, as well as chronic therapy used monthly for one year. Asthma exacerbations were defined as the use of rescue bronchodilators for more than 2 days. After the discharge from the hospital, the families of the children were contacted by telephone every 3 months for the whole year by an external source. The source did not know in which group the child was, collected information from the monthly card register. The primary outcome of the study was the reduction of exacerbations during the year of the study. The secondary outcomes were re-hospitalizations, prednisone bursts, and emergency visits.

This study was approved by the Hospital's Ethics Committee, and a full written consent form was signed by all parents or guardians.

Statistical Analysis

To evaluate differences between groups (E and ESM), the chi-square test and *t* test and analysis of variance (ANOVA) with Bonferroni correction were used for categorical and for continuous variables, respectively. We considered a confi-

dence interval of $\alpha = 0.05$ with a level of significance 95%. Assuming that 90% of children with moderate to severe asthma have at least one exacerbation again in the next year, 33 children are required by each group to detect a difference of 30%. All calculations were performed using SPSS v.15.0.

RESULTS

Eighty-eight of 160 children hospitalized for asthma attack during a 1-year period (May 2006 through April 2007) met the inclusion criteria and were enrolled in the study. The remaining 72 children arrived during the weekend or stayed for less than 24 hours so they could not be included. No parents or guardians declined to participate in the study after being invited. Eleven of 88 children (12.5%) were excluded from the study because they did not answer the telephone (5 from the E and 6 from the ESM group); therefore 77 (87.5%) children finished the study (41 from the E and 36 from the ESM group). However, there were no significant differences in demographic characteristics, morbidity, or treatment between children who finished the study and those who did not complete the study (Table 1).

At admission to the study, there were no significant differences in age, gender, allergic rhinitis, and parental asthma between the E and the ESM groups (Table 2). The duration of asthma was similar between both groups. Overall, more than half had cough with exercise and more than 80% had cough at night between exacerbations. Also, children from both groups had similar parameters of asthma severity in the previous year (number and length of hospitalization, number of exacerbations, number of emergency department visits, and bursts of oral prednisone, see Table 2). Overall, one third of the children had a history of previous hospitalizations and also one third had 6 or more exacerbations in the previous 12 months. In contrast, only 10% of children had no exacerbations in the last year. Furthermore, and without difference between groups, only 42% of the parents recognized that their child had asthma while the rest of parents believed that their child had either "recurrent bronchiolitis" (48%) or bronchial hyperreactivity (3%). The use of inhaled corticosteroids was 35% in the E group and 38% in the ESM group ($p = 0.6$).

Before the present hospitalization, but when the child was enrolled in the study, all the patients received standard management at the emergency department in our hospital. Bronchodilators such as salbutamol alone (by metered dose in-

TABLE 1.—Demographic characteristics, morbidity, and treatment (% or mean $\pm$ SD) between those who completed follow-up and those who did not complete follow-up.

	Complete follow-up (n = 77)	Did not complete follow-up (n = 11)	<i>p</i> value
Age (years $\pm$ SD)	8.0 $\pm$ 2.34	7.8 $\pm$ 2.40	0.78
Males	63.6 %	54.5 %	0.56
Parental asthma	38.9 %	36.4 %	0.87
Previous diagnosis of asthma by physician	41.6 %	54.5 %	0.41
Inhaled corticosteroid use	36.4 %	36.4 %	1
More than 6 exacerbations	33.8 %	36.4 %	0.86
Cough at night between the exacerbations	83.1 %	90.9 %	0.50
Cough with exercise between the exacerbations	54.6 %	72.7 %	0.25

TABLE 2.—Demographic characteristics, morbidity, and treatment (% or mean $\pm$ SD) between the two groups of asthma education programs.

	E (n = 41)	ESM (n = 36)	p value
Demographic characteristics			
Age (y $\pm$ SD)	8.3 $\pm$ 2.4	7.7 $\pm$ 2.3	0.29
Males	71%	56%	0.17
Allergic rhinitis	54%	47%	0.88
More than 2 years with asthma	87%	95%	0.19
Parental asthma	44%	33%	0.63
Previous diagnosis of asthma by physician	35%	52%	0.16
Asthma treatment and morbidity in the last year:			
Inhaled corticosteroid use	35%	38%	0.96
Hospitalizations	29%	33%	0.70
More than 6 exacerbations	30%	38%	0.68
Cough at night between the exacerbations	83%	86%	0.51
Cough with exercise between the exacerbations	56%	57%	0.77
Exacerbation associated with common colds	80%	90%	0.31
Exacerbation associated with contamination exposure	33%	43%	0.36
Exacerbation associated with allergens exposure	56%	63%	0.48
Number of exacerbations	5.40 $\pm$ 4.1	6.80 $\pm$ 5.2	0.21
Number of emergency visits	3.07 $\pm$ 3.0	3.47 $\pm$ 3.2	0.58
Number of prednisone burst	1.76 $\pm$ 1.9	1.64 $\pm$ 1.1	0.75
Number of previous hospitalization	0.29 $\pm$ 0.5	0.47 $\pm$ 0.8	0.31

E = education without self-management plan, ESM = education with self management plan.

haler [MDI] and spacer device or by nebulization) or with ipratropium bromide (only 1 patient from the E group and 2 from the ESM group received ipratropium bromide) and systemic corticosteroids (hydrocortisone 10 mg/kg IV or prednisone 2 mg/kg/day PO) were used. During this admission, there were no differences of oxygen requirements and length of hospitalization between the E versus ESM group ($\text{FiO}_2 = 0.37$ vs. 0.36 and 3.04 ± 1.6 vs. 2.8 ± 1.8 , $p = 0.536$, respectively). Only 5 children used noninvasive ventilation (2 from E and 3 from ESM group). The most frequent antibiotic used was clarithromycin (19.6% vs. 34.2%, respectively, $p = 0.12$).

At the end of the 1-year follow-up, the number of exacerbations, prednisone bursts, emergency visits, and hospitalizations were similar between the E and ESM groups, although the emergency visits were marginally lower among children in the ESM group (Table 3). Also, a significant improvement on asthma control before and after the educational intervention was observed in children inside each group (Table 4). When we analyzed these morbidity parameters at each different period of evaluation (e.g., 3, 6, 9, and 12 months), there were no significant differences between

TABLE 3.—Outcomes (mean $\pm$ SD) at the end of the year between the two groups of asthma education program.

	E (n = 41)	ESM (n = 36)	p value
Asthma exacerbations	3.05 $\pm$ 3.1	2.83 $\pm$ 2.5	0.74
Emergency visits	1.78 $\pm$ 3.0	0.83 $\pm$ 1.2	0.07
Prednisone bursts	0.80 $\pm$ 1.2	0.50 $\pm$ 0.6	0.16
Hospitalizations	0.12 $\pm$ 0.3	0.08 $\pm$ 0.5	0.58

E = education without self-management plan, ESM = education with self-management plan.

TABLE 4.—Comparison of the outcome (mean $\pm$ SD) before and after the 12 months of the asthma education program.

	Before	After	p value
Exacerbations:			
E	5.41 $\pm$ 4.1	3.05 $\pm$ 3.1	0.004
ESM	6.78 $\pm$ 5.2	2.83 $\pm$ 2.5	0.0001
Overall	6.05	2.94	0.0001
Emergency visits:			
E	3.07 $\pm$ 3	1.78 $\pm$ 3	0.014
ESM	3.47 $\pm$ 3.2	0.83 $\pm$ 1.2	0.001
Overall	3.26	1.33	0.0001
Prednisone burst:			
E	1.76 $\pm$ 1.9	0.8 $\pm$ 1.2	0.003
ESM	1.64 $\pm$ 1	0.5 $\pm$ 0.6	0.001
Overall	1.70	0.65	0.0001
Hospitalizations:			
E	0.29 $\pm$ 0.5	0.12 $\pm$ 0.3	0.03
ESM	0.47 $\pm$ 0.8	0.08 $\pm$ 0.28	0.003
Overall	0.39	0.10	0.001

E = education without self-management plan, ESM = education with self management plan.

groups (data not shown). During the follow-up, the use of inhaled corticosteroids increased similarly in both groups at 3 months (91.4% for the E group vs. 88.9% for the ESM group), at 6 months (82.9% vs. 88%, respectively), and at 12 months (77.1% vs. 81.5%, respectively). The inhaled corticosteroid used daily was budesonide in MDI (average dose of 400 μ /d).

DISCUSSION

This study has shown that in our population either educational strategy, with or without self-management plan, started at the moment the children were hospitalized for an asthma attack had a significant impact in improving their asthma control. These strategies resulted in reducing exacerbations by 51%, emergency visits by 60%, systemic steroid bursts by 62%, and re-hospitalization by 75% at the end of the 1-year follow-up.

Previous to the intervention, our patients had their asthma uncontrolled, as 30% had at least one previous hospitalization, 30% had 6 or more exacerbations, 56% had symptoms with exercise, and more than 80% had cough at night between exacerbations in the previous year. It is important to stress that although inhaled corticosteroids have been indicated at baseline in 80% of the children, only 35% used them and only 42% of the parents recognized that their child had asthma. Perhaps most of the parents had difficulty in accepting the chronic condition of their child due to the stigma of asthma or had difficulty getting an appointment by a specialized physician who could really provide the correct diagnosis. A similar situation took place in San Diego, CA, where the Hispanic population had 29% less diagnosis of asthma than whites (7). The accurate rate labelling of the disease allows an effective treatment and management as well as better accounting of the public health impact and adequate mobilization of resources to address it.

In Santiago, Chile, among all the public's consultations in schoolchildren from 5 to 9 years of age in 2006 and 2007, those with asthma were 5.8% and 5.5%, respectively (data from www.ssmso.cl). In the United States, in 2006, asthma-related hospitalization was 5.6% of all hospitalization among children, and the most adverse outcomes (emergency visits,

hospitalizations, and death) were found to be more prevalent among certain populations (e.g. minority race/ethnicity, boys, and very young children and adolescents). Non-Hispanic black children have an emergency visit rate 4.1 times higher and a death rate 7.6 times higher than non-Hispanic white children; black children have an asthma-related hospitalization rate 3 times higher than that of white children. Asthma-related death among Mexican children was higher than non-Hispanic white children (RR 1.5 vs. 1.1) (8).

It is important to stress that in our study, before the educational intervention program almost one third of the children had a history of previous hospitalizations for asthma, as was previously described by Canino et al. (9) in a population with poor education and less adherence to chronic therapy. However, overall after the intervention hospitalizations declined in 66%, from 30% to 10% of the total population studied. This dramatic decline in both groups may have been possible owing to the high quality of the education session done by the trained nurse while the child was hospitalized by the asthma attack. However, at least three other factors could play a role: (1) the recurrent phone calls made every 3 months, (2) the improvement of inhaled corticosteroids used (from 36% to 90% after 3 months of the intervention and to 78% at the end of the one year study), and (3) the decrease by 15% of prevalence of acute respiratory tract infections during 2007 compared with the previous year. The rate of rehospitalization after one year of follow-up, observed in our study, is similar to the reported in a study done in a developed Nordic country (10) where asthmatic schoolchildren had 15% of rehospitalizations in 2 years and with similar averages in the length of hospitalizations (2.5 days) than our population. In a recent study (6), 100 children (2 to 15 years of age) were assigned to receive two structured asthma education programs (booklet vs. booklet plus pictures and video) during their hospitalization for asthma and were received follow-up for 3 months. At the end of the study children from the most complete educational program had significantly fewer hospitalizations (5.5% vs. 28.8%, $p = 0.003$) and fewer emergency visits (24 vs. 57 visits, $p = 0.004$). Although experiences of asthma education programs during a hospitalization are scarce, all of this data suggests that asthma hospitalization is a good moment for parents and children to receive an education program.

Between 1998 and 2005, a study of auditing the management of children hospitalized for an asthma attack in the UK showed that providing written asthma plans significantly increased from 24% to 41%. ($p < 0.001$). The respiratory specialist gave significantly more written asthma plan than general pediatricians (OR = 1.73; 95% CI: 1.55 to 1.93) (11). Similarly to our study, 30% of the children have had at least one previous admission in the last 12 months. Therefore, this UK audit recommends the inclusion of a good asthma education guideline before discharge to diminish the morbidity in the future. In our study, before the intervention, none of children received an education asthma program at discharge from the hospital during their past asthma attack. Therefore, the significant difference in the asthma control seen in our population (exacerbations, fewer emergency visits, less systemic corticosteroid bursts, and reduction in hospitalizations) could be explained, at least in part, by the two educational programs that our patients received. Cloutier et al. (12) found that prescribing anti-inflammatory medication is necessary, but not

enough to reduce hospitalization and emergency visits, and other elements such as written asthma plan and standardized therapy would be also important.

This study has some limitations. First, because children from both groups need to fill out the monthly card and received a telephone call every 3 months by the nurse, this could have a positive reinforcement in their asthma management. This situation happens in clinical trials but not in the real-world, as was shown by Covar et al. (13). Second, the improvements in the outcomes could be related to the higher level of inhaled corticosteroids used in both groups after the enrollment. Third, a contamination of the education program could have occurred when more than one patient shared the same room during the asthma hospitalization. In our hospital the pediatrics unit can receive two to six children, although we intended to reduce this possibility by maintaining the possible participants in different rooms during the study period. Finally, although the total of children who completed the 1 year of follow-up reach the sample size calculated, it is always possible to see differences between groups by having a larger number of patients in the study. Therefore, this study cannot exclude the beneficial role of asthma self-management plans that are broadly recommended by international asthma guidelines (14–16) as an important factor for asthma control.

CONCLUSION

After one year of follow-up, this study has shown that during hospitalization, the start-up an individually taught educational program, assisted by booklet with or without self-management, was an effective strategy to reduce asthma morbidity (fewer exacerbations, emergency visits, re-hospitalizations, and prednisone bursts used). These findings may support the importance of providing an education program in all children who are hospitalized for asthma attacks and using particular time to teach the patients and their families how to improve the asthma control.

DECLARATION OF INTEREST

J. A. C.-R. and F. P. have received lecturing and consultancy fees from Merck Sharp & Dohme, GlaxoSmithKline and Grünenthal. The rest of the authors declared no conflict of interest.

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