

Risk factors associated with poor controlled pediatric asthma in a university hospital

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Summary

Background: Many studies in adults had identified factors associated with partly or uncontrolled asthma. In children, factors related to asthma control were not well defined.

Objective: To find the factors related to partly or uncontrolled asthma in children.

Methods: Asthmatic children who had severity at least in the mild persistent level, were recruited. The asthma control levels were classified as controlled, partly controlled and uncontrolled according to the GINA guideline. Risk factors were compared between the patients with controlled and partly controlled/ uncontrolled asthma groups.

Results: One hundred and ten patients (42.7% females) were included. The mean age was 10.3 ± 2.7 years old. There were 55 patients (50%) in the controlled, 54 patients (49.1%) in partly controlled and 1 patient (0.9%) in uncontrolled asthma group. For asthma severity, 97 patients (88.2%) were in mild persistent, 11 patients (10%) in moderate persistent and 2 patients (1.8%) in severe persistent groups. The risk factors for partly controlled/ uncontrolled asthma compared to controlled asthma were moderate/severe persistent asthma (adjusted OR 18.87 (95% CI 1.92 - 200.00)) and sinusitis ($p = 0.04$). Using the air conditioner decreased risk of partly controlled/ uncontrolled asthma (adjusted OR 0.30 (95% CI 0.10 - 0.91)). The proportion of patients who used medium dose inhaled corticosteroid (ICS) plus long-acting inhaled β_2 -agonist (LABA)

were significantly higher in partly controlled/ uncontrolled asthma than controlled asthma ($p = 0.004$).

Conclusion: Risk factors associated with partly controlled/ uncontrolled asthma were moderate/severe persistent asthma and sinusitis. Using air conditioner seemed to reduce risk of partly controlled/ uncontrolled asthma. (*Asian Pac J Allergy Immunol* 2013;31:253-7)

Key words: asthma, children, control, corticosteroid, GINA, risk factor, skin test

Introduction

Asthma is a common chronic disease in children and its prevalence is markedly increased worldwide.^{1,2} In 1990, the prevalence of pediatric asthma in Thailand was 4%³ and it increased to 11% and 15% in 1995 and 2001, respectively.⁴ The children with asthma had poor quality of life (QOL) due to frequent physician visit, lack of school attendance and impair routine activities.^{5,6} The asthma management is aimed to control asthma symptoms and reduce the risk of poor control which can improve the patients' QOL and save the cost of treatment.⁷

The Global Initiative for Asthma (GINA) guidelines 2008 suggested to classify asthma control into 3 levels i.e. controlled, partly controlled and uncontrolled according to daytime and nighttime symptoms, limitation of activity, need for reliever, exacerbation, forced expiratory volume at 1 second (FEV1) or peak expiratory flow (PEF).⁸ The asthma severity was classified into 4 categories (mild intermittent, mild, moderate and severe persistent asthma) based on daytime and nighttime symptoms, FEV1 or PEF and its variability. In a prospective study by Bateman et al, a controlled or partly controlled week predicted at least partly controlled asthma in the subsequent week. The better is the asthma control, the lower the risk of an uncontrolled asthmatic week.⁹ Thus, current asthma control predicts the future risk of exacerbation.

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A worldwide survey by Rabe et al. in 2004 reported that a significant proportion of asthmatic children and adults had lifestyle restrictions and symptoms necessitated emergency treatment. They found that 15% of the Japanese and 19% of the American asthmatic patients were in the severe persistent severity.¹⁰ The use of anti-inflammatory medication was low, ranging from 26% in Western Europe to 9% in Japan, even in patients with severe persistent asthma. In Europe, a study in asthmatic adults showed that only 15% of the inhaled corticosteroid (ICS) users had their asthma under control.¹¹

A number of studies in adults tried to identify the factor associated with partly or uncontrolled asthma. These factors were oral steroid usage, the presence of comorbidity, abnormal pulmonary function, higher asthma severity, continued exposure to triggers and lower educational status.^{12,14} In children, the factors which related to asthma control were not well studied. The objective of this study was to find the risk factors which related to partly or uncontrolled asthma in children.

Methods

Patients

This study was approved by the Institutional Review Board of the Siriraj Hospital. The medical records of asthmatic children follow up from January to December 2010, at the Pediatric Allergy Clinic, Siriraj Hospital, Mahidol University, Bangkok, Thailand were reviewed. Children aged 3-15 years with allergist-diagnosed asthma, who had severity at least in the mild persistent level, were recruited. The asthma control level of each patient was classified into controlled, partly controlled and uncontrolled according to the GINA guideline 2008. The patients who had other chronic illness such as primary immunodeficiency diseases, heart diseases, genetic diseases and other chronic pulmonary diseases were excluded.

The data collection included the general characteristics of patients such as age, sex, body weight, height, level of asthma controlled, family history of atopy, parental income and education, severity of asthma, comorbidity, adherence to the treatment, result of skin prick tests and pulmonary function test.

Statistical analysis

All calculations were performed with the SPSS package (version 16, SPSS Inc., Chicago, IL, USA). The demographic and clinical data of patients were

expressed using descriptive statistics (frequency, mean, median, SD and range). The univariate analysis was used to identify the possible risk factors that related to partly controlled and uncontrolled asthma. The multiple logistic regressions were used to identify the risk factors. The p value < 0.05 was considered statistically significant.

Results

One hundred and ten patients were included in this study. There were 47 females (42.7%). The mean age was 10.3 ± 2.7 years old (range 4.4 - 14.8 years old). According to the GINA guideline, there were 55 patients (50%) in the controlled, 54 patients (49.1%) in the partly controlled and 1 patient (0.9%) in the uncontrolled asthma groups. For statistical analysis, the partly controlled and the uncontrolled asthma were included into the same group due to the small number of uncontrolled asthmatic patient. For asthma severity, 97 patients (88.2%) were in mild persistent, 11 patients (10%) in moderate persistent and 2 patients (1.8%) in severe persistent groups. For statistical analysis, moderate and severe persistent asthma were gathered into the same group due to the small number of severe persistent asthma.

The mean age and sex were not different between the controlled and the partly controlled/uncontrolled groups. The risk factors for the partly controlled/uncontrolled asthma compared to the controlled asthma were shown in Table 1. These factors were moderate/severe persistent asthma (21.2% in the partly controlled/uncontrolled asthma and 1.8% in the controlled asthma, $p = 0.001$), sinusitis (7.3% in the partly controlled/uncontrolled asthma and 0% in the controlled asthma, $p = 0.04$), and maternal education below bachelor degree (78.9% in the partly controlled/uncontrolled asthma and 57.5% in the controlled asthma, $p = 0.04$). Other factors such as body mass index, FEV1, skin prick test positivity, allergic rhinitis, atopic dermatitis, regularity of follow up, medical adherence, environment factors, atopy in family and parental income were not significantly different between controlled asthma and partly controlled/uncontrolled asthma.

The 6 most common allergens sensitized in asthmatic patients were *D. pteronyssinus* (77.3%), *D. farina* (76.4%), American cockroach (51.8%), German cockroach (40.0%), cat (21.8%) and Bermuda grass (21.8%). There were no statistical difference of the type of allergen sensitization

Table 1. Risk factors and the levels of control of asthmatic children

Risk factors	Controlled asthma (%)	Partly controlled and uncontrolled asthma (%)	p value
Age, mean ± SD year, (range)	10.7 ± 2.8 (4.4-14.8)	10.0 ± 2.7 (4.4-14.8)	0.75
Sex: female (%)	22 (40.0%)	25 (45.5%)	0.33
Body mass index: ≥25 kg/m ²	16/55 (29.1%)	19/55 (34.5%)	0.54
Asthma severity:			
Moderate/ severe persistent	1/55 (1.8%)	12/55 (21.2%)	0.001
FEV1: < 80%	13/48 (27.1%)	16/47 (34.0%)	0.46
Skin prick test: positive	49/55 (89.1%)	50/55 (90.9%)	0.75
Comorbidity			
Allergic rhinitis	53/55 (96.4%)	54/55 (98.2%)	0.56
Atopic dermatitis	2/55 (3.6%)	4/55 (7.3%)	0.40
Sinusitis	0/55 (0%)	4/55 (7.3%)	0.04
Follow up: irregular	9/55 (16.4%)	4/55 (7.3%)	0.14
Medical adherence			
Never forgot	25 (45.4%)	21 (38.2%)	0.77
Forgot every week	9 (16.4%)	13 (23.6%)	
Forgot 2-3 times/month	13 (23.6%)	13 (23.6%)	
Forgot 2-3 times/3month:	3 (5.5%)	5 (9.1%)	
Forgot 2-3 times/6month:	3 (5.5%)	1 (1.8%)	
Forgot 2-3 times/year	2 (3.6%)	2 (3.6%)	
Environmental factors			
House surrounded by industry, smog or dust	17/55 (30.9%)	12/55 (21.8%)	0.28
House surrounded by flower, pollen	31/55 (56.4%)	25/55 (45.5%)	0.25
Air conditioner usage	17/55 (30.9%)	11/55 (20%)	0.19
Smoking in family	17/55 (30.9%)	21/55 (38.2%)	0.42
Carpet in the house	1/55 (1.8%)	4/55 (7.3%)	0.17
Pets in the house	14/55 (25.5%)	21/55 (38.2%)	0.15
Environmental control: done	28/55 (50.9%)	21/55 (38.2%)	0.18
Atopy in the family			
Paternal	15/53 (28.3%)	15/54 (27.8%)	0.95
Maternal	15/54 (27.8%)	21/53 (39.6%)	0.19
Siblings	15/54 (27.8%)	19/54 (35.2%)	0.41
Parental education below bachelor degree			
Paternal	25/39 (64.1%)	30/39 (76.9%)	0.21
Maternal	23/40 (57.5%)	30/38 (78.9%)	0.04
Parental income <20,000 baht/month			
Paternal	29/35 (82.9%)	30/35 (85.7%)	0.74
Maternal	33/39 (84.6%)	34/35 (97.1%)	0.11

between the controlled asthma and the partly controlled/ uncontrolled asthma.

The factors in Table 1 which have a p value less than 0.20 were further analyzed by multiple logistic regressions except sinusitis since no patient in the controlled asthma group had sinusitis. The p value, adjusted odds ratio (OR), and 95% confidence interval (CI) are shown in Table 2. From Table 2, the risk factors for the partly controlled/ uncontrolled asthma was moderate/ severe persistent asthma (compared with mild persistent asthma, $p = 0.012$,

Table 2. Multiple logistic regression analysis of risk factors for the partly controlled and the uncontrolled asthma groups.

Risk factors	b	p value	Adjusted OR (95% CI)
Severity: moderate/ severe persistent	2.934	0.01	18.87 (1.92, 200.00)
Sensitization			
Cat	-0.782	0.16	2.18 (0.73, 6.49)
Bermuda grass	-0.079	0.89	1.08 (0.35, 3.35)
Follow up: Irregular	1.068	0.13	2.91 (0.73, 11.59)
Environmental factors			
Air conditioner usage	-1.194	0.03	0.30 (0.10, 0.91)
Carpet in the house	1.793	0.15	6.00 (0.51, 70.17)
Pets in the house	0.694	0.18	2.00 (0.72, 5.54)
Environmental control: not done	-0.42	0.36	1.52 (0.62, 3.76)
Maternal history of atopy	0.267	0.57	1.31 (0.53, 3.24)
Maternal education below bachelor degree	0.694	0.27	2.00 (0.59, 6.80)
Maternal income <20,000 baht/month	1.069	0.41	2.91 (0.23, 37.57)

adjusted OR 18.87 (95% CI 1.92 - 200.00). Using the air conditioner decreased risk of the partly controlled/ uncontrolled asthma ($p = 0.033$, adjusted OR 0.30 (95% CI 0.10 - 0.91)). Other factors such as sensitization to cat and Bermuda grass, regularity of follow up, using carpet, having pets in the house, environmental control, maternal history of atopy, maternal education and maternal income were not significant risk factors for the partly controlled/ uncontrolled asthma.

The controller usage and the levels of asthma control are shown in Table 3. The proportion of patients who did not use controllers were significantly higher in the controlled asthma than in the partly controlled/ uncontrolled asthma ($p = 0.003$). The proportion of patients who used medium dose ICS plus long-acting inhaled β_2 -agonist (LABA) were significantly higher in the partly controlled/ uncontrolled asthma than the controlled asthma ($p = 0.004$). The usage of ICS, low dose ICS plus LABA, and high dose ICS plus LABA were not significantly different between the partly controlled/ uncontrolled asthma and the controlled asthma. For immunotherapy, a higher number of patients in the partly controlled/ uncontrolled asthma groups (6 patients, 10.9%) received immunotherapy than patients in the controlled asthma group (1 patient, 1.8%), $p = 0.05$.

Discussion

The current trend of asthma management is to aim at asthma control. In a recent survey by Gold et al. patients with partly and uncontrolled asthma

Table 3. Controller usage and the levels of control of asthmatic children

Controllers	Controlled asthma (%)	Partly controlled and uncontrolled asthma (%)	p value
Not use	10 (18.2)	0 (0)	0.003
ICS	37 (67.3)	30 (54.5)	0.17
LABA + low dose ICS	7 (12.7)	14 (25.5)	0.09
LABA + medium dose ICS	1 (1.8)	10 (18.2)	0.004
LABA + high dose ICS	0 (0)	1 (1.8)	0.32

ICS, inhaled corticosteroid; LABA, long-acting inhaled β 2-agonist

were more likely to visiting physicians or the emergency department, or being hospitalized for asthma compared to patients with well controlled asthma.¹⁵

Most studies on the risk factors associated with asthma control were done in adult asthmatic patients. In a study by Desalu et al. factors associated with uncontrolled asthma were asthma severity, an abnormal pulmonary function test, the presence of comorbidity and the lack of adherence to ICS.¹² Peters et al. identified female sex, low education and household income and comorbidity such as sinusitis, as predictive factors of uncontrolled asthma.¹³ In Italy, Terzano et al. reported that the lack of asthma control was associated with sinusitis, continued exposure to irritants/ triggers and poor adherence to therapy.¹⁴ In Brazil, Dalcin et al. reported that factors associated with uncontrolled asthma were asthma severity (OR = 5.33) while the use of ICS decreased the risk (OR = 0.17).¹⁶

In children, Gold et al. conducted a survey of 2,500 patients with asthma who were 12 years or older and found that lower income and educational status of the parents were less likely to have had well-controlled asthma.¹⁵ In a cross sectional study in Iran, 400 asthmatic patients, age ranged between 2-14 years old, were studied on the basis of disease severity. Factors associated with asthma exacerbations were found to be sinusitis and poor adherence to therapy.¹⁷

Our report was a case-controlled study which identified factors associated with partly controlled/ uncontrolled asthma in children. In multivariate analysis, moderate/ severe persistent asthmatic children had a higher risk to have partly controlled/ uncontrolled asthma compared with mild persistent asthmatic children (adjusted OR 18.87). This is relevant to the studies of Desalu et al.¹² and Dalcin

et al.¹⁶ We found that sinusitis was highly prevalent in the partly controlled/ uncontrolled asthma group which was supported by many studies.^{13,14,17,18}

Some reports has identified that low educational status is a risk factor for uncontrolled asthma.^{13,15} Our study found a significant higher prevalence of maternal education below bachelor degree in the partly controlled/ uncontrolled asthma (Table 1). However, multivariate analysis did not confirm this finding.

Another interesting finding from this study was that the air conditioner decreased the risk of the partly controlled/ uncontrolled asthma (adjusted OR 0.30). This result may be explained by the filter in the air conditioner could filter pollens and mold as well as particulate matter which could trigger asthmatic symptoms.^{19,20}

Our study showed that the controlled asthma patients used less controller and immunotherapy compared to the partly controlled/ uncontrolled asthma patients. This was supported by the study of Koga et al who found that asthmatic patients with multiple exacerbations were more likely to use higher doses of ICS.²¹ Siroux et al. found that a higher number of uncontrolled asthma patients used ICS compared to controlled asthma patients.²² Our finding can be explained by the fact that the controlled asthmatic patients had less severity of asthma when compared to partly controlled/ uncontrolled asthmatic patients and therefore needed less controller medications.

In conclusion, moderate/ severe persistent asthma and sinusitis were the risk factors associated with partly controlled/ uncontrolled asthma. The use of air conditioner was a protective factor. Patients with partly controlled/ uncontrolled asthma used more controllers including LABA and medium dose ICS than patients with controlled asthma.

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Conflict of interest

This study was supported by a Siriraj Grant for research (R2R project). All authors report no conflicts of interest and we are responsible for the content and writing this manuscript.

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