

ASTHMA CONTROL

Determinants of asthma control among children in Saudi Arabia

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Abstract

Objective: Asthma is the most common chronic disease among children. Uncontrolled asthma may considerably decrease the quality of life for patients and their families. Our objective was to identify possible risk factors for poor asthma control in children. **Methods:** A cross-sectional study was conducted among children with asthma aged 4–11 years who attended a pediatric clinic for follow-up visits at one of the major teaching hospitals in Riyadh, Saudi Arabia. Asthma control status was measured by the childhood asthma control test. Multiple logistic regression analysis was performed to explore the relationships between the outcome and exposure variables. **Results:** Uncontrolled asthma was present in 89 out of 158 children (59.3%). Asthma control improved with the number of siblings. Control improved by 69% with two or three siblings (OR = 0.31, 95% CI = 0.10–0.96) and by 87% with four or more siblings (OR = 0.13, 95% CI = 0.04–0.48). Similarly, asthma control improved with an increased asthma knowledge of the caregiver (OR = 0.87, 95% CI = 0.81–0.93). Household incomes less than SAR 15 000 and sharing a bedroom increased the odds of having uncontrolled asthma by 2.30 (95% CI = 1.02–5.21) and 3.33 (95% CI = 1.33–8.35), respectively. **Conclusions:** In addition to knowledge, socioeconomic factors, such as family income, household crowding, and the number of siblings are associated with asthma control among children in Saudi Arabia. Further research is needed to investigate the role of these factors.

Keywords

Bedroom, crowding, income, knowledge, Saudi Arabia, sharing, sibling

History

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Introduction

Asthma continues to be an important public health problem, affecting about 235 million people worldwide. Asthma is the most common chronic pediatric disease. Symptoms can occur several times a day if the disease is not controlled. Uncontrolled symptoms considerably decrease the quality of life for patients and family members because of reduced activity levels, daytime fatigue, sleeplessness, and absences from school or work [1–3]. Asthma control is considered to be the primary goal of treatment [4]. However, even in the developed countries, 40–70% of patients achieve inadequate control of their asthmatic symptoms [5,6].

Various factors influence asthma control. These factors include adherence to treatment, appropriate use of an inhaler, psychosocial factors, socio-demographic characteristics, exposure to infections (predominantly viral), tobacco smoke, indoor and outdoor allergens, and pollutants. Appropriate disease management and avoidance of these common risk

factors can substantially improve asthma control and decrease the need for medications [4,7].

The most recent study conducted in 2009–2010 found that the prevalence of physician diagnosed asthma was 19.6% among adolescents in Riyadh [8]. Another study found the prevalence of asthma among 12-year-old children in Jeddah and surrounding villages to be 17.7% and 4.9%, respectively [9]. A study among boys in preparatory and elementary schools in Al-Khobar City showed that 8.1% of children had a physician diagnosed asthma [10].

There are no studies exploring asthma control among children in Saudi Arabia. A recent study among Saudi adults has revealed that 64% of patients have uncontrolled asthma [11]. Thus, the main objectives of our study were to determine the level and risk factors for asthma control in children who attended the pediatric primary care clinic of one of the major public hospitals in Riyadh.

Methods**Study design**

A cross-sectional study was conducted in the pediatric primary care clinic of the King Khalid University Hospital in Riyadh, Saudi Arabia, between the 20 February 2013 and

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20 March 2013 every day except weekends from 8:00 am to 3:00 pm.

Target population

Our study included children with asthma aged 4–11 years old who had been diagnosed by a physician at least 6 months before joining the study to have appropriate time for determining whether children's asthma was controlled or not. We recruited a consecutive series of patients who attended the pediatric clinic for routinely scheduled follow-up visits if respiratory diseases other than asthma were absent.

Caregivers for the patients were approached by nurses in the waiting area before their scheduled appointment. Each caregiver received a written consent form. Oral consent was obtained from each child. Participants were aware that involvement was voluntary and that they could refuse to participate. Further, they understood that they could withdraw from the study at any point in time. The Institutional Review Board (IRB) of the College of Medicine of King Saud University approved this study.

Variables

The outcome of this study was asthma control status during the past 4 weeks, which was measured by the childhood asthma control test (cACT). Patients were classified as having either uncontrolled asthma (cACT ≤ 19) or controlled asthma (cACT > 19) [12]. We assessed putative risk factors for asthma control presented in Table 1, which were selected based on the literature search [1,4,13–16] and team discussions that determined questions more appropriate in the context of Saudi Arabia.

Instruments

In order to measure the outcome variable, investigators used an Arabic version of a valid and reliable childhood asthma control test designed for children aged 4–11 years old. The specificity and sensitivity of the questionnaire are 74% and 68%, respectively [12]. The knowledge of primary caregivers regarding asthma was assessed by another validated questionnaire, asthma knowledge questionnaire for use with parents or guardians of children with asthma (Figure 1) [17], which was translated into Arabic. The Arabic versions of cACT and asthma knowledge questionnaire have not been validated, although a linguistic validation of the cACT was conducted by MAPI research institute (MAPI Institute, Lyon, France). The asthma knowledge questionnaire was translated into Arabic and back to English by two different translators, in order to increase the accuracy of the translation. Also, it was reviewed by a clinician and piloted among caregivers before the study.

Statistical methods

Data were entered and analyzed with IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY) [18]. Distributions and patterns of asthma control in children and covariates of interest were examined by descriptive statistics, scatter plots, and loess curves. Pearson's Chi-square or linear-by-linear association tests were used to evaluate

Table 1. Patient characteristics.

Child's gender, <i>n</i> (%)	
Boy	90 (57%)
Girl	68 (43%)
Child's age, median (IQR)	7 (6–9)
Mother's age, mean (SD)	35.2 (5.6)
Marital status, <i>n</i> (%)	
Married	149 (94%)
Divorced	9 (6%)
Number of siblings, <i>n</i> (%)	
0	8 (5%)
1	25 (16%)
2	41 (26%)
3	41 (26%)
4	24 (15%)
5 and more	19 (12%)
Mother's education, <i>n</i> (%)	
Less than higher	55 (35%)
Higher	103 (65%)
Mother's employment status, <i>n</i> (%)	
Unemployed	67 (42%)
Employed	91 (58%)
Household income, <i>n</i> (%)	
Less than 15 000 SAR	88 (56%)
15 000 SAR or more	70 (44%)
Sharing bedroom, <i>n</i> (%)	
Not sharing	66 (42%)
Sharing	92 (58%)
Smoking (any family member), <i>n</i> (%)	
None	94 (60%)
Any	64 (41%)
Number of family members with asthma, median (IQR)	1 (0–2)
Type of house	
Apartment	70 (44%)
Villa	88 (56%)
Asthma control knowledge, mean (SD)	53.4 (6.5)

associations between categorical variables. Simple logistic regression was used to explore associations between the outcome (asthma control status) and all exposure variables, as presented in Table 1. Variables having a bivariate test with a statistical *p* value less than or near to 0.05 were put into a multiple logistic regression model, which included child's gender, mother's age, number of siblings, mother's education and mother's employment status, household income, sharing bedroom, smoking (any family member), type of house, and asthma control knowledge of caregivers. Only statistically significant variables (*p* < 0.05) were maintained in the final model, which included the number of siblings, sharing bedroom, household income, asthma control knowledge score of caregivers, and smoking status of any family member. The goodness of fit of the logistic regression model was assessed using Hosmer–Lemeshow test. All the covariates were checked for co-linearity and interaction.

Results

One hundred and eighty-nine patients were approached in the waiting area. However, 31 were not included in the analysis, because the accompanying person was not the primary caregiver responsible for managing the child's asthma. All the patients and caregivers completed the interview. No one refused to participate in the study. Table 1 summarizes the

1. Inhaler use can lead to dependence or addiction.
2. Inhalers can affect the heart or damage it.
3. It's not good for children to use the inhaler for too long.
4. After a child's asthma attack, once the coughing is over, use of the inhaler and medications should stop.
5. Children with asthma should use asthma medications only when they have symptoms (coughing, congestion, or wheezing).
6. It's better to use inhalers directly, without a holding chamber, so the medication can go more directly to the lungs.
7. The main cause of asthma is airway inflammation.
8. Parents should ask a doctor to tell the school that an asthmatic child shouldn't exercise or participate in physical education classes.
9. Children who have asthma shouldn't participate in sports that make them run too much.
10. When a child has an asthma attack it's best to go to the emergency room even if symptoms are mild.
11. Asthma attacks can be prevented if medications are taken even when there are no symptoms—between attacks.
12. Flu infections are the main causes or triggers of asthma attacks.
13. It's best not to smoke or let anyone else smoke near a child who has asthma.
14. If the parents of a child with asthma smoke outside the house, it won't affect the child.
15. If an asthmatic child gets the flu, you should apply the inhalers even if there's no coughing or wheezing.
16. Asthmatic children might have attacks that are severe enough to require hospitalization in an intensive care unit or they might even die from an attack.
17. Some medications for asthma don't work unless they're administered every day.

Figure 1. Asthma knowledge questions used for caregivers of children with asthma.

socio-demographic and clinical characteristics of the study population. Eighty-nine out of 158 children (59.3%) had uncontrolled asthma. Girls were 1.83-times more likely to have uncontrolled asthma (OR = 1.83, 95% CI = 0.96–3.5). The odds of having uncontrolled asthma were increased by 4.27 (95% CI = 2.18–8.34), 3.53 (95% CI = 1.80–6.94), and 2.67 (95% CI = 1.39–5.13) for patients with household incomes less than SAR 15 000, apartment homes rather than villas, and shared sleeping arrangements with other family members, respectively. The odds of having uncontrolled asthma decreased by 12% (OR = 0.88, 95% CI = 0.80–0.97) with each year of increase in the mother's age. In contrast, the mother's unemployment status (OR = 1.96, 95% CI = 1.02–3.75) and lack of a higher education (OR = 3.85, 95% CI = 1.85–8.01) had a significantly negative impact on asthma control. The odds of having uncontrolled asthma were 59% less in children with two or three siblings (OR = 0.41, 95% CI = 0.17–1.01) and 77% less in children with four or more siblings (OR = 0.23, 95% CI = 0.09–0.63) compared to those with no more than one sibling. Similarly, asthma control improved by 12% with each point increase in the asthma knowledge score of the main caregiver (OR = 0.88, 95% CI = 0.83–0.93).

Table 2. Factors associated with asthma control (multivariate analysis).

Factor	Adjusted odds ratio (95% CI) ^a	p Value
Number of siblings		
0–1	Reference	
2–3	0.31 (0.10–0.96)	0.042
4 and more	0.13 (0.04–0.48)	0.002
Sharing bedroom		
No	Reference	
Yes	3.33 (1.33–8.35)	0.010
Household income		
Less than 15 000 SAR	Reference	
15 000 SAR or more	0.44 (0.19–0.99)	0.046
Knowledge score	0.87 (0.81–0.93)	<0.001

^aControlled for the smoking status of family members.

Multivariate analysis showed that the number of siblings, sharing a bedroom with other family members, average monthly household income, and the asthma knowledge score of the main caregiver were independently associated with asthma control in children (Table 2).

Discussion

Key results

We found 59.3% prevalence of uncontrolled asthma in our cross-sectional study of children aged 4–11 who had been diagnosed with asthma more than 6 months earlier. Some risk factors, such as the level of asthma knowledge possessed by the main caregiver, who were mainly mothers (97.5%), sharing a bedroom (58.2%), and average monthly household income were in line with our hypotheses. The distinctive characteristics of Saudi society provided an opportunity to assess the protective effects of siblings on asthma control in children.

Interpretation

Although we consider 59.3% prevalence of uncontrolled asthma to be high, we found variable results ranging from 31% in Hungary to 90% in New Zealand [19]. A study of Romanian children with asthma revealed that 75.4% of patients had uncontrolled asthma [20]. A Canadian survey identified poorly controlled asthma in 48% of children [19]. Although methods of assessment differed between surveys, these studies provide some insight into the overall situation of asthma control in children.

We observed better asthma control in children whose caregivers had a higher level of asthma knowledge (OR = 0.87, 95% CI = 0.81–0.93). Knowledge is an enabling factor for asthma management [21,22]. Adherence to long-term medication is more likely if patients (caregivers) have a solid understanding of the disease [23]. In addition, increased knowledge enables caregivers to reduce contact with asthma triggers, resulting in more effective disease management. Previous studies have similarly shown that the level of asthma knowledge possessed by the main caregiver was associated with good asthma control [24–28].

In this study, household income (SAR >15 000) was significantly associated with asthma control in children (OR = 0.44, 95% CI = 0.19–0.99). The cut-off point for

income was determined based on a natural breakpoint using bivariate analysis of income and asthma control status. Other studies as well [16,29,30] have reported that low household income was a significant risk factor for a severity of asthma in children. Several factors associated with lower income levels can negatively influence asthma control, such as reduced access to high-quality health care, poor housing conditions, a polluted environment, and exposure to chemicals, including pesticides [7,31].

According to the resource dilution theory [32], we anticipate that an increased number of siblings should diminish health outcomes in children with asthma. However, we observed an opposite effect in our study. There was a 69% protective effect with two or three siblings (OR = 0.31, 95% CI = 0.10–0.96) and 87% protective effect with four or more siblings (OR = 0.13, 95% CI = 0.04–0.48). Unlike many western societies, the number of children in Saudi households increases with higher socioeconomic status [33]. In a bivariate analysis, we have found that the proportion of families with high income (SAR 15 000 and more) was increasing (30.3% versus 45.1% versus 53.5%, $p = 0.048$) with more siblings (0–1 versus 2–3 versus 4 and more). Similarly, mothers were more likely to have higher education (39.4% versus 73.2% versus 69.8%, $p = 0.012$) and be employed (27.3% versus 68.3% versus 60.5%, $p = 0.009$). The positive relationship between socioeconomic status and asthma control in children has been reported in many studies. Different factors related to socioeconomic status, such as income adequacy level [34], education [35], access to health care [36], indoor and outdoor pollution [37,38], psychological stress [39], have been shown to play a substantial role in the clinical course of the disease.

Our study demonstrated that sharing a bedroom decreased asthma control by 3-fold (OR = 3.33, 95% CI = 1.33–8.35). This was an independent association between sharing a bedroom and the level of asthma control, after controlling for household income and number of siblings, along with other covariates (Table 2). Sharing a bedroom is a measure of crowding [40], which has been reported to decrease asthma control [41]. The seemingly contradictory effects of increased number of siblings and sharing a bedroom can be partially explained by our data, which showed that in the low income group (less than SAR 15 000), there was a strong positive relationship between the number of siblings (0–1 versus 2–3 versus 4 and more) and the prevalence of sharing a bedroom (34.8% versus 84.4% versus 95%, $p < 0.001$), whereas in the high-income group (SAR 15 000 or more) there was only a marginally significant association (20.0% versus 35.1% versus 52.2%, $p = 0.066$). Other crowding measures, such as unit square footage-per-person or persons-per-room, should be explored [40].

Limitations

Since the last three questions of the cACT should have been completed by a caregiver, and one of the potential risk factors was the knowledge of caregivers regarding asthma, a minority of children (16.4%), who was accompanied by non-caregivers, was excluded from further analysis. This factor could potentially influence our results, although no statistically

significant difference ($p = 0.878$) in asthma control was found between groups. Previous studies have shown that caregivers with lower level of asthma knowledge tend to underreport asthma symptoms [42], which can potentially underestimate the association between asthma knowledge of the caregiver and asthma control found in our study. Arabic versions of the cACT and asthma knowledge questionnaire have not been validated, although appropriate measures were taken in order to increase the accuracy of the translation.

Conclusions/key findings

Our findings suggest that in addition to knowledge socioeconomic factors, such as family income, household crowding and the number of siblings are associated with asthma control among children in Saudi Arabia. Further research is needed to investigate the role of these factors.

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Declaration of interest

The authors have no financial, consulting, and personal relationships or conflicts of interest relevant to this article to disclose.

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