Antibiotic Use and Symptoms of Asthma, Allergic Rhinitis and Eczema in Children

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Abstract

**Objective:** Allergic diseases are frequent in children and their prevalence and severity differ in different regions of the world. It has been hypothesized that antibiotic use, early in life, may increase the subsequent risk of asthma and other allergic disorders. The aim of this study was to investigate the association between the use of antibiotics in the first year of life and the subsequent development of asthma and other allergic symptoms.

**Methods:** In our survey using standardized methods (International Study of Asthma and Allergies in Childhood), parents of 6-7 year-old children were questioned regarding asthma, allergic rhinitis and eczema symptoms in their children.

**Findings:** The prevalence of ever wheezing, wheezing during past 12 months and exercise-induced asthma in the children who took antibiotics in the first year of life were not different statistically but the prevalence of asthma ever was significantly higher. No significant relationship was found between the use of antibiotics and hay fever or eczema.

**Conclusion:** We found that the use of antibiotics in early childhood was not associated with an increased risk of developing allergic symptoms in children.

**Key Words:** Allergy; Antibiotics; Asthma; Rhinitis; Eczema; ISAAC

Introduction

Antibiotics are commonly used to treat infections during early childhood. Over the past four decades, there has been a significant increase in allergy and asthma in some countries, which correlates with widespread use of antibiotics [1]. The sales of systemic anti-
Infective agents in general, particularly antibacterials and tuberculostatics, were greater in Iran than in three European countries. Broad-spectrum antibacterial agents accounted for a larger proportion of total sales in Iran [2].

The increase in pediatric allergy and asthma parallels the increase in the use of antibiotics. There is also some evidence that antibiotic and/or paracetamol use may increase the risk of asthma. Antibiotics disturb the flora of the gastrointestinal tract, possibly perturbing the developing immune system [3]. Many lifestyle and medical care characteristics, including the use of antibiotics, have changed the patterns of infectious diseases and bacterial exposure in infancy in the past three decades. Antibiotic use, in addition to affecting the natural history of infection, is well-known to alter gut flora [3]. In industrialized countries, the prevalence of asthma has increased significantly over the last 30 years and is a major public health concern. Although the reasons for asthma epidemic are not clearly understood, one hypothesis is that it is related to the exposure of infants to antibiotics. This is consistent with the "hygiene hypothesis," which suggests that growing up in a more hygienic environment with less microbial exposure may increase atopic (T-helper type 2) immune responses, thus causing the development of asthma.

We studied the relationship between the use of oral antibiotics in the first year of life and asthma, allergic rhinitis, and eczema symptoms at the age 6-7 years in children.

**Subjects and Methods**

The study was fulfilled by analytic cross-sectional method in 6-7 year-old Yazdi students. Cluster sampling was applied and each school was used as a cluster. Sample size calculated by \( P=4\% \) (prevalence of asthma), \( \alpha = 0.05 \) and \( d=0.01 \) came to 1476 and regarding coefficient clustering and missing data, required sample size was set to 3000.

The questionnaire was designed based on the questions from the International Study of Asthma and Allergies in Childhood (ISAAC); then the validity and reliability of the translated questionnaire were tested. Questionnaires were completed by parents who had children aged 6-7 years. The key asthma questions used were those on 'wheeze ever', 'wheeze in the last 12 months', and 'asthma ever'. The key rhinitis questions used were those on 'nose problems ever (sneezing or runny/blocked nose)', 'nose problems in the past 12 months', and 'nose problems with itchy-watery eyes in the past 12 months'. The key eczema questions used were those on 'eczema ever', 'itchy rash ever' (coming and going for \( \geq 6 \) months), and 'rash in the last 12 months'. The data was first analyzed by Epi6 software and after being controlled, it was translated into SPSS 11.5 software. The results were then analyzed by using Chi-Square, Fisher-Exact, and ANOVA tests.

**Findings**

There was no significant relationship between early antibiotic use and ever wheezing (OR: 1.13, 95% CI: 0.77–1.67), wheezing during past 12 months (OR: 0.89, 95% CI: 0.41–1.95) and exercise-induced asthma (OR: 1.42, 95% CI: 0.82–2.47) but was associated with asthma ever (OR: 2.21, 95% CI: 1.05–4.8). No significant relationship was found between the use of antibiotics with hay fever and eczema symptoms (table 1). Antibiotic use during the first year of life was not significantly associated with 'ever hay fever' (OR: 1.22, 95% CI: 0.87–1.72) and eczema (OR: 1.3, 95% CI: 0.79–2.13) symptoms.

**Discussion**

In our previous study in Yazd city (central Iran) the prevalence of asthma, allergic
<table>
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<tr>
<th>Condition</th>
<th>N (%)</th>
<th>Value 95% CI</th>
<th>OR (%)</th>
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<tr>
<td>Severe sleep disturbance because of itchy rash during the past 12 months</td>
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<td>Itchy rash during the past 12 months</td>
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<td>Ever itchy rash</td>
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<td>Daily activity disturbance because of sneezing/runny or blocked nose</td>
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<td>Sneezing/runny blocked nose in the past 12 months</td>
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<tr>
<td>Ever sneezing/runny blocked nose</td>
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<td>Dry mouth coughs in the past 12 months</td>
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<td>Wheezing during/after exercise in the past 12 months</td>
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<td>Positive history of asthma</td>
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<td>Speck limitation due to severe wheezing in the past 12 months</td>
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<td>One or more nights per week distressed sleep due to wheezing</td>
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<td>More than 3 attacks of wheezing in the past 12 months</td>
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<tr>
<td>Wheezing in the past 12 months</td>
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<tr>
<td>Ever wheezing</td>
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**Table 1:** Antibiotic use during the first year of life and the symptoms of asthma, rhinitis and eczema in 6-7-year-old children.
rhinitis and eczema symptoms in children aged 6-7 years was 10.9%, 15.5% and 7.3% respectively[6]. Also we showed the association of asthma with acetaminophen usage in the first year of life and indicated that using some drugs in infancy may be an important risk factor for the subsequent development of atopy and asthma[5].

Research on antibiotic exposure early in life and subsequent risk of asthma and other allergic symptoms has yielded conflicting results. Many studies show that early antibiotic use is associated with the subsequent development of wheezing and other allergic symptoms[3,6,7,8]. Wjst and colleagues examined a possible association of asthma epidemic and antibiotic use in a population-based study of 2,512 children aged 5-14 years in East Germany. They found that wheezing was associated with an increasing number of antibiotic courses (never versus one time OR 1.9, P= 0.012, 2 to 5 times OR 3.0, P<0.001 and more than 5 times OR 6.9, P<0.001) which was also seen for asthma diagnosis. The risk increased with earlier administration (never versus second year OR 4.6, month 7-12 OR 5.4 and birth until month 6 OR 7.9, all P<0.001)[9].

Kozyrskyj and colleagues found that independent from well-known asthma risk factors, asthma was significantly more likely to develop in children who had received antibiotics in the first year of life at age 7 years[10]. The association with asthma was observed for antibiotic use in non-respiratory tract infections (adjusted OR 1.86; 95% CI 1.02 to 3.37). The risk of asthma was highest in children receiving more than four courses of antibiotics (adjusted OR, 1.46; 95% CI, 1.14 to 1.88), especially among rural children, and in the absence of maternal asthma or a dog in the birth year. Broad-spectrum (BS) cephalosporin use was more common in these subpopulations of children[10].

Administration of broad-spectrum antibiotics, frequent practice in pediatric offices, impairs intestinal bacterial colonization during infancy[11]. Noverr et al showed that antibiotic treatment in mice combined with fungal colonization led to increased sensitization to an airway antigen and to pulmonary allergic responses[11]. In humans, the immune response of newborns is associated predominantly with the helper T cell type 2 (Th2) cytokine phenotype, whereas rapid suppression of Th2 immune responses during the first year of life occurs in nonatopic children. Atopic individuals exhibit a continuation of fetal allergen-specific Th2 responses during infancy[12]. Because antibiotic use in infant mice leads to alterations of the intestinal flora and impaired Th1 immune responses, it has been hypothesized that the previously observed association between antibiotic use in early life and asthma in humans is due to antibiotic-induced changes in intestinal flora leading to a Th2-polarized immune deviation[13]. Nutten and colleagues found that antibiotic administration early in life negatively affects the specific immune response to a luminal antigen when it is first introduced during antibiotic administration. The increased mast cell numbers and mediator concentrations in the intestinal mucosa of the antibiotic-treated animals may testify the early stages of an altered immune system homeostasis[14]. On the other hand, many studies found no significant association between antibiotic use in the first year of life and the subsequent risk of asthma, recurrent wheezing, allergic rhinitis, or eczema[15,16].

A US birth cohort study of high-risk children in the Boston area did not implicate antibiotic use in the first year of life as a risk factor for the outcomes of asthma and atopy at the age 5 years, as reported by parents[15]. Folaki and colleagues have conducted an ecologic analysis of the relationship between antibiotics sale and the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema in 99 centers from 28 countries. The result of this study showed a positive association between per capita antibiotics sale and the prevalence of symptoms for asthma, rhinitis, and eczema, but the associations generally became negative once the analyses had been adjusted for Gross National Product (GNP). Their findings are generally not consistent with the hypothesis that antibiotic use
increases the risk of asthma, rhinitis, or eczema\textsuperscript{[17]}. Taken together, we found significant association between treatment with oral antibiotics in the first year of life and subsequent ever asthma (OR: 2.21, 95% CI: 1.05–4.80) but not with ever wheezing, wheezing during past 12 months and exercise-induced asthma at the age 6-7 years. Our study could be influenced by recall bias, as parents of children with asthma may be more likely to report an exposure to antibiotics in infancy. Because of the limitations of our study, additional prospective studies are needed to investigate the association between antibiotic use in early life and allergic symptoms in childhood.

**Conclusion**

Although there are sufficient reasons to avoid unnecessary use of antibiotics, particularly broad-spectrum agents, the results of our study do not support the association between antibiotic use in early life and allergic symptoms in childhood.

**Acknowledgment**

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**References**


