

Dose-Response Association between Smoking and Atopic Eczema: Results from a Large Cross-Sectional Study in Adolescents

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Key Words

Adolescents · Smoking · Environmental tobacco smoke · Atopic eczema · Allergic rhinitis · Asthma severity

Abstract

Background: Tobacco smoking and exposure to environmental tobacco smoke (ETS) are known risk factors for asthma, but their association with atopic eczema is unclear. **Objective:** To investigate the association of smoking and exposure to ETS with prevalence of atopic eczema in a national sample of 13- to 14-year-olds in Israel. **Methods:** Cross-sectional study within the framework of the International Study on Asthma and Allergies in Childhood. **Results:** Complete data were available for 10,298 schoolchildren. Atopic eczema as well as asthma and allergic rhinitis were significantly more prevalent in smokers than nonsmokers. Multiple regression analysis revealed a dose-response association between smoking and atopic eczema compared to not smoking: occasional smokers, odds ratio (OR) = 1.6 (95% confidence interval (CI) = 1.2–2.3); daily smokers, OR = 2.2 (95% CI = 1.4–3.6). Exposure to ETS at home was significantly associated with asthma (OR = 1.25; 95% CI = 1.1–1.5) but not atopic eczema. **Conclusions:** The dose-response association between active smoking and atopic eczema in adolescents is a novel observation which deserves further consideration.

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Introduction

Two of the most frequent chronic conditions of childhood and adolescence are atopic eczema, synonymously termed atopic dermatitis, an inflammatory disease of the skin, and asthma, an inflammatory disease of the airways. Smoking is a well-established risk factor for asthma in adolescents [1, 2], and in asthmatic children, there is strong evidence that exposure to environmental tobacco smoke (ETS) worsens asthma control and adversely affects asthma severity [3, 4]. In one study, children with asthma exposed to high levels of parental tobacco smoke were 2.7 times more likely to have moderate to severe asthma and decreased lung functions than children exposed to low levels [5]. However, data on the potential association of personal smoking and exposure to ETS with the prevalence of atopic eczema and allergic rhinitis are limited and inconsistent in adolescents [6, 7] and children [8, 9] worldwide. One study from the USA reported that parental smoking increased the risk for atopic eczema in 4-year-old children [10] whereas another from New Zealand in the same age group noted no such relationship [11]. Regarding personal smoking, adult smokers from Norway reported having psoriasis, but not atopic dermatitis, more often than nonsmokers [12]. By contrast, a recent study from Taiwan found that early or current exposure to cigarette smoking may cumulatively

contribute to the development of adult-onset atopic dermatitis, and that exposure to ETS in childhood is associated with the development of adult-onset atopic eczema [13]. The considerable discrepancies among these studies may be attributable to differences in methodologies and number of patients included.

The aim of the present study was to investigate the associations between active smoking and exposure to ETS and the prevalence of atopic eczema as well as other atopic diseases in a large sample of Jewish and Arab adolescents in Israel.

Methods

Sample and Procedure

The study was conducted on a national sample of 13- to 14-year-old schoolchildren in Israel, as part of the International Study of Asthma and Allergies in Childhood (ISAAC) [14]. One hundred and six schools were chosen at random from a list of all schools in the country. Each school was considered a sampling unit, and for each unit sampled, all children attending its eighth grade were included in the study. The number of schools selected from each district was weighted for the total number of eighth-graders in that district and the number of children attending each school. Since Jews and Arabs generally have separate schools, sampling was carried out separately for each population group. All questionnaires were filled out anonymously in class; teachers were instructed not to help the children with the answers. Children who were absent from school on the day of the study were asked to complete the questionnaire on a specified day during the following month. The study was approved by the Ethics Committee of Rabin Medical Center.

Questionnaire and Definitions

The standard written core questionnaire developed by the ISAAC [14] was used with the addition of questions on smoking and exposure to ETS. The questionnaire was administered to each group of children in their native language (Hebrew or Arabic). Children were considered to have current allergic rhinitis if they answered 'yes' to the question: 'Do you have allergic rhinitis?' Children were considered to have current atopic eczema if they answered 'yes' to the question: 'Do you have a recurrent, itchy rash in a typical distribution (on your elbows, behind your knees, on your buttocks, on your neck or around your ears or eyes)?' Children were considered to have current asthma if they answered 'yes' to the question: 'Do you have asthma or spastic bronchitis?' Children who reported smoking every day were considered daily smokers, and those who reported smoking 'sometimes' were considered occasional smokers. Exposure to ETS at home was assessed with the following questions: 'Does your father smoke?', 'Does your mother smoke?', 'Do your siblings smoke?', and 'Do other persons living in your home smoke?'

Statistical Analysis

Descriptive statistics were used to summarize the participants' characteristics. The χ^2 test was used to analyze differences in proportions. Bivariate Spearman's correlations were performed between

variables potentially appropriate for multivariate analysis. Logistic regression analyses were used to estimate crude and adjusted odds ratios (OR) and 95% confidence intervals (CI). The covariates in the multivariate analyses were gender, population group (Arabs, Jews), and parental asthma. Allergic rhinitis, atopic eczema, and asthma were included as additional confounders. All tests were two-tailed, and statistical significance was defined as a p value <0.05. The analyses were performed using the PASW Statistics 19.0 for Windows.

Results

Response Rate

The sampling process yielded a study population of 14,187 children from 106 schools. Of these, 11,772 children filled out the questionnaire, for an overall response rate of 82.9%. Complete data on all relevant variables were available for 10,298 participants, and these were included in the analysis.

Smoking and Atopic Disorders

The prevalence of current asthma in the whole study population was 7.2% (7.2% for the Jewish children, 7.0% for the Arab children), of allergic rhinitis 11.2% (10.9% for Jews, 12.1% for Arabs), and of atopic eczema 6.9% (6.7% for Jews, 7.8% for Arabs, $p = 0.001$). Occasional smoking was reported by 497 children (4.8%), and daily smoking by 185 (1.8%). Daily smokers reported smoking on average 11.6 cigarettes per day. Occasional smokers smoked on average 1 cigarette per day.

Occasional and daily smoking was significantly more common in boys than girls (3.9 vs. 1.0% for occasional smoking, 5.9 vs. 2.6% for daily smoking; $p < 0.001$). Arabs reported daily smoking more often than Jews (1.9 vs. 1.6%), and Jews reported occasional smoking more often than Arabs (5.1 and 3.6%; $p = 0.01$).

Allergic rhinitis, atopic eczema, and current asthma were associated with active smoking (fig. 1). There was a dose-response relationship between smoking and atopic eczema, for both occasional smoking (OR = 1.9; 95% CI = 1.4–2.5; $p < 0.001$) and daily smoking (OR = 2.5; 95% CI = 1.7–3.9; $p < 0.001$). Allergic rhinitis and current asthma were more prevalent in daily smokers than in nonsmokers (OR = 1.9, 95% CI = 1.3–2.8, and OR = 2.5, 95% CI = 1.7–3.8, respectively). After controlling for gender, population group, parental asthma, and atopic disorders, smoking remained associated with atopic eczema, asthma, and allergic rhinitis (table 1). A dose-response association between smoking and atopic eczema was established: OR = 1.6 (95% CI = 1.2–2.3) for occasional smokers and OR = 2.2 (95% CI = 1.4–3.6) for daily smokers, compared to nonsmokers.

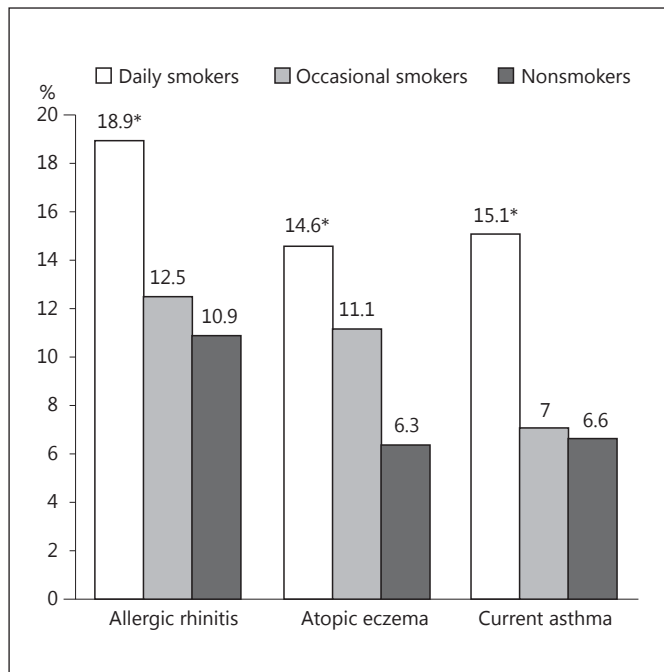


Fig. 1. Prevalence of allergic rhinitis, atopic eczema and current asthma by smoking status. * $p < 0.001$ for the comparison between daily smokers and nonsmokers.

Table 1. Adjusted OR (with 95% CI in parentheses) for allergic rhinitis, atopic eczema, and current asthma in adolescents

Factor	Atopic eczema	Current asthma	Allergic rhinitis
Personal smoking			
Never	1	1	1
Occasional	1.6 (1.2–2.3)*	0.8 (0.5–1.2)	1.1 (0.8–1.4)
Daily	2.2 (1.4–3.6)*	1.7 (1.0–2.7)*	1.6 (1.1–2.5)*
Smoking by at least one family member	1.1 (0.9–1.3)	1.3 (1.1–1.5)*	0.8 (0.7–1.0)

Adjusted for gender, population group, parental asthma, and atopic diseases. * $p < 0.05$.

Exposure to ETS and Atopic Disorders

A total of 2,106 adolescents (20.5%) reported that only their father smoked at home, 542 (5.3%) reported that only their mother smoked, 635 (6.2%) reported that one or more of their siblings smoked. Overall, 1,420 adolescents (13.8%) reported that more than one family member smoked, including both parents (11.3%), and 402 (3.9%) reported that all family members smoked. On

multivariate analysis after controlling for gender, population group, parental asthma, and atopic disorders, smoking by at least one family member was associated with asthma (OR = 1.3; 95% CI = 1.1–1.5) but not with atopic eczema or allergic rhinitis (table 1).

Discussion

The present study shows that there is a significant dose-response association between daily smoking and atopic eczema in adolescents. Our search of the literature revealed no other reports of such an association. While personal and family history of atopy are known risk factors for asthma [15], data on the relationship between smoking and atopic eczema are controversial and based only on a few studies. The ecological analyses of the ISAAC phase 1 found no association between smoking in adolescents and eczema [7], although a previous population-based study from France using the ISAAC questionnaire yielded an increased prevalence of atopic eczema as well as asthma among active adolescent tobacco smokers [16]. This finding is in accordance with the results of the present study.

A recent large-scale adult-population survey from Sweden found that both self-reported smoking during the year preceding the survey and a history of smoking (stopped smoking at least 1 year before the survey) were associated with current eczema [17]. These results were in agreement with a study from Taiwan [13] but not studies from Norway [12] or the UK [18]. The results of the present study support the association between smoking and atopic eczema.

The reported findings may be explained by the probable immunological and nonimmunological effects of smoking. Although the exact mechanisms underlying the association between cigarette smoke and immunity have not been fully defined [19], smoking may play a role in the production of proinflammatory cytokines by augmenting the production of tumor necrosis factor- α and interleukin-1 and decreasing the levels of anti-inflammatory cytokines, such as interleukin-10 [20]. Nicotine, carbon monoxide, or other toxic substances produced by cigarette smoke might also damage the blood flow in the skin and skin oxygenation [21], which may account for the skin changes characteristic of atopic eczema. The association of smoking and hand eczema or contact dermatitis is also not well established [12, 22]. A significant impact of smoking on early irritant hand dermatitis in metal workers was recently reported [23]. More research is needed to understand the impact of smoking on skin diseases.

Previous studies of the association between exposure to ETS and atopic eczema in the pediatric population focused on parental smoking and atopic disorders in pre-school and 6- to 7-year-old children. One study reported that both maternal smoking during pregnancy and parental smoking during the child's first months of life increased the risk for atopic eczema [10]. However, another found no association of maternal smoking during pregnancy and the child's first 6 months of life with eczema in 10- to 12-year-old children [24]. In the present study, exposure to smoking at home was not found to be associated with atopic eczema, in accordance with earlier studies from Europe on the effect of parental smoking habits, conducted among 13- to 14-year-old schoolchildren [25, 26] and one study from Taiwan on environmental smoking at home, conducted in younger children [27].

The large number of participants and high response rate in our study contribute to its validity. The study may have been methodologically limited by our reliance solely on adolescent self-reports. However, previous studies have shown that school-age children are able to effective-

ly report on their own general health and well-being [28]. In addition, the validity of assessing active and passive smoking by questionnaire has been extensively proven [29]. Concerning the reliability of the reports of atopic diseases, the ISAAC questionnaire is a validated instrument used worldwide [14]. Since this is a cross-sectional study, it is not possible to comment on the temporality of the association between allergic eczema and smoking. Information on age at onset of atopic eczema is not available in the ISAAC questionnaire.

In conclusion, the main new finding in the present study is the dose-response association between smoking and atopic eczema in adolescents. This information should prompt medical teams at dermatology and allergy clinics to encourage adolescents to refrain from smoking and to convince those who already smoke to stop.

Disclosure Statement

The authors declare no conflicts of interest.

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