ORIGINAL ARTICLES

Associations Between Family History of Allergy, Exposure to Tobacco Smoke, Active Smoking, Obesity, and Asthma in Adolescents

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OBJECTIVE: The relationships between asthma in adolescents and various environmental and social exposures needs to be clarified. The aim of this study was to determine the association between family history of allergy, passive or active tobacco smoking, obesity, and asthma in adolescents.

SUBJECTS AND METHODS: A population–based case–control study was carried out. A random sample of 4003 students aged 13 to 18 years old was selected from secondary and preparatory schools in an urban area in northeastern Mexico. Data was gathered in physical examinations and with a questionnaire administered by trained staff. Two study groups were formed: a group of 253 adolescents with asthma and a control group of students without asthma.

RESULTS: Variables associated with asthma were history of allergy (odds ratio [OR], 1.62; 95% confidence interval [CI], 1.28-2.06), passive smoking (OR, 1.53; 95% CI, 1.18-1.99), and obesity (OR, 1.96; 95% CI, 1.45-2.65). Female gender and active smoking were unrelated to asthma. The percentage of obese adolescents was higher in the group of asthmatics (18.2%) than in the control group (12.8%).

CONCLUSIONS: Family history of allergy, passive tobacco smoking, and obesity seem to be the main risk factors for the development of asthma in adolescents. The relationship of active smoking and asthma requires further study.

Key words: Atopic hypersensitivity, familial. Tobacco use disorder. Obesity. Asthma. Adolescents.

Asociación entre atopia familiar, exposición a humo de tabaco, tabaquismo activo, obesidad y asma en adolescentes

OBJETIVO: Es necesario aclarar la relación entre varias exposiciones ambientales y sociales y el asma en la población adolescente. El objetivo de este estudio ha sido determinar la asociación entre la atopia familiar, la inhalación pasiva o activa de humo de tabaco, la obesidad y el asma en adolescentes.

SUJETOS Y MÉTODOS: Se ha realizado un estudio de casos y controles basado en un estudio de población. Se encuestó a 4,003 estudiantes de 13 a 18 años de edad, seleccionados aleatoriamente, que acudían a escuelas de secundaria y preparatoria de un área urbana del nordeste de México. La información sobre las variables estudiadas se recabó a través de la exploración física y de la aplicación de un cuestionario por parte de personal capacitado. Se formaron 2 grupos de estudio: uno compuesto por 253 adolescentes con asma, y un grupo control formado por estudiantes sin asma.

RESULTADOS: Las variables asociadas con la enfermedad fueron historia de alergia (odds ratio [OR] = 1,62; intervalo de confianza [IC] del 95%, 1,28-2,06), exposición involuntaria al humo de tabaco (OR = 1,53; IC del 95%, 1,18-1,99) y la obesidad (OR = 1,96; IC del 95%, 1,45-2,65). El sexo femenino y el tabaquismo activo no se relacionan con dicha enfermedad. El porcentaje de obesos fue mayor en el grupo de adolescentes con asma (18,2%) que en el grupo control (12,8%).

CONCLUSIONES: La atopia familiar, la inhalación involuntaria de humo de tabaco y la obesidad parecen ser los factores de riesgo más importantes para el desarrollo de asma en adolescentes. La relación entre tabaquismo activo y asma requiere una mejor evaluación.


Introduction

Over the last 2 decades the prevalence of asthma in adolescents has increased alarmingly worldwide and the reasons have not yet been explained satisfactorily.1,2 Results from studies of the association between asthma
and familial atopic hypersensitivity, smoking, and obesity in adolescents have been inconsistent. The discrepancies can be attributed to the research designs used and the complexity of each of the variables considered.

Innumerable studies have shown that genetic factors put a person at considerable risk of developing asthma in childhood, but the relationship between a family history of allergy and asthma in older persons is debated. A review of current literature on the high prevalence of asthma, particularly in adolescents, makes clear that the increase cannot be attributed to genetic factors alone. There is an evident need to learn more about the association between environmental and behavioral factors and asthma in adolescents in order to clarify the situation.

For some years, active or passive exposure to tobacco smoke has been related to the development of chronic respiratory diseases, and smoking is currently considered an important public health problem. The information available on the association between active smoking and asthma in adolescents is abundant but disparate, with some authors showing that smoking puts female and male at risk for the development of asthma and others finding no association at all.

From another standpoint, excess weight and obesity together present the most common nutritional problem of our time and are important risk factors for the development of diseases like type 2 diabetes mellitus, heart disease, cerebrovascular disease, cancer, high blood pressure, and respiratory diseases. In recent years the study of the association between obesity and asthma has drawn the attention of many researchers but results to date have been inconclusive. Gilliland et al10 and Chinn et al11,12 among others, have demonstrated a positive association between obesity and asthma but others have not. Meanwhile, Mishra, Tantisira et al13,14,15 identified an association in women but not in men. Still others suggest the relationship is reversed, that the obesity is caused by the asthma.16,17

The present study was therefore designed to ascertain the relation between a family history of allergy, smoking, obesity, and asthma in a large population sample of adolescents between 13 and 18 years of age who were residents of an urban area in northeastern Mexico. The diagnosis of asthma was made based on uniform criteria. Behavioral, demographic, and socioeconomic factors were recorded.

Subjects and Methods

A population-based case–control study was carried out. Healthy persons with a diagnosis of asthma between 13 and 18 years old were enrolled. The subjects attended secondary schools located in Altamira, a large town near the city of Tampico, and were classified following WHO recommendations as obese when weight was greater than the 95th percentile for age and sex. BMI was calculated by dividing weight in kilograms by height in meters squared (kg/m²). The adolescents were classified as having asthma if they answered affirmatively to the first question (Do you smoke?) in part A of the questionnaire (Appendix). Information was obtained with questions 1 through 6 of part B. An adolescent was classified as having asthma if he or she responded affirmatively to question 1 (Has a doctor ever said that you have asthma?), question 2 (Have you had an asthma attack in the last 12 months?), and question 3 (Has your doctor ordered...
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Results

We studied 4003 adolescents (49.1% males) with a mean age of 14.29 (1.51) years. A diagnosis of asthma by a doctor was reported by 6.3%, and 6.1% had symptoms related to asthma. Females were slightly more numerous in the sample as a whole and in the groups of patients with diagnosed asthma or complaining of asthma symptoms. Table 1 shows the personal and clinical characteristics of the study population by sex.

A family history of allergy was reported by 1327 adolescents (44.7% of cases and 30.5% of controls), a family history of allergy put a certain effect on asthma (8.8% of obese and 6.0% of nonobese adolescents had asthma; OR, 1.47; 95% CI, 1.18-1.86; P<.01). A higher rate of asthma (8.7%) was found among adolescent smokers than in the group living with nonsmokers (5.7%). The effect of the presence of smokers in the home on asthma in adolescents was significant (OR, 2.06; 95% CI, 1.53-2.80; P<.01). Likewise, obesity had a certain effect on asthma (8.8% of obese and 6.0% of nonobese adolescents had asthma; OR, 1.47; 95% CI, 1.08-1.99; P<.01). Active smoking was unrelated to having a diagnosis of asthma. Table 3 shows the effect of family history of allergy, smoking, and obesity on adolescent asthma. A family history of allergy was also related to having asthma symptoms in these adolescents (8.7% with a family history vs 5.2% of the controls). A family history of allergy put adolescents at risk of asthma (OR, 1.62; 95% CI, 1.28-2.06; P<.01). A higher rate of asthma (8.7%) was found in the group of adolescents who reported living with smokers than in the group living with nonsmokers (5.7%). The effect of the presence of smokers in the home on asthma in adolescents was significant (OR, 1.53; 95% CI, 1.18-1.99; P<.01). Likewise, obesity had a certain effect on asthma (8.8% of obese and 6.0% of nonobese adolescents had asthma; OR, 1.47; 95% CI, 1.08-1.99; P<.01). Active smoking was unrelated to having a diagnosis of asthma. Table 3 shows the effect of family history of allergy, smoking, and obesity on adolescent asthma.

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Likewise, the presence of smokers in the home influenced probability of having asthma symptoms (9.9% of those living with smokers vs 5.1% of those living with nonsmokers were symptomatic; OR, 1.93; 95% CI, 1.50-2.49; \(P < .01\)). Male gender seemed to protect against having asthma symptoms in adolescence (OR, 0.62; 95% CI, 0.47-0.78; \(P < .01\)). Active smoking with 10.1% of smokers vs 6.0% of nonsmokers symptomatic (OR, 1.72; 95% CI, 0.99-2.99; \(P = \text{not significant (NS)}\)) and obesity with 6.1% of both obese and nonobese adolescents symptomatic (OR, 0.99; 95% CI, 0.69-1.42; \(P = \text{NS}\)) were unrelated to risk of having asthma symptoms. Table 4 shows the effect of family history of allergy, smoking, and obesity on asthma symptoms in adolescents.

Multivariate regression analysis showed that having parents with a history of allergy and living with smokers were independent risk factors for having a diagnosis of asthma and symptoms of asthma. Obesity had an effect on risk of diagnosed asthma and female gender affected risk of asthma symptoms. Each variable that maintained significance was studied separately.

### Discussion

Epidemiological surveys, such as the ISAAC study, have been used for some time to gather information on respiratory diseases. However, findings based on self-reporting in response to such questionnaire surveys should be interpreted cautiously because of the possibility of inaccuracy or bias. The questionnaire used in this study was based on the previously cited projects. The robustness of the results is supported by the fact that interviewers were trained to apply consistent criteria when recording information about demographic and behavioral variables, when conducting the physical examination, and when taking measurements. The criteria for identifying adolescents with a diagnosis of asthma established by a physician and/or symptoms of asthma were similarly consistent.

#### Table 3

<table>
<thead>
<tr>
<th>Gender</th>
<th>Diagnosed With Asthma (n=23), n (%)</th>
<th>Controls (n=3758), n (%)</th>
<th>OR (95% CI)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>126 (6.4)</td>
<td>1844 (93.6)</td>
<td>1.02 (0.80-1.30)</td>
<td>NS</td>
</tr>
<tr>
<td>Females</td>
<td>127 (6.2)</td>
<td>1909 (93.8)</td>
<td>1.40 (0.52)</td>
<td>0.76</td>
</tr>
<tr>
<td>Family history of allergy</td>
<td>Yes 113 (8.5)</td>
<td>1214 (91.5)</td>
<td>1.62 (1.28-2.06)</td>
<td>(&lt; .01)</td>
</tr>
<tr>
<td></td>
<td>No 140 (5.2)</td>
<td>2536 (94.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smokers at home</td>
<td>Yes 75 (8.7)</td>
<td>786 (91.3)</td>
<td>1.53 (1.18-1.99)</td>
<td>(&lt; .01)</td>
</tr>
<tr>
<td></td>
<td>No 178 (5.7)</td>
<td>2964 (94.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active smoker</td>
<td>Yes 9 (7.8)</td>
<td>107 (92.2)</td>
<td>1.23 (0.65-2.54)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>No 244 (6.3)</td>
<td>3643 (93.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>Yes 46 (8.8)</td>
<td>479 (91.2)</td>
<td>1.47 (1.08-1.99)</td>
<td>(&lt; .01)</td>
</tr>
<tr>
<td></td>
<td>No 207 (6.0)</td>
<td>3271 (94.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI indicates confidence interval; NS, not significant; OR, odds ratio.

#### Table 4

<table>
<thead>
<tr>
<th>Gender</th>
<th>Asthmatic Symptoms (n=248), n (%)</th>
<th>Controls (n=3758), n (%)</th>
<th>OR (95% CI)</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>91 (4.6)</td>
<td>1876 (95.4)</td>
<td>0.62 (0.47-0.78)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Females</td>
<td>154 (7.6)</td>
<td>1882 (92.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history of allergy</td>
<td>Yes 116 (8.7)</td>
<td>1211 (91.3)</td>
<td>1.81 (1.42-2.31)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>No 129 (4.8)</td>
<td>2547 (95.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smokers at home</td>
<td>Yes 85 (9.9)</td>
<td>776 (90.1)</td>
<td>1.93 (1.50-2.49)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td></td>
<td>No 160 (5.1)</td>
<td>2982 (94.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active smoking</td>
<td>Yes 12 (10.1)</td>
<td>104 (87.7)</td>
<td>1.72 (0.92-2.99)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>No 233 (6.0)</td>
<td>3644 (94.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity</td>
<td>Yes 32 (6.1)</td>
<td>493 (93.9)</td>
<td>0.99 (0.69-1.42)</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>No 213 (6.1)</td>
<td>3265 (93.9)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI indicates confidence interval; NS, not significant; OR, odds ratio.
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However, it is important to point out that although we were careful to identify cases in accordance with design procedures, the diagnosis of asthma was unconfirmed by spirometry or bronchial challenge testing. Numerous studies have shown that a family history of allergy is an important risk factor for the development of asthma in childhood. The association between smoking and asthma in adolescence is debated, however. Certain authors, such as Sears et al. found that a family history of allergy increases risk of asthma, as the risk of an asthma diagnosis in the adolescent respondents in our study with such a family history was higher in comparison with controls by a factor of 1.62 (95% CI, 1.28-2.06; P<.01). Their risk of symptoms was also higher, with an OR of 1.81 (95% CI, 1.42-2.31; P<.01). The higher rate of obesity (18.6%) among asthmatic adolescents who had a family history of allergy in comparison with those whose parents were not allergic (17.7%) also merits mention.

Passive or active smoking is an important risk factor for respiratory diseases. The adverse effect of smoking on the airways has been well documented in the literature, and passive smoking has been associated with childhood asthma. However, the relation of smoking to asthma in adolescence is debated. Our results, unlike those of Rhodes et al., demonstrated an association between the presence of smokers in the adolescents’ homes and obesity (P<.01) and asthmatic symptoms (P<.01). Active smoking is currently a significant health problem in the adolescent population. An association between active smoking and adolescent asthma remains unclear. Certain authors, such as Chen et al., among others, 16 had only been able to find an association between smoking and asthma in females, whereas other authors have found no correlation. We are aware that the percentage of adolescents who reported smoking in this study (a prevalence of 2.9%) is smaller than that reported by other authors, such as Annens-Maesano et al., (prevalence of 9.3%). A selection bias should therefore be taken into account when interpreting the results, which can not be generalized to all adolescents.

We consider that a large number of adolescents did not report their smoking because authorities in the Mexican schools they attended and the subjects’ parents forbade it under threat of punishment if the rule is broken. This is particularly the case for adolescents with chronic respiratory disease. However, we can base certain conjectures on a comparison of our findings with those of other studies. We found no association between smoking and asthma (P>NS), an observation that is probably due to the selection bias. It is noteworthy, however, that like other authors, 17,18 we observed higher rates of smoking among asthmatics than among healthy controls. With regard to gender differences, more female (3.9%) than male asthmatics (2.2%) smoked.

At present, findings from studies of the relationship between obesity and asthma are inconsistent. Von Mutius, 19 Mishra, 20 and Gennuso et al. 21 found that obesity increases the risk of asthma for children and adolescents, whereas Sin et al. 22 found no association and others have reported an association for only one sex. 23 Furthermore, information available on the relations among obesity, asthma, and gender in adolescence is not very convincing. It is known that asthma increases among females during adolescence and that the ratio of males to females with the disease changes from 2:1 during childhood to a more even balance during adolescence. In adults, the proportion of women who are asthmatics is twice that of men. It is important to remember these patterns because there is some suggestion that female hormones might play a direct or indirect role in a causal relationship between obesity and asthma. 24 Other authors have shown that asthma symptoms, but not bronchial hyperreactivity, increase with obesity, and they have speculated that anatomical changes in the upper airway may be responsible. 25 Our results show that obese adolescents have a risk of asthma that is 1.47 (95% CI, 1.08-1.99; P<.01) times that of nonobese adolescents. We observed no association between obesity and asthmatic symptoms (P>NS). In our study population, there were more obese male adolescents with asthma (15.39%) than females (12.7%), observations that are consistent with those of Gilliland et al., but different from those of Chen et al. 26

In conclusion, understanding the relationship between asthma and factors such as family history of allergy, and exposure to tobacco smoke can be important for establishing strategies to limit the negative effects of the disease. Family history of allergy is clearly the most important risk factor for developing either asthma or asthmatic symptoms and should be borne in mind when establishing preventive programs. Based on our findings and a review of the current literature, we conclude that exposure to tobacco smoke and obesity also increase risk to a certain extent. This is important to remember because both factors are related to lifestyle and can be modified in a positive way, with great benefits for the population in general.

REFERENCES


APPENDIX

Questionnaire for Interviewing Adolescents

Part A

1. Do you smoke?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

2. Have you had an asthma attack in the last 12 months?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

3. Has your doctor ever ordered a spirometric test for you?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

4. Have you used any medication for asthma in the past year?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

5. Have you noticed wheezing in your chest in the past year?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

6. Did your medication relieve the wheezing?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

Part B

1. Has your doctor ever said you have asthma?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

2. Have you had an asthma attack in the last 12 months?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

3. Has your doctor ever ordered a spirometric test for you?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

4. Have you used any medication for asthma in the past year?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

5. Have you noticed wheezing in your chest in the past year?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked

6. Did your medication relieve the wheezing?
   - [ ] Yes
   - [ ] No
   - [ ] Not asked