Maternal Smoking and Childhood Asthma

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The role of maternal smoking as a causal factor for the incidence of childhood asthma is still not clearly established. It was investigated among 3- and 4-year-old child incident cases confirmed by a 6-year follow-up (n = 294) and cases who no longer had symptoms after diagnosis (n = 110). The study took place in Montréal, Canada, between 1988 and 1997. Persistent and transient cases were compared with their respective controls from the original case-control study of incidence. The odds ratio for heavy maternal smoking adjusted for known risk factors for asthma was 3.84 (95% confidence interval: 1.68, 8.76) among persistent cases and close to one among transient cases. Am J Epidemiol 1999;150:528-31.

MATERIALS AND METHODS

Cases and controls from the initial study

The methods of the initial study have been described in detail (5). Briefly, 457 cases were recruited between 1988 and 1990, as they were diagnosed for the first time with asthma by a pediatrician at the emergency room of a university-affiliated pediatric hospital in Montréal. Cases were 3- and 4-year-old children. One control per case, matched for age (±1 month) and census tract of residence at the time of diagnosis, was recruited from government files that include all families of legal residents and citizens with children under the age of 18 years. Parents were contacted to check for study eligibility, such as first-time diagnosis for cases and no previous diagnosis of asthma by a physician for controls. Next, an interviewer, blind to the case or control status, collected information through a structured telephone interview within 1 month of the date of diagnosis of the case. The questionnaire included the child’s personal susceptibility factors and past infectious diseases, family history of asthma, personal susceptibility factors, past infections, maternal schooling, and sex. At this age, however, asthma is a difficult diagnosis (6) and may be a transient phenomenon accompanying an infectious episode (7). Time is probably the best way to confirm a diagnosis of asthma in young children. The importance and the nature of risk factors may differ for persistent asthma and the transient form of the disease.

The objective of the present study was to analyze the relation between maternal smoking and clinically diagnosed incident cases of childhood asthma shown to be persistent by a 6-year follow-up period.
sociodemographic characteristics, and the child's exposure to maternal smoking between birth and diagnosis. Because most mothers smoked during more than half the period between birth and diagnosis, we report smoking as an average number of daily cigarettes during that period.

**Follow-up of cases**

We carried out a follow-up of the 457 cases included in the initial study 6–7 years after diagnosis. We were able to track 407 families of which 404 (88.4 percent of the original case group) accepted a telephone interview. For yearly periods from the time of diagnosis to the time of the survey, we asked, "After the diagnosis of asthma, has your child continued to have asthma in the form of episodes of wheezing that caused breathing difficulty or shortness of breath?"; we also asked if these episodes were treated by medication. Independently of episodes, we asked if during the study period the child had taken medication prescribed by a physician to control asthma. Cases who no longer had symptoms or used asthma medication during the follow-up period were defined as transient; cases who continued to have symptoms or to use asthma medication were called persistent.

**Analysis**

Conditional logistic regression was used to analyze the matched sets of cases and controls, contrasting the sets with persistent cases with those including transient cases. Odds ratios and 95 percent confidence intervals were estimated.

**RESULTS**

The interview established that 110 children initially diagnosed with asthma never had symptoms or used asthma medication after diagnosis, whereas 294 continued to have symptoms, to use medication, or both.

Maternal smoking information before diagnosis was missing for one case and one control in the sets of persistent cases and for two transient cases. The proportion of mothers who reported smoking before diagnosis was 41.9 percent (123/293) among persistent cases and 40.7 percent (44/108) among transient cases. In the controls for these groups, the proportions were 36.1 percent (106/293) and 40.9 percent (45/110), respectively.

In a crude analysis (apart from matching factors) including cases with persistent symptoms during follow-up and their controls, the odds ratio was 1.05 (95 percent CI: 0.74, 1.49) for maternal smoking of 20 cigarettes or less daily and 2.45 (95 percent CI: 1.24, 4.84) for smoking more than 20 cigarettes daily in comparison with the reference group of nonsmokers. In a similar analysis with transient cases, these odds ratios were 0.88 (95 percent CI: 0.45, 1.71) and 1.14 (95 percent CI: 0.47, 2.75), respectively. The effect of maternal smoking was adjusted for potential confounders (table 1). In comparison with the crude estimates, the risk associated with heavy maternal smoking increased for persistent cases (odds ratio = 3.84, 95 percent CI: 1.68, 8.76) and remained close to one in the group of transient cases. The interaction between parental asthma and maternal smoking was not statistically significant. In addition to the variables in table 1, a model included paternal smoking and other smokers in the home (mostly the babysitter); these variables were not independent predictors of risk among the transient cases. Among persistent cases, the odds ratio for other smokers was 3.36 (95 percent CI: 1.53, 7.40), whereas paternal smoking did not increase the risk for asthma.

The prevalence of maternal smoking after diagnosis may have influenced the persistence of symptoms; however, it was similar between persistent and transient cases.

**DISCUSSION**

The strength of this study relies mainly on the facts that cases were incident and diagnosed by a pediatrician and that a high percentage was followed over time to confirm diagnosis. The study reassesses the contribution of maternal smoking to the incidence of asthma among cases that time has shown to be persistent using population-based control subjects as a comparison group and contrasts the role of maternal smoking between persistent cases and cases that time has shown to be transient. Other longitudinal studies of childhood asthma into young adulthood have compared persistent cases with transient ones (8, 9). Martinez et al. (7) compared persistent and transient wheezers with children who remained disease free in a clinical cohort followed from birth to 6 years of age. Early maternal smoking showed the same increased effect in both groups (odds ratios of approximately 2 and statistically significant); the prevalence of maternal smoking was approximately 20 percent in both groups, a surprisingly low figure for the beginning of the 1980s when data from national household surveys reported prevalences of approximately 35 percent in women between 18 and 44 years of age (10).

Our study also has weaknesses. Whereas time helped to confirm the diagnosis of cases, we did not have the opportunity to confirm the healthy status of controls. Assuming that 80 percent of children who develop asthma will experience their first episode of wheeze before the age of 3 years (11), most controls

<table>
<thead>
<tr>
<th>Factor</th>
<th>Persistent cases and their controls*</th>
<th>OR § 95% CI</th>
<th>Transient cases and their controls†</th>
<th>OR § 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. with factor</td>
<td>Cases</td>
<td>Controls</td>
<td>Cases</td>
</tr>
<tr>
<td>Maternal smoking (cigarettes/day)#</td>
<td>156</td>
<td>186</td>
<td>1.00</td>
<td>62</td>
</tr>
<tr>
<td>None</td>
<td>92</td>
<td>93</td>
<td>1.22</td>
<td>0.79, 1.88</td>
</tr>
<tr>
<td>&gt;0–&lt;20</td>
<td>30</td>
<td>13</td>
<td>3.84</td>
<td>1.68, 8.76</td>
</tr>
<tr>
<td>&gt;20</td>
<td>67</td>
<td>43</td>
<td>1.72</td>
<td>1.04, 2.95</td>
</tr>
<tr>
<td>Child is allergic</td>
<td>67</td>
<td>40</td>
<td>2.30</td>
<td>1.27, 4.15</td>
</tr>
<tr>
<td>Child has eczema</td>
<td>30</td>
<td>9</td>
<td>3.40</td>
<td>1.45, 7.96</td>
</tr>
<tr>
<td>Asthma in father</td>
<td>34</td>
<td>9</td>
<td>3.42</td>
<td>1.45, 8.05</td>
</tr>
<tr>
<td>Asthma in mother</td>
<td>33</td>
<td>13</td>
<td>3.06</td>
<td>1.41, 6.64</td>
</tr>
<tr>
<td>Asthma in siblings</td>
<td>65</td>
<td>24</td>
<td>3.45</td>
<td>1.90, 6.29</td>
</tr>
<tr>
<td>Child had pneumonia</td>
<td>13</td>
<td>5</td>
<td>3.29</td>
<td>0.86, 12.53</td>
</tr>
<tr>
<td>Child had tonsillectomy</td>
<td>66</td>
<td>60</td>
<td>1.28</td>
<td>0.78, 2.09</td>
</tr>
<tr>
<td>Maternal education**</td>
<td>165</td>
<td>152</td>
<td>1.29</td>
<td>0.87, 1.90</td>
</tr>
</tbody>
</table>

* In the analysis, 287 matched sets were used.
† In the analysis, 105 matched sets were used.
§ OR, odds ratio; CI, confidence interval.
¶ Numbers were based on 288 cases and 292 controls with complete data.
** The mother has some university schooling.

should remain disease free. However, if some controls have become cases and are compared with persistent cases, this would result in a bias toward the null; in the comparison with transient cases where maternal smoking seems to have no effect, the risk may nevertheless be underestimated with such an occurrence. The exposure measure was based on reporting. Urinary cotinine measures correlate well with recent exposure to environmental tobacco smoke (12), but they are not so advantageous over a questionnaire when long-term exposure is of interest (13). The prevalence figure for maternal smoking obtained with our questionnaire among controls was very similar to that from an independent population survey (14). Although the prevalence of maternal smoking is higher in our population than among American women at comparable periods (10, 15), the relative proportion of heavy smokers may not be that different (16). Unfortunately we have no data on maternal smoking during pregnancy; this exposure along with early postnatal exposure may be critical in understanding the mechanisms of asthma development (17). Finally, we observed that, in the persistent case group, the proportion of controls smoking more than 20 cigarettes daily was lower than that of the controls in the transient case group. We have no ready explanation for this except that maternal education was lowest in this group.

Recent US data show that 38 percent of children aged 2 months to 5 years were exposed to environmental tobacco smoke in the home (18). Given these findings and ours, the problem is of considerable public health importance. The present study supports a causal role for heavy maternal cigarette smoking for persistent cases of asthma diagnosed at an early age.

ACKNOWLEDGMENTS

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REFERENCES