Incidence and Prevalence of Asthma Among Adult Finnish Men and Women of the Finnish Twin Cohort From 1975 to 1990, and Their Relation to Hay Fever and Chronic Bronchitis*

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Study objectives: To examine the prevalence of asthma and hay fever, and the incidence and temporal relationships of asthma, hay fever, and chronic bronchitis among adult twins during a 15-year period.

Design: Prospective cohort study.

Participants: A population of 11,540 Finnish adult men and women, initially 18 to 45 years of age, who returned a health questionnaire in 1975, 1981, and 1990 as part of the Finnish Twin Cohort study.

Methods: Age-standardized prevalences and cumulative incidences among individuals were calculated for asthma, hay fever, and chronic bronchitis. The incidence of asthma among subjects with and without hay fever or chronic bronchitis was analyzed in the entire cohort as well as in twin pairs discordant for incident asthma.

Results: The prevalence of asthma increased slightly from 1975 (2.0% in men and 2.2% in women) to 1990 (2.9% in men and 3.1% in women). The prevalence of hay fever showed a larger increase in men and women (from 6.8% and 9.8% to 11.8% and 15.3%, respectively). Compared with figures for 1976 to 1981, no significant increase in asthma incidence occurred from 1982 to 1990, whereas the incidence of hay fever was lower during the latter period among men (incidence rate ratio, 0.7; 95% confidence interval, 0.6 to 0.9) as was the incidence of chronic bronchitis among women (incidence rate ratio, 0.7; 95% confidence interval, 0.6 to 0.9). Hay fever and chronic bronchitis were usually diagnosed before asthma. Both diseases increased the risk of asthma significantly on the basis of analyses of all individuals and of discordant twin pairs.

Conclusions: The pattern of increase in asthma and hay fever prevalence with time was similar, and hay fever was a strong predictor of asthma. These diseases showed no significant increase in incidence.

Key words: asthma; chronic bronchitis; cohort study; hay fever; incidence; prevalence

Abbreviations: CI = confidence interval; IRR = incidence rate ratio

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Although the rising prevalence of asthma in children in recent decades is well known,1–4 a concurrent and significant increase has also occurred among young men in Finland and Sweden,5,6 and in all age groups in England and Wales7 and in Canada.8 In the Busselton study, Peat et al9 found an increased prevalence of doctor-diagnosed asthma among adults, but not of current asthma (defined as recent wheeze plus bronchial hyperresponsiveness) during a 9-year period.

Prevalence refers to the cases of a disease that exist at a specified time, and incidence to the number of new cases that develop during some specified time interval. Thus, prevalence is a func-
tion of incidence and duration of the disease. Longitudinal epidemiologic studies show that the natural history of asthma includes phases of prolonged remission and even of recovery, and that asthma reduces survival in adults. Notable differences between prevalence and incidence studies of asthma are therefore to be expected.

Incidence studies on asthma are rare compared with prevalence studies. Yunginger et al noted an increase in asthma incidence among children from 1964 to 1983, whereas rates among adults remained constant. The incidence of asthma among young Israeli adults was also stable during 1987 to 1989. However, a Finnish study found a rising trend of medication-requiring asthma incidence among young adults for the period 1986 to 1993, although there was only a slight increase among women aged 50 to 64 years, and even a decrease in men of the same age.

Hay fever prevalences have also risen in recent decades, but no such trend in hay fever incidence was found by Ross and Fleming during the last 12 years. Because diagnostic variation is a common problem when studying chronic bronchitis, trends in its prevalence and incidence are not easily clarified.

This prospective cohort study examined the incidence of asthma, hay fever, and chronic bronchitis among adults during a 15-year follow-up period, as well as the prevalence of asthma and hay fever. The co-occurrence of hay fever and chronic bronchitis among asthmatic subjects and their influence on asthma incidence were also studied.

MATERIALS AND METHODS

Study Population

The study population was based on the Finnish Twin Cohort, which consists primarily of adult twin pairs with both members born before 1958 and alive in 1967. Pairs of individuals with the same birth date and sex, as well as the same surname and local community at birth, were identified from the Central Population Registry of Finland. These selection criteria also captured a small number of unrelated individuals. A postal questionnaire was sent to cohort members in the autumn of 1975 (response rate, 89%), with questions on twinship, medical history, symptoms, state of health, social factors, and psychological traits. Twinship was determined from questionnaire responses and confirmed, when necessary, from birth records in local parish registers. Follow-up postal questionnaires were sent in 1981 and 1990, with response rates of 84% and 77%. Each questionnaire asked whether asthma, allergic rhinitis including hay fever (called hay fever from here on), or chronic bronchitis had ever been diagnosed by a physician. The question was “Have you ever been told by a doctor that you have or have had asthma/allergic cold, eg, hay fever/chronic bronchitis?” This question was identical in all three questionnaires.

The incidence and prevalence analyses were based on different sets of subjects selected from the Finnish Twin Cohort. The study population for incidence analysis consisted of all twins who answered all three questionnaires, whereas prevalence analyses were based on all subjects responding to the questionnaire of the year for which prevalence was calculated, ie, 1975, 1981, or 1990. The incidence analyses respondents were born from 1930 to 1957 (N = 11,540), and 45% were men. Both twins of 3,753 pairs responded in addition to 4,034 twins whose twin sibling did not respond. Prevalences, by contrast, were calculated among subjects aged 30 to 59 years at the time of each questionnaire, except for the 1990 study, when the range was 33 to 59 years. The numbers of subjects were 14,468 in 1975, 15,317 in 1981, and 12,219 in 1990. The data for calculating 1975 prevalences included some singletons (N = 2,085, 14.4% of all subjects), whereas 1981 and 1990 prevalences were based on twins only. All prevalences and incidences were calculated from individuals.

To investigate the co-occurrence of hay fever and chronic bronchitis with asthma, those with missing data on asthma, hay fever, or chronic bronchitis in any questionnaire (n = 862) were excluded. Subjects reporting asthma in 1981 or 1990 were then defined as “new asthma cases,” ie, asthma diagnosed from 1976 to 1990 (n = 219).

Statistical Analysis

The prevalences of asthma and hay fever were calculated in 1975, 1981, and 1990 after excluding those with missing data on the respective disease in each questionnaire. The European standard population was used to calculate age-standardized prevalences by 5-year age groups separately for men and women. Confidence intervals (CIs) were computed using an appropriate software (Confidence Interval Analysis; M. J. Gardner and British Medical Journal; London, UK) program.

Separate incidences were computed among those reporting no asthma, hay fever, or chronic bronchitis in the 1975 questionnaire for the whole follow-up time (1976 to 1990) and for the first 6 years of follow-up (1976 to 1981). Cumulative incidences were calculated separately for men and women in age groups based on birth decade (1930 to 1939, 1940 to 1949, 1950 to 1957). Age-trend analyses were based on these three birth-decade groups and performed with the Rate Analysis program derived from the formulas given by Miettinen. Similarly incidence rate ratios (IRRs) by sex and their CIs were calculated by the Rate Analysis program. Basic statistics were derived by a software package (SAS: SAS Institute; Cary, NC).

To compare incidences of asthma, hay fever, and chronic bronchitis during the first 6 and last 3 years of the follow-up time, incidences were calculated separately for two periods (1976 to 1981 and 1982 to 1990). The initial ages of subjects (ie, in 1975 and 1981) were used, and only those aged 25 to 44 years at the beginning of each follow-up were included in these analyses to make the age distributions of the two periods as comparable as possible. Person-years were calculated by multiplying the number of subjects at risk by the number of years (6 or 9) of follow-up. The European standard population was used to calculate age-standardized incidences per 10,000 person-years by 5-year age groups during 1976 to 1981 and 1982 to 1990, and CIs were computed by the Confidence Interval Analysis program.

IRRs and their CIs were computed by stratifying 5-year age groups using the Rate Analysis program. To study the effects of hay fever and chronic bronchitis on the risk of developing asthma, the cumulative incidence of asthma during 1976 to 1990 was calculated among subjects reporting hay fever or chronic bronchitis in 1975, and among those not reporting it. IRRs were computed by stratifying birth decade using the Rate Analysis program.
questionnaire, or in both (N = 161), were identified to examine whether the risk of asthma in relation to a history of hay fever and chronic bronchitis (in 1975) differed from the risk in their age-matched twins (either dizygotic or monozygotic) without these diseases. These co-twins represent persons who have generally shared the same childhood environment as the diseased (asthma) subject, and have part or all of their genes in common by descent. The estimate of relative risk was calculated from the ratio of number of pairs in which the diseased twin had had the condition (hay fever or chronic bronchitis) and the healthy twin had not, to the number of pairs in which the opposite had occurred; CIs were also computed.23

RESULTS

The three questionnaires permitted assessment of stability of response to the disease questions. Of those reporting asthma in 1975, 10 of 53 men (19%) and 9 of 50 women (18%) no longer reported it either in 1981 or in 1990. Furthermore, 13 of 53 men (25%) and 6 of 50 women (12%) reported asthma only in one of the later questionnaires. Among those subjects not reporting asthma in 1975, 11 of 29 men (38%) and 22 of 53 women (42%) who reported asthma in 1981 no longer reported it in 1990; among those not reporting hay fever or chronic bronchitis in 1975, the corresponding proportions for hay fever were 71 of 202 men (35%) and 106 of 318 women (33%), and for chronic bronchitis, 92 of 152 men (61%) and 104 of 216 women (48%).

The age-standardized prevalence of asthma in 1975 was 2.0% (95% CI, 1.6 to 2.5%) among men and 2.2% (95% CI, 1.8 to 2.6%) among women, and there were no significant prevalence rate differences between the singletons and twins. The 1981 prevalence was quite similar, being 2.1% (95% CI, 1.7 to 2.5%) and 2.3% (95% CI, 1.9 to 2.7%). In 1990, there was some increase in asthma prevalence both among men 2.9% (95% CI, 2.4 to 3.4%) and women 3.1% (95% CI, 2.6 to 3.5%). The prevalence of hay fever in 1975 was 6.8% (95% CI, 6.1 to 7.5%) for men and 9.4% (95% CI, 8.7 to 10.2%) for women. In 1981 it was 7.9% (95% CI, 7.3 to 8.6%) and 10.6% (95% CI, 9.8 to 11.4%), and in 1990, 11.8% (95% CI, 10.8 to 12.8%) and 15.3% (95% CI, 14.3 to 16.4%), respectively. Age-specific prevalences for asthma and hay fever are shown in Figure 1 by sex and time of assessment.

Cumulative incidences of asthma, hay fever, and chronic bronchitis are shown in Table 1. The incidence of asthma was similar among men (2.3%) and women (2.6%) throughout the whole follow-up period of 1976 to 1990. Hay fever had a higher incidence than asthma among both men (9.4%) and

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21911/ on 04/19/2017)
women (13.6%), and the sex difference was significant (IRR, 1.4; 95% CI, 1.3 to 1.6). Chronic bronchitis was also diagnosed more often among women (incidence of 8.8%) than men (7.2%; IRR, 1.2; 95% CI, 1.1 to 1.4) (Table 1). Age-trend analyses revealed a significant age dependence among men in asthma incidences during the first 6 years, which persisted throughout the entire 15-year follow-up period (p = 0.006 and p = 0.0001, respectively). Among women, age dependence was seen in asthma incidences during the entire follow-up (p = 0.0003) and in chronic bronchitis during both follow-up periods (p = 0.0016 and p = 0.0001) (Table 1).

There was a 50% increase in asthma incidence among men from 1982 to 1990 compared with 1976 to 1981, but the 95% CIs were wide (95% CI, 0.9 to 2.4) because of the small number of cases (Table 2). In contrast, the incidence of hay fever was significantly lower during the later time period (IRR, 0.7; 95% CI, 0.6 to 0.9). Women had a nonsignificant increase of 20% in asthma incidence and no change in hay fever incidence, but the decline in their chronic bronchitis was significant (IRR, 0.7; 95% CI, 0.6 to 0.9) (Table 2). We also calculated age- and sex-adjusted IRRs among men and women combined. In asthma incidence there was a 30% increase, which almost reached statistical significance (IRR, 1.3; 95% CI, 1.0 to 1.8). There was a lesser decrease in incidence of hay fever (IRR, 0.9; 95% CI, 0.8 to 1.0), whereas the decline in chronic bronchitis was significant (IRR, 0.8; 95% CI, 0.7 to 0.9).

The co-occurrence of hay fever and chronic bronchitis among 219 subjects with incident asthma is displayed in Figure 2. There were 60 men (64%) and 91 women (73%) with asthma who also had hay fever. Hay fever was usually diagnosed before asthma both among men (34%) and women (39%), and only two men and six women had asthma before their hay fever. Chronic bronchitis was less common, but the same temporal relationship was evident. Thirty-five asthmatic men (37%) and 62 women (50%) had chronic bronchitis, but only 3 and 5 of these, respectively, had their asthma diagnosed first (Fig 2). Overall, 28% of asthmatic men and 15% of asthmatic women had only asthma, with no history of hay fever or chronic bronchitis, and 29% and 38% had asthma with both diagnoses.

Both hay fever and chronic bronchitis significantly increased the risk of asthma (Table 3). Men reporting hay fever in 1975 had > 4 times the incidence of asthma during 1976 to 1990 than men without hay fever in 1975. Among women the effect of hay fever was even greater (IRR, 6.0; 95% CI, 4.2 to 8.3). Chronic bronchitis increased the risk of asthma more

### Table 1—Cumulative Incidences of Asthma, Hay Fever, and Chronic Bronchitis From 1976 to 1981 (6 yr) and 1976 to 1990 (15 yr) by Age and Sex

<table>
<thead>
<tr>
<th>Birth Year</th>
<th>Age in 1975, yr</th>
<th>Incidence, %</th>
<th>Asthma</th>
<th>Hay Fever</th>
<th>Chronic Bronchitis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 yr</td>
<td>15 yr</td>
<td>6 yr</td>
<td>15 yr</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950–1957</td>
<td>18–25</td>
<td>0.3</td>
<td>1.2</td>
<td>4.2</td>
<td>9.0</td>
</tr>
<tr>
<td>1940–1949</td>
<td>26–35</td>
<td>0.7</td>
<td>2.8</td>
<td>4.9</td>
<td>9.6</td>
</tr>
<tr>
<td>1930–1939</td>
<td>36–45</td>
<td>1.1</td>
<td>3.2</td>
<td>3.9</td>
<td>9.8</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>0.6</td>
<td>2.3</td>
<td>4.4</td>
<td>9.4</td>
</tr>
<tr>
<td>No. of cases</td>
<td></td>
<td>29</td>
<td>111</td>
<td>202</td>
<td>429</td>
</tr>
<tr>
<td>Subjects at risk</td>
<td></td>
<td>4,855</td>
<td>4,855</td>
<td>4,570</td>
<td>4,570</td>
</tr>
<tr>
<td>Age-trend analyses, p value†</td>
<td></td>
<td>0.0060</td>
<td>0.0001</td>
<td>0.86</td>
<td>0.47</td>
</tr>
</tbody>
</table>

| Women      |                |      |       |      |       |      |       |
| 1950–1957  | 18–25          | 0.8  | 1.9   | 5.9  | 14.5  | 2.7  | 7.3   |
| 1940–1949  | 26–35          | 0.8  | 2.5   | 5.5  | 13.1  | 4.7  | 9.2   |
| 1930–1939  | 36–45          | 1.3  | 4.0   | 5.8  | 12.8  | 4.5  | 11.2  |
| All        |                | 0.9  | 2.6   | 5.8  | 13.6  | 3.8  | 8.8   |
| No. of cases |              | 53   | 150   | 318  | 754   | 216  | 504   |
| Subjects at risk |         | 5,842| 5,842 | 5,535| 5,535 | 5,736| 5,736 |
| Age-trend analyses, p value† |     | 0.15 | 0.0003 | 0.82 | 0.12 | 0.0016 | 0.0001 |

| Gender IRR‡ |        |        |        |
| Men        | 1.0    | 1.0    | 1.0    |
| Women      | 1.6    | 1.2    | 1.3    |

| 95% CI      |        |        |        |
| 1.0–2.5    | 0.9–1.5 | 1.1–1.5 | 1.3–1.6 |

*Subjects with missing data on asthma (n = 740), hay fever (n = 715), or chronic bronchitis (n = 657) in any questionnaire were excluded from analyses of the respective disease.
†Based on birth decades.
‡Calculated by stratifying on birth decades.
among men (IRR, 5.8; 95% CI, 3.6 to 9.5), but the increase was also significant among women (IRR, 4.3; 95% CI, 2.8 to 6.7) (Table 3). Asthma incidences were also elevated among subjects with hay fever or chronic bronchitis during the first 6 years (1976 to 1981) and last 9 years (1982 to 1990) (data not shown).

The risk of asthma in relation to a history of hay

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**Figure 2.** Co-occurrence of hay fever and chronic bronchitis among 94 men and 125 women with asthma (percentages). The occurrence of hay fever and its temporal relationship with asthma were defined among “new asthma cases” (see “Materials and Methods” section) as follows: no hay fever (no hay fever reported in the 1975, 1981, or 1990 questionnaire), prior hay fever (hay fever reported for the first time in an earlier questionnaire than asthma), concomitant hay fever (hay fever and asthma reported for the first time in the same questionnaire), and later hay fever (hay fever reported for the first time in a later questionnaire than asthma). A similar grouping was formed for chronic bronchitis.
fever or chronic bronchitis was also studied exclusively among asthma-discordant twin pairs (Table 4). These risks were consistent with, though somewhat lower than, those found among the individuals of the whole cohort. The risk ratio for hay fever was 3.2 (95% CI, 1.5 to 7.7) and for chronic bronchitis 2.9 (95% CI, 1.2 to 8.0). CIs were wide because of the small number of asthma-discordant pairs also discordant for the condition, especially when subgroups were divided by sex or zygosity. Higher asthma risk owing to hay fever was seen in all subgroups, but was significant only among women and dizygotic twins. Chronic bronchitis similarly increased the risk of developing asthma, but not significantly in any subgroup, and there was no apparent difference by zygosity (Table 4).

Discussion

Because our study population consisted of young and middle-aged adults who were all ≤60 years at the end of the follow-up, we avoided most diagnostic problems common among the elderly. Subjects reporting the study diseases in the first questionnaire in 1975 were excluded from the incidence analyses. It is possible that some of the diseases diagnosed in childhood were not reported in 1975 because they were in remission or forgotten. As Grol et al26 have recently concluded, disappearance of symptoms does not mean the disease is cured. Thus, defining an incident case of asthma is much more difficult than assessing prevalent cases. Nonetheless, the low rates of diagnosed asthma and hay fever in the 1960s and

<table>
<thead>
<tr>
<th>Condition</th>
<th>A. Negatively Concordant</th>
<th>B. Negatively Discordant</th>
<th>C. Positively Discordant</th>
<th>D. Positively Concordant</th>
<th>Total No. of Pairs</th>
<th>RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay fever</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>114</td>
<td>9</td>
<td>29</td>
<td>9</td>
<td>161</td>
<td>3.2</td>
<td>1.5–7.7</td>
</tr>
<tr>
<td>Men</td>
<td>53</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>65</td>
<td>3.5</td>
<td>0.7–34.5</td>
</tr>
<tr>
<td>Women</td>
<td>61</td>
<td>7</td>
<td>22</td>
<td>6</td>
<td>96</td>
<td>3.1</td>
<td>1.3–8.7</td>
</tr>
<tr>
<td>DZ</td>
<td>84</td>
<td>6</td>
<td>21</td>
<td>6</td>
<td>117</td>
<td>3.5</td>
<td>1.4–10.6</td>
</tr>
<tr>
<td>MZ</td>
<td>23</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>36</td>
<td>2.3</td>
<td>0.5–14.0</td>
</tr>
<tr>
<td>Chronic bronchitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>133</td>
<td>7</td>
<td>20</td>
<td>1</td>
<td>161</td>
<td>2.9</td>
<td>1.2–8.0</td>
</tr>
<tr>
<td>Men</td>
<td>54</td>
<td>3</td>
<td>8</td>
<td>0</td>
<td>65</td>
<td>2.7</td>
<td>0.6–15.6</td>
</tr>
<tr>
<td>Women</td>
<td>79</td>
<td>4</td>
<td>12</td>
<td>1</td>
<td>96</td>
<td>3.0</td>
<td>0.9–12.8</td>
</tr>
<tr>
<td>DZ</td>
<td>104</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>117</td>
<td>3.0</td>
<td>0.8–17.2</td>
</tr>
<tr>
<td>MZ</td>
<td>23</td>
<td>3</td>
<td>10</td>
<td>0</td>
<td>36</td>
<td>3.3</td>
<td>0.9–18.9</td>
</tr>
</tbody>
</table>

*DZ = dizygotic; MZ = monozygotic; RR = relative risk of developing asthma in relation to hay fever or chronic bronchitis status (number of pairs in column C divided by number of pairs in column B); A = neither twin had hay fever or chronic bronchitis at baseline; B = twin with asthma did not have hay fever or chronic bronchitis at baseline, whereas co-twin (without asthma during follow-up) had hay fever or chronic bronchitis; C = twin with asthma had hay fever or chronic bronchitis at baseline, whereas co-twin (without asthma during follow-up) did not; D = both twins had hay fever or chronic bronchitis at baseline. Results for 8 pairs of uncertain zygosity are not shown.
earlier in Finland strongly suggest that the incidences of asthma, hay fever, and chronic bronchitis in this study are largely based on cases diagnosed for the first time in adulthood.

We used a questionnaire-based classification of physician-diagnosed asthma, hay fever, and chronic bronchitis. The advantage of using these diagnoses lay in the consistency of follow-up information provided by the identical questions in each questionnaire. Finns tend to know quite well what diseases they have when their knowledge is compared with medical records. The validity of questionnaire-based diagnoses of asthma is adequate according to previous studies. Moreover, questionnaire-based diagnoses of asthma are both sensitive and specific as predictors of asthma deaths. In the present study, about 40% of those who reported asthma in 1981 for the first time no longer reported it in 1990, consistent with previous study findings. Hay fever was reported somewhat more consistently than asthma in the present study, and a Norwegian study shows good agreement between self-reported diagnosis of hay fever and the physician’s clinical examination. Thus, questionnaire-based information for hay fever, too, can be considered adequate. Of those reporting chronic bronchitis in 1981, half no longer reported it 9 years later, probably because definition problems are common in all epidemiologic studies of chronic bronchitis, and the occurrence of symptoms of chronic bronchitis is known to vary over time. However, cumulative incidences were based on diagnoses in one or both questionnaires to discover the total probability of having these diseases diagnosed during the follow-up period.

Asthma prevalences in 1975 were consistent with those of previous studies in Finland and Sweden. The present study detected only a slight rise in the prevalence of asthma during 1975 to 1990, whereas a Finnish study on conscripts showed as high as a sixfold increase in recent decades. The age distribution of our study group differed from that of Haahdela et al because our data included no young adults <30 years old in prevalence calculations. Thus, the greater rise in asthma prevalence of other studies is probably because of an increase among children and young adults. Moreover, our prevalence figures are based on subjects aged 30 to 59 years old at the time of each survey, and thus on different subjects from our incidence analysis.

Cumulative incidence provides an estimate of the probability, or risk, that an individual will develop a disease during a specified period of time. The probability of developing asthma during the 15-year period was approximately 2% for both men and women, but risk was dependent on age, even though all subjects were adults. Thus, on average, 1.6 new asthma diagnoses were made annually per 1,000 adults, which is consistent with the annual age- and sex-adjusted incidence for definite asthma (1.38/1,000) in the study of Yang et al and with the standardized incidence (2.10/1,000/yr) found by McWhorter et al. The probability of being diagnosed with hay fever during the same period was higher, with men having a risk of almost 10% and women, 13.6%, although age had no effect. This means that annually there is an average of six new hay fever diagnoses among 1,000 adult men and nine among 1,000 adult women.

The increase in asthma incidence between 1976 to 1981 and 1982 to 1990 was more obvious among men than women, although neither was statistically significant; at the same time the incidence of chronic bronchitis decreased. It is possible that these trends are partly because of changes in diagnostic criteria, especially among men, with a preference for an asthma diagnosis. Atopy is found to be a predisposing factor for chronic bronchitis, but allergic subjects with symptoms such as cough and phlegm are more likely to be considered as asthmatics than chronic bronchitis sufferers. One reason is that in Finland the costs of asthma medication have been better subsidized by the Social Insurance Institution of Finland throughout the whole study period, whereas medication costs for chronic bronchitis have been included in this higher subsidy category only since 1986.

The association between smoking and chronic bronchitis is well-known. The proportion of smoking men has been decreasing in Finland, and Finnish women are also currently smoking less than before, although a rising trend appeared among women during the 1980s. Thus, the decrease in incidence of chronic bronchitis cannot be explained wholly by smoking habits. In the present study, the women were more likely to have chronic bronchitis, whereas a Swedish study on the prevalence of chronic bronchitis showed a significantly higher prevalence among men than women. Our proportion of subjects reporting chronic bronchitis in 1981 but no longer in 1990 was higher among men than women; thus men diagnosed soon after the 1981 questionnaire might have forgotten to report it in the next questionnaire, especially if they had quit smoking during the follow-up interval.

The prevalence of allergic rhinitis has increased among young Swedish men, and there has been an increase in hay fever prevalence in all age groups in England and Wales, without the same trend in hay fever incidence. The present study showed no change in the incidence of hay fever during the two follow-up periods among women, but among men there was a significant decrease. However, the prev-
The incidence of asthma was significantly higher among our subjects with hay fever or chronic bronchitis. These diseases cannot be considered purely as predisposing factors for asthma, because they may also be early symptoms or manifestations of asthma, as seen in the temporal relationship of the diagnoses. Thus, the increase in asthma risk caused by these diseases is probably overestimated, but still significant. The data on our discordant-twin pairs indicate that hay fever and chronic bronchitis increase the risk of developing asthma, even when compared with the risk in siblings.

In conclusion, there was a slight increase in the prevalence of asthma during 1975 to 1990 and also some evidence of a rise in asthma incidence. The prevalence of hay fever has also increased during recent decades, even though no rise in hay fever incidence has occurred. That hay fever was a strong predictor of new asthma cases and that hay fever and chronic bronchitis were almost always made before or at the same time as the diagnosis of asthma, but rarely afterwards.

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