Intergenerational 20 year trends in the prevalence of asthma and hay fever in adults: the Midspan family study surveys of parents and offspring

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Abstract

Objective To estimate trends between 1972-6 and 1996 in the prevalences of asthma and hay fever in adults.

Design Two epidemiological surveys 20 years apart. Identical questions were asked about asthma, hay fever, and respiratory symptoms at each survey.

Setting Renfrew and Paisley, two towns in the west of Scotland.

Subjects 1477 married couples aged 45-64 participated in a general population survey in 1972-6; and 2338 offspring aged 30-59 participated in a 1996 survey. Prevalences were compared in 1708 parents and 1124 offspring aged 45-54.

Main outcome measures Prevalences of asthma, hay fever, and respiratory symptoms.

Results In never smokers, age and sex standardised prevalences of asthma and hay fever were 3.0% and 5.8% respectively in 1972-6, and 8.2% and 19.9% in 1996. In ever smokers, the corresponding values were 1.6% and 5.4% in 1972-6 and 5.3% and 15.5% in 1996. In both generations, the prevalence of asthma was higher in those who reported hay fever (atopic asthma). In never smokers, reports of wheeze not labelled as asthma were about 10 times more common in 1972-6 than in 1996. With a broader definition of asthma (asthma and/or wheeze), to minimise diagnostic bias, the overall prevalence of asthma changed little. However, diagnostic bias mainly affected non-atopic asthma. Atopic asthma increased more than twofold (prevalence ratio 2.52 (95% confidence interval 1.01 to 6.28)) whereas the prevalence of non-atopic asthma did not change (1.00 (0.53 to 1.90)).

Conclusion The prevalence of asthma in adults has increased more than twofold in 20 years, largely in association with trends in atopy, as measured indirectly by the prevalence of hay fever. No evidence was found for an increase in diagnostic awareness being responsible for the trend in atopic asthma, but increased awareness may account for trends in non-atopic asthma.

Introduction

The prevalence of asthma has increased in children during the past few decades.[1 2] As childhood asthma may persist or recur during adulthood, an increasing prevalence of asthma in adults is expected as cohorts of children increasingly affected by asthma become older. Studies of students[3] and conscripts[4] suggest that the prevalence of asthma is rising in young adults, but little information exists at older ages.

Methodological questions often dominate the interpretation of secular trends.[5] To minimise bias, the same survey instrument should be used on two or more occasions in populations that are defined as far as possible in the same way. As there is no test for asthma, the detection of secular trends relies on questionnaires. Changes in awareness and diagnosis of asthma may influence trends detected by questionnaire, so it is important to ask about symptoms. In older populations, however, cigarette smoking makes it difficult to attribute symptoms to asthma.[6]

We compared the prevalence of asthma and hay fever, and the combined prevalence of recognised and unrecognised asthma, in two generations of men and women aged 45 to 54 years. Both generations had taken part in the Midspan family study in Renfrew and Paisley, in the west of Scotland; the older generation had taken part in 1972-6[7] and the younger generation (the offspring) in 1996.[8]

Methods

Sampling

Parents—All residents of Renfrew and Paisley aged 45 to 64 years were invited in 1972-6 to complete a questionnaire and attend a cardiorespiratory examination; 15 406 men and women participated (response rate 78%),[7] among whom there were 4064 married couples.

Offspring—Offspring were identified by writing to survivors in the couples who had participated. Where records showed that husband and wife had both died, permission was obtained from the privacy committee of the registrar general for Scotland to write to the death certificate informant.[9] Addresses of survivors or informants were available for 3445 couples, and replies were received from 2841. We identified 4829 offspring

aged 30-59 years from up to 2365 couples with children (the precise number is unknown because 200 couples did not want to take part in the pilot study in which we traced offspring); 3202 offspring from 1767 families lived locally and formed the eligible population. In 1996 these offspring were invited to complete a questionnaire and attend a cardiorespiratory examination at a community clinic.[8] In all, 1040 male and 1298 female offspring from 1477 families participated (response rate for individuals was 73% and for families was 84%). Approval for the study was obtained from appropriate local research ethics committees.

Survey methods

The following questions, extracted or adapted from the 1965-6 version of the Medical Research Council's questionnaire,[10] were asked at both surveys:

- Hay fever: "Do you suffer from, or have you ever suffered from, hay fever?"
- Asthma: "Do you suffer from, or have you ever suffered from, asthma?"
- Wheeze: "Does your chest sound wheezy or whistling on most days (or nights)?"
- Chronic sputum: "Do you usually bring up any phlegm from your chest first thing in the morning in the winter?" and "Do you bring up phlegm like this on most days for as much as three months in the winter each year?"
- Breathlessness: "Do you get short of breath walking with other people of your own age on level ground?"

In 1996, offspring also answered the European Community respiratory health survey questionnaire.[11] There were small differences between the surveys in smoking questions, chiefly because the 1970s instrument did not ask about occasional smoking. We have ignored pipe or cigar use, which were and are uncommon. Social class was coded using the registrar general's classification.[12]

Analysis

Statistical procedures were performed in STATA.[13] Prevalences were directly standardised for age in five year age groups. We used logistic regression to adjust for age when testing the significance ($P<0.05$) of differences between parents and other participants. We estimated prevalence ratios (95% confidence intervals) between generations using logistic regression, adjusting for age, sex, and other covariates as indicated, and for familial clustering. Any effect of clustering will be small because the mean number of offspring (aged 45-54) per family was 1.3.

Results

The ages of parents and offspring mainly overlapped at 45-54. In 1972-6, 7897 participants aged 45-54 had complete data, of whom 1708 were parents of offspring who participated in 1996. Of 2338 participant offspring, 1124 were aged 45-54 with complete data. At ages 45-49 and 50-54 there were respectively 213 and 524 fathers, 443 and 528 mothers, 322 and 172 sons, 405 and 225 daughters. The total number of participants was therefore 2832.

Selection of parents

The prevalences of hay fever, asthma, wheeze, chronic sputum, and breathlessness were lower in the family study parents compared with those of other participants in 1972-6, but only the difference for wheeze in women was significant (table 1). Differences in the prevalence of symptoms between parents and other participants participating in 1972-6 were largely explained by differences in smoking and social class (data not shown).

Table 1 Age standardised prevalences (numbers of participants) of respiratory illness in Renfrew and Paisley study during 1972-6 in parents aged 45-54 whose offspring subsequently participated during 1996, and in all other participants aged 45-54 in 1972-6 study

	Men		Women	
	Family study fathers (n=737)	All other participants (n=2994)	Family study mothers (n=971)	All other participants (n=3195)
Hay fever	5.4 (42)	6.0 (181)	5.8 (56)	7.6 (243)
Asthma	1.4 (13)	2.7 (82)	2.8 (27)	3.3 (105)
Wheeze	13.9 (109)	15.6 (465)	9.0 (88)	11.8 (377)*
Chronic sputum	23.9 (181)	26.3 (787)	13.4 (130)	13.9 (445)
Breathlessness	9.0 (67)	10.5 (308)	13.2 (128)	15.6 (497)

Standardisation for age differences means that percentages differ from estimates based on raw numerators and denominators.
*P<0.05 for family study mothers versus all other female participants.

Changes in prevalence of respiratory illness, smoking, and social class

Table 2 shows the changes in the prevalences of respiratory illness, smoking, and social class during the 20 year interval. The prevalences of hay fever and asthma increased: for hay fever, from 5.4% and 5.8% in men and women respectively in 1972-6 to 15.4% and 20.0% in 1996; for asthma, from 1.4% and 2.8% in 1972-6 to 4.9% and 8.0% in 1996. In both generations the prevalence of asthma was higher in participants with hay fever. Despite the increased prevalence of asthma in the 1996 survey, the prevalence of wheeze had decreased in men and women, as had the prevalences of chronic sputum and breathlessness. The prevalence of current smoking halved in men and women between

Table 2 Age standardised prevalences (numbers of participants) of respiratory illness, smoking, and social class at age 45-54 years

	Men		Women	
	Fathers, 1972-6 (n=737)	Sons, 1996 (n=494)	Mothers, 1972-6 (n=971)	Daughters, 1996 (n=630)
Respiratory illness				
Hay fever	5.4 (42)	15.4 (79)	5.8 (56)	20.0 (128)
Asthma:				
In those without hay fever	1.0 (9)*	4.1 (16)*	1.8 (16)*	4.8 (25)*
In those with hay fever	9.7 (4)†	9.1 (9)†	19.9 (11)†	20.5 (26)†
All	1.4 (13)	4.9 (25)	2.8 (27)	8.0 (51)
Wheeze	13.9 (109)	5.7 (28)	9.0 (88)	4.7 (27)
Chronic sputum	23.9 (181)	14.2 (73)	13.4 (130)	7.0 (43)
Breathlessness	9.0 (67)	6.3 (29)	13.2 (128)	9.2 (60)
Cigarette smoking				
Never	20.4 (151)	38.2 (199)	40.0 (389)	46.2 (296)
Former	24.6 (190)	35.4 (166)	8.3 (81)	29.4 (185)
Current	55.0 (396)	26.4 (129)	51.7 (501)	24.4 (149)
Social class				
Non-manual	32.5 (242)	55.4 (274)	47.2 (457)	76.7 (480)
Manual	67.5 (495)	44.6 (220)	52.8 (514)	23.3 (150)

Standardisation for age differences means that percentages differ from estimates based on raw numerators and denominators.
*Denominator is those without hayfever.
†Denominator is those with hayfever.

Table 3 Age and sex standardised prevalences (numbers of participants) of respiratory illness by smoking status, and prevalence ratios in 1996 compared with 1972-6 in men and women aged 45-54 years

	1972-6	1996	Prevalence ratio adjusted for age and sex	Prevalence ratio adjusted for all covariates*
Never smokers	n=540	n=495		
Hay fever	5.8 (34)	19.9 (110)	4.17 (2.75 to 6.32)	3.53 (2.30 to 5.43)
Asthma:				
In those without hay fever	1.8 (12)†	6.3 (23)†	2.54 (1.21 to 5.33)	2.86 (1.36 to 6.02)
In those with hay fever	18.1 (8)‡	13.0 (19)‡	0.65 (0.24 to 1.77)	0.76 (0.25 to 2.36)
All	3.0 (20)	8.2 (42)	2.38 (1.34 to 4.23)	2.60 (1.41 to 4.80)
Wheeze	4.6 (24)	1.1 (6)	0.31 (0.12 to 0.80)	0.32 (0.11 to 0.90)
Chronic sputum	5.1 (26)	5.1 (28)	1.03 (0.60 to 1.79)	1.11 (0.60 to 2.04)
Breathlessness	8.3 (55)	6.3 (32)	0.68 (0.42 to 1.09)	0.92 (0.55 to 1.53)
Asthma and/or wheeze	6.4 (37)	8.5 (44)	1.33 (0.83 to 2.15)	1.40 (0.83 to 2.36)
Ever smokers	n=1168	n=629		
Hay fever	5.4 (64)	15.5 (97)	3.21 (2.28 to 4.53)	2.76 (1.91 to 3.98)
Asthma:				
In those without hay fever	1.0 (13)†	3.4 (18)†	3.17 (1.57 to 6.42)	2.92 (1.37 to 6.23)
In those with hay fever	11.6 (7)‡	15.9 (16)‡	1.46 (0.54 to 3.95)	0.95 (0.33 to 2.76)
All	1.6 (20)	5.3 (34)	3.36 (1.94 to 5.82)	2.69 (1.49 to 4.84)
Wheeze	14.2 (173)	8.1 (49)	0.53 (0.37 to 0.76)	0.79 (0.53 to 1.17)
Chronic sputum	23.9 (285)	14.2 (88)	0.50 (0.38 to 0.66)	0.73 (0.55 to 0.97)
Breathlessness	12.0 (140)	8.8 (57)	0.75 (0.54 to 1.05)	0.85 (0.59 to 1.22)
Asthma and/or wheeze	15.1 (184)	12.0 (75)	0.77 (0.57 to 1.04)	1.04 (0.76 to 1.43)

Standardisation for age differences means that percentages differ from estimates based on raw numerators and denominators.
*Age, sex, and social class in never smokers; and age, sex, social class, pack years, and former or current status in ever smokers.
†Denominator is those without hay fever.
‡Denominator is those with hay fever.

1972-6 and 1996. The proportion of men and women who were manual workers also fell.

"Ever asthma," current asthma, and wheeze

Of the participants with asthma, 40% (16/40) and 16% (12/76) reported wheeze most days in 1972-6 and 1996 respectively. Participants in 1972-6 were not asked about medication. Improvements between surveys in the treatment of asthma, however, may explain the reduction in the prevalence of wheeze in those who reported asthma: 47% (36/76) of asthmatic participants reported using inhaled corticosteroids in 1996. Although wheeze was the symptom most strongly associated with asthma, the observation at both surveys that fewer than half of the asthmatic participants reported wheeze probably also reflects the severity of the definition of wheeze (most days) and the use of "ever" rather than "current" asthma. In 1996, 62% (47/76) of participants with ever asthma had current asthma according to the criteria of the European Community respiratory health survey—that is, they were receiving medication for asthma or had experienced an attack of asthma in the previous 12 months, or both of these. Of these 47 participants, 23%[11] reported wheeze most days and 81%[38] reported wheeze at some time during the previous year.

Table 4 Age and sex standardised prevalences (numbers of participants) of asthma ("asthma" and "asthma and/or wheeze") in never smokers by hay fever status, and prevalence ratios in 1996 compared with 1972-6

Asthma definition	1972-6 (n=540)	1996 (n=495)	Prevalence ratio adjusted for all covariates	P value
Asthma:				
With hay fever	1.3 (8)	3.0 (19)	2.65 (0.99 to 7.09)	0.052
Without hay fever	1.7 (12)	5.2 (23)	2.43 (1.13 to 5.19)	0.023
All	3.0 (20)	8.2 (42)	2.60 (1.41 to 4.80)	0.002
Asthma and/or wheeze:				
With hay fever	1.4 (9)	3.2 (20)	2.52 (1.01 to 6.28)	0.048
Without hay fever	5.0 (28)	5.3 (24)	1.00 (0.53 to 1.90)	0.996
All	6.4 (37)	8.5 (44)	1.40 (0.83 to 2.36)	0.203

Standardisation for age differences means that percentages differ from estimates based on raw numerators and denominators.

Prevalence changes stratified by smoking

Table 3 shows the changes in prevalence of respiratory illness by smoking status. The prevalences of asthma and hay fever increased between surveys irrespective of smoking: fully adjusted prevalence ratios for hay fever were 3.53 (95% confidence interval 2.30 to 5.43) and 2.76 (1.91 to 3.98) in never and ever smokers respectively, and those for asthma were 2.60 (1.41 to 4.80) and 2.69 (1.49 to 4.84). In never smokers the prevalence of wheeze was lower in 1996 than in 1972-6 (0.32 (0.11 to 0.90)), whereas the prevalences of chronic sputum and breathlessness were unchanged. In ever smokers the prevalence of symptoms changed little between surveys. In combined data for never and ever smokers, including adjustments for smoking status and pack years, the fully adjusted prevalence ratio for wheeze was 0.68 (0.48 to 0.99).

Diagnostic bias

Ten times as many never smokers reported wheeze but not asthma in 1972-6 (3.4%[17]) compared with 1996 (0.3%[2]). This finding is based on small numbers, but a similar age standardised proportion of never smokers reported wheeze but not asthma in the entire 1972-6 survey (3.5% (74/2345)). In 1996, none of the never smokers who denied asthma or wheeze reported using inhaled corticosteroids, so the low prevalence of wheeze that was not labelled as asthma was unlikely to be due to treatment. To minimise diagnostic bias we combined participants with asthma with those who reported wheeze (whether or not they reported asthma) as a new group (asthma and/or wheeze). Whereas the prevalence of reported asthma increased more than twofold between surveys, the prevalence of reported asthma and/or wheeze in never smokers changed little (fully adjusted prevalence ratio 1.40 (0.83 to 2.36)).

Hay fever and asthma

Clinicians and epidemiologists often use hay fever as a marker of atopy. Table 3 shows the prevalence of asthma in participants with and without hay fever, estimated by using individuals in each stratum as denominator. Asthma increased between the surveys in those without but not with hay fever (heterogeneity test $P = 0.02$). Even though asthma was no more frequent at the later survey in those with hay fever, the increased prevalence of hay fever in the whole population resulted in an increased proportion of the population who reported both asthma and hay fever (atopic asthma). We estimated prevalence trends for atopic and non-atopic asthma in never smokers. Using the narrow definition of asthma, table 4 shows an increased prevalence of atopic and non-atopic asthma between 1972-6 and 1996. However, using the broad definition (asthma and/or wheeze) only atopic asthma increased between surveys. Diagnostic bias therefore mainly affected non-atopic asthma. Findings were unchanged when we restricted the analysis to parents

and married offspring or substituted all participants of the 1972-6 survey for the parents (data not shown).

Discussion

Methodology

Parents participated in a general population survey with a high response.[7] Families in which two generations participated were not randomly drawn from all families in Renfrew and Paisley because the combination of a successful response to offspring tracing[9] in 1993-4 and offspring participation[8] in 1996 retrospectively "selected" couples who were healthier than the general population. Absolute prevalences of respiratory illness in parents slightly underestimate those in the general population survey, but it is reasonable to expect intergenerational trends in these families to follow trends in the general population. It is likely that we underestimated the lifetime prevalence of asthma and hay fever because recall tends to reflect prevalence over a shorter time period.[14] We asked identical questions about respiratory illness at both surveys but did not measure bronchial responsiveness or atopy.

Main findings

We found a twofold to threefold increase between 1972-6 and 1996 in the prevalences of lifetime asthma and hay fever reported by adults aged 45-54, irrespective of smoking. In never smokers, reports of wheeze not labelled as asthma were about 10 times more common in parents and all participants of the general population survey in 1972-6 compared with offspring in 1996. In view of the increased professional and public awareness of asthma since the 1980s,[15] our findings probably reflect underrecognition of asthma 20 years ago. To assess the effect of possible diagnostic bias, and also confounding by cigarette smoking, we reviewed trends in the prevalence of any report of asthma and/or wheeze in never smokers. Little difference existed between parents and offspring in the prevalence of this broader definition of asthma. Subgroup analysis showed that the increased clinical recognition of asthma had occurred in non-atopic rather than atopic participants (using the presence of hay fever as a marker of atopy). Based on our broader definition of asthma, the prevalence of non-atopic asthma did not change between 1972-6 and 1996, but the prevalence of atopic asthma increased more than twofold.

Comparison with other studies

Few opportunities exist for comparing prevalences of asthma and hay fever at an interval of 20 years in older adults because most epidemiological studies during the 1970s focused on cardiovascular disease and chronic bronchitis. To our knowledge this is the first population study of secular trends of respiratory illness in older adults that is stratified by smoking. Fleming and Crombie[16] reported twofold rises in consultation rates for asthma and hay fever in British general practices at all ages between 1970-1 and 1980-1, but lack of information about smoking and symptoms may have biased this study[16] and other studies based solely on healthcare records. In repeated Australian surveys,[17] hay fever increased between 1981 and 1990, but the prevalences of wheeze and diagnosed asthma increased only in those aged below 40. Reviewing British population studies, Cook et al[6] reported that the prevalence of chronic sputum, but not wheeze, had fallen in line with decreased smoking and suggested that wheeze may have been sustained by factors related to asthma that were increasing. In our study, reports of wheeze most days decreased over time (despite increased asthma) and fewer asthmatics reported wheeze in 1996 than in 1972-6. This may be the result of improved asthma treatment. Although we did not record medication in 1972-6, primary care corticosteroid prescriptions for asthma increased more than sixfold between 1980 and 1990.[18]

What is already known on this topic

The prevalences of asthma and atopy have increased in children, university students, and conscripts during the past few decades, but little information exists about trends at older ages

Prevalence trends detected by questionnaire are vulnerable to biases, including information bias from changed awareness and diagnosis of asthma

What this study adds

The prevalence of asthma in adults has increased more than twofold in 20 years, largely in association with trends in atopy (indexed by hay fever)

No evidence was found for increased diagnostic awareness being responsible for the trend in atopic asthma, but increased awareness may account for trends in non-atopic asthma

Heterogeneity of asthma

Without objective measurements we cannot be certain that the prevalence of atopy increased between surveys, nor can we validate the atopic status of the groups with and without hay fever. Strong positive associations between hay fever and asthma at both surveys support the validity of hay fever as an atopic marker, but relations between asthma, hay fever, skin test reactivity, and immunoglobulin E are complex.[19 20] The heterogeneity of asthma in children is well recognised, but in studies of respiratory disease in adults asthma is often considered as a single entity to be distinguished from emphysema and chronic obstructive pulmonary disease.[20 21] Studies that have used atopic markers to subdivide asthma in adults have shown differences in rate of decline of lung function[22] and mortality.[23] It is therefore important to investigate which asthma phenotypes are becoming more common. Our results are consistent with reported increases in prevalence of atopic, rather than non-atopic, wheeze in children.[24]

Conclusion

The prevalence of asthma in adults has increased more than twofold in 20 years, largely in association with trends in atopy, as measured indirectly by the prevalence of hay fever. Greater diagnostic awareness does not seem to be responsible for the trend in atopic

asthma, but increased awareness may account for trends in non-atopic asthma.

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Contributors: GCMW conceived the idea for the Midspan family study. GCMW and GDS conceived the 20 year comparison of respiratory disease. MNU designed the questionnaire and supervised fieldwork in 1996. Victor Hawthorne and CRG supervised fieldwork in 1972-6. MNU conceived and performed the analysis and wrote the first draft of the paper. CMcS supported MNU with early drafts. AMcC checked the analysis and managed the 1996 database. CLH managed the 1970s database. All authors contributed to data interpretation and revisions to multiple drafts of the manuscript. MNU is guarantor for the paper.

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Memorable patients

Up close and personal

I recently had the opportunity to observe the progress of two middle aged women admitted to hospital after a stroke. I occupied the bed between them. Both had similar levels of impairment and had been in hospital for several months, and plans for their discharge were progressing.

Mary could easily have graced the "memorable patient" column. She was intelligent, articulate, despite severe dysarthria, was positive, willing to give anything a go, and had a wicked, infectious sense of humour. She was popular. Ruth on the other hand was quiet, and somewhat introverted, complained a lot, and found every step in her rehabilitation fraught with danger.

Around Mary's bed there was always a throng of visitors, and when they left it was difficult to see her for the flowers and garlands of cards. In contrast, Ruth rarely had visitors and had only a handful of cards. She told me that she preferred to sleep through visiting times to dispel her loneliness. Very occasionally she became animated and chatty, such as on return from a car trip with people from the local church.

It is generally accepted that personality and social support are the best predictors of recovery, and it will come as no surprise that Mary's functional progress was excellent and Ruth's was slow. What came as a surprise to me was not the contrast between the two women but the contrast in the way that they were treated. I saw the effects of throw away comments made by the staff, half joking, half serious, that built up the one and diminished the other. I watched the subtle differences in approach that could have unintentional but devastating effects.

Mary's small steps of progress were greeted with delighted cries of "Well done, you're a star. Keep up the good work." Ruth's faltering steps usually provoked such responses as, "See. We told you you could do it. What was there to be so frightened of after all?" It was as if people believed that Ruth's fear of falling could be reasoned or even bullied away. I do not know how many of the staff had been able to sit with her long enough to learn that when she had her stroke she fell backwards down a flight of stairs. She remembers hitting every single step. Ruth complained of being ignored, and it was not paranoia. She gave little back to those who did try to help her. She did not have the energy.

It seemed as if Mary, who had everything, was given more, and Ruth, who had so little, had even that taken away. Have I been guilty of doing that? We can and should learn from our exceptional patients, but our understanding, compassion, and skills should extend to all our patients. I am starting to improve by acknowledging that my actions and casual comments can so easily and subtly undermine this ideal.