Temporal change in the prevalence of respiratory symptoms and obstructive airways disease 1993–2001

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ABSTRACT

Background
There has been little available information regarding secular changes in the prevalence of respiratory symptoms since the mid-1990s.

Aim
To examine changes in the prevalence of respiratory symptoms for 1993–2001.

Design of study
A series of postal questionnaire surveys.

Setting
Two general practice populations, including all age groups.

Method
Four postal respiratory questionnaire surveys were conducted between 1993 and 2001. Subjects who replied to two or more surveys (8058 adults and 2350 children) were included in the main analyses. Validated scoring systems were used to define obstructive airways disease in adults and asthma in children.

Results
Over the 8-year observation period there were increases among adults in the crude prevalence of wheeze, being woken by cough, receipt of current asthma medication, and of obstructive airways disease, compared with decreases in children for wheeze, night cough, asthma attacks, and asthma. For adults, adjusted odds ratios per year of secular increase were 1.03 (95% confidence interval [CI] = 1.02 to 1.03) for wheeze, 1.03 (95% CI = 1.02 to 1.03) for being woken by cough, 1.03 (95% CI = 1.02 to 1.04) for asthma medication, and 1.02 (95% CI = 1.01 to 1.03) for obstructive airways disease. These increases were greater in those aged over 44 years, in males, and in those without a family history of asthma or a history of hayfever or eczema. Corresponding decreases for children were 0.94 (95% CI = 0.92 to 0.97) for wheeze, 0.93 (95% CI = 0.91 to 0.96) for night cough, 0.93 (95% CI = 0.90 to 0.95) for asthma attacks and 0.98 (95% CI = 0.95 to 1.00) for asthma.

Conclusion
The increases found in adults are more likely to be due to chronic obstructive pulmonary disease (COPD) than asthma. This is supported by the decreases in symptom and asthma prevalence in children.

Keywords
asthma; pulmonary disease, chronic obstructive; signs and symptoms, respiratory; trends.

INTRODUCTION

It is generally agreed that asthma prevalence increased between the 1970s and the early 1990s[1–11] in countries with widely differing lifestyles and ethnic groups.[12] However, although there are some reported changes since 1995,[13] there is less consensus concerning trends since then and whether any changes were real or apparent.[14–16] Increased chronic obstructive pulmonary disease (COPD) has also been reported.[17–19] Interpretation of both asthma and COPD trends is further complicated by differences in methodology, diagnostic criteria, epidemiological terminology, and population characteristics.[3,15,20,21] No recent study has examined respiratory-symptom trends in a combined adult and child population. Furthermore, most studies use only two points of measurement, which may give an inherently unreliable measure of trend.[16]

Reports of prevalence trends have relied mostly on repeated cross-sectional surveys in different populations living under similar conditions,[3] but interpretation may be misleading due to changes in the populations studied at each survey. Longitudinal studies can provide important aetiological clues that may be missed by repeated cross-sectional surveys.[21]

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The present study includes both longitudinal and repeated cross-sectional data from identical surveys at four time points between 1993 and 2001, in two general practice populations. Examination of secular changes in both obstructive airways disease and in symptoms suggesting respiratory disease surmounts the difficulties in defining asthma and COPD.

The study (approved by the local research ethics committee) forms part of the Wythenshawe Community Asthma Project (WYCAP), a long-term observational study of respiratory illness.[22-26]

How this fits in

There is some evidence that the trend in the increasing prevalence of asthma, found up to the early 1990s, has flattened in recent years. Little objective evidence is available, however, from UK studies that include all age groups. The present study is based on 8 years' observation of two general practice populations and supports a reduction in the prevalence of asthma in both adults and children between 1993 and 2001. The increasing prevalence of respiratory syptoms in adults is likely to reflect an increase in the prevalence of COPD, reinforcing the need for clinicians to address the smoking problem in this country.

METHOD

In 1993, 1995, 1999, and 2001 postal questionnaires were sent to all subjects registered with two neighbouring general practices. Non-responders were sent reminders after 4 and 8 weeks. Persistent non-responders either no longer lived at the mailing address ('ghosts') or simply didn't reply ('true non-responders'). For the 1993 survey, ghost patients were estimated to be 5.4% of the adult population in these practices.[22] This proportion was assumed in subsequent surveys.

Responders to two or more surveys were included in the main analyses; subjects entered in 1993, 1995 or 1999 and were observed over 2–8 years.

The adult questionnaire was based on the European Community Respiratory Health Questionnaire[27]. The questionnaire that was completed by a parent/guardian for children (aged <16 years) was based on that used for the International Study of Asthma and Allergies in Children.[28]

Temporal prevalence trends in symptoms, risk factors and the likely prevalence rates for obstructive airways disease (OAD) in adults and asthma in children were examined. Adult OAD was defined as four or more symptoms/risk factors from the following six questions on: wheeze, being woken by cough, being woken by tightness in the chest, being woken by shortness of breath (all in the previous year), history of hayfever/eczema, and family history of asthma. Childhood asthma was defined by three or more of the following five questions on: wheeze, night cough, more than three course of antibiotics (all in the past year); history of hayfever/eczema, and family history of asthma. These scoring systems have been shown to be good at identifying adults with OAD[24] and children aged 5–15 years with asthma.[26] The children's scoring system was only used for this age group.

Analysis

A series of cross-sectional surveys, with many subjects included more than once, gave the study a quasi-longitudinal structure. Within-subject changes over time could be examined using standard longitudinal statistical techniques in addition to estimating crude prevalence for individual surveys. Thus, two types of analysis were carried out.

The first analysis calculated crude symptom, OAD (adults), and asthma (children) prevalence for all responders to each survey. This included individuals excluded from the second analysis as they only answered one survey, but it is likely to yield the most accurate prevalence estimates.

The second (and main) analysis only included responders to at least two surveys, allowing consideration of changes in prevalence over time on a longitudinal basis, but with a reduced number of subjects. Children who reached the age of 16 years by the time a second questionnaire was due were excluded from these analyses because they were no longer eligible to receive the children's questionnaire after this age. The Generalised Estimating Equations (GEE) approach using STATA 6.0 (Stata Corporation, College Station, Texas) took account of the repeated measures made, assuming a constant correlation between any pair of time points (independent of year of measurement). Analysis of subjects who answered all four surveys would have been statistically less stable, both due to smaller numbers being included and potential inclusion bias.

The principal analysis determined the effect of 1 year's advance in time on the 1-year prevalence of symptoms or OAD (in adults) or asthma (in children), after adjustment for confounders measured at the time of each survey expressed as an odds ratio (OR) with 95% confidence intervals (CIs) constructed using robust standard errors. Adult potential confounders considered were current cigarette smoking status, gender, and age; for children these were gender, age, and exposure to tobacco smoke (based on the report of adult smokers in the household). History of hayfever/eczema and family history of asthma were also included as potential confounders for individual symptoms in both adults and children. Age was included as a categorical, rather than a

Table 1. Number of responders in the four surveys by the number of surveys to which they replied.

Questionnaires answered (*n*)	Adults (*n*)	Percentage	Children (*n*)	Percentage
4	3045	23.4	366	7.9
3	2112	16.2	632	13.6
2	2901	22.3	1297	27.9
1	4949	38.1	2350	50.6
Total responders	13 007	100.0	4645	100.0

linear, variable as empirical clinical evidence suggests a bimodal distribution of symptom prevalence with resolution as the youngest group ages (both adults and children).

Differences in change over time relating to gender, smoking (smokers at home for children), age, hayfever/eczema, and family history of asthma were investigated. First, a stratified analysis of time trends (after adjustment for confounders) in subgroups was made. Second, an interaction term of time with each specific factor was incorporated into the GEE models to represent possible diverse time trends between subgroups. This was expressed as an OR for the difference in secular change, for example between males and females. Occasionally, *P* values are reported as <0.05 but the 95% CIs include 1.00. This is because the CI limits are rounded to two decimal places.

RESULTS

The adult response rates after adjustment for ghosts were 76.3% (1993), 76.8% (1995), 71.0% (1999), and 68.9% (2001); for children these were 77%, 74%, 69%, and 67% respectively. In all, 13 007 adults aged 16–97 years, and 4645 children ≤16 years completed at least one questionnaire. Information was available for at least two surveys in respect of almost two-thirds of these in adults (62%) and almost half in children (49.4%) (Table 1). However, 1363 children had reached the age of 16 years by the time of their second survey and were, therefore, not eligible to be included in the main analyses. If these are excluded from the total of 4645, then replies to two or more surveys were received for 69.9% of children.

In order to establish whether adult non-responders were materially different from responders, a 5% random sample from each group in 1993 was compared with respect to age, gender, practice record of 'asthma diagnosis', and number of respiratory and total consultations in the previous year. Responders were older and more likely to have consulted during 1993, but were similar in other respects. For children, using the 1999 survey, random samples of 100 children from each group were compared with respect to age, gender, number of respiratory and total number of consultations for the previous year. There were no important differences between the groups on any of these parameters. This suggests that non-response is unlikely to have biased the results.

Table 2. Crude percentage prevalence of individual symptoms, receipt of asthma medication, or obstructive airways disease in adults who responded to the specific question in each survey.[a]

	1993		1995		1999		2001	
	n	Prevalence (95% CI)	*n*	Prevalence (95% CI)	*n*	Prevalence (95% CI)	*n*	Prevalence (95% CI)
Wheeze[b]	7653	30 (29 to 31)	6924	30 (29 to 31)	6455	35(33 to 36)	6344	34 (33 to 35)
Woken by chest tightness[b]	7630	21 (21 to 22)	6939	21 (20 to 22)	6496	22 (21 to 23)	6374	20 (20 to 22)
Woken by cough[b]	7653	31 (30 to 32)	6916	33 (31 to 34)	6499	35 (34 to 36)	6393	36 (35 to 37)
Woken by shortness of breath[b]	7614	14 (13 to 15)	6940	14 (13 to 14)	6492	15 (14 to 16)	6368	14 (13 to 15)
Asthma attack[b]	7648	8 (7 to 9)	6928	8 (7 to 9)	6486	9 (8 to 9)	6359	8 (7 to 9)
Current asthma medication	7700	12 (11 to 13)	6990	12 (11 to 13)	6526	14 (13 to 15)	6421	14 (13 to 15)
Obstructive airway disease	7681	15 (14 to 16)	6977	15 (14 to 16)	6543	16 (16 to 17)	6422	16 (16 to 17)

[a]*Including responders who replied in only one survey.* [b]*In the last 12 months.*

Table 3. Crude percentage prevalence of individual symptoms, receipt of asthma medication, or obstructive airways disease in children who responded to the specific question in each survey.

	1993		1995		1999		2001	
	n	Prevalence (95% CI)	*n*	Prevalence (95% CI)	*n*	Prevalence (95% CI)	*n*	Prevalence (95% CI)
Wheeze[a]	2478	27 (25 to 29)	2228	24 (22 to 26)	1985	25 (23 to 27)	1781	22 (20 to 24)
Night cough[a]	2495	33 (31 to 35)	2238	30 (28 to 32)	1995	29 (27 to 31)	1791	25 (23 to 27)
Asthma attacks[a]	2489	13 (11 to 14)	2226	11 (10 to 12)	1980	10 (9 to 12)	1782	7 (6 to 9)
Current asthma medication	2495	16 (15 to 18)	2230	16 (15 to 18)	1994	17 (15 to 19)	1786	14 (12 to 16)
>3 courses of antibiotics[a]	2481	16 (15 to 18)	2213	12 (11 to 14)	1979	13 (12 to 15)	1784	9 (8 to 10)
Likely asthma	1699	21(19 to 23)	1636	21 (19 to 23)	1409	23 (21 to 25)	1259	19 (17 to 21)

[a]*In the last 12 months.*

Table 4. Percentage prevalence of individual symptoms, receipt of asthma medication, or obstructive airways disease and odds ratios for 1 year of increase in time after adjustment for potential confounders in adults who responded to the specific question in two or more surveys.

	1993		1995		1999		2001		
	n	Prevalence (%)	*n*	Prevalence (%)	*n*	Prevalence (%)	*n*	Prevalence (%)	Odds ratio (95% CI)
Wheeze[a]	5461	29	5783	31	4896	33	4351	35	1.03 (1.02 to 1.03) *P*<0.001
Woken by chest tightness[a]	5459	20	5781	21	4907	21	4355	21	0.99 (0.98 to 1.00) *P* = 0.23
Woken by cough[a]	5473	30	5787	32	4908	35	4365	36	1.03 (1.02 to 1.03) *P*<0.001
Woken by shortness of breath[a]	5466	13	5792	14	4912	14	4362	15	1.00 (1.00 to 1.02) *P* = 0.23
Asthma attack[a]	5475	7	5792	8	4906	8	4357	8	1.01 (0.99 to 1.02) *P* = 0.46
Current asthma medication[a]	5490	11	5816	12	4926	13	4375	14	1.03 (1.02 to 1.04) *P*<0.001
Obstructive airway disease[b]	5661	14	5993	14	5068	16	4512	17	1.02 (1.01 to 1.03) *P*<0.001

[a]*In the previous 12 months and adjusted for age, smoking, gender, history of hayfever/eczema, and family history of asthma.* [b]*Adjusted for age, smoking, and gender.*

Cross-sectional data for all subjects responding to each survey revealed an increase in the annual crude prevalence for adults over the 8-year study period for wheeze (from 30% to 34%), being woken by cough (from 31% to 36%) and receipt of asthma medication (from 12% to 14%). There was no meaningful change in the other outcomes (Table 2). For children, the trend was in the opposite direction for all outcomes, with marked decreases between 1993 and 2001 in wheeze (from 27% to 22%), night cough (from 33% to 25%), asthma attacks (from 13% to 7%), receipt of asthma medication (from 16% to 14%), receipt of antibiotics (from 16% to 9%) and likely asthma (from 21% to 19%, 5–15 year olds only) (Table 3).

Restricting the analysis to subjects with information from at least two surveys and adjusting for confounders gave similar results. In adults, there were significant increases in wheeze, being woken by cough, receipt of asthma medication, and OAD (Table 4). The ORs per year of secular increase were 1.03 (95% CI = 1.02 to 1.03) for wheeze, 1.03 (95% CI = 1.02 to 1.03) for being woken by cough, 1.03 (95% CI = 1.02 to 1.04) for receipt of asthma medication, and 1.02 (95% CI = 1.01 to 1.03) for OAD. These correspond to annual increases in wheeze of 2.6%, being woken by cough of 2.4%, receipt of asthma medication of 3.9%, and OAD of 2.2%. There were no significant changes in the prevalence of reporting an asthma attack or of the other outcomes over time.

In children, the adjusted analysis revealed significant decreases in wheeze 0.94 (95% CI = 0.92 to 0.97), night cough 0.95 (95% CI = 0.93 to 0.96), asthma attacks 0.92 (95% CI = 0.89 to 0.95), and for receipt of three or more courses of antibiotics 0.93 (95% CI = 0.90 to 0.96) (Table 5). This corresponded to annual decreases of 3.7%, 4.8%, 5.0% and 8.9%, respectively. The decreases in the receipt of current asthma medication and of likely asthma did not reach statistical significance.

Adult males had significantly greater secular increases in being woken by tightness in the chest and OAD than females with adjusted odds ratios of 1.02 (95% CI = 1.00 to 1.04) and 1.02 (95% CI = 1.00 to 1.05) respectively (Table 6). Gender differences in other outcomes were not significant. Those aged ≥45 years at study entry had significantly greater annual increases in prevalence than younger individuals for several outcomes: wheeze 1.03 (95% CI = 1.01 to 1.05), being woken by cough 1.02 (95% CI = 1.00 to 1.05), receipt of asthma medication 1.04 (95% CI = 1.02 to 1.06) and OAD 1.02 (95% CI = 1.00 to 1.04). Subjects with hayfever/eczema had a lower annual increase in prevalence of all outcomes than those without such a history. These differences were significant for wheeze 0.97 (95% CI = 0.95 to 0.99), being woken

Table 5. Percentage prevalence of outcomes in children adjusted for potential confounding factors and adjusted odds ratios for annual change in prevalence.[a]

	1993		1995		1999		2001		
	n	Prevalence (%)	*n*	Prevalence (%)	*n*	Prevalence (%)	*n*	Prevalence (%)	Odds ratio (95% CI)
Wheeze[b]	1319	27	1669	25	1389	22	1168	20	0.94 (0.92 to 0.97) *P*<0.001
Night cough[b]	1349	34	1709	31	1429	26	1255	24	0.93 (0.91 to 0.96) *P*<0.001
Asthma[b]	1328	12	1678	11	1384	9	1238	8	0.93 (0.90 to 0.95) *P*<0.001
Current asthma medication	1332	16	1683	17	1395	16	1247	16	0.99 (0.95 to 1.03) *P* = 0.09
>3 courses antibiotics[b]	1321	17	1672	13	1389	10	1239	8	0.94 (0.89 to 0.99) *P* = 0.01
Likely asthma	873	23	1306	22	1106	20	1045	20	0.98 (0.95 to 1.00) *P* = 0.19

[a]*Only children for whom information was supplied on two or more occasions are included.* [b]*In the last 12 months.*

Table 6. Odds ratios for 1 year of increase in time in the prevalence of individual symptoms, receipt of asthma medication or obstructive airways disease by gender, age, smoking, history of hayfever/eczema, and family history of asthma after adjustment for the other potential confounders.

	Gender male/female	Age at entry ≥45 yrs /<45 yrs	Smokers/ non smokers[a]	History of hayfever or eczema yes/no	Family history of asthma yes/no
Wheeze (95% CI)	1.01 (0.99 to 1.03) *P* = 0.23	1.03 (1.01 to 1.05) *P*<0.001	1.01 (0.99 to 1.02) *P* = 0.42	0.97 (0.95 to 0.99) *P* = 0.002	0.99 (0.97 to 1.00) *P* = 0.09
Chest tightness (95% CI)	1.02 (1.00 to 1.04) *P* = 0.02	1.01 (0.99 to 1.03) *P* = 0.21	0.99 (0.97 to 1.01) *P* = 0.45	0.97 (0.95 to 0.99) *P* = 0.002	0.97 (0.95 to 0.99) *P* = 0.004
Cough (95% CI)	1.01 (0.99 to 1.03) *P* = 0.25	1.02 (1.00 to 1.04) *P* = 0.04	0.99 (0.98 to 1.01) *P* = 0.43	0.97 (0.95 to 0.98) *P* <0.001	0.98 (0.97 to 0.99) *P* = 0.05
Shortness of breath (95% CI)	1.00 (0.98 to 1.02) *P* = 0.90	1.01 (0.99 to 1.04) *P* = 0.28	1.00 (0.98 to 1.03) *P* = 0.75	0.98 (0.96 to 1.00) *P* = 0.08	0.97 (0.95 to 1.00) *P* = 0.02
Asthma attack (95% CI)	1.01 (0.98 to 1.04) *P* = 0.88	1.02 (0.99 to 1.05) *P* = 0.19	1.02 (0.99 to 1.05) *P* = 0.15	0.96 (0.93 to 0.98) *P* = 0.002	0.96 (0.93 to 0.99) *P* = 0.003
Asthma medication (95% CI)	1.00 (0.98 to 1.02) *P* = 0.71	1.04 (1.02 to 1.06) *P* <0.001	1.00 (0.98 to 1.03) *P* = 0.73	0.97 (0.95 to 0.99) *P* = 0.01	0.99 (0.97 to 1.01) *P* = 0.22
Obstructive airways disease (95% CI)	1.02 (1.00 to 1.05) *P* = 0.04	1.02 (1.00 to 1.04) *P* = 0.11	1.00 (0.97 to 1.02) *P* = 0.83	n/a	n/a

[a]*Smokers were those who reported smoking in any of the surveys; non-smokers were those who reported they were non-smokers in all the studies to which they responded.*

by cough 0.97 (95% CI = 0.95 to 0.98), being woken by tightness in the chest 0.97 (95% CI = 0.95 to 0.99), and asthma attacks 0.96 (95% CI = 0.93 to 0.98). Family history of asthma was similarly associated with lower increases in prevalence for all outcomes. The differences reached statistical significance for cough 0.98 (95% CI = 0.97 to 0.99), being woken by shortness of breath 0.97 (95% CI = 0.95 to 1.00), being woken by tightness in the chest 0.97 (95% CI = 0.95 to 0.99) and asthma attacks 0.96 (95% CI = 0.93 to 0.99). Smoking was not associated with significant differences in secular trends when smokers at any survey were compared with non-smokers in all the surveys to which they responded.

For children, no important differences were found in the size of the secular trends for each outcome with regard to gender, exposure to tobacco smoke, hayfever/eczema, although family history of asthma appeared to be associated with a reduction in the prevalence of asthma medication (Table 7).

DISCUSSION

Summary of main findings

The WYCAP study surveyed two general practice populations four times between 1993 and 2001 using identical methodology and respiratory questionnaires. Secular trends in adults and children were in opposite directions. In adults there were significant increases in the self-reported 1-year prevalence of wheeze, being woken by cough, receipt of current asthma medication, and likely OAD over the 8-year period. In children there were decreases in most outcomes.

Interpretation of results and comparison with existing literature

The scoring systems used to define likely OAD in adults and likely asthma in children were developed as screening tools to identify subjects unknown to the medical services who would be most likely to benefit from clinical review. Asthma and COPD in adults are not differentiated by the screening tool so the changes found may have been due to increases in asthma, COPD, or both. The secular increases were greater in males, those older than 45 years, and those without hayfever/eczema or family history of asthma, suggesting that changes were more likely to be due to an increasing prevalence of COPD than asthma. This interpretation is consistent with other reports of increasing COPD prevalence,[17,18,29] and is supported by our findings for children showing a decreasing prevalence of symptoms and asthma over the same period. The absence of an increase in the prevalence of reported asthma attacks in adults would also suggest no increase in asthma prevalence itself, although this may be a reflection of improved asthma management.

Our results for adults contrast with a recent major international study[30] but, although some of the subjects were from the UK, no results were given for individual countries. It is possible, therefore, that as the UK has a known high level of smoking-related disease, the results were in fact similar to the present study but different from the other countries surveyed. The present results are not incompatible with a recent British study[31] showing an increase in the prevalence of 'managed asthma' over the past decade. This referred to the number of patients with

Table 7. Adjusted odds ratio of annual change in symptom prevalence among different groups using data for children about whom information was supplied on at least two occasions.

	Gender male/female	Smokers/ non smokers[a]	History of hayfever or eczema yes/no	Family history of asthma yes/no
Wheeze[a] (95% CI)	1.02 (0.98 to 1.06) *P* = 0.40	1.00 (0.96 to 1.04) *P* = 0.85	1.03 (0.99,1.07) *P* = 0.17	0.98 (0.93 to 1.02) *P* = 0.27
Night cough[a] (95% CI)	1.03 (0.99 to 1.07) *P* = 0.11	1.04 (1.00 to 1.07) *P* = 0.07	1.00 (0.96 to 1.04) *P* = 0.83	0.97 (0.93 to 1.01) *P* = 0.12
Asthma attacks[a] (95% CI)	1.01 (0.95 to 1.06) *P* = 0.86	0.96 (0.91 to 1.07) *P* = 0.15	1.03 (0.97 to 1.08) *P* = 0.37	0.94 (0.88 to 1.00) *P* = 0.06
Current asthma medication (95% CI)	1.03 (0.99 to 1.08) *P* = 0.13	1.01 (0.97 to 1.05) *P* = 0.07	0.99 (0.95 to 1.04) *P* = 0.79	0.94 (0.89 to 0.98) *P* = 0.006
≥3 courses antibiotics[a] (95% CI)	0.99 (0.93 to 1.04) *P* = 0.61	0.97 (0.92 to 1.03) *P* = 0.36	1.06 (1.00 to 1.11) *P* = 0.05	0.98 (0.92 to 1.04) *P* = 0.43
Likely asthma (95% CI)	1.01 (0.96 to 1.06) *P* = 0.79	1.03 (0.98 to 1.08) *P* = 0.30	n/a	n/a

[a]*In the last 12 months.*

an ever-recorded asthma diagnosis, who had had an asthma-related consultation or medication in the past year. This increase may have resulted from better asthma management. The same study also reported a decrease in the incidence of managed asthma, defined as the number of patients with a first ever asthma-related medical code or respiratory drug prescription in a particular year. This could have been due to a true decrease in incidence or better differentiation between asthma and COPD, although a recent review described the distinction between the two conditions as a major difficulty in epidemiological studies.[29]

The finding of a general decrease in respiratory symptom prevalence in children supports results from other recent studies worldwide,[13,31–34] which suggest that the increases in childhood asthma observed up to the mid-1990s may be ending. Decreased symptom prevalence in children may simply reflect better management, but the symptom questions related to any occurrences in the preceding 12 months and it is unlikely that even with optimal management, asthmatic children would remain symptom-free for a complete year. The prevalence of 'receipt of current asthma medication' also failed to rise in children, supporting a true decrease in symptom prevalence; the possibility of an improvement in quality of care as a factor, however, cannot be excluded.

Strengths and limitations of this study

A number of potential sources of bias were considered. Although there may have been variation in the interpretation of wheeze between responders and even in the same responders over time, these problems are likely to have been lessened by asking the same population the same questions on four occasions.

In the present study, OAD (in adults) and asthma (in children) were defined using simple scoring systems, developed and validated for the WYCAP study. The use of such a system ensures uniformity compared with potentially variable diagnostic labels such as 'physician diagnosed asthma'. In addition, the use of self-reported or parent/guardian-reported respiratory symptoms as subjective markers of respiratory disease is likely to have reduced the extent of diagnostic bias.

The four surveys had adjusted response rates between 67% and 77%. The estimate of 5.4% being ghost patients that was used for adjustment is likely to be conservative. A study from Newcastle, using a different method of calculation, reported adjusted response rates 33% and 22% above the crude response figures for its first and second surveys respectively.[14]

Responder bias was also addressed and it is unlikely that non-response biased the results.

A potential problem for longitudinal studies is loss to follow-up. The use of the GEE method of analysis enabled the inclusion of all subjects who returned questionnaires in at least two surveys — almost two-thirds of all responders. At the same time, by including four separate observation points, it was possible to evaluate more precisely changes in prevalence than in studies with fewer time points.[16] It is noteworthy that crude prevalence estimates based on all responders to each survey (Table 2 and Table 3) were very similar to those based on responders who completed at least two questionnaires (Table 4 and Table 5). This suggests that there was little bias from loss to follow-up.

Asking subjects repeatedly about the same symptoms may affect their responses ('fatigue factor'). This was examined in a comparison of cross-sectional and longitudinal analyses within the same populations, which concluded that repeated questioning did not bias prevalence findings compared with a similar population studied only once.[35]

The present study did not conduct objective investigation of other social and environmental factors that may have contributed to the temporal changes in respiratory symptoms in these populations. Although it was conducted in only two practice populations, the results were very similar between the practices and were similar to other recent studies in the UK.[5,31,34] It is, therefore, likely that the present results are representative of the country as a whole.

The observed secular increases in the prevalence of respiratory symptoms and OAD in adults between 1993 and 2001 are more likely to be due to changes in COPD prevalence than asthma, and probably represent real rather than apparent changes. This is supported by the finding of a decrease in the prevalence of both individual symptoms and likely asthma prevalence in children over the same period.

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Ethics committee

No ethical approval was required for the first two postal questionnaire surveys. Ethical approval for the last two was obtained from South Manchester Ethics Committee

Competing interests

PIF, TLF, MLH, SH, and MFL have been variously funded by GlaxoSmithKline, Astra Zeneca, and Merck for attending conferences; TLF has been funded by GlaxoSmithKline, Merck, Schering Plough, and Boehringer Ingelheim for various research projects. TLF has lectured at meetings sponsored by GlaxoSmithKline, Astra, Schering Plough, and Boehringer Ingelheim

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