ASTHMA

Asthma prevalence in 1973, 1988 and 2003

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Background: A study was undertaken to see whether the prevalence of asthma has changed since a survey was conducted in 1988, using the same methods that showed an increase during the previous 15 years.
Methods: A survey of 12 year old children was conducted in schools in South Wales where surveys had taken place in 1973 and 1988. The survey comprised a parentally completed questionnaire and an exercise challenge test, performed when no bronchodilator had been recently used.
Results: In 1973, 1988, and 2003, questionnaires were obtained for 817, 965 and 1148 children, respectively; the exercise test was performed by 812, 960 and 1019 children, respectively. The prevalence of reported wheeze in the last year rose during each 15 year period (9.8%, 15.2%, 19.7%), with an even steeper rise in reported asthma ever (5.5%, 12.0%, 27.3%). There was a continued increase in wheeze attributed to running, in terms of all children (5.8%, 10.5%, 16.0%) and also as the proportion of those with a history of wheeze (34.1%, 47.0%, 57.3%). The use of inhaled corticosteroids (not available in 1973) increased fourfold between 1988 and 2003. The prevalence of exercise induced bronchoconstriction rose between 1973 and 1988 but had declined by 2003.
Conclusions: The rise in the prevalence of asthmatic symptoms has continued since 1988. This appears to conflict with a reported recent decline, unless asthma prevalence peaked in the 1990s. The decline in exercise induced bronchoconstriction is probably attributable to better control of the disease as more children are now using inhaled corticosteroids as preventive treatment.

The prevalence of the symptoms of asthma in Britain has risen steadily for several decades, but there is some disagreement as to whether or not the increase is continuing.[1 2] Other European countries show differing trends: the prevalence of asthma seems to have levelled off in Italian, Swiss and German schoolchildren[3–5] but is still rising in Finnish young men.[6]

Very few studies have used objective measures to monitor the prevalence of asthma over time. We describe the findings of three surveys conducted at 15 year intervals in the same schools and using the same protocol (parentally completed questionnaire plus exercise challenge test) on each occasion. The main objective of the most recent survey (2003) was to see whether there had been a continuation in the rise in the prevalence of asthmatic symptoms and exercise induced bronchoconstriction.

METHODS

Details have already been published about the methods for the surveys conducted in 1973 and 1988.[7 8] Briefly, a population of schoolchildren was defined in terms of the catchment areas of certain high schools, including also the children who lived in those areas but who attended state supported Anglican, Roman Catholic and Welsh language schools. The sample to be surveyed comprised those children in their first year at high school, their 12th birthdays falling during the current school year, apart from children in special needs classes.

The survey was repeated in 2003 in the same catchment areas as before and using the same procedure. An explanatory letter was sent to the parents, together with a short questionnaire enquiring about respiratory symptoms. As in the previous surveys, ''wheeze'' was defined as ''a whistling sound, whether high or low pitched, and however faint''. The 1988 and 2003 questionnaires contained questions about asthma treatment over the past year that were not asked in 1973.

The children were seen in school at the same time of year (late April to early June) as on previous occasions. Five measurements were made of the peak expiratory flow rate (PEFR) and the mean of the highest three readings was taken as the true value. Children whose PEFR fell below 70% of the predicted value were asked to attend on another occasion so as not to undertake exercise challenge when already subject to bronchoconstriction. The exercise test consisted of 6 minutes of free running followed by 5 minutes of rest; five further measurements of PEFR were then recorded. Children who had recently used a bronchodilator were retested when it had not been used for 6 hours (for short acting preparations) or 24 hours (long acting) unless the PEFR had fallen by 15% or more after exercise. The use of inhaled corticosteroids was recorded but not restricted.

Signed consent was obtained from parents and signed assent from the children. Ethical approval for the study was granted by the Bro Taf local research ethics committee.

RESULTS

The results of the 1973 and 1988 surveys have already been published.[7 8] More children were eligible for the survey in 2003 than before owing to residential developments in the schools' catchment areas. Table 1 shows the numbers of children for whom questionnaires were completed and who performed the exercise test on each occasion; in 2003 the

Table 1 Numbers of children and response rates

	1973	1988	2003
Total available	818	965	1205
Completed questionnaires (%)	817 (99.9)	965 (100)	1148 (95.3)
Undertook exercise test (%)	812 (99.3)	960 (99.5)	1022 (84.8)

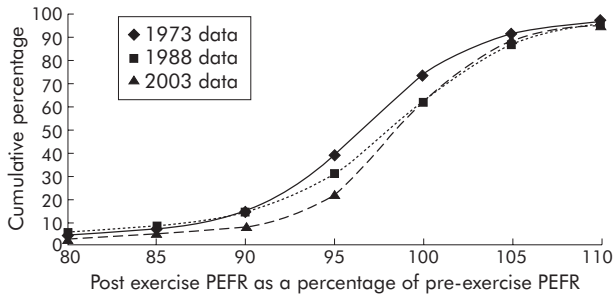

Figure 1 Distributions of percentage change in peak expiratory flow rate (PEFR) after exercise in the three surveys.

response rates were lower than before. The prevalence of reported asthma ever was 27% in those who undertook the exercise test and 31% in those who did not; asthma in the last 12 months was reported for 15.5% and 14.4%, respectively.

Table 2 shows the percentages of children exhibiting various indices of asthma and atopy in the three surveys. The proportion with a history of asthma doubled over each 15 year period and there was a continued rise in those with asthma in the last year (a history of asthma plus wheeze in the last 12 months). The male:female ratio in successive surveys was 1.75, 1.4 and 1.4 for asthma ever, and 2.1, 1.3 and 1.1 for asthma in the last year. There was also a steady increase in the prevalence of a history of wheeze, wheeze in the last year, breathless wheeze, wheeze in the absence of a cold, and eczema ever. The prevalence of ''hay fever/allergic rhinitis'' rose from 1998 to 2003; in 1973 the words ''allergic rhinitis'' were not used in the questionnaire so the comparable prevalence is not available.

On each occasion some children were retested because of recent treatment with bronchodilators or (in 1973 and 1988) cromolyns, the repeat results being used instead: two in 1973 (0.2% of those tested), 19 in 1988 (2.0%), and 23 in 2003 (2.0%). The definition of ''recent'' varied slightly: 5 hours in 1973, 8 hours in 1988, and 6 hours in 2003. From 1973 to 1988 there was a rise in the proportion of children whose PEFR fell after exercise by 15% or (particularly) 25%, but in 2003 these proportions had fallen significantly. The prevalence of smaller reductions in PEFR declined in successive surveys (fig 1). In 2003, as before, the effect of exercise was related to symptoms: a fall in PEFR of at least 15% occurred in 31 (15.3%) of those who had wheezed in the last year and in 17 (2.1%) of those who had not (95% CI for difference 8.7% to 18.8).

The response to exercise in 1988 and 2003 may have been affected by recent use of inhaled corticosteroids. Among the children whose PEFR did not fall by 15%, seven had taken inhaled corticosteroids within 24 hours in 1988 and 35 in 2003. If this medication had protected all these children against exercise induced bronchoconstriction, a fall of 15% in PEFR might have occurred in 8.4% and 8.1% of all children in 1988 and 2003, respectively, the difference being −0.3% (95% CI −2.8 to 2.1).

Table 3 shows the numbers of children whose parents considered that the wheeze ever occurred when the child had a cold or was brought on by the stated factors; the proportions are expressed in terms of those who had ever wheezed. There was a continued rise in the proportions of wheezy children whose symptoms were attributed to running and contact with animals. The rise was even steeper when expressed in terms of all children: wheeze brought on by running occurred in 5.8% in 1973, 10.5% in 1988, and 16.0% in 2003, and wheeze brought on by animals occurred in 1.7%, 3.6%, and 5.7%, respectively.

Table 4 shows that in 2003 more children had used anti-asthma medication than in 1988. The use of inhaled corticosteroids rose fourfold from 1988 to 2003; the difference between the proportions having used this medication in the last 48 hours was 4.8% (95% CI 3.2 to 6.5). In 1973 comparable data were not obtained; inhaled corticosteroids and long acting bronchodilators were not available at that time. No child was currently taking oral corticosteroids in 1988; in 2003 one child was taking an oral corticosteroid and a leukotriene receptor antagonist when the questionnaire was completed but not at the time of the exercise test.

DISCUSSION

The three surveys were conducted in the same school catchment areas using virtually the same protocol, so the findings should be comparable. The different intervals (5–8 hours) used to define ''recent'' treatment are unlikely to have changed the findings. The response rate for the exercise challenge test was lower in 2003 than before, but the prevalence of reported asthma was similar in those who did and those who did not exercise, so it is unlikely that any great degree of bias arose in this way.

The prevalence of asthma symptoms showed a further rise from 1988 to 2003. This was quite apart from the use of the word ''asthma'', so it cannot be attributed merely to a growing readiness to diagnose the disease. It is possible that parents have become progressively more aware of their children's wheezing, or more liable to apply the term ''wheeze'' to other symptoms. There is evidence that parents understand this word in a number of ways that do not always correspond to its use by clinicians.[9 10] In these surveys the same definition was supplied on each occasion so that variation in parental interpretation should have been reduced. The increase in wheeze was confined to children with reported asthma: the prevalence of wheeze without a

Table 2 Prevalence (%) of asthma and other atopic conditions in three surveys

Asthma criterion or symptom	1973 (n = 817)	1988 (n = 965)	2003 (n = 1148)	Difference 2003–1988 (95% CI)
Asthma ever	5.5	12.0	27.3	15.2 (11.9 to 18.5)
Asthma in last 12 months	4.2	9.1	15.4	6.3 (3.5 to 9.1)
Wheeze ever	17.0	22.3	28.0	5.7 (2.0 to 9.3)
Wheeze in last 12 months	9.8	15.2	19.7	4.5 (1.2 to 7.7)
Breathless wheeze ever	9.2	14.0	19.9	6.0 (2.7 to 9.1)
Wheeze without cold ever	6.6	13.8	17.8	4.0 (0.9 to 7.1)
Inhaler in last 12 months	–	10.1	19.1	9.0 (6.0 to 12.0)
PEFR fell >15% after exercise*	6.7	7.7	4.7	−3.0 (−5.2 to −0.9)
PEFR fell >25% after exercise*	2.0	4.1	2.4	−1.7 (−3.3 to −0.2)
Hay fever/allergic rhinitis ever	–	16.0	19.4	3.5 (0.2 to 6.7)
Eczema ever	4.8	15.9	23.1	7.2 (3.8 to 10.6)

PEFR, peak expiratory flow rate.
*n = 812, 960 and 1019 in 1973, 1988 and 2003, respectively.

Table 3 Attributed causes of wheezing in the three surveys

	1973		1988		2003		
Causative factor	N	% of all wheezers (n = 138)	N	% of all wheezers (n = 215)	N	% of all wheezers (n = 321)	Difference 2003–1988 (95% CI) %
Colds	125	90.6	166	77.2	267	83.2	6.0 (−0.8 to 13.1)
Running	47	34.1	101	47.0	184	57.3	10.3 (1.7 to 18.8)
Worry	22	15.9	27	12.6	44	13.7	1.1 (−4.9 to 6.8)
Excitement	27	19.6	44	20.5	43	13.4	−7.1 (−13.8 to −0.7)
Animals	14	10.1	35	16.3	65	20.2	4.0 (−2.9 to 10.4)
Food	1	0.7	16	7.4	10	3.1	−4.3 (−8.9 to −0.6)

diagnosis of asthma was 5.6%, 6.1% and 4.3% in the successive surveys. There is therefore no evidence of a non-specific increase in parents' awareness of any wheezing by their children. The prevalence of asthma ever has converged with that of wheeze ever, presumably reflecting an increasing tendency to diagnose asthma at a younger age.

In contrast to these findings, a repeat survey in the International Study of Asthma and Allergies in Childhood (ISAAC) reported that the prevalence of wheeze in the last year among 12–14 year old British children declined from 1995 to 2002.[2] A possible explanation for this discrepancy is that the apparent trends may arise from year to year differences; a survey at the end of a bad winter for chest illness will show an increase in prevalence in comparison with a previous survey at the end of a mild winter. The continued rise in the prevalence of ''wheeze ever'' suggests that this is not the whole explanation for the upward trend. Perhaps the difference is partly attributable to the different ages of the children in the two surveys; a repeat ISAAC survey in Sheffield showed a rise in asthma symptoms among children aged 8–9 years between 1991 and 1999.[1] Another possible explanation is that the prevalence of asthma may have peaked in the 1990s. This suggestion receives some support from changes in the incidence of new episodes of asthma presenting to general practitioners which increased up to 1993–4 and fell thereafter. The trends could not be attributed to diagnostic transfer between acute asthma and acute bronchitis.[11 12] In successive surveys of 9–12 year old children in Aberdeen the prevalence of asthma symptoms (which had risen markedly since 1964) changed little between 1994 and 1999, suggesting that the upward trend has ceased.[13] It is obviously important to continue to monitor the prevalence of asthma so that this impression can be confirmed or refuted.

In 2003, asthma ever was still more often reported in boys than in girls (in contrast with the Aberdeen findings), but the male excess for asthma in the last year had virtually disappeared (as in Aberdeen).[13] Perhaps the crossover in the sex ratio for asthma is occurring at an earlier age than before.

Among the factors that seem to provoke wheezing, running and exposure to animals increased steadily in importance both in terms of all children and among those who wheeze. These trends perhaps strengthen the case for a real increase in asthma during the past 30 years.

Few repeat surveys of asthma have included objective measurements. From 1973 to 1988 there was a rise in the prevalence of exercise induced bronchoconstriction, particularly of a more severe degree (25% reduction in PEFR). Since 1988 the prevalence has declined, contrary to what might be expected from the trend in symptoms. The difference may be largely attributable to the substantial rise in treatment with inhaled corticosteroids which ameliorate exercise induced bronchoconstriction in asthmatic children[14] so that asthma is now better controlled. The same trends in symptoms, exercise response, and treatment were found 1989–2000 in New Zealand surveys using protocols very similar to ours.[15] Furthermore, in Sheffield the increase in the prevalence in wheeze in 1991–9 was restricted to mild symptoms, being offset by a rise in medication.[1] The discrepancy between the trends in symptoms and exercise induced bronchoconstriction disappears if it is assumed that all those who had used inhaled corticosteroids within 24 hours of exercise would otherwise have shown a 15% fall in PEFR. Even if this assumption is not entirely correct, the protective effect of inhaled corticosteroids probably continues for several days after their regular use so the difference between the numbers of ''protected'' children in 1988 and 2003 may well be at least as great as we estimate. The use of cromolyns in 1973 and 1988 should not have affected the findings as children who had used them before exercise were re-exercised on another occasion, at least 5 hours (1973) or 8 hours (1988) after their use. Increased parental awareness of wheeze could also have contributed to the discrepancy, although we have no evidence that this occurred.

The prevalence of hay fever and eczema at any time has continued to rise, as in the ISAAC and Aberdeen surveys.[2 13] These increases support the impression that the rise in atopic disorders has not yet stabilised, although they may merely reflect changes in diagnosis.

The results of this study therefore suggest that the prevalence of childhood asthma has continued to rise over the last 15 years, although the increase has been offset by better medical treatment.

Table 4 Children with a history of inhaled treatment within the last 48 hours and the last 12 months in 1988 and 2003

	1988 (n = 965)		2003 (n = 1146)		Difference 2003–1988 (95% CI) %	
Inhaled drug	Last 48 hours	Last 12 months	Last 48 hours	Last 12 months	Last 48 hours	Last 12 months
Short acting bronchodilator	31 (3.2%)	83 (8.6%)	75 (6.5%)	210 (18.3%)	3.3 (1.5 to 5.2)	9.7 (6.8 to 12.6)
Long acting bronchodilator	0 (0%)	0 (0%)	10 (0.9%)	14 (1.2%)	0.9 (0.3 to 1.6)	1.2 (0.6 to 2.0)
Cromolyn	13 (1.3%)	36 (3.7%)	0 (0%)	1 (0.1%)	−1.3 (−2.3 to −0.7)	−3.7 (−5.1 to −2.7)
Corticosteroid	14 (1.5%)	24 (2.5%)	72 (6.3%)	129 (11.3%)	4.8 (3.2 to 6.5)	8.8 (6.7 to 10.9)

Data shown as n (%).

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LUNG ALERT

Allergic disease may increase the risk of atherosclerosis

▲ Knoflach M, Kiechl S, Mayr A, *et al*. Allergic rhinitis, asthma, and atherosclerosis in the Bruneck and ARMY studies. *Arch Intern Med* 2005;**165**:2521–6

This paper describes two studies investigating the association between common allergic conditions (allergic rhinitis and asthma) and atherosclerotic disease.

In the Bruneck study of 826 middle aged and elderly Italian subjects, 32 (3.9%) had a diagnosis of allergic disease. The 5 year development and progression of atherosclerosis in the internal and common carotid arteries was investigated by ultrasonography. Subjects with allergic disorders were at a significantly increased risk for atherosclerosis development and progression (odds ratio 3.8, 95% CI 1.4 to 10.2, $p = 0.007$). Furthermore, IgE levels were significantly raised in subjects in whom atherosclerosis had developed or progressed (odds ratio 1.9, 95% CI 1.3 to 2.8, $p = 0.001$).

The Atherosclerosis Risk Factors in Male Youngsters (ARMY) study took 141 male Austrian subjects aged 17 and 18 years and compared the vascular intima-media thickness (IMT) of the 34 subjects (24.1%) diagnosed as having allergic disease with that of the healthy subjects. IMT was measured by ultrasonography in the internal and common carotid arteries, the carotid bulb, and the superficial femoral arteries. Subjects with allergic disorders were at significantly increased risk for high IMT (odds ratio 2.5, 95% CI 1.1 to 5.5, $p = 0.03$).

Both these studies show a significant correlation between allergic disease and atherosclerosis, suggesting that components of the allergic process such as leukotrienes and mast cells may be involved in atherogenesis.

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