Time trends in respiratory symptoms in childhood over a 24 year period

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Abstract

Two cross sectional surveys, 24 years apart, using the same respiratory questionnaire, were carried out to examine changes in prevalence rates of cough, phlegm, and wheeze and to relate changes in wheeze to objective peak expiratory flow rates (PEFRs). The surveys were done in towns in southern and northern England and South Wales in schoolchildren aged 6.0-7.5 years; n=1655 in 1966 and n=2323 in 1990. Parents reported on winter cough and winter phlegm (early morning or day/night) and wheeze; PEFRs were also measured.

The proportion of children reported as wheezing on most days or nights increased from 3.9% to 6.1% (95% confidence interval (CI) for increase -0.2 to 4.6), with a smaller increase in the prevalence of those who had ever wheezed. The proportion of children with day or night time cough increased from 21.1% to 33.3% (95% CI for increase 3.8 to 20.6) and the proportion with day or night time phlegm increased from 5.8% to 10.0% (95% CI for increase 0.4 to 8.0). Smaller increases in the prevalence of persistent cough (from 9.0% to 12.4%) and persistent phlegm (from 2.4% to 3.5%) were also observed, while morning cough and morning phlegm showed little change. The increases in cough and phlegm were apparent in subjects with and without a history of wheeze. Both absolute and proportional changes in symptom prevalence were generally greater in the north than in the south. Similar social class trends were seen in each survey. The mean difference in PEFR between subjects with and without wheeze was smaller in 1990 than in 1966, but this result could be influenced by a greater proportion of subjects receiving antiasthmatic treatment in the 1990 survey.

These apparent increases in the prevalence of persistent wheeze, day and night time cough and phlegm, occurring over a period during which outdoor air pollution levels have decreased substantially, deserve further investigation.

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The possibility that childhood asthma is on the increase has aroused considerable interest. In Britain there has been a marked increase in the rate of general practice consultations¹ and hospital admissions for childhood asthma,^{2,3} although earlier suggestions that asthma mortality is increasing in childhood⁴ have not been substantiated.^{3,5} The increase in medical activity may reflect changes in the prevalence or severity of the disease. Alternatively, it may

reflect improvement in the recognition of the condition, or an increase in the use of asthma as a diagnostic label. Studies of the prevalence of asthmatic symptoms have produced conflicting results. While reviews of the findings of one off prevalence surveys have observed little consistent change in the prevalence of wheezing illness,⁶⁻⁸ serial surveys conducted in the same location with similar methodologies have generally supported the possibility of an increase in the prevalence of wheeze.⁹⁻¹⁴ Several of these serial surveys also observed increases in the prevalence of asthma reported by parents that were substantially more marked than the increases in the prevalence of wheeze,⁹⁻¹³ suggesting the possibility of a considerable rise in the recognition and labelling of wheezing illness as asthma. However, in one recent survey the increases in wheezing and reported asthma were similar¹⁴ and in another the increase in prevalence of wheeze was greater in subjects without a diagnostic label than in subjects with one,¹² suggesting that changes in the recognition and labelling of asthma do not provide a complete explanation for the increases in the prevalence of wheezing illness observed.

Despite the interest in changes in wheeze, little attention has been paid to time trends in other childhood respiratory symptoms, particularly cough and phlegm. This report describes changes in the prevalence of childhood respiratory symptoms between two surveys conducted in England and Wales in 1966 and 1990 using the same questions to inquire about wheeze, cough, and phlegm. Both surveys included measurements of peak expiratory flow rate (PEFR), providing an objective measure of respiratory function that can be used to address the validity of changes in reported symptom prevalence.¹⁵

Subjects and methods

SCHOOLCHILD CHEST HEALTH SURVEY (1966)

This survey was conducted in five urban and five rural areas of England and Wales, of which only the urban areas are included here.¹⁶ The five urban areas included two in southern England (Bristol and Reading), two in northern England (Bolton and Newcastle) and one in Wales (Merthyr Tydfil). Within each of these centres a random sample of local primary schools (stratified by district in the case of the largest towns) provided a sample of 500 children of each sex aged between 6 and 10 years who were invited to take part. The survey was conducted between September and November 1966.

Questionnaire

A questionnaire was sent to parents at the outset,

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requesting information on the child's respiratory symptoms and history of past respiratory illness (but not medications for respiratory illness). Father's occupation was used to define social class; no distinction was made between III non-manual and III manual. A response rate of 97.8% was obtained. Parents were asked the following questions about cough, phlegm, and wheeze:

● Does he/she usually cough first thing in the morning in winter? (yes/no)

● Does he/she usually cough during the day, or at night in winter? (yes/no)

● If 'yes' (to either or both of these questions), does he/she cough like this on most days for as much as three months each year? (yes/no)

● Does he/she bring up any phlegm (spit) from the chest first thing in the morning in winter? (yes/no)

● Does he/she bring up any phlegm (spit) from the chest during the day or at night in the winter? (yes/no)

● If 'yes' (to either or both of these questions), does he/she bring up phlegm like this on most days for as much as three months each year? (yes/no)

● Does this child's chest ever sound wheezy or whistling? (yes/no)

● If 'yes', does he/she get this on most days or nights of the year? (yes/no)

(The presence of cough or phlegm lasting for three months of the year is referred to as 'persistent cough' or 'persistent phlegm'.)

Clinical measurements

PEFR was measured using a Wright peak flow meter by a total of 30 school medical officers in different locations. Five measurements were made in each case; the mean of the last three readings was used in analysis. All measurement procedures were standardised and meters were centrally calibrated.

TEN TOWNS STUDY (1990)

This study of blood pressure and respiratory function was conducted in 10 towns, selected on the basis of their size (population 50 000 to 100 000) and their current adult cardiovascular mortality rate.¹⁷ Five with exceptionally high

cardiovascular mortality rates (Wigan, Port Talbot, Burnley, Rhondda, Rochdale) and five with exceptionally low rates (Esher, Chelmsford, Leatherhead, Bath, Tunbridge Wells) were included. Within each of these towns a stratified random sample of primary schools provided a sample of 550 children aged between 5 and 7 years who were invited to take part. The survey was conducted between January and July 1990.

Questionnaires

Questionnaires were sent to the parents of all children who took part in the measurement survey and were returned for 68% of those invited. The questionnaire included precisely the same questions about cough, phlegm, and wheeze as those in the Schoolchild Chest Health Survey. In addition, parents were asked whether the child had ever had asthma, bronchitis, pneumonia, bronchiolitis, eczema, or hayfever and were asked to list all medications taken by the child; those used for the treatment of asthma were identified using a 1990 *British National Formulary*. Social class coding was based on the occupation of the father as in the 1966 survey, using the Registrar General's 1980 manual for social class coding. In order to ascertain the prevalence of respiratory illnesses in non-participants, a brief questionnaire was sent to all non-respondents in the last four towns surveyed, which included the same questions about named illnesses as in the main questionnaire. A response to this brief questionnaire was obtained from 259 of 612 subjects (42%).

Clinical measurements

Measurements of respiratory function were made by one of a team of four research nurses. Three forced expiratory manoeuvres were carried out using a Vitalograph Compact pneumatochograph (Vitalograph Ltd); in accordance with American Thoracic Society recommendations,¹⁸ the peak expiratory flow measurement associated with the best forced expiratory volume in one second (FEV₁)+forced vital capacity (FVC) measurement was recorded.

STATISTICAL METHODS

The results presented here are restricted to the age group common to the two studies, 6.0 to 7.5 years. No children in ethnic minority groups were included in the Schoolchild Chest Health Survey and results are therefore restricted to children of European origin throughout. Because the Ten Towns Study was entirely based in urban areas, results presented for the Schoolchild Chest Health Survey are restricted to the five urban areas and exclude rural locations. In order to ascertain the comparability of the towns included in the two surveys, their recent adult mortality experience for chronic obstructive pulmonary disease (ICD-9 490-496) is summarised for the years 1982-6 using standardised mortality ratios in the figure. In both study groups mortality rates are markedly higher in northern England and Wales than in the south; within each of these regions standardised

Standardised mortality ratios for chronic obstructive pulmonary disease and allied conditions (ICD-9 490-496) in adults (men and women 35-74 years; 1982-6) for the district health authority populations relating to the towns studied in 1966 (Schoolchild Chest Health Survey) and in 1990 (Ten Towns Study). Source: Office of Population Censuses and Surveys.

Table 1 Prevalence rates (%) of childhood respiratory symptoms in 1966 and 1990 surveys

	1966	1990	Adjustment	Increase (SE)	95% CI	p Value
Wheeze ever	18.3	21.8	None	3.5 (1.9)		0.09
			North-south	3.7 (2.0)	(-0.7 to 8.0)	0.09
Wheeze most days or nights	3.9	6.1	None	2.2 (1.2)		0.08
			North-south	2.5 (0.8)	(0.8 to 4.2)	0.007
Morning cough	11.2	11.3	None	0.1 (1.5)		0.95
			North-south	0.4 (1.2)	(-2.2 to 3.0)	0.72
Day-night cough	21.1	33.3	None	12.1 (4.2)		0.01
			North-south	13.2 (2.8)	(7.1 to 19.3)	0.0001
Persistent cough	9.0	12.4	None	3.4 (2.0)		0.11
			North-south	3.8 (1.8)	(-0.0 to 7.6)	0.05
Morning phlegm	5.0	5.8	None	0.9 (1.1)		0.47
			North-south	1.1 (1.0)	(-1.1 to 3.3)	0.31
Day-night phlegm	5.8	10.0	None	4.2 (1.9)		0.04
			North-south	4.6 (1.5)	(1.2 to 7.9)	0.01
Persistent phlegm	2.4	3.5	None	1.1 (1.0)		0.30
			North-south	1.3 (0.9)	(-0.6 to 3.2)	0.15

Proportions and SE are based on town data, which are presented for each symptom without adjustment and with a north-south adjustment.
CI=confidence interval.

Table 2 Prevalence rates (%) of childhood respiratory symptoms in 1966 and 1990 surveys by region

	North			South		
	1966	1990	Increase (SE)	1966	1990	Increase (SE)
Wheeze ever	17.8	23.1	5.3 (2.6)	19.0	20.5	1.5 (3.1)
Wheeze most days or nights	5.1	7.7	2.6 (1.1)	2.1	4.5	2.4 (1.2)
Day-night cough	22.0	40.7	18.7 (2.1)	19.8	25.8	6.0 (4.4)
Persistent cough	8.4	15.5	7.1 (1.7)	10.0	9.4	-0.6 (2.4)
Day-night phlegm	6.5	12.6	6.1 (1.3)	3.9	7.5	2.5 (3.0)
Persistent phlegm	2.8	4.8	2.0 (1.2)	1.7	2.2	0.5 (1.2)

mortality ratios appear similar in the two studies. A similar comparison emerges if mortality rates at the time of the 1966 survey are examined.

The symptom analyses presented are based on towns, not on individual subjects. Such analyses allow the effect of random variation in town characteristics between studies to be taken into account. The only exceptions are the analyses for social class, which are based on individuals. Adjustment for the effect of age and sex between studies had no important effect on the results and has therefore been omitted; because the results were similar for boys and girls all results are presented for both sexes combined. Two sample *t* tests were used to compare town prevalence rates in the two studies. Geographic differences in symptoms were allowed for by grouping towns into those in the south and those in the north (including Wales), using the conventional dividing line between the Bristol Channel and The Wash. Town prevalence rates were then regressed on two 0/1 variables, one representing period, the other geographic location.

Analyses of PEFs are based on individuals. Adjustment for age and height (fitted as continuous variables) and sex (fitted as a 0/1 variable) was carried out using a standard linear regression technique (PROC GLM, SAS). Peak flow measurements were carried out using different techniques in 1966 and 1990 and are not directly comparable. Peak flow results (table 5) have therefore been presented as percentages of values in the non-wheezers within each study.

Results

The symptom prevalence results are based on 1655 children aged 6.0 to 7.5 years in the 1966 survey and 2323 children in the 1990 survey. The

Table 3 Prevalence rates (%) of childhood respiratory symptoms in 1966 and 1990 surveys by father's social class

Social class	No		Day-night cough		Day-night phlegm		Wheeze most days/nights	
	1966	1990	1966	1990	1966	1990	1966	1990
I	63	176	12.7	20.6	1.6	4.1	1.6	3.5
II	156	666	14.7	26.3	2.7	6.8	1.3	3.0
III	935	1616	20.6	34.6	6.3	10.7	3.5	6.4
IV	248	224	25.0	39.7	6.2	13.8	3.8	4.9
V	142	90	24.7	52.2	9.5	15.6	7.2	17.8

proportion of children with each symptom in the 1966 and 1990 surveys is presented in table 1. Because of the marked difference in symptom prevalences between north and south (table 2) and the different balance of towns between the north and south in the two studies, results are presented both without and then with adjustment for north-south differences. Although the prevalence of 'wheeze ever' increased between 1966 and 1990, the proportional increase (19%) was small. However, there was a striking proportional increase in the prevalence of 'wheeze on most days and nights' (56%). 'Morning cough' and 'morning phlegm' showed little change but there were marked increases in the prevalence of 'day-night cough' and 'day-night phlegm', while 'persistent cough' and 'persistent phlegm' showed more modest increases. North-south standardisation accentuated both the size of the increases and their statistical significance levels in all cases.

CHANGES IN GEOGRAPHIC AND SOCIAL DISTRIBUTION OF SYMPTOMS

The distribution of respiratory symptoms between the north and south in the 1966 and 1990 survey is examined in table 2. Morning cough and morning phlegm, which showed little overall change between 1966 and 1990, have not been included in this table. In the 1966 survey wheeze on most days or nights, day-night phlegm and persistent phlegm had a greater prevalence in the north while the other three symptoms showed no marked north-south difference. In the 1990 survey, all six symptoms had higher prevalence rates in the north than the south. As a corollary, the absolute increases in prevalence rate between 1966 and 1990 were markedly greater in the north than in the south for all symptoms except wheeze on most days or nights; the difference in trend between the north and south achieved statistical significance ($p<0.05$) for day-night cough and persistent cough. The social class distribution of the prevalence rates of day-night cough, day-night phlegm, and wheeze on most days or nights in the 1966 and 1990 surveys are presented in table 3. Each of the three symptoms showed a social class gradient in the 1966 survey, with all symptoms being more prevalent in the classes IV and V than in I and II. The social class gradient was weakest for day-night cough (twofold difference) and strongest for day-night phlegm (fivefold difference). In the 1990 survey, social class gradients of a similar direction and magnitude were observed for each symptom, implying that the proportionate increases in symptoms over

Table 4 Prevalence rates (%) of childhood respiratory symptoms in 1966 and 1990 surveys in non-wheezers

	1966	1990	Adjustment	Increase (SE)	p Value
Day-night cough	13.2	23.7	None	10.4	0.001
			North-south	11.4 (2.8)	
Persistent cough	3.3	5.4	None	2.2	0.10
			North-south	2.5 (1.4)	
Day-night phlegm	2.5	5.1	None	2.6	0.03
			North-south	2.9 (1.2)	
Persistent phlegm	0.7	0.9	None	0.2	0.43
			North-south	0.3 (0.4)	

Proportions and SE are based on town data, which are presented for each symptom without adjustment and with a north-south adjustment.

Table 5 Relationship between wheeze and PEFrs in 1966 and 1990 surveys

	PEFR (% of non-wheezers)		
	Non-wheezers	Wheeze ever % (SE)	Wheeze most days or nights % (SE)
1966 Survey*			
All subjects	100	95.3 (1.4)	90.7 (2.5)
1990 Survey†			
All subjects	100	97.8 (1.3)	95.5 (1.9)
Subjects on antiasthmatic treatment excluded (n=186)	100	98.1 (1.5)	91.6 (2.5)

Wheeze categories in this analysis have been treated as mutually exclusive (that is subjects with wheeze most days or nights are excluded from the wheeze ever group). All analyses are adjusted for age, sex, and height.

*Subjects in 1966 survey were: 1312 non-wheezers, 211 with wheeze ever, 60 with wheeze on most days and nights.

†Subjects in 1990 survey were: 1668 non-wheezers, 300 with wheeze ever, 126 with wheeze on most days and nights.

time were similar for all social class groups. However, changes in the allocation of occupations to social class groups between 1966 and 1990 complicate interpretation of time trends within each social class group.

CHANGES IN COUGH AND PHLEGM IN NON-WHEEZERS

In view of the well recognised association between cough and asthma,¹⁹ the extent to which the increases in cough and phlegm were apparent in non-wheezers has been examined (table 4). All cough and phlegm symptoms increased between the 1966 and 1990 surveys. Moreover, the proportional increases in symptoms in non-wheezers were similar to those in the study population as a whole for all symptoms except persistent phlegm.

RELATION BETWEEN WHEEZE SYMPTOMS AND PEFR

In order to explore the extent to which the increase in the prevalence of reported wheeze reflects greater parental awareness of symptoms or a real increase in the prevalence of asthma, the relationship between grades of wheeze and PEFrs (expressed as a proportion of those in the non-wheezers) has been compared in the two surveys (table 5). Within each survey there was a graded relationship between frequency of wheeze and mean PEFR; subjects with wheeze ever and wheeze most days or nights having progressively lower mean PEFrs than subjects who had never wheezed. If the increase in prevalence of asthma was due to greater parental awareness, it might be expected that the proportional decrease in PEFR in wheezers would be smaller in 1990 than in 1966. The comparison between non-wheezers and both grades of

wheeze based on all subjects in the 1966 and 1990 studies is consistent with this possibility, with smaller proportional decreases in peak flow between non-wheezers and those with wheeze ever and wheeze most days or nights in 1990 than in 1966. However, the differences between the studies are not statistically significant either for wheeze ever ($p=0.16$) or for wheeze most days or nights ($p=0.09$). Moreover, this analysis does not take account of antiasthmatic treatment, which may have influenced the lung function of those reporting wheeze symptoms. Subjects receiving antiasthmatic treatment in the 1966 survey cannot be identified, although the results of contemporary surveys suggest that the prevalence would have been very low (of the order of 1%).¹¹ If subjects receiving antiasthmatic treatment are excluded from the 1990 study ($n=186$), the pattern of peak flow differentials observed in the remaining subjects is very close to that of the 1966 survey, particularly for subjects with wheeze most days or nights (table 5). Thus, when the effect of antiasthmatic treatment is taken into account, the severity of airway obstruction does not appear to have decreased with the increase in prevalence of wheeze.

Discussion

The comparisons of the prevalence of childhood respiratory symptoms in 1966 and 1990 described here showed a marked proportional increase in the prevalence of wheeze on most days or nights and a smaller proportional increase in the prevalence of those who had ever wheezed. The prevalences of cough or phlegm during the day or at night (and to a lesser extent persistent cough and persistent phlegm) had increased, while the prevalences of morning cough and morning phlegm were unchanged. The extent to which the changes observed can be explained by differences in the design and conduct of the 1966 and 1990 surveys must be considered. While the towns included in the two surveys were different, the adult respiratory mortality experience of the towns examined in the 1966 and 1990 surveys were similar in both cases (figure). Moreover, the study findings were not dependent on any individual town. The lower response rate observed in 1990 could in theory have had an important effect on the results. However, in a comparison of the reported prevalence of named respiratory and atopic illnesses in responders and non-responders in the 1990 survey, the prevalence of reported asthma was slightly lower in responders (13.1%) than in non-responders (14.7%); a similar, slightly more marked, difference was observed for bronchitis (7.6% in responders and 10.4% in non-responders). These results suggest that the lower response rate observed in 1990 is unlikely to have accounted for the higher prevalence of symptoms in 1990. The difference in the time of year at which the two surveys were conducted is another potential source of bias. However, the effect of month of year on recall of symptoms within the 1990 survey between January and July was apparently small, suggesting that this factor is unlikely to explain the changes in symptom prevalence between 1966 and 1990. Although

the occurrence of an influenza epidemic immediately before the 1990 survey²⁰ might have accounted for a higher prevalence of acute respiratory symptoms, this should have had little effect on the response to the questions asked in the survey, especially those addressing persistent cough, phlegm, and wheeze.

SECULAR CHANGES IN WHEEZE

The prevalence rates for subjects reporting a history of wheeze ever in the 1990 survey (21.8%) are comparable with those of other recent surveys,^{10 11 21} while those for wheeze on most days or nights (6.1%) are reasonably consistent with those of the most recent cohorts in the National Study of Health and Growth.¹² The greater prevalence of persistent wheeze observed in the north and Wales is consistent with, although more marked than, the geographic variations in wheeze described in earlier reports.²² The proportionate annual increase between 1966 and 1990 in the prevalence of wheeze on most days or nights (1.9%) is rather smaller than the estimate of 5.2% provided by the National Study of Health and Growth between 1973 and 1986,¹² although the 95% confidence limits on both estimates are wide. The annual increase is of a similar magnitude to that reported for wheeze in the past 12 months between 1978 and 1991 by Strachan and Anderson (1.1%),¹³ although smaller than that reported by Hill *et al* for 1985 to 1988 (3.8%),¹⁰ and by Burr *et al* for 1973–88 (3.7%).¹¹

There are several possible explanations for the increase in the prevalence of wheeze observed. While the change may reflect a true increase in the prevalence of asthma, increased parental awareness of childhood respiratory symptoms, or a lower threshold for reporting, are also potential explanations. A lower reporting threshold is likely to be a particular problem with the unquantified question about wheeze on most days or nights, which was used both here and elsewhere¹² to identify children with persistent wheeze. However, the data on the relationship between wheeze symptoms and PEFR in the 1966 and 1990 surveys do not give strong support for this possibility. While the reduction in PEFR associated with wheeze ever and wheeze most days or nights was less marked in 1990 than in 1966, this finding was strongly dependent on the inclusion of subjects on antiasthmatic treatment in the 1990 survey. The exclusion of subjects on treatment in the 1990 study produced a marked increase in the difference in PEFR between non-wheezers and those with wheeze on most days or nights, which became comparable with that in the 1966 survey. This finding does not support the possibility of a diminution in the severity of airway obstruction in subjects with wheeze on most days or nights. However, these results are difficult to interpret for two reasons. First, the effect of excluding those on treatment is seen only in the small group with wheeze most days and nights, and not in the very much larger group with wheeze ever. Second, it is not possible to exclude subjects on treatment in the 1966 survey in order to produce a comparable analysis. However, data from contemporary

surveys suggest that the prevalence of antiasthmatic treatment would have been substantially lower in the 1966 survey, possibly of the order of 1%,¹¹ in which case removal of the group on treatment would have little effect. The results therefore suggest that the increase in the prevalence of wheeze is likely to be real, but emphasise the need for further longitudinal study in which symptom assessment is coupled with standardised measures of airway obstruction. They also point to the particular importance of taking into account changes in the prevalence of antiasthmatic treatment over time when interpreting the results.

SECULAR CHANGES IN COUGH AND PHLEGM

The results reported here suggest that the prevalence rates of cough or phlegm during the day or night and, to a lesser extent, persistent cough or phlegm, had increased between 1966 and 1990, while the north-south gradient in cough and phlegm already apparent in the 1966 survey (and further substantiated by other surveys²³), had become more marked in 1990. An increase in the prevalence of asthma could in theory account for the increase in the prevalence of cough,¹⁹ even in the absence of wheeze. However, this seems an unlikely explanation for the observation. The proportional increase in cough was at least as great in non-wheezers as in those with a history of wheeze and did not follow the same geographic pattern as the increase in wheeze. Moreover, in the non-wheezers group there was no difference in the mean PEFR of those with or without cough (data not presented).

Other explanations for the observed increases in the prevalences of cough and phlegm are therefore required. Changes in parental awareness of respiratory symptoms, or in the parental threshold for symptom reporting, represent one possibility. However, the prevalences of morning cough and phlegm remained very consistent between 1966 and 1990, emphasising that any change in parental awareness or reporting threshold was being observed only for specific questions. An increase in the prevalence of lower respiratory tract infections (particularly acute bronchitis, bronchiolitis, or pneumonia) seems unlikely, given the consistent evidence from other sources that childhood morbidity and mortality from these conditions in childhood is declining.²⁴ A further possibility is that the increase in the prevalence of symptoms is the result of bronchial irritation from non-infective causes, which could have included cigarette smoke and atmospheric or domestic air pollution. Active smoking seems an unlikely explanation in 6–7 year olds, a conclusion that is supported by the results of salivary cotinine analyses in the 1990 survey, suggesting that active smoking rates were extremely low (M J Jarvis, C Feyerabend, personal communication). Earlier studies have suggested that passive smoking, particularly resulting from parental smoking, is an important cause of childhood respiratory morbidity.²⁵ Although no systematic data on changes in the prevalence of parental smoking are available, the prevalence of adult cigarette smoking has fallen steadily since the

end of the 1960s, although marked regional variations in smoking prevalence remain.²⁶

Atmospheric air pollution from sulphur dioxide and smoke, implicated as causes of childhood respiratory morbidity by earlier investigators,^{27,28} fell markedly following the introduction of the Clean Air Acts.²⁹ Our observation that the falls in the levels of these pollutants have not been paralleled by reductions in the prevalence of respiratory symptoms in childhood is consistent with those of longitudinal studies conducted in the 1970s³⁰ and with the findings of other point prevalence surveys conducted between the 1960s and 1980s.³¹⁻³⁴ Increases in concentrations of other atmospheric pollutants, particularly oxides of nitrogen, have been observed.³⁵ However, the contribution of atmospheric levels of these factors to childhood respiratory morbidity in childhood has still to be established. Despite earlier suggestions that nitrogen dioxide produced by gas cookers might be an important domestic cause of childhood respiratory morbidity,³⁶ subsequent reports suggested that the effects were likely to be very small.³⁷ The striking increases in the prevalence of childhood cough and phlegm observed here require further substantiation before more detailed investigations are carried out to establish the causes.

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