Prevalence of asthma in Melbourne schoolchildren: changes over 26 years

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Abstract

Objectives—To determine the prevalence of asthma in the past 12 months in Melbourne schoolchildren aged 7, 12, and 15 years and to compare the prevalence of a history of asthma with that of 26 years ago.

Design—A questionnaire on respiratory symptoms was distributed to children for completion by parents and return to the school. Subjects were selected by a stratified cluster design.

Setting—Government and non-government schools in the greater Melbourne area, Australia.

Subjects—10 981 children. Parents completed questionnaires for 3324 children aged 7, 2899 aged 12, and 2968 aged 15. The overall response rate was 90%.

Main outcome measures—History of wheeze or asthma in the past 12 months and in lifetime.

Results—The prevalences of wheeze in the past 12 months were 23.1%, 21.7%, and 18.6% for 7, 12, and 15 year olds respectively. A history of wheeze was more common in boys than in girls at age 7 (443/1711 v 324/1614) and 12 (418/1767 v 322/1718) but not at age 15. Overall, 78% (1548) of those reporting wheeze also reported a history of asthma and 83% (1611) had used a bronchodilator. The prevalence of a history of asthma among 7 year olds was 46% compared with 19.1% in the 1964 survey, an increase of 141%.

Conclusions—The current prevalence of asthma in Melbourne schoolchildren is high and has risen substantially over the past 26 years.

Subjects and methods

Three age groups were selected for study: 7 year olds (school year 2), 12 year olds (school year 7), and 15 year olds (school year 10). The 7 year olds were selected for direct comparison with the 1964 study⁹; the 12 year olds because by this age respiratory infection seems to be a minor component of asthma and the perception of the patient and parents about the nature of wheezing and its requirement for treatment may change; and 15 year olds because after this age many children leave school. Retention rates for year 10 in Victoria are 99.3%. To provide 95% certainty of being within 1% of the true prevalence of current asthma, assuming it to be 10%, approximately 3225 subjects in each group were studied.

We used a two stage sample design. Schools were randomly sampled for study from metropolitan Melbourne and adjacent areas within one hour's drive from the centre of Melbourne. We invited all children in the relevant grade of the selected school to participate; government, Catholic, and independent schools were included. For administrative purposes schools with 30 or fewer second year students were excluded. To prevent an overrepresentation of the remaining small schools all schools with 31-50 second year students were paired with the nearest school on the sampling frame to form a "pseudoschool." The sampling procedure therefore selected a mixture of pseudoschools (62-100 students) and regular schools (≥ 51 students).

This two stage design may result in clustering of similar students within schools. As clustering can cause an underestimation of standard error if simple random sample methods are used we adjusted the sample size used for calculating standard error using the sample estimate of the intraclass correlation coefficient.¹⁰

We issued a three page questionnaire on respiratory symptoms to schools for distribution to parents (appendix). The questionnaire included questions used in similar surveys¹¹⁻¹³ and three questions identical to those used in 1964.⁹ Translations into six common languages in the community were available in identical format. Questionnaires were issued on a second occasion if the first was not returned.

We used the statistical package SPSS X to categorise and analyse the data. χ^2 Analyses of contingency tables and χ^2 test for trend were used to assess the differences in the prevalence rates.

Results

Seventy one of 963 primary schools and 27 of 380 secondary schools in the area were selected for study. We issued 10 198 questionnaires and 9192 were returned completed, an overall response rate of 90%. Table I gives parents' responses to the questions.

Reported wheeze was significantly more common in the 7 year olds than in the 15 year olds, as were sleep disturbance due to wheeze, night cough, and use of bronchodilators ($p < 0.001$). Exercise induced wheeze

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Introduction

The prevalence of asthma has been reported to be increasing in the United Kingdom and New Zealand.¹² Similar increases have been reported in hospital admission rates for asthma in the United Kingdom, New Zealand, United States, and Australia,³⁻⁶ but we do not know whether this increase is real or due to changes in medical practice or diagnostic labelling. Recently, Burney *et al* suggested that the increase in asthma morbidity is real.⁷ In Australia, the hospital admission rate for paediatric asthma has increased significantly, to 4.13 per 1000 population in 1986.⁶ Australia has the second highest reported mortality from asthma in the world,⁸ and over the past 10 years mortality in the 0-19 age group has increased by 50% (Australian Bureau of Statistics). Reasons proposed for this increase include a change in diagnostic fashion, an increase in the severity of asthma, and a true increase in prevalence.

In 1964 a survey of 7 year old Melbourne schoolchildren found a prevalence of a history of symptoms suggestive of asthma of 19.1%, which was far higher than prevalences found in other published studies at the time.⁹ We studied a similar population of children to determine if the prevalence of asthma had changed.

TABLE 1—Responses of parents to questionnaire on their children's respiratory symptoms. Values are numbers responding positively (percentage; 95% confidence interval)

Variable	Age of children (years)		
	7	12	15
Mean (SD) age (years)	7.3 (0.63)	12.3 (0.42)	15.3 (0.49)
No of questionnaires issued	3473	3274	3451
No (%) responding	3325 (96)	2899 (89)	2968 (86)
Ever had wheeze	1362 (41.0; 38.8 to 43.2)	1059 (36.5; 32.6 to 40.4)	1054 (35.5; 32.3 to 38.7)*
Ever had asthma	802 (24.1; 22.1 to 26.1)	673 (23.2; 20.3 to 26.0)	653 (22.0; 19.9 to 24.1)
Symptoms in past 12 months:			
Wheeze	767 (23.1; 21.7 to 24.5)	628 (21.7; 19.4 to 22.4)	553 (18.6; 17.0 to 19.8)*
Sleep disturbance	482 (14.5; 13.2 to 15.8)	317 (10.9; 9.4 to 12.4)	260 (8.8; 7.9 to 9.7)*
Severe episode	119 (3.6; 2.9 to 4.3)	104 (3.6; 2.9 to 4.3)	101 (3.4; 2.8 to 3.9)
Exercise induced wheeze	500 (15.0; 13.7 to 16.4)	592 (20.4; 17.5 to 23.3)	686 (23.1; 20.7 to 25.5)*
Night cough	934 (28.1; 26.5 to 29.7)	560 (19.3; 17.6 to 21.0)	478 (16.1; 14.7 to 17.6)*
Morning mucous	499 (15.0; 13.8 to 16.2)	462 (15.9; 14.3 to 17.5)	620 (20.9; 19.4 to 22.4)*
Morning tightness	322 (9.7; 8.7 to 10.7)	325 (11.2; 9.8 to 12.6)	389 (13.1; 11.9 to 14.2)*
Wheeze with allergens	203 (6.1; 5.3 to 6.9)	261 (9.0; 7.8 to 10.2)	348 (11.7; 10.3 to 13.1)*
Used bronchodilators in the past 12 months	918 (27.6; 25.8 to 29.4)	629 (21.7; 19.3 to 24.1)	575 (19.4; 17.7 to 21.2)*

* $p < 0.001$ for χ^2 test for trend in proportions.

and wheeze on exposure to allergens were reported more commonly in the 15 year olds ($p < 0.001$). In 7 year olds a history of wheeze in the past 12 months was more common in boys than in girls (443/1711, 25.9% boys *v* 324/1614, 20.1% girls; $p < 0.001$). This gender difference was slightly less at age 12 (418/1767, 23.7% *v* 209/1132, 18.5%; $p < 0.01$) and not seen at age 15 (322/1718, 18.7% *v* 231/1250, 18.5%). At age 7 severe episodes of wheezing were reported more commonly in boys than in girls (74, 4.3% *v* 45, 2.8%; $p < 0.01$) as was exercise induced wheeze (297, 17.4% *v* 203, 12.6%; $p < 0.001$). These differences were not observed at other ages.

Of the 1984 children reported to have had wheeze in the past 12 months, 714 had had four or more attacks (table II); 599 (78%) children aged 7, 494 (79%) aged 12, and 426 (77%) aged 15 were also reported to have a history of asthma. Among children who had had four or more attacks of wheeze in the past 12 months, asthma was reported in 244 (92%) aged 7, 226 (92%) aged 12, and 182 (91%) aged 15. A total of 1611 (83%) children who had had wheeze in the past 12 months had used a bronchodilator, with the proportion increasing with increasing frequency of wheeze (table II). Among those reported to have ever had asthma and to have had four or more episodes of wheeze in the past 12 months, a bronchodilator was used in the past 12 months by 238/240 (99%) aged 7, 221/228 (97%) aged 12, and 178/180 (99%) aged 15.

Some children who were reported as having had no wheeze in the past 12 months had had other respiratory symptoms suggestive of asthma (table III). Overall, 123 of the 409 children reported to have sounded wheezy after exercise in the past 12 months but not to have had a wheeze attack in the past 12 months used a bronchodilator. If this group was further defined to include only those reported ever to have had asthma 83/128 (65%) were reported to have used a bronchodilator.

The prevalence of a history of asthma among 7 year

olds in the 1964 survey was determined by adding those whose parents responded positively to the questions Has your child ever had asthma? and Has your child ever had wheezing with bronchitis or cold? The prevalence in 1964 was 19.1% compared with 46% (1528/3325; 95% confidence interval 44.3 to 47.7) in 1990, representing an increase of 141%. The prevalence of a history of asthma symptoms in the 12 and 15 year olds was 39.7% (1151/2899) and 40.3% (1196/2968) respectively.

TABLE III—Respiratory symptoms in children reported not to have wheezed in the past 12 months

	Number (percentage) of children aged:		
	7 (n=2558)	12 (n=2271)	15 (n=2415)
Exercise induced wheeze	62 (2.4)	103 (4.5)	244 (10.1)
Night cough	371 (14.5)	215 (9.5)	222 (9.2)
Morning tightness	48 (1.9)	62 (2.7)	124 (5.1)
Use of bronchodilators	241 (9.4)	117 (5.2)	136 (5.6)

Discussion

We found that the prevalence of a history of wheeze or asthma reported by parents was 46% among 7 year olds, 39.7% among 12 year olds, and 40.3% among 15 year olds. For 7 year olds this represents an increase of 141% over the past 26 years. Though some of this increase is probably real, part of it may be explained by a change in diagnostic labelling as a result of increased awareness of asthma in the medical and general communities. Similarly, the increase in the report of wheeze may well be due to an increase in awareness of the symptom of wheeze in the community; increased awareness could also result in some false positive reporting of wheeze.

Two recent studies have provided objective evidence of increased prevalence of asthma as assessed by exercise induced bronchoconstriction¹ and increased morbidity due to asthma.⁷ All available objective measures of asthma morbidity, such as sales of drugs for asthma,¹⁴ increase in hospital admissions of people with asthma without reciprocal decrease in admissions due to other respiratory conditions,^{3,6} and mortality,⁸ have increased in recent years, but these may also be influenced by a change in diagnostic fashion. The objective evidence suggests that an appreciable component of the increase must be real. It is impossible, however, with current knowledge to accurately apportion reasons for the observed increase.

The prevalence of a history of wheeze or asthma we have found is far higher than in other studies. An earlier Australian study (1982-4) reported a prevalence of a history of respiratory symptoms of 34%.¹⁵ Other recent international studies have reported prevalence

TABLE II—Frequency and other characteristics of wheeze in children reported to have wheezed in past 12 months. All values are numbers (percentages) of children

Symptoms in past 12 months	Age of children (years)		
	7 (n=767)	12 (n=628)	15 (n=553)
<4 episodes	496 (65)	372 (59)	342 (62)*
Used bronchodilators	421 (85)	271 (73)	244 (71)
4-12 episodes	195 (25)	171 (27)	135 (24)
Used bronchodilators	185 (95)	160 (94)	123 (91)
>12 episodes	70 (9)	76 (12)	67 (12)
Used bronchodilators	66 (94)	75 (99)	66 (99)
Sleep disturbed by wheeze	468 (61)	305 (49)	251 (45)*
Severe episode	191 (25)	102 (16)	95 (17)
Exercise induced wheeze	438 (57)	489 (78)	442 (80)*

* χ^2 test for proportions of frequency of episodes, controlling for age $p < 0.001$.

in 7 year olds of 19.4% in the United Kingdom¹⁶ and 29.4% in New Zealand.¹⁷

The prevalence of wheeze in the past 12 months in our study was higher in all age groups than prevalences in similar recent studies from the United Kingdom¹⁶ and New Zealand (table IV).¹⁷ The circa 1988 study of children in suburban Sydney suggested a prevalence of wheeze in the past 12 months of 17.7% in 8-12 year old children.¹⁵ The increased prevalence of wheeze that we found among 7 year old boys is similar to that reported in the Southampton study (14.3% in boys v 9.5% in girls).¹⁶ This difference diminished with increasing age, a trend also seen in the Southampton study.

TABLE IV—Percentage of children reported to have wheezed in past 12 months in different studies

	Age of children (years)		
	7	12	15
Southampton, 1986 ¹⁶	11.9	12.3	
Dunedin, 1987 ¹⁷	19.5		
Tyneside, 1987 ¹⁵			8.6
Cardiff, 1988 ¹		15.2	
Melbourne, 1990	23.1	21.7	18.6

Though the prevalence of wheeze fell with increasing age, the prevalence of exercise induced wheeze, morning tightness, and wheeze on exposure to common allergens increased. The increase in exercise induced wheeze has not been reported previously. It may reflect a change in exercise patterns to endurance type exercise and the participation in organised sporting activities. The increased prevalence of wheeze on exposure to allergens may also reflect a change in the pattern of asthma. Whereas respiratory tract infections are the most common precipitating factors in young children these occur less often in teenagers, for whom the peak hospital admission rate occurs in spring.

Asthma was reported in roughly 79% of children who wheezed in the past 12 months, the same figure as quoted in the Southampton study¹⁶ and much higher than the 32% in Dunedin¹⁷ and 12% in the Tyneside study.¹⁸ The level of treatment with bronchodilators in our study was much higher at 84% overall and 96% (age 7) to 93% (age 15) in those reported to have asthma compared with 41% and 66% in the Southampton study¹⁶ and 34% in the Tyneside study.¹⁸ We did not consider the adequacy of the bronchodilator treatment or the use of prophylactic treatment.

We did not test bronchial responsiveness. Though this test would provide an objective measure for future comparison and previous population surveys have shown an association between clinical asthma and bronchial hyperresponsiveness, it lacks both sensitivity and specificity. In an Australian study 6.7% of those without symptoms of asthma had bronchial hyperresponsiveness and 66% of those with respiratory symptoms suggestive of asthma did not.¹⁹ This pattern was confirmed by a second Southampton study, in which 17.5% of those without respiratory symptoms had bronchial hyperresponsiveness and 47% of those with a current history of wheeze and shortness of breath did not.²⁰

Within its limitations our survey has identified a large increase in the prevalence of a history of wheeze or asthma in 7 year old children in Melbourne over the past 26 years and a high prevalence of current respiratory symptoms suggestive of asthma.

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Appendix

RESPIRATORY SYMPTOMS QUESTIONNAIRE

- Has your child ever had wheezing or whistling in the chest?
- Has your child ever had asthma?

If yes to questions 1 or 2 then:

- In the past 12 months has your child had a wheezing or asthma attack?
- In the past 12 months how many wheezing attacks did your child have: (a) <4, (b) 4-12, (c) >12?
- In the past 12 months has any wheezing attack woken your child at night?
- In the past 12 months has any wheezing attack been severe enough to limit speech to only one or two words at a time?

Everyone to answer the following questions:

- In the past 12 months has your child sounded wheezy during or after exercise?
- In the past 12 months has your child had a dry cough at night (apart from a cough associated with a cold or chest infection)?
- In the past 12 months has your child usually brought up phlegm or mucous from the chest first thing in the morning?
- In the past 12 months has your child woken with a feeling tightness in the chest first thing in the morning?
- In the past 12 months has your child had tightness in the chest or become short of breath when near animals, feathers, or dust?
- In the past 12 months has your child been treated at any time with any of the following drugs: Ventolin, Bricanyl, Nuelin, Somophyllin, Respolin, Berotec, Theo-Dur, Elixophyllin, or Slo-Bid?
- Has your child ever had bronchitis?
- Has your child ever suffered from wheezing with bronchitis or with a cold?