Asthma among school children in the Barwon region of Victoria

Peter J Vuillermin, Mike South, John B Carlin, Maree I Biscan, Sharon L Brennan and Colin F Robertson

Studies from North America have shown that lower socioeconomic status is associated with a decrease in regular asthma reviews and an increase in the use of acute asthma-related health resources.[1-3] There is a lack of similar research from Australia, and such local data are needed to guide strategic asthma initiatives. There is also a lack of data on regional variations in asthma prevalence. Phase 3 of the International Study of Asthma and Allergies in Childhood (ISAAC) multicountry survey showed that the estimated prevalence of asthma varies widely across time and place.[4] Melbourne is the only site in Australia where ISAAC surveys have been conducted repeatedly, and it is not known whether these data are representative of a broader cross-section of Australian children. Finally, we need data on age-related changes in the pattern of asthma in children.

We conducted a survey of asthma prevalence and management among primary school children in the Barwon region of Victoria using the ISAAC protocol. We assessed (i) the effect of socioeconomic status on asthma management and use of health resources; (ii) regional variation in asthma within the Barwon region (comparing with data obtained in Melbourne);[5] and (iii) age-related changes in the pattern of asthma during primary school years: whether the switch from male to female predominance in occurrence of asthma symptoms[6] begins during primary school; and whether there is an age-related increase in the prevalence of children with very frequent wheeze (≥ 12 episodes) per year.

METHODS

Study region

The study was conducted in the Barwon region of Victoria (Box 1) between March and September 2005. We randomly selected 36 of 91 primary schools (government, Catholic and Independent) within an estimated 90-minute return car journey from the Geelong Hospital. We used a computer-generated random selection method.

The metropolitan zone of the Barwon region was defined as a region of continuous urban development, extending from the

ABSTRACT

Objectives: To determine (i) the relationship between asthma management and socioeconomic status; (ii) whether recent estimates from the International Study of Asthma and Allergies in Childhood (ISAAC) conducted in Melbourne apply to a broader cross-section of Victorian children; and (iii) age-related trends in asthma prevalence.

Design: A questionnaire survey, based on the ISAAC protocol.

Participants and setting: Subjects were children aged 4–13 years from a random sample of primary schools in the Barwon region of Victoria. The survey was conducted between March and September 2005.

Main outcome measures: Parent-reported wheeze and wheeze-related use of health resources during the preceding 12 months.

Results: Questionnaires were returned by 7813/9258 students (84%). Lower socioeconomic status was associated with increased frequency of regular asthma reviews ($P < 0.01$ for trend), but not of emergency department visits ($P = 0.19$). The prevalence of wheeze among 6- and 7-year-old children in the Barwon region was similar to that in Melbourne children (20.2% v 20.0%, respectively). There was an age-related increase in the proportion of children with ≥ 12 episodes of wheeze ($P = 0.01$); but an age-related decrease in emergency department visits ($P = 0.02$).

Conclusions: Disadvantaged children have good access to regular asthma reviews and are no more likely to attend an emergency department with an episode of acute wheeze. Asthma prevalence in 6- and 7-year-old children in the Barwon region is similar to that in Melbourne. The prevalence of children with very frequent wheeze increases with age, but their use of health resources decreases.

MJA 2007; 187: 221–224

central business district of Geelong. The coastal zone was defined as the townships within 1 km of the coast (Port Phillip Bay or Bass Strait), and which were not within the metropolitan zone. All other areas were defined as lying within the rural zone.

Survey protocol

We used the ISAAC protocol to survey primary school children from school entry to Year 6.[7] The survey instrument was a four-page questionnaire, containing the first of three standard ISAAC modules, which include items related to demographic data and asthma symptoms. A module asking about asthma treatment was added. No translations were supplied.

For comparison data, we used the ISAAC study conducted in Melbourne during 2002.[5]

Socioeconomic status

Socioeconomic status was determined by matching each respondent's postal address with the corresponding Australian Bureau of Statistics (ABS) census collection district (about 250 households per district). We
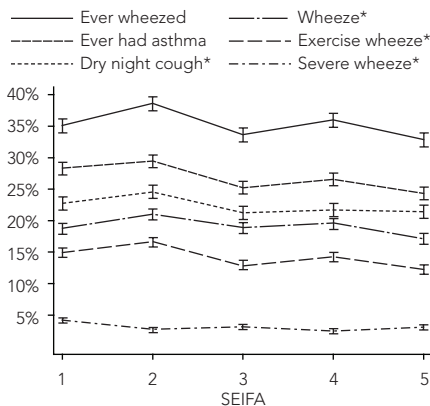
used ABS software to determine the Socio-Economic Index for Areas (SEIFA) value from the 2001 census of each respondent. The SEIFA is a composite measure: low values indicate an area of disadvantage, and high values indicate an area of advantage.

1 The Barwon region, south-west of Melbourne, Victoria


The Barwon region has a population of approximately 210 000, with similar demographic characteristics to that of Victoria as a whole (Australian Bureau of Statistics census data, 2002). ◆

2 Parent-reported asthma symptoms in children attending primary school, by SEIFA quintile (n = 7408)

—— Ever wheezed   —·—· Wheeze*
– – – Ever had asthma   – – – Exercise wheeze*
········ Dry night cough*   –··–·· Severe wheeze*

*During the preceding 12 months. Bars indicate 95% CIs. SEIFA = Socio-Economic Index for Areas. SEIFA 1 = most disadvantaged quintile; SEIFA 5 = least disadvantaged quintile. ◆

3 Proportion of the children with wheeze during the preceding 12 months (n = 1472) who had a regular asthma review by a GP, or attended an ED with a wheeze episode, by SEIFA quintile

—— Regular review   – – – ED visit

$P<0.01$ for trend

$P=0.21$ for trend
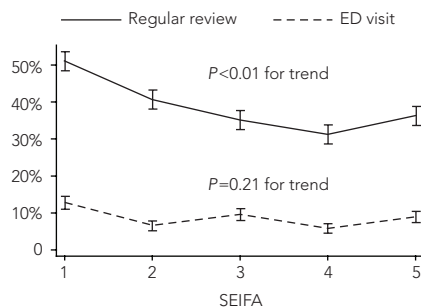
Bars indicate 95% CIs. ED = emergency department. GP = general practitioner. SEIFA = Socio-Economic Index for Areas. SEIFA 1 = most disadvantaged quintile; SEIFA 5 = least disadvantaged quintile. ◆

Statistical analysis

We investigated the relationship between asthma-related outcomes and a range of exposures using simple (univariate) logistic regression to assess trends across categories of ordinally classified exposures. We then investigated potential confounding in the relationship between asthma-related outcomes and, firstly, the SEIFA index of advantage/disadvantage, and, secondly, age in years, using multivariate logistic regression. We planned to include all variables that were associated with wheeze during the preceding 12 months ($P<0.05$) in univariate analysis. Sex was the only variable to meet this criterion. However, we adjusted for both age and sex in the multivariate analyses. All P values quoted represent tests for trend. Standard errors were adjusted for clustering at the school level. Analyses were performed with Stata, version 9 (StataCorp, College Station, Tex, USA).

Ethics approval

Approval for the study was obtained from Barwon Health Research and Ethics Advisory Committee and from the Victorian Department of Education and Training.

RESULTS

All 36 schools agreed to participate. Questionnaires were issued to 9258 students, and 7813 were returned (response rate, 84.4%). For most questions, less than 1% of the answers were missing. The mean age of respondents was 8.3 years (range, 4–13 years).

Socioeconomic comparisons

We were able to determine the ABS census collection district number for 7408 of the 7813 respondents (94.8%). There was some evidence that disadvantaged children were more likely to have exercise-induced wheeze ($P=0.06$), and episodes of asthma severe enough to limit speech to a few words ($P=0.013$) (Box 2). However, SEIFA-related trends were not evident for the remaining asthma symptoms ($P>0.05$ for each).

Among children with parent-reported wheeze during the preceding 12-month period, disadvantaged children were more likely to have received a regular asthma review with a general practitioner, but were no more likely to have attended an emergency department with an episode of acute wheeze than less disadvantaged children (Box 3). There were no SEIFA-related trends in the proportion of children who had been provided with a written asthma plan ($P=0.81$), or who regularly used an inhaled corticosteroid ($P=0.43$).

Regional comparisons

The prevalence of asthma symptoms and asthma-related use of health care resources was similar in coastal, rural and metropolitan zones of the Barwon region (Box 4).

As the ISAAC study conducted in Melbourne in 2002 included 6- and 7-year-old children only,[5] we restricted the comparison between the Barwon region and Melbourne to this age group. There was no indication of any differences in the prevalence of asthma symptoms or asthma-related use of health care resources between Melbourne (2002) and the Barwon region (2005) (Box 5).

Age-related changes

The analysis of age-related changes in asthma symptoms was restricted to children aged 5–12 years ($n=7800$), as there were only 13 respondents outside this range.

The proportion of children with parent-reported wheeze during the preceding 12 months was greater among boys than girls (mean difference, 4.2%; 95% CI, 1.9%–6.4%), and this relationship remained relatively constant throughout the primary school years (Box 6).

Among children with parent-reported wheeze during the preceding 12 months, there was an age-related increase in the proportion of children who had very frequent wheeze (≥ 12 episodes per year) (Box 7). However, by contrast, there was an age-related decrease in wheeze-related GP reviews ($P<0.001$), emergency department visits ($P=0.02$), and hospitalisation ($P=0.04$).

DISCUSSION

As far as we are aware, this is the first Australian study to investigate the relationship between asthma management and socioeconomic status. We have shown that disadvantaged children in the Barwon region, compared with their less disadvantaged peers, access more regular asthma reviews and are no more likely to attend a hospital emergency department with an episode of acute asthma. This finding is novel, and in distinct contrast to data from other parts of the world.[1-3]

Factors that may be relevant to this novel finding include: access to free medical care in Australia, the activities of the National Asthma Council over recent decades, implementation of the Asthma Friendly Schools Program in 2000 (http://www.asthma.org.au/Default.aspx ?tabid=211), and the Asthma 3+ Visit Plan in 2001 (http://www.health.gov.au/internet/ wcms/publishing.nsf/content/health-mediarel-yr2001-mw-mw01102.htm). It is also noteworthy that the Barwon region has a relatively good supply of GPs: 156 full-time equivalents for a population of about 210 000 (Ms Tricia Balane, Workforce Officer, Geelong Division of General Practice, personal communication, 15 May 2007). It would be of interest to examine whether access to regular asthma reviews among disadvantaged children is also adequate in areas of Australia less well served with GPs.

4 Prevalence (95% CI) of asthma symptoms and use of health care resources among primary school children in coastal, rural and metropolitan zones of the Barwon region

|	Barwon region, coastal (n = 1539)	Barwon region, rural (n = 1387)	Metropolitan Geelong (n = 4887)
Wheeze ever	34.5% (26.2% to 43.0%)	34.1% (31.3% to 36.9%)	35.5% (33.6% to 37.4%)
Ever had asthma	25.5% (20.1% to 31.0%)	26.2% (23.1% to 29.4%)	27.1% (25.4% to 28.8%)
Symptoms during past year			
Wheeze	19.1% (12.9% to 25.5%)	19.3% (17.5% to 21.2%)	18.7% (17.4% to 20.1%)
Wheeze episode severe enough to limit speech	2.7% (2.2% to 3.3%)	3.5% (2.6% to 4.5%)	3.0% (2.5% to 3.6%)
Dry night cough not associated with a "cold"	22.1% (17.7% to 26.6%)	23.2% (19.6% to 26.8%)	14.1% (12.7% to 15.6%)
Wheeze during or after exercise	13.4% (9.4% to 17.4%)	14.5% (12.5% to 16.6%)	14.1% (12.7% to 15.6%)
Wheeze episodes			
1–3	11.5% (8.1% to 14.7%)	12.3% (11.0% to 13.6%)	12.1% (11.0% to 13.3%)
4–12	5.6% (3.4% to 7.8%)	5.7% (4.3% to 7.1%)	4.7% (4.0% to 5.3%)
> 12	1.5% (0.7% to 2.3%)	0.9% (0.2% to 1.7%)	1.5% (1.1% to 1.9%)
Sleep disturbance			
Never	90.3% (87.2% to 93.6%)	90.3% (87.2% to 93.6%)	89.8% (7.5% to 9.7%)
< 1 night per week	7.8% (5.3% to 10.3%)	9.1% (7.8% to 10.5%)	8.2% (7.6% to 8.9%)
≥ 1 night per week	1.8% (0.7% to 3.0%)	2.6% (1.9% to 3.6%)	1.6% (1.4% to 2.5%)
Emergency department attendance*	1.4% (0.2% to 2.6%)	1.7% (0.9% to 2.5%)	1.6% (1.3% to 2.0%)
Hospital admission*	1.0% (0.0 to 2.0%)	1.0% (0.2% to 1.8%)	0.9% (0.4% to 1.3%)

* Emergency department attendances resulting in hospital admission are double-counted (the convention in reporting ISAAC data [International Study of Asthma and Allergies in Childhood]).[4] ◆

5 Prevalence (95% CI) of asthma symptoms and use of health care resources among 6- and 7-year-old primary school children in Melbourne (2002) and the Barwon region (2005)
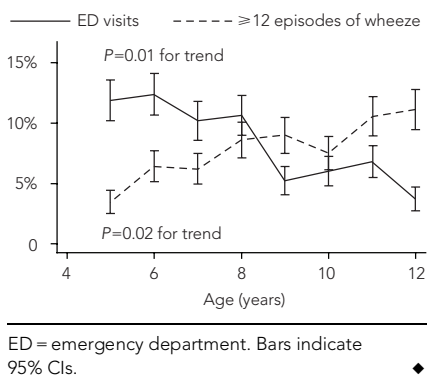
	Melbourne 2002[5] (n = 2968)	Barwon region 2005 (n = 2208)	Difference (none statistically significant)
Wheeze ever	37.1% (34.8% to 39.5%)	35.0% (32.8% to 37.2%)	–2.1% (–5.3% to 1.1%)
Ever had asthma	25.5% (23.7% to 27.4%)	24.4% (22.8% to 26.0%)	–1.1% (–3.5% to 1.3%)
Symptoms during the past year			
Wheeze	20.0% (18.4% to 21.8%)	20.2% (1.84% to 22.2%)	0.2% (–2.3% to 2.7%)
Wheeze episode severe enough to limit speech	3.1% (2.5% to 3.8%)	3.4% (2.6% to 4.2%)	0.3% (–0.7% to 1.3%)
Dry night cough not associated with a "cold"	22.1% (17.7% to 26.6%)	24.0% (22.5% to 25.6%)	1.9% (–2.8% to 6.6%)
Wheeze during or after exercise	13.4% (9.4% to 17.4%)	13.2% (11.8% to 14.6%)	–0.2% (–4.4% to 4.0%)
Wheeze episodes			
1–3	11.5% (8.1% to 14.7%)	13.5% (12.0% to 15.1%)	2.0% (–1.6% to 5.6%)
4–12	5.6% (3.4% to 7.8%)	5.1% (4.2% to 6.0%)	–0.5% (–2.9% to 1.9%)
> 12	1.5% (0.7% to 2.3%)	1.2% (0.8% to 1.8%)	–0.3% (–1.2% to 0.6%)
Sleep disturbance			
Never	90.3% (87.2% to 93.6%)	88.1% (87.1% to 89.3%)	–2.2% (–5.6% to 1.2%)
< 1 night per week	7.8% (5.3% to 10.3%)	9.7% (8.8% to 10.6%)	1.9% (–0.8% to 4.6%)
≥ 1 night per week	1.8% (0.7% to 3.0%)	2.1% (1.6% to 2.7%)	0.3% (–1.0% to 1.6%)
Emergency department attendance*	1.4% (0.2% to 2.6%)	2.2% (1.4% to 3.0%)	0.8% (–0.6% to 2.2%)
Hospital admission*	1.0% (0.0 to 2.0%)	1.2% (0.7% to 1.6%)	0.2% (–0.9% to 1.3%)

* Emergency department attendances resulting in hospital admission are double-counted (the convention in reporting ISAAC data [International Study of Asthma and Allergies in Childhood]).[4] ◆

6 The proportion of school children with parent-reported wheeze during the preceding 12 months ($n = 7800$), by age

Boys ——— Girls - - - - -

$P=0.13$ for trend

$P=0.52$ for trend

Age (years)

Bars indicate 95% CIs.
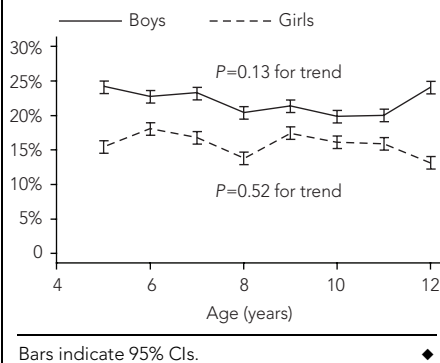
7 The proportion of the children with wheeze during the preceding 12 months ($n = 1472$) who attended an ED or had ≥ 12 episodes of wheeze in this period, by age

ED visits ——— ≥12 episodes of wheeze - - - - -

$P=0.01$ for trend

$P=0.02$ for trend

Age (years)

ED = emergency department. Bars indicate 95% CIs.

We have also shown that the estimated prevalence of asthma is similar in all three (coastal, rural and metropolitan) zones of the Barwon region when compared with Phase 3 ISAAC estimates conducted in Melbourne during 2002.[5] Melbourne appears to be a legitimate sentinel site for asthma monitoring in Victoria, and its population is likely to be representative of a significant proportion of the Australian population.

The age-related data from our study suggest that the switch from male to female predominance in occurrence of asthma symptoms does not occur during the primary school years. Previous studies have shown a female predominance in those with asthma symptoms by the mid-teens.[8] Further studies are required to determine the environmental and intrinsic factors that mediate this switch, and these should focus on early adolescence.

We also showed that older children are less likely to attend a hospital because of asthma, but are more likely to have very frequent wheeze. This may simply reflect an age-related reduction in the severity of wheeze episodes. Alternatively, with time and experience, families may be better able to manage asthma without assistance. It would be useful to determine if there are specific skills that families acquire, as these may be relevant to the design of asthma education strategies.

Our study has a number of limitations. First, the use of parent-reported wheeze as a primary outcome measure in the ISAAC survey methods lacks specificity,[9] and a significant proportion of parents misunderstand the term "wheeze".[10] As a result, ISAAC surveys tend to overestimate the prevalence of asthma. Second, the use of an area-based, rather than an individual-based, classification of socioeconomic status lacks precision: random misclassification of individuals using this approach tends to lead to an underestimate of effect size, and it is possible that we have underestimated socioeconomic trends. Third, the zones that we defined within the Barwon region were relatively arbitrary, and may not be sufficiently different from one another to allow these data to be generalised: the spectra of some exposures are likely to be adequate (eg, airborne pollutants and allergens), but for other exposures (eg, humidity, sunlight) may be relatively narrow.

Finally, the use of a prevalence measure to investigate the age at which more boys than girls have asthma symptoms is not ideal: asthma is a disease with a prolonged and variable duration. Hence, a measure of incidence (which would require longitudinal rather than cross-sectional data) would be superior.

In conclusion, we have shown, firstly, that disadvantaged children in the Barwon region of Victoria have relatively good access to regular asthma reviews and are not over-represented in the hospital system; secondly, that the prevalence of asthma in 6- and 7-year-old school children in the Barwon region of Victoria is similar to that in Melbourne; and, thirdly, that the switch from male to female predominance in occurrence of asthma symptoms is not evident during the primary school years; and, finally, that there is an age-related increase in the prevalence of children with very frequent wheeze, but a decrease in asthma-related use of health resources.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

AUTHOR DETAILS

Peter J Vuillermin, FRACP, Paediatrician[1]
Mike South, MD, Professor[1]
John B Carlin, PhD, Professor[1,2]
Maree I Biscan, Mstrs, Research Nurse[3]
Sharon L Brennan, Mstrs, Research Assistant[3]
Colin F Robertson, MD, Principal Fellow[1]
1 Department of Paediatrics, University of Melbourne, Melbourne, VIC.
2 Department of Public Health, University of Melbourne, Melbourne, VIC.
3 Barwon Health, Geelong, VIC.
Correspondence:
peterv@barwonhealth.org.au

REFERENCES

1 Hanania NA, David-Wang A, Kesten S, Chapman KR. Factors associated with emergency department dependence of patients with asthma. *Chest* 1997; 111: 290-295.

2 Chen Y, Tang M, Krewski D, Dales R. Relationship between asthma prevalence and income among Canadians. *JAMA* 2001; 286: 919-920.

3 Watson JP, Cowen P, Lewis RA. The relationship between asthma admission rates, routes of admission, and socioeconomic deprivation. *Eur Respir J* 1996; 9: 2087-2093.

4 Asher MI, Montefort S, Björkstén B, et al. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. *Lancet* 2006; 368: 733-743.

5 Robertson CF, Roberts MF, Kappers JH. Asthma prevalence in Melbourne schoolchildren: have we reached the peak? *Med J Aust* 2004; 180: 273-276.

6 Dodge RR, Burrows B. The prevalence and incidence of asthma and asthma-like symptoms in a general population sample. *Am Rev Respir Dis* 1980; 122: 567-575.

7 Asher MI, Keil U, Anderson HR, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. *Eur Respir J* 1995; 8: 483-491.

8 Robertson CF, Bishop J, Sennhauser FH, Mallol J. International comparison of asthma prevalence in children: Australia, Switzerland, Chile. *Pediatr Pulmonol* 1993; 16: 219-226.

9 Mai XM, Nilsson L, Kjellman NI, Björkstén B. Hypertonic saline challenge tests in the diagnosis of bronchial hyperresponsiveness and asthma in children. *Pediatr Allergy Immunol* 2002; 13: 361-367.

10 Michel G, Silverman M, Strippoli MP, et al. Parental understanding of wheeze and its impact on asthma prevalence estimates. *Eur Respir J* 2006; 28: 1124-1130.