Trends in asthma prevalence and population changes in South Australia, 1990–2003

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ABSTRACT

Objectives: To examine changes in asthma prevalence in the context of other population changes between 1990 and 2003, for specific age and sex groups.

Design: Cross-sectional survey based on household interviews, repeated annually.

Setting and participants: Representative samples of the South Australian population between 1990 and 2003 (around 3000 people per year).

Main outcome measures: Current prevalence of doctor-diagnosed asthma and other health and demographic variables potentially associated with asthma, and asthma management.

Results: Response rate was over 71%. Between 1990 and 2003, asthma prevalence increased significantly, doubling in females (from 7.3% in 1990 to 14.6% in 2003), with a smaller increase in males (from 7.8% to 9.4%). Asthma also increased in all age groups, but the largest relative increases occurred in people aged 55 years and older. Logistic regression analyses showed that obesity was a major predictive variable for every age group studied. The prevalence of asthma morbidity (waking at night and days lost from usual activities because of asthma) among those with asthma showed no significant changes between 1990 and 2003. Asthma action plans (introduced on a population basis in 1992) peaked in their distribution at 42% in 1994, and then declined to half that percentage in 2003. The increase in asthma prevalence occurred at the same time as increases in population prevalence of obesity (10.3% to 18.7%) and diabetes (3.1% to 6.9%), and decline in recent vigorous exercise (42.4% to 32.7%).

Conclusions: The increase in asthma prevalence over a decade was large, but concentrated among specific sex and age groups. The increase accompanied population increases in obesity and diabetes and a decline in vigorous exercise.

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Asthma is an important chronic disease and a National Health Priority Area in Australia. A number of epidemiological studies have suggested that the burden of asthma is increasing in this country.[1-6] International studies have also identified changes in the prevalence and natural history of asthma.[7-10] However, a 1997 review of repeated epidemiological studies from around the world concluded that the evidence for increased asthma prevalence is weak, because of the possibility of systematic error arising from changing diagnostic practice, and lack of objective measures.[11] The authors concluded that studies need to be repeated in the same population over time before we can accept evidence of an increasing trend in asthma. Trend data are also essential to develop policy and strategies, and to assess their impact over time.

In this study, we analysed data on asthma collected annually between 1990 and 2003 from large representative population samples, using the same sampling methods and questionnaires. We examined population changes in asthma prevalence and morbidity in the context of changes in other health and demographic variables.

METHODS

The survey used data collected as part of the South Australian Health Omnibus Survey, as described previously.[12]

Population sample

The Omnibus Survey used Australian Bureau of Statistics collector districts. A random starting point was selected within each district, and 10 households were sampled using a fixed skip interval. One adult aged 15 years or older, whose birthday was next, was selected for interview in his or her home by trained health interviewers. There was no replacement for non-respondents.

Over 3000 people were interviewed each year except 1990, when 2559 people were interviewed. Survey response rates exceeded 71%. Data in each sample were weighted using Australian Bureau of Statistics population estimates. Age and sex standardisation of the data was considered necessary only for the overall asthma prevalence rate.

Data collection

Respondents were asked whether they had ever been diagnosed with asthma by a doctor, and whether they still had asthma, to determine current asthma status. Those with asthma were also asked about asthma morbidity (frequency of waking at night [weekly or more often], hospital admissions for asthma in the previous 12 months, and days lost from usual activities because of asthma in the previous 12 months) and whether they had a written asthma action plan (ie, a plan of what to do in an asthma attack).

Data were also collected on other health variables: doctor-diagnosed diabetes, body mass index (BMI; computed from self-reported height and weight data), smoking status and smoking history, a previous doctor diagnosis of high blood pressure or elevated cholesterol level, alcohol consumption at risk levels,[13] and vigorous exercise activity in the previous 2 weeks.

Demographic data were also collected. Socioeconomic status was derived from the Australian Standard Classification of Occupation codes.[14]

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1 Prevalence (%) of asthma and other health-related and demographic variables in South Australia, 1990–2003

Variable	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	*P* for trend*
Asthma prevalence															
All ages (standardised)	7.5	na	9.2	10.0	9.5	11.4	11.6	12.3	11.6	12.2	12.3	12.7	13.4	12.2	< 0.001
15–34 years	8.4	na	11.7	11.7	12.0	14.7	14.4	15.7	14.5	16.1	16.0	15.6	18.2	15.1	< 0.001
35–54 years	8.1	na	7.6	9.2	6.6	9.7	9.7	10.4	10.0	9.5	11.8	11.4	10.4	9.5	< 0.001
55 + years	5.6	na	7.8	8.9	9.7	9.1	10.3	10.0	9.7	10.2	8.2	10.8	10.5	11.7	< 0.001
Male	7.8	na	7.9	8.4	7.1	10.8	9.7	10.4	9.2	8.8	9.8	9.8	10.8	9.4	0.01
Female	7.3	na	10.6	11.8	11.9	11.9	13.5	14.0	13.7	15.2	14.4	15.4	15.1	14.6	< 0.001
Demographic variables															
Country residence	na	31.8	29.1	31.1	30.9	30.7	30.6	31.3	28.8	31.4	31.4	29.8	30.1	29.9	0.78
Post-school education	40.6	42.9	40.0	41.8	42.6	41.9	42.7	44.0	46.2	45.5	46.0	46.4	47.9	49.7	< 0.001
Income < $20 000 pa	na	25.9	30.6	29.1	29.3	27.1	26.3	26.4	25.6	26.1	23.1	22.7	20.8	21.0	< 0.001
Unemployed	5.2	4.9	5.3	na	4.7	4.2	5.1	3.9	4.5	3.3	3.8	3.5	2.7	2.9	< 0.001
Australian born	74.6	74.8	73.8	75.1	75.1	75.6	76.9	77.3	75.5	75.7	76.7	75.2	77.5	76.2	0.01
Biomedical variables															
Diabetes	3.1	3.4	2.6	3.2	3.9	4.2	3.8	4.4	5.2	5.3	6.0	5.2	7.0	6.9	< 0.001
Smoker	27.3	24.8	27.0	25.6	27.8	27.0	28.1	26.7	25.8	25.3	24.2	23.7	24.1	23.5	< 0.001
Obesity (BMI ⩾ 30 kg/m^2)															
Overall	na	10.3	9.8	11.1	13.6	13.3	15.0	15.3	14.8	na	na	17.8	na	18.7	< 0.001
Males	na	9.3	9.1	10.8	13.2	13.1	14.2	14.7	12.5	na	na	16.2	na	18.4	< 0.001
Females	na	11.2	10.4	11.4	13.9	13.5	15.8	15.9	17.1	na	na	19.4	na	19.1	< 0.001
High-risk alcohol use	na	4.9	3.6	3.6	4.8	5.6	5.8	6.2	5.1	na	na	na	na	9.2	< 0.001
Raised cholesterol level	na	20.1	22.0	18.9	na	16.9	14.5	15.9	14.5	na	na	na	na	na	< 0.001
Raised blood pressure	na	7.4	10.3	10.8	na	9.9	10.3	10.1	10.8	na	na	na	na	na	0.004
Recent vigorous exercise†	na	42.4	39.8	44.9	na	25.3	25.6	25.3	26.6	na	na	na	na	32.7	0.001
Asthma management and morbidity variables‡															
Asthma action plan	na	na	21.9	15.5	32.6	42.2	33.3	31.6	29.1	24.1	25.1	22.2	18.5	20.8	0.002
Waking at night due to asthma (weekly or more)	na	na	na	na	15.7	12.5	15.4	21.6	13.3	14.5	11.8	15.9	17.6	16.2	0.70
Asthma-related hospital admission (previous 12 months)	na	na	na	na	8.1	6.7	4.4	5.3	3.7	6.0	4.0	4.0	7.2	3.2	0.09
Days lost from work (previous 12 months)	na	na	na	na	20.2	20.1	13.4	18.2	13.6	na	17.6	17.5	22.5	18.9	0.39

*Mantel–Haenszel test. † In previous 2 weeks. ‡ Among those with asthma. na = not asked in that year. pa = per annum. BMI = body mass index. ◆

Statistical analyses

Data were analysed using SPSS version 12.0 for Windows (SPSS Inc, Chicago, Ill, USA); Stata version 8.1 (StataCorp, College Station, Tex, USA); and Epi Info 2002 (Centers for Disease Control and Prevention, Atlanta, Ga, USA). The significance of correlations was assessed using StatXact 4 (Cytel Inc, Cambridge, Mass, USA). These tests are exact and make no distributional assumptions. The analyses conducted with Stata version 8.1 used the survey estimators provided by the software. These estimators allow the user to specify strata, clustering of the sample within the primary sampling unit, a non-integer weighting variable, and a finite population correction factor where the sampling fraction is non-negligible.

As there were insufficient observations for time series analyses, data were analysed for linear trend over the period. Pearson correlation coefficients were calculated to identify changes and direction of changes in asthma over time.

Bivariate and multivariate logistic regression analyses were conducted to identify the best sets of explanatory variables associated with asthma, both overall and for age and sex groups. Variables that were statistically significant in the bivariate analyses were entered into logistic regression analyses. The asthma-related morbidity

variables (waking at night, hospital admissions, days lost from work, and asthma action plan) were not included in these analyses, as data were not collected in the early years.

RESULTS

Prevalence data

There were relatively large changes in prevalence of asthma and other health-related variables over the 14 years of observation (Box 1). Asthma prevalence increased by 63%, from 7.5% to 12.2% over the period. An increase occurred in both sexes, but females had the largest proportional change, with prevalence doubling over the period. Obesity increased by 82%, diabetes by 122%, alcohol consumption at risk levels by 88%, while vigorous exercising declined by 30%, and smoking by 16%. These changes were all statistically significant.

As shown in Box 1, changes in asthma prevalence were accompanied by changes in population demographic and reported biomedical characteristics. For those with asthma, there were no significant linear changes in reported asthma morbidity variables (waking at night and days lost from usual activities because of asthma), but self-reported hospital admissions for asthma and ownership of an asthma action plan declined, the latter significantly.

Variables associated with asthma

Pearson correlation coefficients were calculated for asthma and other variables from Box 1 (coefficients not shown). There was a significant positive correlation between asthma and year, which reinforced the linear trends of increasing asthma prevalence in all age groups identified in Box 1. There was also a significant correlation between asthma and obesity for all age groups except those aged 35–54-years; however, in the logistic regression analyses, which controlled for the effects of other variables, the association was significant for all age groups. Further data on correlations are available from the authors.

Variables that were significant at the bivariate level were entered into age and sex-specific logistic regression models. Asthma was associated with female sex, youth, low income, Australian birthplace, country residence, ex-smoking status, overweight (BMI ≥ 25 kg/m^2) and year of survey (Box 2). With the exception of overweight, this set of explanatory variables also held for a logistic regression analysis for females only, with the addition of obesity, elevated blood pressure and current smoking (Box 2). For males, the variables country residence, overweight and year were not significant. However, underweight (BMI < 18.49 kg/m^2) and obesity were statistically significant (Box 2).

Logistic regression analyses were also conducted separately for different age groups. Consistently across the groups, asthma was significantly associated with female sex, hypertension and obesity. In addition, Australian birth was significantly associated with asthma prevalence in those aged 15–54 years, and with ex-smoking status in those aged 55 years or older.

2 Multivariate logistic regression analyses of variables associated with asthma (combined dataset, 1990–2003)

	Odds ratio (95% CI)		
Variable	Overall	Females	Males
Sex			
Male	1.0	na	na
Female	1.49 (1.34–1.64)		
Age (years)			
55 +	1.00	1.00	1.00
35–54	1.07 (0.95–1.22)	1.34 (1.10–1.68)	0.89 (0.73–1.09)
15–34	1.67 (1.48–1.89)	1.99 (1.66–2.40)	1.49 (1.22–1.82)
Income			
> $20 000	1.00	1.00	na
⩽ $20 000	1.22 (1.10–1.36)	1.16 (1.00–1.34)	
Socioeconomic status			
At least medium	1.00	1.00	1.00
Low	1.00 (0.90–1.11)	0.86 (0.75–1.00)	1.15 (0.96–1.39)
Not stated	1.33 (1.11–1.58)	1.19 (0.94–1.50)	1.66 (1.17–2.35)
Country of birth			
Overseas	1.00	1.00	1.00
Australia	1.39 (1.24–1.55)	1.41 (1.19–1.66)	1.39 (1.14–1.69)
Area of residence			
Metropolitan	1.00	1.00	na
Country	1.16 (1.05–1.29)	1.18 (1.03–1.36)	
Smoking status			
Non-smoker	1.00	1.00	1.00
Ex-smoker	1.29 (1.15–1.44)	1.18 (1.00–1.39)	1.47 (1.20–1.80)
Current smoker	1.10 (0.98–1.24)	1.27 (1.08–1.51)	0.98 (0.80–1.20)
Raised blood pressure			
No	na	1.00	na
Yes		1.38 (1.17–1.61)	
Body mass index (kg/m^2)			
18.5–24.9	1.00	1.00	1.00
⩽ 18.49	1.06 (0.90–1.25)	0.85 (0.68–1.07)	1.55 (1.14–2.11)
25.0–29.9	1.15 (1.02–1.29)	1.18 (0.99–1.40)	1.11 (0.92–1.33)
⩾ 30.0	1.51 (1.32–1.73)	1.54 (1.27–1.86)	1.43 (1.13–1.82)
Year	1.03 (1.02–1.05)	1.05 (1.01–1.08)	na

na = the variable was not significant in the bivariate analyses and was excluded from the final model of the logistic regression. ◆

DISCUSSION

We conclude that the prevalence of asthma diagnosed by a doctor has increased in Australia since the early 1990s, especially among females and the elderly. In addition, our study shows that there has been no

decrease in asthma morbidity among people with asthma (as determined by waking at night and days lost from normal activities), but an apparent decline in the use of asthma action plans, despite increased case finding. We conclude that the population burden of asthma is increasing, given the combination of increased prevalence and constant morbidity. This is despite increasing international concern about asthma, the proliferation of asthma guidelines and, in Australia, its nomination as a National Priority Area.

The study provides a perspective on the natural history of asthma since 1990 and is the first Australian study to provide data on asthma over time using consistent methods of sampling, survey and analysis. It allowed us to assess the asthma problem from the perspective of societal changes through the trend and correlation analyses, and to identify the best predictors of asthma, overall and in specific age and sex groups, through the logistic regression analyses.

The increase in asthma prevalence could be a real increase or, alternatively, an increase in awareness and reporting by people with asthma, improved diagnosis by doctors, or a combination of these factors. However, the latter explanations seem less likely, unless increased awareness and better diagnosis affect subgroups with asthma differentially. Asthma prevalence increased over the period by 21% in males, 100% in females and 137% in people aged over 55 years. These differential increases suggest that at least part of the increasing trend in asthma is due to a real increase in disease in some groups. However, we cannot entirely refute changed awareness in the population or among health professionals as contributing factors.

In explaining the current overall burden of asthma, the population changes since 1990 — declining exercise levels, increased alcohol consumption, obesity and unspecified factors associated with a higher standard of living — all provide plausible biological hypotheses. These are structural and cultural variables reflecting the changing health status of society overall, as much as explanatory asthma risk factors. As societal changes, they must be addressed at a population level, in the general context of chronic disease, rather than targeted specifically as asthma risk factors.

The association between asthma and obesity reported previously[15,16] and found in our study suggests that the increase in asthma may be at least partly a result of the increased prevalence of obesity. However, it has also been argued that obesity may be a marker of recent lifestyle changes that are also associated with asthma.[16] In our study, such changes included a decline in exercise and an increase in alcohol consumption, but these proved not to be among the best predictors of asthma in the logistic regression analyses. In contrast, obesity dominated as a predictor in every age and sex group, and, although we cannot conclude a causal relationship from cross-sectional studies, the consistency of the associations increases its likelihood.

Young women aged 15–34 years are a priority asthma target group, but the trend data also identified asthma in older people as a burgeoning problem. The question of why asthma is increasing so dramatically in the elderly needs to have an important place in overall asthma policy.

A possible limitation of this study was self-reporting of symptoms and diagnoses. However, the consistency of estimates from year to year supports the reliability of the data, and there is no objective test for asthma that could replace doctor diagnosis in epidemiological studies.[17,18] Nevertheless, it is also probable that some self-reported diagnoses of asthma in obesity might be due to reduced lung function and consequent airway narrowing.[19]

This study has shown that asthma increased substantially over the past decade. While this increase occurred in all age groups and both sexes, it was most dramatic in females and the elderly. Future studies need to investigate the biomedical and anthropological aspects of these dramatic changes and also to investigate any effect of the decline in use of asthma action plans.

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COMPETING INTERESTS

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