

ORIGINAL ARTICLE

Obesity and asthma at school entry: Co-morbidities and temporal trends

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Aim: A decline in asthma prevalence from 2000 to 2005 was reported previously. The objective is to examine the temporal trends for the prevalence of obesity and other childhood disorders and consider the extent to which associations between asthma and other co-morbidities can be accounted for by body mass index.

Methods: Serial cross-sectional surveys of primary school entrants ($n = 18\,999$) in the Australian Capital Territory between 2001 and 2005 were used. Asthma, recent respiratory symptoms and diabetes data were extracted from parental reports. Anthropometric measurements were obtained from health assessments by school nurses. Child obesity was defined using the age and sex-specific Cole criteria. Time trends for the prevalence of obesity and other disorders, and the association between 'current asthma' and co-morbidities were analysed using multiple logistic regression and other analyses.

Results: Obesity prevalence was 5.24% in 2001 decreasing to 3.60% in 2005 (test of linear trend $P = 0.02$). Overweight (adjusted odds ratio (AOR) 1.30 (95% confidence interval (CI) 1.16, 1.46), $P < 0.001$) and obese (AOR 1.36 (95% CI 1.13, 1.62), $P = 0.001$) children were more likely to report 'asthma ever'. Children with diabetes (AOR 9.35 (95% CI 3.11, 28.12, $P < 0.001$)) and attention deficit (AOR 3.39 (95% CI 2.04, 5.64), $P < 0.001$) were more likely to report 'current asthma'.

Conclusions: The pattern of association with co-morbidities was different for asthma and obesity. The temporal decline/plateau effect in 'current asthma' could not be explained by concurrent body mass index changes. The decline in obesity was largely driven by the 2005 findings. Longer term trends need to be evaluated further.

Key words: asthma, co-morbidity, cross-sectional survey, obesity, school entry.

What is already known on this topic

- 1 International literature reports escalating obesity epidemic among children and a positive association of childhood asthma with obesity.
- 2 Asthma and obesity are associated with a burden of co-morbidities in children.
- 3 A decline in asthma prevalence is reported from Australian studies.

What this paper adds

- 1 This large representative study of serial cross-sectional surveys notes a welcome declining trend/plateau effect in body mass index (overweight/obesity) among new school entrants.
- 2 The pattern of association of co-morbidities is different for children with asthma, compared to those with obesity. Asthma is clearly associated with atopy, respiratory symptoms, type 1 diabetes and attention deficit hyperactivity disorder. Obesity appears associated with asthma, epilepsy and respiratory symptoms, but not eczema, type 1 diabetes or attention deficit hyperactivity disorder.
- 3 Thus, the mechanism of the temporal decline in 'current asthma' is not achieved through the concurrent decline in obesity.

School entry health screening provides an opportunity to improve child health at the individual level and provide data on

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the temporal trends in prevalence of common childhood conditions at the population level. In the Australian Capital Territory (ACT), serial school entry surveys at approximately 5 years of age have been conducted since 1998. Two childhood conditions of high public health significance are childhood obesity and asthma.

Asthma is the most frequently reported chronic illness affecting Australian children with prevalence estimates of 14.8% in boys and 8.7% in girls.¹ Childhood asthma has been linked to

various co-morbidities, poor quality of life and increased health-care costs.^{2,3} A 2010 report states that the knowledge of asthma co-morbidities in childhood is sparse and that further studies are urgently needed to optimise asthma management.⁴

Childhood obesity has a high prevalence in Australia. In 2007, 6% of children were reported to be obese and 17% were overweight. An analysis of data from pre-school children in the National Health and Nutrition Examination Survey from 1999 to 2008 demonstrated that the prevalence of child obesity was increasing and that severe obesity was associated with 17 comorbidities.⁵ Little similar data exists on the co-morbidity profile of Australian children with obesity.

We have previously reported a temporal decline in asthma among school entrants in the ACT.⁶ A similar decline in 'asthma ever' and 'current wheeze' was observed among South Australian pre-school children.⁷ Because a positive association between asthma and obesity exists⁸ and obesity appears to be causally related to asthma prevalence in some studies,^{9,10} it has been postulated that changes in asthma prevalence over time may reflect a change in body mass index (BMI) of children as a proxy for changes in obesity.^{11,12}

Here we report on the prevalence by gender of important chronic childhood conditions at school entry in the ACT during 2001–2005. We examine the co-morbidity profiles associated with asthma and obesity available from the health screening and assessment data that can affect learning, development and quality of life. Further, we examine temporal changes in these conditions and the extent to which changes in child obesity can account for the previously reported decline in child asthma in this setting.⁶

Methods

School health nurses offer a health assessment to new kindergarten entrants in all primary schools in the ACT. In preparation for the health assessment, a child health screening questionnaire is sent home to the parents of all current students who have just started primary school. Ethical approval for the study was obtained from the ACT Health and Community Care Human Research Ethics Committee.

We examined the data collected by school nurses and questionnaire at school entry from 18 999 children between the years 2001 and 2005. The questionnaire included standardised core questions from the International Study for Asthma and Allergy in Childhood, including wheeze frequency over the last 12 months and frequency of ever having had asthma and other respiratory history.^{13,14}

We report on parent-reported asthma during the past year ('current asthma') along with four recent respiratory symptoms as previously described.⁶ Parents were also asked to report if their child was suffering from diabetes. Any positive response was cross-checked against the ACT diabetes registry for type 1 diabetes (T1D) and the subset of cases also listed there is classified as confirmed T1D cases. Data were also available on other disorders including epilepsy and attention deficit hyperactivity disorder (ADHD) from the questionnaire based on parent report.

Anthropometric measurements (height and weight) were performed by school health nurses following a standard proto-

col. Body mass (kg) and height (m) were directly measured to the nearest 0.1 kg and 0.1 cm, respectively, without shoes and in light clothing, using a Stadiometer and weighing scales. BMI was calculated from weight (kg) divided by height (m²). Cut-off points for BMI for overweight and obese classification by sex for ages 4, 5 and 6 were adopted from UK-based criteria for children.¹⁵ BMI scores under the overweight cut-off point were considered normal.

Socio-economic status (SES) was measured using the Socio-Economic Indexes for Areas Index of Disadvantage from the Australian Bureau of Statistics.¹⁶ The index of disadvantage was based on the postcode of residence.

Statistical methods

Categorical variables were described using percentages and continuous variables as mean (standard deviation (SD)) or median (interquartile range) if not normally distributed. Missing data for some children were due to incomplete questionnaire responses. For prevalence estimates, 95% confidence intervals (CIs) were calculated using binomial sampling methods. The associations between various characteristics and asthma were first explored using Pearson's chi-square test of independence, with positive associations then included in multiple logistic and linear regression models. Logistic regression was used as the main form of analysis with exposure terms being other co-morbidities and asthma or obesity being the outcomes of interest. Multinomial logistic regression was used when the BMI category trends over time were analysed. Potential confounders such as age, sex and usual GP (a measure of usual/continuous care) were included as covariates. For temporal trend analyses, we used dummy variables to adjust for year of survey. The level of significance was set at 5%. Analyses were conducted using Stata 11.0 (Stata Corporation, College Station, TS, USA, 2009).

Results

Routine health screening data from a large number of school entry children ($n = 18\,999$) aged 4–6 years between 2001 and 2005 in the ACT are presented here. Participation rates for this survey by parents have been high, ranging from 85% to 89% per year.⁶ Of the 18 999 returned questionnaires, 3 have missing sex information. There are 1627 (8.6%) missing height measurements and 1611 (8.5%) missing weight measurements. The mean age of the child participants is 5.03 years (SD 0.37). A similar gender distribution is seen with 50.75% (9591/18 986) of the sample male. Overall, 5.57% (1054/18 914) of children in this survey are born overseas.

Table 1 summarises the characteristics of all children for whom there is data for the years 2001–2005. Males were slightly taller and heavier, but less likely to be overweight. More males than females had current asthma and ADHD.

Figure 1 shows that there is a positive association between higher BMI categories and the likelihood of 'current asthma' for both boys (test of trend $P = 0.004$) and girls (test of trend $P = 0.01$). Normal weight children seem less likely to report asthma in both genders, compared with children in overweight and obese categories. Higher rates of asthma are evident for boys in all three BMI categories. The correlation coefficient for the

Table 1 Characteristics of the school entry sample in years 2001 to 2005 by gender

	Prevalence % (95% CI) or prevalence % (n/N)			P-value for difference by gender
	Total	Males	Females	
Age (year)	5.03 (5.02, 5.03)	5.06 (5.05, 5.06)	5.00 (4.99, 5.00)	<0.001
Height (m)	1.16 (1.16, 1.6)	1.17 (1.17, 1.17)	1.15 (1.15, 1.6)	<0.001
Weight (kg)	21.61 (21.56, 21.66)	21.90 (21.83, 21.98)	21.31 (21.24, 21.39)	<0.001
BMI (kg/m ²)	15.94 (15.91, 15.96)	15.96 (15.92, 15.99)	15.92 (15.88, 1615.95)	0.14
BMI categories				
Normal weight	83.93 (14 274/17 008)	86.21 (7400/8548)	81.60 (6874/8424)	
Overweight	11.68 (1987/17 008)	9.59 (823/8548)	13.82 (1164/8424)	<0.001
Obese	4.39 (747/17 008)	4.21 (361/8548)	4.58 (386/8424)	
'Current asthma'	13.11 (2378/18 145)	15.38 (1410/9166)	10.78 (968/8979)	<0.001
Attention deficit disorder	0.58 (102/17 504)	0.94 (83/8787)	0.22 (19/8717)	<0.001
Type 1 diabetes	0.10 (18/17 571)	0.10 (9/8823)	0.10 (9/8748)	0.99
Epilepsy	0.35 (62/17 598)	0.35 (31/8837)	0.35 (31/8761)	0.97
Overseas born	5.56 (1052/18 907)	5.39 (515/9548)	5.74 (537/9359)	0.30
Socio-economic categories†				
Lowest quintile (1) 961.31–1058.79	31.52 (5946/18 862)	32.18 (3065/9526)	30.86 (2881/9336)	
(2) 1058.80–1065.38	14.61 (2756/18 862)	14.19 (1352/9526)	15.04 (1404/9336)	
(3) 1065.39–1081.38	14.42 (2719/18 862)	13.87 (1321/9526)	14.97 (1398/9336)	0.05
(4) 1081.39–1095.91	19.46 (3670/18 862)	19.63 (1870/9526)	19.28 (1800/9336)	
Highest quintile (5) 1095.92–1132.74	19.99 (3771/18 862)	20.13 (1918/9526)	19.85 (1853/9336)	

†SES categories based on SEIFA index of disadvantage range from most disadvantaged (961.31–1058.79 category), to least disadvantaged (1095.92–1132.74 category) based on postcode of residence. BMI, body mass index; CI, confidence interval.

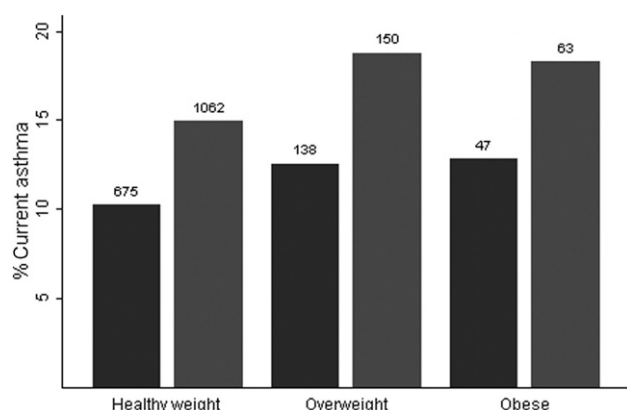


Fig. 1 The proportion (%) of children with 'current asthma' at school entry by gender and obesity category, with number in each category. P-value for girls = 0.01, P-value for boys = 0.004. (■) Female, (■) Male.

association between BMI categories and 'current asthma' is 0.03 ($P = 0.0003$). There was a low magnitude, but it was significant. Among those with current asthma, oral steroid medication use was not associated with higher BMI ($P = 0.24$).

Table 2 presents the co-morbidities associated with obesity. Asthma and respiratory symptoms are overrepresented in overweight/obese children, compared with those of normal weight, but not hay fever or eczema. Children with 'current asthma' are heavier than their peers (0.26 kg (95% CI 0.10,

0.42), $P = 0.001$) but do not differ with regard to height. After adjusting for age and sex, weight is significantly higher (0.19 kg (95% CI 0.03, 0.35), $P = 0.02$) for those with 'current asthma'. Asthmatics are also more likely to be classified as overweight or obese (18.64%), compared with non-asthmatics (15.59%) (odds ratio (OR) 1.24 (95% CI 1.10, 1.40), $P < 0.001$). Neither ADHD nor T1D show variation by child BMI categories. Obese, but not overweight children, are more likely to have epilepsy. This factor associated with obesity does not differ by gender (Table 1). Further adjustment for SES or height individually did not markedly change the magnitude or the significance level of the associations reported in Table 2 (data not shown).

For asthma co-morbidity, a different pattern is demonstrated (Table 3). Children with respiratory symptoms and eczema or hay fever are more likely to have 'current asthma', as are children with ADHD or T1D. Among children with confirmed T1D, this positive association with 'current asthma' is even stronger in magnitude (adjusted odds ratio 9.35 (95% CI 3.11, 28.12)) when adjusted for confounding variables including BMI categories. Children with epilepsy are more likely to have 'current asthma' on univariate analysis, but this association does not persist after accounting for BMI and other factors.

Table 4 shows the association between SES and BMI. The less disadvantaged areas seem to be associated with lower BMI compared with the most disadvantaged.

Temporal trends

Figure 2 shows the proportion of children who are obese or overweight by year of survey. A decline in obesity (from 5.24%

Table 2 Co-morbid conditions among school entrants by BMI category

	Normal	BMI categories		Obese	
	OR† (95% CI)	Overweight OR† (95% CI)	P-value	OR† (95% CI)	P-value
'Current asthma'	1.00 (reference)	1.29 (1.12, 1.48)	<0.001	1.29 (1.05, 1.60)	0.02
'Asthma ever'	1.00 (reference)	1.30 (1.16, 1.46)	<0.001	1.36 (1.13, 1.62)	0.001
Attention deficit disorder	1.00 (reference)	1.03 (0.51, 2.07)	0.93	0.56 (0.14, 2.30)	0.42
Type 1 diabetes‡	1.00 (reference)	2.08 (0.58, 7.51)	0.26	1.84 (0.24, 14.30)	0.56
Epilepsy	1.00 (reference)	0.95 (0.37, 2.41)	0.91	3.08 (1.30, 7.31)	0.01
Eczema ever	1.00 (reference)	1.03 (0.93, 1.14)	0.60	0.95 (0.81, 1.12)	0.53
Hay fever ever	1.00 (reference)	1.00 (0.88, 1.14)	0.98	1.20 (0.99, 1.45)	0.07
Recent wheeze	1.00 (reference)	1.30 (1.15, 1.48)	<0.001	1.34 (1.10, 1.63)	0.004
Wheeze with URTI	1.00 (reference)	1.29 (1.15, 1.45)	<0.001	1.47 (1.24, 1.74)	<0.001
Night cough	1.00 (reference)	1.20 (1.05, 1.36)	0.005	1.30 (1.07, 1.57)	0.007
Shortness of breath	1.00 (reference)	1.50 (1.27, 1.77)	<0.001	2.16 (1.73, 2.70)	<0.001

†Adjusted for age, sex and usual general practitioner. ‡Not adjusted for usual GP. BMI, body mass index; CI, confidence interval; OR, odds ratio; URTI, upper respiratory tract infection.

to 3.60%) and overweight (from 12.48% to 9.23%) is seen from 2001 to 2005. This figure particularly reflects the lower proportions evident in 2005. It should also be noted that we have previously reported that the prevalence of 'current asthma' also declined ($P < 0.001$) in the same population from 2000 to 2005.⁶ The prevalence of current asthma generally declined from 2001 to 2005 (13.7%, 14.67%, 13.5%, 12.12% and 11.62%) (heterogeneity χ^2 test $P = 0.001$). This linear decline over time remains evident even after adjusting for age, sex and usual GP (OR overweight 0.94 (95% CI 0.91, 0.98; $P = 0.001$ per year); OR obese 0.93 (95% CI 0.89, 0.98; $P = 0.01$ per year).

Analysis of the BMI trend data by country of birth, that is, whether the child was born in Australia or born overseas shows that no such significant decline among the overseas-born children (OR overweight 0.94 (95% CI 0.80, 1.11; $P = 0.49$); OR obese 0.98 (95% CI 0.79, 1.22; $P = 0.88$). The declining trend remains statistically significant for Australian born children only.

Table 5 shows that even after controlling for the obesity trend, the previously reported findings⁶ of a temporal decrease in asthma with a temporal increase in eczema persists to 2005. The rarer disorders of ADHD, T1D and epilepsy have no significant change in prevalence over time.

Discussion

We find temporal trends suggesting a decrease in both asthma (previous report) and high BMI categories that are not explained by an association between these two conditions. The finding that child overweight/obesity has not been continuing to rise over half a decade in the ACT is in contrast to some findings, particularly in the USA where the obesity epidemic continues unabated.¹⁷ However, it is consistent with other Australian reports, with a recent meta-analysis of trends in childhood obesity in Australian children 1985 to 2008 reporting that

there has been a plateau, or only a slight increase, in the percentage of boys and girls classified as overweight or obese, with almost no change over the last 10 years.¹⁸ In boys and girls, prevalence rates have settled around 21–25% for overweight and obesity together, and 5–6% for obesity alone.¹⁸ The slightly lower rates in our study may be related to higher socio-economic (Tables 1 and 4) and education levels of the parents of the child participants in this population.

As expected, asthma and obesity are common childhood disorders at school entry, with prevalence estimates similar to national estimates.¹⁹ The previously demonstrated association between obesity and 'current asthma' is clearly evident here, and unlike some previous reports,^{20,21} there are no differences in the magnitude of the association by gender.

We also find common co-morbidities associated with both asthma and BMI classifications, but the co-morbidity patterns are different for the obese and asthmatic groups. In contrast to obesity, 'current asthma' is associated with an increased risk of ADHD, T1D and epilepsy. The association between epilepsy and 'current asthma' does not persist after adjusting for obesity. However, the ADHD – 'current asthma' and T1D – 'current asthma' associations do persist after accounting for obesity. The first US National Survey of Children's Health has also reported children with asthma have higher rates of ADHD.^{2,22} Although prevalence estimates of ADHD have been higher in Australian populations,²³ these are for children aged 6–17, who are older than our survey participants. ADHD may not yet have been diagnosed in our study population, as the children have just commenced their first year of formal education and reported behavioural issues may still be forthcoming.

Strengths of the study include the large representative sample of children and parents surveyed and the high participation rates obtained, reducing potential selection bias. The parental report of 'current asthma' has been validated against specialist paediatric diagnosis.¹³ Obesity classifications are determined

Table 3 Co-morbid conditions among school entrants by 'current asthma' status

	Among those with 'current asthma'	Among those without 'current asthma'	Odds ratio (95% CI) for 'current asthma'	P-value	Adjusted odds ratio† (95% CI) for 'current asthma'	P-value
Type 1 diabetes	0.40 (7/1771)	0.06 (9/15 716)	6.93 (2.58, 18.62)	<0.001	9.35 (3.11, 28.12)	<0.001
Attention deficit disorder	1.59 (28/1762)	0.39 (61/15 623)	4.12 (2.63, 6.46)	<0.001	3.39 (2.04, 5.64)	<0.001
Epilepsy	0.62 (11/1770)	0.24 (37/15 697)	2.65 (1.35, 5.20)	0.005	1.89 (0.82, 4.35)	0.13
Eye sight problems	38.84 (867/2232)	36.98 (5518/14 923)	1.08 (0.99, 1.19)	0.09	1.09 (0.99, 1.20)	0.07
Hearing problems	31.01 (720/2322)	30.54 (4724/15 469)	1.02 (0.93, 1.12)	0.65	1.05 (0.94, 1.16)	0.39
Eczema ever	55.45 (1257/2267)	31.59 (4793, 15 171)	2.69 (2.46, 2.95)	<0.001	2.62 (2.38, 2.89)	<0.001
Hay fever ever	41.52 (859/2069)	15.58 (2271/14 580)	3.85 (3.49, 4.24)	<0.001	3.85 (3.46, 4.27)	<0.001
Recent wheeze	70.73 (1670/2361)	6.54 (1026/15 697)	34.56 (30.99, 38.54)	<0.001	33.55 (29.87, 37.68)	<0.001
Wheeze with URTI	74.65 (1758/2355)	12.74 (1991/15 631)	20.17 (18.18, 22.39)	<0.001	20.27 (18.14, 22.66)	<0.001
Night cough	64.09 (1506/2350)	9.33 (1464/15 686)	17.33 (15.68, 19.16)	<0.001	17.67 (15.87, 19.67)	<0.001
Shortness of breath	39.30 (907/2308)	3.08 (482/15 627)	20.34 (17.98, 23.01)	<0.001	20.80 (18.20, 23.76)	<0.001

†Adjusted for age, sex, usual GP, BMI categories. CI, confidence interval; URTI, upper respiratory tract infection.

using age- and sex-specific objective criteria and parental reports are essentially complete.

Limitations include the cross-sectional nature of data, limiting our ability to determine if the development of obesity or 'current asthma' preceded or followed the development of the other co-morbid conditions. But these limitations are partly offset by our findings that are mostly consistent with other reported data from various epidemiological studies with different designs as summarised in the following.

Incidence of 'asthma ever' and respiratory symptoms associated with 'current asthma' are significantly higher among the obese children in our study. Many other cross-sectional studies also show a strong association between childhood asthma and obesity.^{21,24,25} The question is whether obesity causes asthma, or asthma contributes to obesity. Many prospective studies show that obesity precedes development of asthma in children.^{9,26} Obesity may cause asthma by reducing lung compliance, lung volumes and the diameter of the peripheral airways thereby affecting the ventilation-perfusion relationships.²⁷ Obesity is also a pro-inflammatory state like asthma because adipose tissue produces inflammatory mediators that may upregulate allergic inflammation of asthma.^{27,28}

The lack of a similar association between obesity and hay fever or eczema calls into question as to whether the obesity-asthma link reflects either non-atopic airway alteration or specific airway inflammation,^{29,30} rather than a general upregulation in allergic inflammation.²⁸ Obesity, secondary to avoidance of exercise to prevent exacerbation of asthma^{25,31} or steroid use to treat asthma are plausible explanations for some children. Common genetic antecedents may also be involved.²⁷ In any case, this report highlights the overrepresentation of obesity among children with asthma, reinforcing that asthma management should include normal weight control where indicated.

Other notable findings include gender differences observed with an excess of overweight/obese children among females and an asthma excess among males. In this age group, a female excess of obesity has not been commonly found although a male excess of asthma has been previously reported.³²

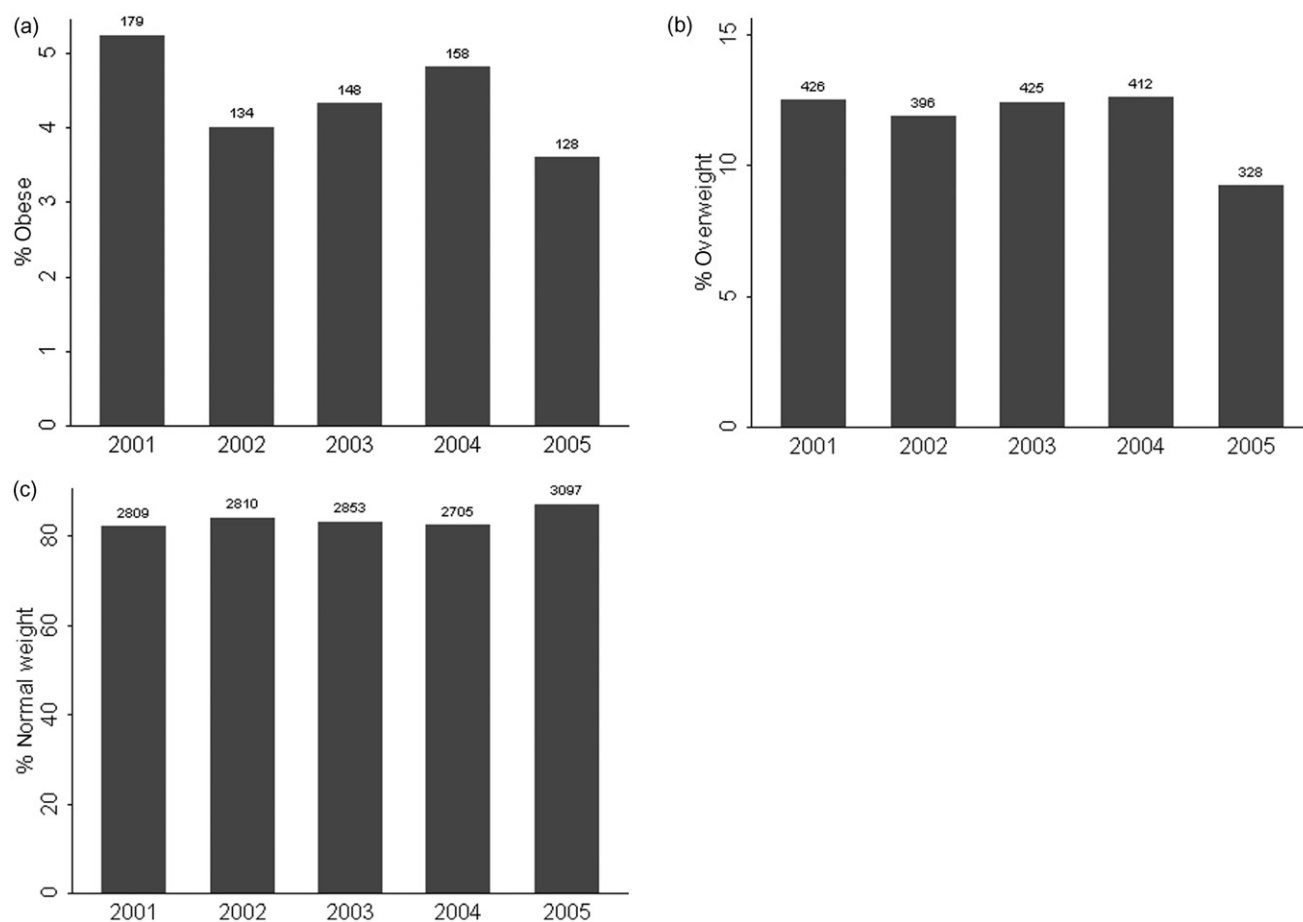
The positive association of asthma and T1D in this large population of school entrants support findings from some, but not all other studies.³³ Since the 1950s, both T1D and asthma incidence have increased, although the latter has now plateaued among Australian children.⁶ Internationally, there is a strong positive association between the prevalence of T1D and symptoms of asthma in European and non-European countries.³⁴ However, a meta-analysis of 25 studies on childhood asthma and diabetes prevalence reported a small but significant inverse relationship between the two.³³ Obesity, asthma and T2D may be related through anatomical, inflammatory and/or combined mechanisms.³⁵ Because adjusting for obesity in this study did not reduce the association between asthma and T1D, the asthma association cannot be the result of a common mechanism of pathogenesis with obesity. The association may be through common immunomodulatory mechanisms of diabetes and non-atopic asthma, as diabetes was not associated with eczema or hay fever (analysis not shown in this article).

We tested the hypothesis that the plateau and decline in child obesity at school entry may reflect different immigration

Table 4 Socio-economic status and the association with body mass index

Body mass index	Coefficient (95% CI)	P-value	Coefficient† (95% CI)	P-value
Socioeconomic categories				
Lowest quintile (1) 961.31–1058.79	Ref		Ref	
(2) 1058.80–1065.38	0.09 (0.01, 0.18)	0.03	0.09 (0.003, 0.17)	0.04
(3) 1065.39–1081.38	−0.10 (−0.18, −0.01)	0.02	−0.09 (−0.17, 0.001)	0.05
(4) 1081.39–1095.91	−0.17 (−0.25, −0.10)	<0.001	−0.18 (−0.25, −0.10)	<0.001
Highest quintile (5) 1095.92–1132.74	−0.07 (−0.15, 0.001)	0.05	−0.07 (−0.15, 0.01)	0.08
Linear test of trend across quintiles		<0.001		<0.001

†Adjusted for age, sex, usual GP. CI, confidence interval.

**Fig. 2** The proportion (%) of obese (a), overweight (b) and normal weight (c) children by year, with number in each category. $P \leq 0.001$. Overweight/normal adjusted odds ratio (AOR)† per year = 0.94 (0.91, 0.97), $P < 0.001$. Obese/normal AOR† per year = 0.94 (0.89, 0.99), $P = 0.01$. †Adjusted for age and sex.

patterns but found, if anything, that the decline in obesity over 2001–2005 was more evident among Australian-born children. We also found no evidence to support that the previously reported temporal asthma decline reflected changes in overweight or obesity among children over time. The possible decline in obesity was largely driven by the 2005 findings and thus further work to evaluate longer term trends are required.

This report demonstrates one useful application of routinely collected school screening health data for monitoring child health at the population level. We agree that ongoing population-based anthropometric measurement of children is³⁶ fundamental to efforts to assess the problem of obesity over time³⁷ and develop appropriate primary and secondary preventative strategies.²⁴

Table 5 Adjusted OR and 95% CI for disease or symptoms in the school entry survey per increasing year from 2001 to 2005

Outcome	OR (95% CI)	P-value	AOR† (95% CI)	P-value	AOR‡ (95% CI)	P-value
Type 1 diabetes	1.24 (0.88, 1.73)	0.22	1.22 (0.87, 1.71)	0.25	1.28 (0.88, 1.88)	0.20
Attention deficit disorder	0.91 (0.79, 1.05)	0.19	0.92 (0.79, 1.06)	0.23	0.88 (0.76, 1.03)	0.11
Epilepsy	1.06 (0.89, 1.26)	0.52	1.04 (0.87, 1.25)	0.66	1.03 (0.84, 1.26)	0.77
Eye problems	0.76 (0.75, 0.78)	<0.001	0.77 (0.75, 0.79)	<0.001	0.72 (0.71, 0.74)	<0.001
Hearing problems	1.03 (1.00, 1.05)	0.02	1.03 (1.01, 1.05)	0.008	1.07 (1.05, 1.10)	<0.001
'Asthma ever'	0.96 (0.94, 0.99)	0.002	0.95 (0.93, 0.98)	<0.001	0.96 (0.93, 0.98)	0.002
'Eczema ever'	1.06 (1.04, 1.08)	<0.001	1.06 (1.03, 1.08)	<0.001	1.06 (1.03, 1.08)	<0.001

†Adjusted for age, sex, usual GP. ‡Adjusted for age, sex, usual GP, BMI categories. AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

Conclusion

This study is consistent with previous reports of declining asthma and obesity among children in Australia. However, the previously reported temporal decline in asthma in this child population is not explained by the changes in overweight or obesity over time. Overweight and obese children are more likely to be reported to have 'asthma ever', as are children with diabetes or ADHD. Ongoing research is recommended to tease out the interactions between asthma and obesity, and explain the differing co-morbidity profiles associated with them for optimal management of affected children.

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