

ORIGINAL ARTICLE

The 2002–2007 trends of prevalence of asthma, allergic rhinitis and eczema in Irish schoolchildren

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Abstract

Background: Irish adolescents have the third highest asthma prevalence in the world. Few data examine trends of prevalence of asthma and allergic disorders in younger Irish children. We compared the prevalence of asthma, allergic rhinitis and eczema in school children, aged 6–9 in 2002 and 2007.

Methods: In two cross-sectional studies, parents of children aged 6–9, completed identical ISAAC-based questionnaires in the same 24 Cork City schools in 2002 ($n = 1474$, response rate = 74.8%) and in 2007 ($n = 1535$, response rate = 76.2%).

Results: The prevalence of asthma in our study population of schoolchildren, aged 6–9 remained stable in 2007 (23.5%) since the 2002 finding of 21.7% ($p = 0.27$). Significant increases were found in the prevalence of rhino-conjunctivitis (7.6–10.6%, $p = 0.005$) and eczema (8.9–13.5%, $p < 0.001$). In 2007, male preponderance for suffering the symptoms of current asthma existed (M:F 1.2:1, $p = 0.075$), although it had lost its significance since 2002 (M:F 1.5:1, $p < 0.001$). M:F ratio for most allergic rhinitis related symptoms moved from equal sex distribution to male predominance (nasal problems ever: 2002 – M:F 1.1:1, $p = 0.117$; 2007 – M:F 1.2:1, $p = 0.012$, current rhinitis: 2002 – M:F 1.2:1, $p = 0.98$; 2007 M:F 1.3:1, $p = 0.009$, hay fever ever: 2002 – M:F 1:1, $p = 0.57$; 2007 – M:F 1.5:1, $p = 0.007$). The sex-specific prevalence of rhino-conjunctivitis and the severity of symptoms suffered, remained equally sex distributed in both timeframes. From 2002 to 2007, the prevalence of all the reported symptoms of eczema were equally distributed between the sexes, while lifetime prevalence of eczema moved from male predominance to equal distribution.

Conclusion: The prevalence of asthma in 6–9 yr old Cork schoolchildren remained static between 2002 and 2007; however, rhino-conjunctivitis and eczema have become increasingly prevalent. Co-morbidity of allergic conditions continues to pose a considerable health burden in this young population. We also demonstrated an alteration in the sex-specific profile of current asthma and lifetime allergic rhinitis towards equalization in distribution.

Asthma, allergic rhinitis and eczema are common chronic childhood disorders. Asthma is a complex heterogeneous disease characterised by episodes of wheezing, breathlessness, chest tightness and coughing (1). Allergic rhinitis is a disease affecting the upper airways, involving nasal itching, sneezing, watery rhinorrhoea and nasal obstruction (2). Eczema is a

highly pruritic chronic inflammatory skin condition, associated with skin dryness and lesions that ooze when scratched (3). All three conditions are a major burden to children and families, resulting in impaired quality of life, frequent healthcare visits and school and parental work absenteeism (1–3). Many studies, using different methodologies, have

highlighted a rising prevalence in childhood asthma and allergic disorders in the last two decades (4, 5). The International Study of Asthma and Allergies in Childhood (ISAAC) reported that in the nineties, Ireland had the fourth highest 12-month prevalence of asthma in 13- to 14-yr-old children in the world (5).

Trends of prevalence are crucial to healthcare management and planning. International time trend analyses, using the ISAAC (Phase Three) protocol, have yielded variable results. In Spain, the prevalence of asthma was found to have stabilised in adolescents but increased in the younger age groups, whereas in Hong Kong, rates of asthma decreased in adolescents and stabilised in 6- to 7-yr-olds, but increased rates of allergic rhinitis and eczema were found in the latter age group (5). ISAAC reported that 59% of international centres demonstrated alterations in asthma prevalence in the 6- to 7-yr-old age group; the majority of which were increases, especially in Western Europe (6). Equal decreases and increases in asthma prevalence were apparent in adolescents (5). Although asthma prevalence decreased in Irish adolescents, it remains high at 26.7%, and now jointly ranks with New Zealand at 3rd highest in the world, after Costa Rica and the Isle of Man (5).

International Study of Asthma and Allergies in Childhood trends of rhino-conjunctivitis revealed a slight worldwide increase in prevalence, in both young and older children (7). Irish and Spanish adolescents jointly have the 4th highest prevalence in Western Europe for rhino-conjunctivitis (7). Time trend analyses of eczema differ between regions and age groups (4). Prevalence in Phase Three decreased in adolescents from developed countries with previously high prevalence in Phase One, such as Ireland, the UK and New Zealand. On the other hand, adolescent eczema prevalence in centres from developing countries with previously high prevalence in Phase One continued to rise. Irish adolescents have the 4th highest prevalence of eczema in Western Europe (4). The prevalence of eczema increased in most ISAAC centres in the younger age group (6–7 yr). We do not have Irish ISAAC data for this young age group.

Childhood and adult asthma prevalence is either stable or increasing in many countries but data gaps remain. There are few Irish data about trends of prevalence of asthma and allergic disorders in the 6- to 9-yr-old age group. In 2002, using ISAAC-based questionnaires, Sturley examined primary school children aged 6–9 yr and found the prevalence of asthma was 21.7% (8). This was significantly higher than the prevalence in similar age groups in Galway, a different region of Ireland (15.5%) (9), and in the UK (18.8%) (5).

Given the considerable burden of asthma and allergy on children worldwide and our current rudimentary understanding of their origin, prevalence studies that characterise asthma and allergy are invaluable. In 2002 and 2007, we performed prevalence studies in Cork schoolchildren aged 6–9 yr, using the validated ISAAC methodology, aiming to provide prevalence trends and the profile of asthma and allergy in this population. The findings are characterised into sex-specific prevalence and the co-morbidity of allergic disorders is also investigated.

Methods

Two cross-sectional studies were performed 5 yr apart (2002 and 2007), in the same 24 randomly selected state primary schools in Cork (city and suburbs). Parents of children aged 6–9 yr were asked to complete identical ISAAC-based questionnaires. Although the studies were not part of ISAAC, the core questions from ISAAC and its methodology were used. As with ISAAC, the main outcome measures used were the 12-month prevalence of symptoms of asthma (wheeze), allergic rhinitis (rhinitis – nasal problems in the absence of a cold or flu and rhino-conjunctivitis – associated with itchy eye) and eczema (persistent rash in flexural areas). Both cross-sectional studies were carried out in the same season and used identical methodologies, thus allowing for direct comparison.

To initiate the studies, we applied for and received ethical approval from the Clinical Research Ethics Committee of the Cork Teaching Hospitals. State schools were chosen as they are the predominant providers of primary school education in Ireland and therefore are representative of all socio-economic groups nationally. All data regarding schools was attained from a Department of Education school list (10). School principals were contacted initially by letter and then by telephone within the following week, their participation was discussed and a suitable date for a visit was made. To promote optimal response rates, teachers/principals and children were spoken with personally, wherever possible. Questionnaires and information sheets were sent home with children and a date agreed (usually 1 wk from distribution) for return of the questionnaires. Questionnaires were visually checked and entered into the Statistical Package for Social Sciences database (SPSS Inc., Chicago, IL, USA) using a data scanner.

The main outcome measures used to assess the prevalence of asthma, allergic rhinitis and eczema were identical in both studies (ISAAC outcome measures). Prevalence rates in 2002 and 2007 were compared with estimation of the 95% confidence intervals for the difference using standard methods (11). Alterations in the male/female ratio of symptoms from 2002 to 2007 were assessed using logistic regression models containing the main effects of sex and study and the interaction between the sex and study.

Results

The 2002 study involved 1474 children aged 6–9 yr, of which 47.3% were boys (mean age = 8.0 yr). The 2007 study involved 1535 children aged 6–9 yr, of which 52.1% were girls (mean age = 7.6 yr). The response rates were 74.8% in 2002 and 76.2% in 2007. Study and population characteristics are presented in Table 1.

The prevalence of asthma and atopy in 2002 and 2007

Table 2 demonstrates the trends of prevalence of asthma, allergic rhinitis and eczema in 6- to 9-yr-old children, over the 5-yr period from 2002 to 2007. There was no significant alteration in the prevalence of current, diagnosed or severe asthma; however, the symptom of night cough had significantly decreased

Table 1 Characteristics of the 2002 and 2007 prevalence studies

	Sturley, 2002	Duggan, 2007
Participants (%)		
Male	47.3	52.1
Age (%)		
6 yr	26 (1.8)	36 (2.3)
7 yr	357 (24.3)	627 (40.8)
8 yr	702 (47.8)	722 (47.0)
9 yr	368 (25.1)	150 (9.8)
Mean age	8 yr	7.6 yr
Studies		
Total sample	1474	1535
Response rate (%)	74.8	76.2

from 31.1% to 21.8% ($p < 0.001$) from 2002 to 2007. In 2007, 14% ($n = 215$) of children suffered from a dry night cough, current wheeze and were diagnosed for asthma, whilst 14.8% ($n = 228$) were being treated for asthma. Of the children diagnosed with asthma, 10.7% ($n = 41$) suffered from a dry night cough in the absence of current wheeze, of which 90.2% ($n = 37$) received treatment for asthma.

Most symptoms of allergic rhinitis remained unchanged from 2002 to 2007, except for the prevalence of rhinoconjunctivitis, which had increased significantly from 7.6% to 10.6% ($p < 0.005$). In 2002, the prevalence of rhinitic symptoms peaked (approximately 12%) during winter and spring,

sharply declined (6–7%) over summer and sharply increased again over autumn (Fig. 1). In 2007, symptoms peaked (12%) in late spring/early summer, decreased and levelled off to approximately 6% during late summer and autumn months and rose again to 7–9% in winter.

There were significant increases (all to $p < 0.001$) in the symptoms of rash ever (14.2–20.7%), current rash (11.8–16.2%), current eczema (8.9–13.5%) and occurrence of rash < 2 yr of age (4.5–7.8%). Lifetime diagnosis eczema had significantly reduced from 21.6% to 15.0% ($p < 0.001$), and the severity of eczema symptoms suffered, remained unaltered.

Sex-specific prevalence

Stratification by sex demonstrated no significant alterations in the distribution of asthma symptoms from 2002 to 2007 (Table 3). In 2007, a male preponderance for current asthma was still apparent (M:F 1.2:1), although it had lost its significance since 2002 (M:F 1.5:1, $p < 0.001$). The move towards equalisation was attributed to a significant increase in current wheeze in girls (17.4–21.4%, $p = 0.05$), and the alteration was close to statistical significance. Both time frames revealed a male predominance in most asthma symptoms, except for severe symptoms, which were equally distributed between both sexes. Although statistically non-significant, the M/F ratio for the most allergic rhinitis symptoms had moved away from equal sex distribution to male predominance. Most

Table 2 Prevalence of asthma and allergic disease symptoms in children aged 6–9 yr in 2002 and 2007*

	Sturley, 2002 ($n = 1474$) (%)	Duggan, 2007 ($n = 1535$) (%)	Difference (%) (95% CI)	p-value
Asthma				
Ever wheezed	610 (41.3)	620 (40.4)	0.9 (–3.0 to 5.0)	0.580
Current wheeze	321 (21.7)	360 (23.5)	1.8 (–1.0 to 5.0)	0.272
Exercise-induced wheeze	228 (15.5)	236 (15.4)	0.1 (–3.0 to 3.0)	0.943
Night cough	458 (31.1)	335 (21.8)	9.3 (6.0 to 12.0)	< 0.001
Ever had asthma	375 (25.4)	382 (24.9)	0.5 (–3.0 to 4.0)	0.726
Speech limitation	54 (3.7)	57 (3.7)	0.1 (–1.0 to 1.0)	0.942
≥ 4 wheeze attacks/past yr	96 (6.5)	104 (6.8)	0.3 (–2.0 to 2.0)	0.773
Woken by wheeze ≥ 1 night/wk	58 (3.9)	78 (5.1)	1.2 (–0.4 to 3.0)	0.130
Allergic rhinitis				
Nasal problems ever	433 (29.4)	470 (30.6)	1.2 (–2.0 to 5.0)	0.450
Current allergic rhinitis	385 (26.1)	418 (27.2)	1.1 (–2.0 to 4.0)	0.491
Associated itchy eye	112 (7.6)	162 (10.6)	3.0 (1.0 to 5.0)	0.005
Ever had hay fever	133 (9.0)	159 (10.4)	1.4 (–1.0 to 4.0)	0.216
Mod/Severe interference with daily living	56 (3.8)	78 (5.1)	1.3 (–0.2 to 3.0)	0.088
Eczema				
Ever had persistent rash	209 (14.2)	318 (20.7)	6.5 (4.0 to 9.0)	< 0.001
Current persistent rash	174 (11.8)	248 (16.2)	4.4 (2.0 to 7.0)	< 0.001
Affecting flexural areas	131 (8.9)	207 (13.5)	4.6 (2.0 to 7.0)	< 0.001
Ever had eczema	319 (21.6)	230 (15.0)	6.6 (4.0 to 9.0)	< 0.001
1st occurrence < 2 yr	66 (4.5)	120 (7.8)	3.3 (2.0 to 5.0)	< 0.001
Not cleared in past year	49 (3.3)	58 (3.8)	0.5 (–1.0 to 2.0)	0.501
Kept awake ≥ 1 night/wk	17 (1.2)	27 (1.8)	0.6 (–0.3 to 2.0)	0.167

*Parental Report confidence interval (CI).

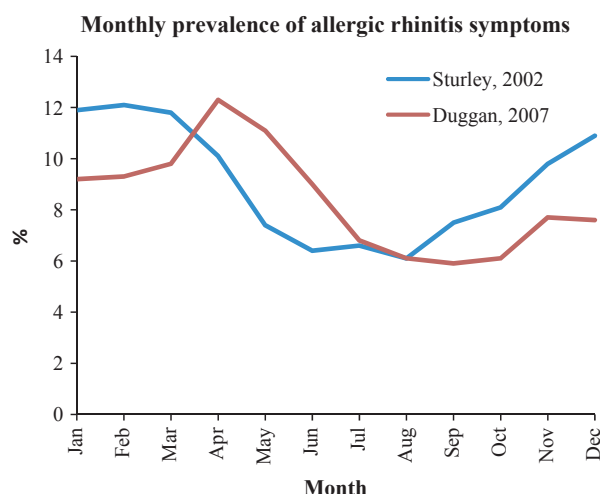


Figure 1 Monthly prevalence of symptoms of allergic rhinitis in children aged 6–9 yr.

apparent was the lifetime diagnosis of hay fever in which the M/F ratio moved from 1:1 to 1.5:1, because of a significant increase in male diagnosis (9.1–12.3%, $p = 0.05$). The prevalence of all the reported symptoms of eczema were equally distributed between the sexes during both time frames, except for the lifetime diagnosis of eczema that had moved from male predominance to equal sex distribution ($p < 0.001$, sex/study interaction).

Co-morbidity of allergic disease

A high level of co-prevalence of current symptoms and lifetime diagnosis of asthma, allergic rhinitis and eczema persists (Fig. 2). From 2002 to 2007, all levels of co-morbidity of cur-

rent asthma, allergic rhinitis and eczema symptoms had increased (≥ 1 condition – 40% to 42.8%, ≥ 2 conditions – 15.1% to 17.1% and symptoms of all three conditions – 3.2% to 4.1%). The only statistically significant increase was in the percentage of children suffering from current symptoms of all three conditions ($p < 0.001$). All indices of co-prevalence of lifetime diagnosis had decreased non-significantly between 2002 and 2007 (diagnosed with at least one condition – 39.7% to 36.6%, at least two – 12.1% to 11.4% and diagnosed with all three conditions – 2.2% to 2%).

Tobacco smoking

There was a significant reduction in the prevalence of maternal smoking during pregnancy (33.3–21.0%, $p < 0.001$), in the first year of life (38.1–31.1%, $p < 0.001$) and currently (35.4–28.9%, $p < 0.001$) during the study interval (Table 4). Secondary tobacco smoke exposure in the home also decreased significantly (39.7–22.3%, $p < 0.001$).

Discussion

We have examined the prevalence of asthma and allergic disease in 6- to 9-yr-old children in 2002 and 2007, using the ISAAC methodology, focussing also on sex-specific prevalence and the co-prevalence of multiple allergic disorders. To our knowledge, this is the first Irish study to examine trends in the prevalence of asthma and allergic disease in this young age group of children (6–9 yr).

Asthma

In our young population (6–9 yr), we found the prevalence of current asthma and lifetime diagnosed asthma had remained constant, but high in relation to many other countries (5). Our findings of a broadly static prevalence of

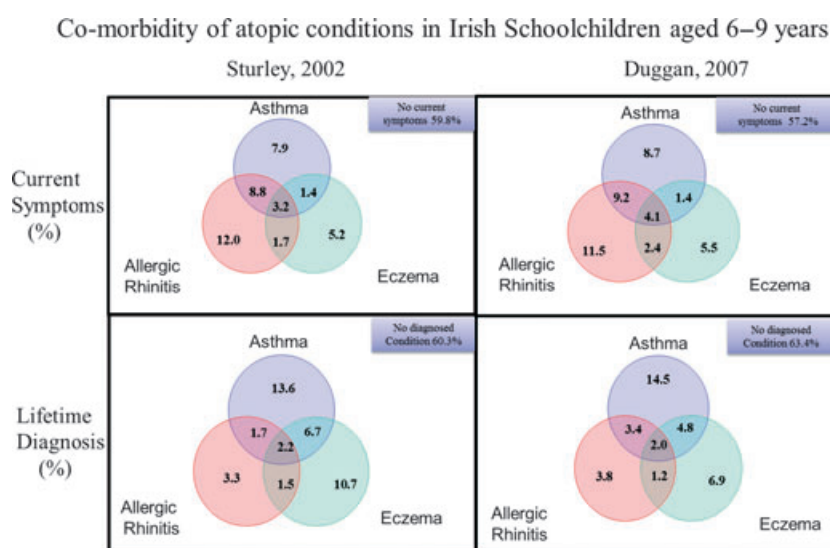


Figure 2 Co-morbidity of atopic disorders in 2002 and 2007 study populations (age 6–9 yr).

Table 3 Sex distribution of asthma and atopic symptoms in children aged 6–9 yr in 2002 and 2007*

	Male/Female (%)				Male/Female ratio				Ratio alteration
	2002		2007		2002		2007		2002–2007
	Boys (n = 699)	Girls (n = 775)	Boys (n = 795)	Girls (n = 740)	M:F ratio	p-value†	M:F ratio	p-value†	p-value‡
Asthma									
Ever wheezed	317 (45.4)	295 (38.1)	355 (44.6)	262 (35.4)	1.2:1	0.005	1.3:1	<0.001	0.563
Current wheeze	187 (26.8)	135 (17.4)	200 (25.2)	158 (21.4)	1.5:1	<0.001	1.2:1	0.075	0.057
Ever had asthma	205 (29.4)	172 (22.2)	221 (27.8)	158 (21.4)	1.3:1	0.002	1.3:1	0.005	0.880
Exercise-induced wheeze	134 (19.2)	98 (12.7)	139 (17.5)	96 (13.0)	1.5:1	0.001	1.3:1	0.018	0.486
Night cough	239 (34.3)	228 (29.4)	193 (24.3)	139 (18.8)	1.2:1	0.049	1.3:1	0.012	0.528
Speech limitation	29 (4.2)	25 (3.2)	31 (3.9)	26 (3.5)	1.3:1	0.346	1.1:1	0.813	0.694
≥4 wheeze attacks/past yr	54 (7.7)	42 (5.4)	58 (7.3)	46 (6.2)	1.4:1	0.073	1.2:1	0.962	0.482
Woken by wheeze ≥1 night/wk	29 (4.2)	29 (3.7)	42 (5.3)	36 (4.9)	1.0:1	0.688	1.1:1	0.559	0.954
Allergic rhinitis									
Nasal problems ever	220 (31.5)	215 (7.8)	264 (33.2)	201 (27.2)	1.1:1	0.117	1.2:1	0.012	0.498
Current allergic rhinitis	197 (28.2)	189 (24.4)	237 (29.8)	176 (23.9)	1.2:1	0.098	1.3:1	0.009	0.499
Associated itchy eye	56 (8.0)	56 (7.2)	88 (11.1)	73 (9.9)	1.1:1	0.570	1.1:1	0.459	0.948
Ever had hay fever	64 (9.1)	69 (8.9)	98 (12.3)	60 (8.1)	1.0:1	0.866	1.5:1	0.007	0.083
Mod/Severe interference with daily living	33 (4.7)	23 (3.0)	51 (6.4)	27 (3.6)	1.6:1	0.079	1.8:1	0.118	0.763
Eczema									
Ever had persistent rash	98 (14.0)	112 (14.5)	158 (19.9)	157 (21.2)	1.0:1	0.813	0.9:1	0.486	0.811
Current persistent rash	79 (11.3)	95 (12.3)	117 (14.7)	128 (17.3)	1.0:1	0.570	0.8:1	0.075	0.639
Affecting flexural areas	62 (8.9)	69 (8.9)	98 (12.3)	107 (14.5)	1.0:1	0.982	0.8:1	0.762	0.477
Ever had eczema	172 (24.6)	50 (19.4)	121 (15.2)	108 (14.6)	1.3:1	<0.001	1.0:1	0.802	<0.001
Not cleared in past year	23 (3.3)	21 (2.7)	28 (3.5)	30 (4.1)	1.2:1	0.513	0.9:1	0.901	0.395
Woken by rash ≥1 night/wk	6 (0.9)	10 (1.4)	15 (1.9)	12 (1.6)	0.6:1	0.424	1.2:1	0.365	0.384

*Parental report.

†p-Value for difference between sex distribution of symptoms within each study.

‡p-Value for sex/study interaction.

Table 4 Reported prevalence of and exposure to tobacco smoking in 2002 and 2007

	Sturley, 2002 (n = 1474) (%)	Duggan, 2007 (n = 1535) (%)	Difference (%) (95% CI)	p-value
Mother smoked during pregnancy	491 (33.3)	323 (21.0)	12.3 (9.0–15.0)	<0.001
Mother smoked in 1st year of child's life	562 (38.1)	477 (31.1)	7.0 (3.7–10.0)	<0.001
Mother currently smoking	522 (35.4)	443 (28.9)	6.5 (3.2–9.9)	<0.001
Exposure to tobacco smoke in the home	586 (39.7)	342 (22.3)	17.4 (14.2–20.7)	<0.001

current asthma are in agreement with ISAAC Phase Three findings in Hong Kong and in Belgium and Austria in a similar age group (age 6–7) (5). Conversely, in Western Europe nine of eleven centres found increases in the prevalence of current asthma in 6- to 7-yr-old children, albeit the increases were small in many instances (5). Many variations exist worldwide; Irish ISAAC data were not gathered for this age group.

The prevalence of the symptom of night cough significantly decreased over the 5-yr period. The lower prevalence of dry night cough in our 2007 study compares favourably with others worldwide (12, 13). Night cough is a recognised associated symptom of asthma and shares many of the

long-term effects of classic wheezing asthma, for example, airway remodelling (14). However, whilst cough variant asthma is well recognised in adults, there is a paucity of related empirical data in children (15). In 2007, 9.5% of children who suffered from a dry night cough without wheeze had a diagnosis of and were being treated for asthma compared with only 1% of children in 2002. Recognition and treatment of cough variant asthma is included in the Global Initiative for Asthma Guidelines (GINA) (16). Increased ascertainment of cough variant asthma, following the implementation of the GINA guidelines, is a possible explanation for our findings. Reduced exposure to tobacco smoke may

also have been a contributory factor. We found that the prevalence of maternal smoking during pregnancy, the first year of the child's life and currently, combined with smoking in the home had decreased significantly over the study periods; this reduction is in agreement with national figures (17) and is most likely as a result of anti-smoking legislation and governmental educational campaigns during the intervening years.

Eczema

We found the prevalence of current eczema had significantly increased in our young population (age 6–9 yr). Raised symptom awareness from media and internet sources may have resulted in reporting mild, non-persistent symptoms; however, our finding concurs with ISAAC worldwide trends in 6- to 7-yr-old children (4). The increasing prevalence is most likely due to strong environmental influences, rather than simply being of genetic origin (4). It is plausible that the increasing eczema prevalence in the young children in our study is associated with elevated hygiene practices around young children and their activities, influenced by increased affluence and standard of living linked to Ireland's economic success in the 1990s and early 2000s (18–21). In contrast to the rising prevalence of current eczema symptoms, the prevalence of lifetime diagnosed eczema decreased over the study period. This may be due to recall bias; however, alterations are more likely to be multifactorial. Improved diagnostic practice from the implementation of new criteria may have reduced physician misclassification of contact dermatitis as eczema. Also, parents may self-treat mild symptoms rather than present to their doctor.

Allergic rhinitis

We found a significant increase in the prevalence of rhino-conjunctivitis in the study interval. This finding is in agreement with the worldwide trend of an overall (although slight) increase in the prevalence of rhino-conjunctivitis in 6- to 7-yr-olds (7). There is increasing evidence that exposure to busy roads has negative respiratory and sensitisation implications for children (22, 23). ISAAC Phase 3 found an exposure–response relationship between self-reported truck traffic exposure (validated by objective measures of traffic density) and rhino-conjunctivitis prevalence (24). Between 2002 and 2007, the Irish population moved from public transport to private car ownership (22% greater), whilst car dependence, even for short journeys and commute times, increased significantly (21). It is possible that the consequent higher traffic-related air pollution may have been a significant factor in the increasing prevalence of rhino-conjunctivitis. Examination of seasonal prevalence of rhinitis symptom demonstrated different patterns in both studies. In 2002, there was high winter/spring prevalence, which alleviated during the summer months and increased again for winter, indicating that symptoms were possibly of infectious rather than allergic origin (7). In 2007, the prevalence of symptoms of rhinitis peaked in late spring/early summer, which is more suggestive of allergic aetiology.

In both time periods, the reported prevalence of current allergic rhinitis and eczema symptoms was significantly higher than the reported diagnosis of hay fever and eczema, respectively. Overestimation of symptom prevalence is a recognised limitation of epidemiological questionnaires, and misclassification of symptoms has also been found to often lead to physician under-diagnosis (4, 25). Alterations in disease labelling and diagnostic practice greatly challenge epidemiological findings. However, our study found good agreement between the prevalence of reported current asthma symptoms and lifetime asthma diagnosis in both 2002 and 2007.

Much debate and speculation exist about the differing impacts of environment on the development of asthma and allergy in different populations and ages. Asher et al. (5) suggest that environmental changes may have a greater impact on the prevalence of eczema and rhinitis rather than asthma in young children. The complex interactions of environmental factors and the diversity of any subsequent changes that occur within these factors vary between exposure, location and population, possibly resulting in contradictory findings regarding causal inference (4, 5, 7). Nevertheless, some environmental factors authentically operate at population level, and the assessment of determinants and/or modifiers in the prediction of health effects can be of critical importance in highlighting interventions (5).

Sex-specific prevalence

We stratified our prevalence results by sex and in so doing, were able to demonstrate the direction of sex-specific alterations attributing to distributional changes. The most striking changes were firstly, the increase in reported current wheeze in girls (23%), decreasing the ratio of male/female dominance, towards sex equalisation and secondly, the increase in lifetime diagnosis of hay fever in boys (6%), resulting in equal sex distribution.

Male preponderance to asthma in young children had traditionally been the accepted norm; however, this male/female gap appeared to diminish in many studies, as substantial increases in asthma prevalence in young female children were reported (12, 13, 26–28). Increased awareness and reporting of mild symptoms is a possible cause for the increase in female current asthma symptoms (28), although it is unlikely to be the only factor, as it would have affected both sexes. Another hypothesis is that current increasing levels of female precocious puberty (29) may be decreasing the age of disadvantage for young males and in turn have contributed to the relatively higher increases in asthma prevalence in girls than in boys (26). However, further examination of sex-specific trends and risk factors are required to assess this hypothesis (28).

The sex-specific prevalence of rhinitis and eczema are not reported to the same extent as asthma and to date, no clear pattern has emerged (12, 13, 26). In our study, the only sex-specific alteration in the prevalence of eczema-related symptoms was the equalisation in the distribution of lifetime eczema, as a result of a significant reduction in the prevalence of lifetime eczema in boys.

Co-morbidity of allergic disease

We demonstrated that a high percentage of young Irish children continue to suffer symptoms of more than one allergic disease. Our 2007 study showed a significant increase (3.2–4.1%, $p < 0.001$) since 2002, in the current symptom prevalence of all three conditions. Both study findings are significantly higher than ISAAC Phase Three, in which only 1% of 6- to 7-yr-old children suffered symptoms of all three conditions (5). From 2002 to 2007, we also found increases (non-significant) in children suffering co-morbidity of two conditions. Internationally, ISAAC Phase Three also reported overall increases in co-prevalence at all levels, however the increases were very small, ranging from 0.1% to 0.4%. Life-time diagnosis of all three allergic disorders in our 2007 study was 2%, minimally lower than in 2002 (2.2%). Our results compare favourably with those of Punekar and Sheikh, who found a clinician diagnosed co-prevalence of 2.5% for all three conditions (30). Although a cohort study (0–18 yr), a significant portion of children in their study who suffered co-morbidity of allergic disorders were diagnosed with all three conditions in early childhood allowing comparisons to be made with our study population.

Strengths and limitations

The use of the validated ISAAC core questionnaire and methodology obviate selection bias and ensure the comparability of results. Our sample size of circa 1500 during both time frames may have limited our statistical power to detect severity of symptoms and our study interval of 5 yr may have contributed to many of our unchanged indices. On the other hand, although ISAAC recommended a sample size of 3000, they accepted trend data from centres with >1000 participants and also deemed 5 yr as being an acceptable time interval for trend studies (5). Our study population were marginally younger in 2007 than in 2002, and the children in both our studies are slightly older than ISAAC (6–7 vs. 6–9). However overall, the trends found in our studies correlate well with worldwide ISAAC trends.

We investigated the possibility of demographic alterations between 2002 and 2007 threatening the comparability of our

results. From 2002 Ireland was experiencing an economic boom, which attracted migrant workers and their families to work and settle in Ireland. According to National statistics, a large immigration from Eastern Europe occurred in 2004, after the Sturley study of 2002 (21). The 2002 study did not collect data on nationalities; however, immigration was not evident in the 2007 study, as it contained 88.2% Irish parents (the remaining 11.8% were divided evenly over several different nationalities). Therefore, it is fair to say that demographically, both populations examined in each time frame are comparable.

As with many ISAAC centres, both studies were performed in the same mixed urban and suburban settings, different patterns may be apparent in rural populations, which were not reported in this phase of our project. We did not perform clinical reviews of every respondent or diagnostic testing for the allergic phenotypes being studied.

Conclusion

The examination of trends of prevalence in our young study population revealed that the previously high prevalence of asthma has plateaued. Sex-specific trends revealed an increase in the current prevalence of asthma in females causing the distribution to move towards sex equalisation, whilst male preponderance persists in diagnosed asthma. The prevalence of rhino-conjunctivitis and eczema has increased, and a large percentage of young children continue to suffer the burden of co-morbidity of two or all three conditions.

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Competing interests

The author(s) declare that they have no competing interests.

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