

Increase in chronic or recurrent rhinitis, rhinoconjunctivitis and eczema among schoolchildren in Greece: Three surveys during 1991–2003

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The prevalence of allergic rhinitis, hay fever and eczema has risen worldwide during the last four decades but may have reached a plateau in some westernized societies. We examined time trends in the prevalence of childhood chronic or recurrent rhinitis, rhinoconjunctivitis and eczema in urban Greece. Using identical methodology, three population-based cross-sectional parental questionnaire surveys on current (last two years) and lifetime allergic symptoms of the nose, eyes and skin were performed among 8–10-yr-old children in 1991, 1998 and 2003 in Patras, Greece. Exactly 2417, 3006 and 2725 questionnaires were completed in 1991, 1998 and 2003, respectively. Prevalence rates of current (lifetime) symptoms of chronic or recurrent rhinitis were 5.1% (6.0%) for 1991, 6.5% (8.0%) for 1998 and 8.0% (9.8%) for 2003. Respective values for rhinoconjunctivitis were 1.8% (2.1%), 2.7% (3.4%) and 3.6% (4.6%) and for eczema 2.5% (4.5%), 3.4% (6.3%) and 5.0% (9.5%) (p for trend < 0.001). Among current asthmatics there was an increase in lifetime rhinitis ($p = 0.038$), current ($p = 0.025$) and lifetime rhinoconjunctivitis ($p = 0.007$) and current ($p = 0.001$) and lifetime eczema ($p < 0.001$); male predominance increased throughout the study. The proportion of atopic asthma (current asthma with chronic or recurrent rhinitis and/or rhinoconjunctivitis and/or eczema) increased during the same period ($p < 0.001$). In conclusion, there is a continuous increase in the prevalence of allergic manifestations among preadolescent children in Patras, Greece during the period 1991–2003. In our population, boys have contributed to this increase more than girls and the increase of atopy is, at least partially, responsible for the increase of asthma.

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A rise in the prevalence of childhood asthma and allergic disease has been extensively documented in western societies over the last four decades; Galassi et al. (1) have summarized the time trend studies with baseline assessments after 1990 and sequential assessments more than 5 yr apart published through 2002. Although this increase

can be explained, at least partially, by changes in diagnostic criteria (2) the few serial studies that used identical methodology support the impression that there has been a true increase in the prevalence of childhood asthma, allergic rhinitis, hay fever and eczema, at least until the mid 1990s (3–7). However, recent data suggests that this rise

may have reached a plateau (8–12) or may even be starting to decline (11–15). Predominance of males over females regarding the risk of asthma during childhood and a reversal of this situation after puberty has been established (16); however, there is scarce information in the literature of the effect of sex on prevalence time trends of childhood asthma and other allergic diseases (8, 17, 18). The causes of these time trends are not clearly understood and they continue to be the subject of considerable research (19).

Using a standard parental questionnaire, we have demonstrated a continuous increase in the prevalence of asthma among 8–10-yr-old schoolchildren in Patras, Greece in four consecutive surveys – 1978, 1991, 1998 and 2003 – albeit at a decelerating rate (6). Similar to some reports (8, 18) but in contrast to others (3, 17), male predominance of asthma persisted in our population over the entire 25-yr surveillance period (6).

In this study, we present our findings on the prevalence of chronic or recurrent rhinitis, rhinoconjunctivitis and eczema in the last three surveys, when standard questions on current and lifetime symptoms of allergic disease other than asthma were incorporated in the questionnaire, and analyse the role of sex on time trends of these prevalence rates. We also investigate the influence of coexistence of symptoms of other allergic diseases in the rise of asthma prevalence.

Materials and methods

Questionnaire

The standard parental questionnaire distributed to schoolchildren consisted of simple questions on current (within the last 2 yr) and lifetime (ever had) symptoms of asthma supplemented by questions on symptoms of other allergic diseases. The exact wording of the questions on asthma and the definitions of current and lifetime asthma have been presented previously (6, 20).

The questions on nasal, eye and skin symptoms were: [1] Did your child have a problem with runny or blocked or itchy nose or sneezing apart from colds that came and went or that persisted for a few weeks or longer *within the last 2 yr*? [2] Did your child *ever* have a problem with runny or blocked or itchy nose or sneezing apart from colds that came and went or lasted for a few weeks or longer? [3] Did your child have these nose problems, as described before, *accompanied by conjunctivitis* (red, itchy or watery eyes) *within the last 2 yr*? [4] Did your child *ever* have these nose problems, as described before, *accompanied*

by conjunctivitis (red, itchy or watery eyes)? [5] Did your child have an itchy skin rash that came and went or persisted for more than a few months *within the last 2 yr*? [6] Did your child *ever* have an itchy skin rash that came and went or persisted for more than a few months? ‘Current chronic or recurrent rhinitis’ was defined as a positive answer to question no. [1]; ‘lifetime chronic or recurrent rhinitis’ was defined as a positive answer to question no. [2]; ‘current chronic or recurrent rhinoconjunctivitis’ was defined as a positive answer to question no. [3]; ‘lifetime chronic or recurrent rhinoconjunctivitis’ was defined as a positive answer to question no. [4]; ‘current eczema’ was defined as a positive answer to question no. [5]; ‘lifetime eczema’ was defined as a positive answer to question no. [6].

Study population and design

In all three surveys the questionnaires were distributed in the months of January or February to third- and fourth-grade schoolchildren (i.e. 8–10 yr of age; 1991: n = 2417, 1181 boys; 1998: n = 3076, 1507 boys; 2003: n = 2725, 1337 boys). Identical methodology in the targeting, distribution and collection of the parental questionnaire and in the confirmation of responses (by personal communication with parents) was used in all three surveys; it has been presented in detail elsewhere (6, 20). The study population represented over 80% of the target population in all three surveys (National Statistical Services, census 1991, 2001).

The mean rate of change between surveys was calculated as change per year per initial prevalence measured $(/yr/ip) \times 100$ (6, 8).

The presence of at least one positive response to one or more of the questions (nos [2], [4] and [6]) among children with current-diagnosed asthma and/or wheezing was termed ‘atopic asthma’ while in the absence of any of these allergic symptoms, it was termed ‘non-atopic asthma’.

Formal approval was obtained from the University of Patras ethics committee and the Ministry of Education of Greece. The researchers approached the headmasters of the primary schools surveyed and distributed the questionnaire along with an informative statement on asthma and allergic diseases; they were assisted in the classrooms by the teachers.

Statistical analysis

Prevalence was calculated as the ratio of cases to the total number of children surveyed and was

expressed in absolute and relative numbers. Prevalence ratios between surveys, corresponding to 95% confidence intervals and prevalence differences were calculated. Comparisons of prevalence of asthma between males and females were performed using the Z-test. The Mantel–Haenszel extension of the chi-square test for trend was used to evaluate tendency between time points and multiple logistic regressions in order to assess the effect of sex on time trends. A p-value <0.05 for two-sided hypotheses for between-group comparisons was considered as statistically significant. All calculations were performed with the STATA v.8 (STATA Corp., College Station, TX, USA) statistical software.

Results

The response rates in 1991, 1998 and 2003 were 81.9% (range 76.1–92.8%), 90.5% (range 78.2–96.5%) and 91.3% (range 81.1–96.6%),

respectively. The overall sample included 90.7% participants of Greek ethnic origin. After personal communication with all positive responders and a random sample of 10–12% of negative responders, only minor changes occurred in parental responses; questionnaires with missing values (1.7%) were not included in the analysis (6, 20).

There was a continuous increase in all variables measured in the three surveys. Table 1 shows the prevalence of current and lifetime asthma (6), chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis, eczema as well as the prevalence of at least one of these diagnoses in our population. The relative risk between consecutive surveys and p-values for time trend and the sex ratio in 1991, 1998 and 2003 as well as the calculated mean increase per year per initial prevalence for current allergic symptoms between surveys is also presented. The increase in prevalence was not influenced by

Table 1. Prevalence of current- and lifetime-diagnosed asthma and/or wheezing, chronic or recurrent rhinitis, rhinoconjunctivitis, eczema and at least one of these diagnoses in 1991, 1998 and 2003 and the corresponding p for trend in Patras, Greece. Values are absolute numbers (%) unless stated otherwise

Parameter	1991	1998	2003	Prevalence rate ratio (95% CI)		p for trend
				1998:1991	2003:1998	
Number surveyed	2417	3076	2725	NA	NA	
Male-to-female ratio	0.95:1	0.96:1	0.96:1			
Current-diagnosed asthma and/or wheezing	112 (4.6%)	184 (6.0%)	189 (6.9%)	1.29 (1.03–1.62)	1.16 (0.95–1.41)	<0.001
Male-to-female ratio	1.15:1	1.16:1	1.22:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 4.3, 1998–2003: 3.9					
Lifetime-diagnosed asthma and/or wheezing	194 (8.0%)	296 (9.6%)	338 (12.4%)	1.20 (1.01–1.43)	1.29 (1.11–1.49)	<0.001
Male-to-female ratio	1.13:1	1.26:1	1.43:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 2.8, 1998–2003: 7.0					
Current chronic or recurrent rhinitis	123 (5.1%)	201 (6.5%)	217 (8.0%)	1.28 (1.03–1.60)	1.22 (1.01–1.47)	<0.001
Male-to-female ratio	1.01:1	0.93:1	1.09:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 3.9, 1998–2003: 5.8					
Lifetime chronic or recurrent rhinitis	145 (6.0%)	245 (8.0%)	267 (9.8%)	1.33 (1.09–1.62)	1.23 (1.04–1.45)	<0.001
Male-to-female ratio	0.93:1	1.01:1	1.1:1			
Mean increase/yr/initial prevalence	1991–1998: 4.7, 1998–2003: 6.0					
Current chronic or recurrent rhinoconjunctivitis	43 (1.8%)	83 (2.7%)	98 (3.6%)	1.52 (1.05–2.18)	1.33 (1.00–1.78)	<0.001
Male-to-female ratio	1.15:1	1.02:1	1.13:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 7.1, 1998–2003: 10.0					
Lifetime chronic or recurrent rhinoconjunctivitis	51 (2.1%)	104 (3.4%)	125 (4.6%)	1.60 (1.15–2.23)	1.36 (1.05–1.75)	<0.001
Male-to-female ratio	0.89:1	1.17:1	1.05:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 8.8, 1998–2003: 11.4					
Current eczema	60 (2.5%)	104 (3.4%)	135 (5.0%)	1.36 (1.00–1.86)	1.47 (1.14–1.88)	<0.001
Male-to-female ratio	1.14:1	0.93:1	1.03:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 5.1, 1998–2003: 12.8					
Lifetime eczema	109 (4.5%)	194 (6.3%)	258 (9.5%)	1.40 (1.11–1.76)	1.50 (1.26–1.80)	<0.001
Male-to-female ratio	0.91:1	1.13:1	1.03:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 5.7, 1998–2003: 14.2					
At least one current 'allergic' disease	249 (10.3%)	432 (14.0%)	438 (16.1%)	1.36 (1.18–1.58)	1.14 (1.01–1.29)	<0.001
Male-to-female ratio	1.12:1	1.02:1	1.07:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 5.1, 1998–2003: 4.0					
At least one lifetime 'allergic' disease	366 (15.1%)	569 (18.5%)	642 (23.7%)	1.22 (1.08–1.38)	1.27 (1.15–1.41)	<0.001
Male-to-female ratio	0.96:1	1.14:1	1.16:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 3.2, 1998–2003: 6.8					

CI, confidence interval.

Table 2. Prevalence of current- and lifetime-diagnosed asthma and/or wheezing, chronic or recurrent rhinitis, rhinoconjunctivitis, eczema and at least one of these diagnoses in boys and girls in the three surveys, risk ratios of boys:girls and p values of the influence of sex on the time trends of allergic disease. Values are absolute numbers (%) unless stated otherwise

Parameter	1991	1998	2003	Male:female risk ratio (95% CI)	p value for the effect of sex on time trend
Current-diagnosed asthma and/or wheezing, boys	60 (5.1%)	99 (8.0%)	104 (7.8%)	1.41 (1.18–1.67)	<0.001
Current-diagnosed asthma and/or wheezing, girls	52 (4.2%)	85 (4.6%)	85 (6.1%)		
Lifetime-diagnosed asthma and/or wheezing, boys	103 (8.7%)	165 (13.3%)	199 (14.9%)	1.54 (1.35–1.75)	<0.001
Lifetime-diagnosed asthma and/or wheezing, girls	91 (7.4%)	131 (7.1%)	139 (10.0%)		
Current chronic or recurrent rhinitis, boys	64 (5.4%)	97 (7.8%)	113 (8.5%)	1.22 (1.04–1.43)	0.017
Current chronic or recurrent rhinitis, girls	59 (4.8%)	104 (5.7%)	104 (7.5%)		
Lifetime chronic or recurrent rhinitis, boys	70 (5.9%)	123 (9.9%)	140 (10.5%)	1.22 (1.05–1.41)	0.007
Lifetime chronic or recurrent rhinitis, girls	75 (6.1%)	122 (6.6%)	127 (9.2%)		
Current chronic or recurrent rhinoconjunctivitis, boys	23 (2.0%)	42 (3.4%)	52 (3.9%)	1.30 (1.00–1.68)	0.049
Current chronic or recurrent rhinoconjunctivitis, girls	20 (1.6%)	41 (2.2%)	46 (3.3%)		
Lifetime chronic or recurrent rhinoconjunctivitis, boys	24 (2.0%)	56 (4.5%)	64 (4.8%)	1.26 (1.00–1.58)	0.054
Lifetime chronic or recurrent rhinoconjunctivitis, girls	27 (2.2%)	48 (2.6%)	61 (4.4%)		
Current eczema, boys	32 (2.7%)	50 (4.0%)	69 (5.2%)	1.21 (0.97–1.51)	0.095
Current eczema, girls	28 (2.3%)	54 (2.9%)	66 (4.8%)		
Lifetime eczema, boys	52 (4.4%)	103 (8.3%)	131 (9.8%)	1.23 (1.05–1.45)	0.010
Lifetime eczema, girls	57 (4.6%)	91 (5.0%)	127 (9.2%)		
At least one current 'allergic' disease, boys	132 (11.2%)	219 (17.7%)	227 (16.9%)	1.27 (1.13–1.42)	<0.001
At least one current 'allergic' disease, girls	117 (9.5%)	213 (11.6%)	211 (15.2%)		
At least one lifetime 'allergic' disease, boys	180 (15.4%)	304 (24.6%)	346 (25.9%)	1.32 (1.21–1.44)	<0.001
At least one lifetime 'allergic' disease, girls	186 (15.1%)	265 (14.4%)	296 (21.3%)		

CI, confidence interval.

changes in sex or age ratios of children participating in the three surveys (p for differences in male-to-female participation rates during the course of the study >0.1). The frequency of concomitant presence of all four diseases (i.e. asthma, chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis and eczema) in the three surveys for current and lifetime symptoms was 0.1% and 0.3% in 1991, 0.2% and 0.4% in 1998 and 0.6% and 1.2% in 2003, respectively.

Table 2 presents the prevalence and male:female risk ratios of current- and lifetime-diagnosed asthma and/or wheezing, chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis, eczema and at least one 'allergic' disease (including diagnosed asthma and/or wheezing) in 1991, 1998 and 2003, and the influence of sex on the time trend of symptoms of allergic disease. All current symptoms, except for eczema, showed an effect of sex on the increase in prevalence over time, with boys contributing more than girls to the increasing trend. All lifetime symptoms, showed a similar effect of sex on the increase in prevalence over time, with chronic or recurrent rhinoconjunctivitis exhibiting a borderline effect.

Table 3 presents the prevalence of current and lifetime chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis and eczema among current-diagnosed asthmatics and/or wheezers in 1991, 1998 and 2003, and the corresponding

p-values for time trend. There were significantly increasing trends in prevalence for lifetime (but not current) chronic or current rhinitis and for current and lifetime rhinoconjunctivitis and eczema.

Atopic asthma showed an increasing trend, both crude (p < 0.001) and adjusted for sex, over the period of the study; non-atopic asthma exhibited a declining trend, both crude (p < 0.001) and adjusted for sex (Table 4). There was no difference in the boys:girls ratio between atopic and non-atopic asthmatics in any of the surveys.

Discussion

In the present series of three cross-sectional surveys (1991, 1998, 2003) of third- and fourth-grade schoolchildren that span 12 yr we examined, for the first time in Greece, time trends in the prevalence of chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis and eczema using a standard parental questionnaire. We found a continuous rise in the prevalence of current and lifetime chronic or recurrent rhinitis, rhinoconjunctivitis and eczema throughout the study period. Similar to asthma, boys contributed more than girls to this increase. The rising trend of asthma associated with symptoms of other allergic diseases suggests that the increase in atopy is, at least partially, responsible for the rise in the prevalence of asthma.

Table 3. Prevalence of current and lifetime chronic or recurrent rhinitis, chronic or recurrent rhinoconjunctivitis and eczema among current-diagnosed asthmatics and/or wheezers in 1991, 1998 and 2003 and the corresponding p for trend values. Values are absolute numbers (%) unless stated otherwise

Parameter	1991	1998	2003	Prevalence rate ratio (95% CI)		p for trend
				1998:1991	2003:1998	
Current chronic or recurrent rhinitis	35 (31.3%)	60 (32.6%)	75 (39.7%)	1.04 (0.74–1.47)	1.22 (0.93–1.60)	0.128
Male-to-female ratio	1.06:1	0.86:1	1.5:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 0.6,	1998–2003: 4.5				
Lifetime chronic or recurrent rhinitis	38 (33.9%)	71 (38.6%)	87 (46.0%)	1.14 (0.83–1.56)	1.19 (0.94–1.52)	0.038
Male-to-female ratio	1:1	1.09:1	1.49:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 1.9,	1998–2003: 4.3				
Current chronic or recurrent rhinoconjunctivitis	8 (7.1%)	20 (10.9%)	30 (15.9%)	1.52 (0.69–3.34)	1.46 (0.86–2.48)	0.025
Male-to-female ratio	1.67:1	0.67:1	1.31:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 7.6,	1998–2003: 4.0				
Lifetime chronic or recurrent rhinoconjunctivitis	9 (8.0%)	24 (13.0%)	37 (19.6%)	1.62 (0.78–3.37)	1.50 (0.94–2.41)	0.007
Male-to-female ratio	1.25:1	0.71:1	0.95:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 8.9,	1998–2003: 16.5				
Current eczema	11 (9.8%)	27 (14.7%)	46 (24.3%)	1.49 (0.77–2.89)	1.66 (1.08–2.55)	0.001
Male-to-female ratio	0.57:1	1.45:1	1.3:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 7.1,	1998–2003: 19.5				
Lifetime eczema	15 (13.4%)	41 (22.3%)	67 (35.5%)	1.66 (0.97–2.86)	1.59 (1.14–2.22)	<0.001
Male-to-female ratio	0.86:1	1.41:1	1.23:1			
Mean increase/yr/initial prevalence × 100	1991–1998: 9.4,	1998–2003: 19.7				

CI, confidence interval.

Table 4. Frequency of boys and girls with atopic and non-atopic asthma among children with current asthma and/or wheezing, boys:girls relative risk (95% CI) and p for time trend values adjusted for sex

Parameter	1991	1998	2003	p for trend, adjusted for sex
Atopic asthma, boys	19 (31.7%)	51 (51.5%)	63 (60.6%)	<0.001
Atopic asthma, girls	21 (40.4%)	46 (54.1%)	49 (57.6%)	<0.001
Boys:girls RR (95% CI)	0.78 (0.48–1.29)	0.95 (0.72–1.25)	1.05 (0.83–1.33)	<0.001

RR, relative risk; CI, confidence interval.

All p values from chi-squared tests of proportion of boys:girls by survey year were >0.05.

In two previous reports we have shown that in Patras, Greece, a city with a much lower prevalence of asthma as compared with the other western societies, current asthma prevalence rose continuously between 1978 and 2003, albeit at a slowing rate, while male predominance persisted throughout this period (6, 20). Although public awareness of asthma and wheezing have not been accounted for, our findings, similar to those of others (3–5, 7), support a true increase in asthma prevalence. In the present study we found that the prevalence of current and lifetime chronic or recurrent rhinitis rose by 57% and 63%, respectively, during the study period. Respective increases for chronic or recurrent rhinoconjunctivitis were 100% and 119% and for eczema 100% and

111%. The yearly rise in prevalence of chronic or recurrent rhinitis, rhinoconjunctivitis and especially of eczema became steeper during the 1998–2003 vs. the 1991–1998 period. This finding contrasts with the gradual decline in the rate of rise of current asthma and/or wheezing observed in our study (Table 1; 6) and by others (3, 9–15). The worldwide results on symptoms of rhinitis and conjunctivitis of the recently published International Study of Asthma and Allergies in Childhood (ISAAC)/phase-III study showed a decrease in the regions with the highest prevalence rates as compared with ISAAC/phase-I suggesting that prevalence has peaked in these regions. Conversely, an increase in allergic disease was recorded mostly in low- and mid-income countries that was more pronounced in the older (13- to 14-yr-old) age group (14).

In the early studies of childhood asthma prevalence a 2:1 male:female ratio was reported that has apparently decreased in subsequent decades (17). However, recent surveys report conflicting results on sex-specific prevalence of asthma and other allergic diseases. In two cross-sectional surveys (1994/95 and 1999/00), Maziak et al. (21) reported a more rapid increase of asthma, allergic rhinitis and atopic eczema in girls as compared with boys; a similar trend was recently reported by the Aberdeen study group (17). An opposite trend was found for asthma in three surveys (1985, 1995 and 2000) in northern Norway; there was a continuous increase among boys while a plateau was reached among girls

that even showed a decrease in the last survey (18). In the northeast England ISAAC study, the trends observed over a 6-yr period varied depending on the type of disease and the age of the sample (22). We found persistence of male predominance among children with current and lifetime asthma, chronic or recurrent rhinitis, rhinoconjunctivitis and eczema; boys contributed more to the rise that was observed in all diseases, with the exception of current eczema where boys and girls contributed equally to the increase.

Regarding atopic status, although not directly measured, the increasing proportion of asthmatics with symptoms of at least one other 'allergic' disease (termed 'atopic asthma') in the three consecutive Patras surveys supports the conclusion that atopy – particularly in males – drove, at least in part, the increase of asthma prevalence. The few studies that have focused on the separate effects of atopic vs. non-atopic asthma on prevalence time trends have reached conflicting conclusions (17, 23, 24).

The reasons for the worldwide variability of time trends in the prevalence of asthma and other allergic manifestations and the inconsistencies of the influence of sex and atopy on these trends are not clear. This variability in itself suggests that environmental factors – some possibly unidentified as yet – are the leading determinants rather than changes in diagnostic criteria and public awareness (19). It can be speculated that different levels of the gene–environment interaction potential that underlies the development of asthma and other allergic diseases has been reached in various regions; this potential in any given population is entirely unknown but apparently can be quite high as indicated by the high prevalence rates observed in certain regions (13). A plausible explanation is the variability in temporal and geographical trends between boys and girls in the intensity and duration of outdoor physical activity and the consequent avoidance of indoor allergens (25). More importantly these differences may offer important clues regarding environmental factors that determine asthma and allergies (19, 26). In the case of asthma, physiological differences between sexes (narrower airways and higher levels of immunoglobulin E among boys during childhood) have also been incriminated (17); however, the earlier pubertal maturation observed in Greek girls (27) would be expected to ameliorate rather than enhance sex differences of allergic symptoms in our population.

In our study we did not employ objective measures to assess prevalence. Although it has been argued that such measures may improve outcome (2), standardized written questionnaires are probably the method of choice for comparing prevalence in large epidemiological studies; indeed, bronchial hyperresponsiveness may have lower validity than symptom questionnaires in defining asthma (28). As our questionnaire was set up prior to the publication of the ISAAC questionnaire, the two are not comparable. In addition, our study carries the inherent limitations of repeated cross-sectional surveillance reports over extended time periods. However, the three Patras surveys were conducted using identical methodology. The questions on rhinitis, rhinoconjunctivitis and eczema did not differ in essence from those of the ISAAC questionnaire (29); however, the term 'current' in our surveys refers to the two years prior to surveillance, which is different from the ISAAC questionnaire where 'current' refers to the last 12 months. The term 'hay fever' is very uncommon in the Greek language, even in the medical literature, and therefore was not included. Finally, issues regarding changes in the population of children of non-Greek ethnic origin in our samples – a result of the sociopolitical changes that occurred in the Balkans and eastern Europe in the last decade of the twentieth century – have been addressed previously and bear no influence on our findings regarding the rise in asthma and allergic disease in children of Greek ethnic origin (6, 20).

In conclusion, our findings show a continuing rise in the prevalence of allergic rhinitis, rhinoconjunctivitis and eczema during 1991–2003 with a steeper increase after 1998 that contrasts with the deceleration in the rise of asthma during the same period. In our population, the increase in the prevalence of asthma can be, at least partially, accounted for by a general increase of atopic diseases. Contrary to some reports, male predominance was strengthened during the last five years of the study. These observations may offer important clues to the understanding of environmental factors that determine the expression of asthma and other allergic diseases in children.

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