ORIGINAL ARTICLE

Prevalence of asthma among schoolchildren in Patras, Greece: four questionnaire surveys during 1978–2003

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Background: The prevalence of asthma and wheezing has risen during the past four decades. Recent reports suggest that the "asthma epidemic" has reached a plateau.

Objective: To examine further trends in the prevalence of childhood diagnosed asthma and wheezing in an urban environment in Greece.

Methods: A population-based cross-sectional parental questionnaire survey was repeated among third-grade and fourth-grade school children (8–10 years) of public primary schools in 2003 in the city of Patras, Greece, by using methods identical to that of surveys conducted in 1978 (completed questionnaires, n = 3003), 1991 (n = 2417) and 1998 (n = 3076).

Results: 2725 questionnaires were completed in the 2003 survey. The prevalence rates of current asthma and/or wheezing in 1978, 1991, 1998 and 2003 were 1.5%, 4.6%, 6% and 6.9%, respectively (p for trend <0.001). The lifetime prevalence of asthma and/or wheezing in the three more recent surveys was 8%, 9.6% and 12.4%, respectively (p for trend <0.001). The male:female ratios of current asthma and/or wheezing in the four surveys were 1.14:1, 1.15:1, 1.16:1 and 1.22:1, respectively. The proportion of those with wheezing diagnosed with asthma has increased during the study period, more so among non-current children with asthma.

Conclusions: Our findings show a continuous increase in the prevalence of asthma and wheezing among preadolescent children in Patras, Greece, over 25 years, albeit at a decelerating rate. There seems to be a true increase in wheezing, despite some diagnostic transfer, particularly among younger children. The male predominance of the disease has persisted in the population of this study.

Several studies have reported a rise in the prevalence of childhood asthma in Western countries over the past 3–4 decades. This increase can be, at least partially, explained by changes in diagnostic criteria and increased public awareness of the disease.¹ Those few serial studies that have used identical methods support the impression of a true increase in the prevalence of childhood asthma.^{2–7} However, recently reported trends show no further increase in the prevalence of asthma, suggesting that the asthma epidemic may have reached a plateau.^{8–11}

Using a standard parental questionnaire, the increasing prevalence of asthma was shown among 8–10-year-old school children in Patras, Greece, in 1978, 1991 and 1998.⁶ In this study, we hypothesised that a plateau in the prevalence of asthma has been reached in the city of Patras as well. To test this hypothesis, we performed another survey in 2003 using the same method as in the previous years and reanalysed the data, including sex analysis of the prevalence of asthma over the whole 25-year surveillance period.

METHODS

The standard parental asthma questionnaire consisted of two simple questions on current asthma (all four surveys) and two questions on non-current asthma (1991, 1998 and 2003 surveys). The exact wording of the standard questionnaire and definitions of current, non-current and lifetime asthma have been presented before,⁶ and are available as part of the web publication of this report (for supplementary material see <http://adc.bmjournals.com/supplemental>). The ratio of "current physician-diagnosed asthma": "current physician-diagnosed wheezing not identified as asthma" and that of "non-current physician-diagnosed asthma": "non-current

physician-diagnosed wheezing not identified as asthma" were calculated and compared as a means of assessing physician diagnosis of asthma in children with diagnosed wheezing.

The questionnaire, similar to the three previous surveys (1978: n = 3003, 1473 boys; 1991: n = 2417, 1181 boys; 1998: n = 3076, 1507 boys), was distributed in the month of January 2003 to third-grade and fourth-grade school children (ie, 8–10 years of age) of the same 44 primary public schools that were surveyed in 1998, in the city of Patras, Greece. The study population represented 86% of the target population (National Statistical Services, 2001). Methods identical to the 1991 and 1998 surveys were used in the distribution and collection of the parental questionnaire and in the confirmation of responses.⁶ The mean rate of change between surveys was calculated as change per year per initial prevalence (/yr/ip) measured $\times 100$.⁹

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

Statistical analysis

Prevalence was calculated as the ratio of cases to total number of children surveyed and was expressed in absolute and relative numbers. Prevalence ratios between surveys, corresponding 95% confidence intervals and prevalence differences were calculated. Comparisons of the prevalence of asthma between males and females were performed using the z test. The Mantel–Haenszel extension of the χ^2 test for trend was used to evaluate the tendency between time points. A p value <0.05 for two-sided hypothesis for between-group comparisons was

considered significant. All calculations were performed with the SPSS V.13 statistical software.

RESULTS

In the 2003 survey, we distributed our questionnaire to the parents of 2984 children; 2725 (1337 boys) questionnaires were completed (overall response rate 91.3%; range 81.1–96.6%); questionnaires with missing values (1.7%) were not included in the analysis. The overall sample included 9.3% non-Greek ethnic origin groups—that is, 5.1% Albanian, 3% former Yugoslavian and essentially all the rest from former eastern European countries; children of non-Greek ethnic origin comprised 6.5% (5.1% Albanian and 1.3% Eastern European) in the 1998 survey and 1.2% (1.1% Albanian) in the 1991 survey. After personal communication with positive responders, only one current and two non-current patients with asthma maintained that, despite a diagnosis of asthma, they did not have physician-diagnosed wheezing. None of the negative controls could recall with certainty a diagnosis of asthma or wheezing.

Table 1 shows the prevalence of current and lifetime asthma and the sex ratios in 1978, 1991, 1998 and 2003, as well as the mean calculated increase per year per initial prevalence for current asthma during the time periods between surveys. Males also exhibited a higher prevalence of non-current diagnosed asthma than females only during the 1998 and the 2003 surveys ($p < 0.01$). The increase in the prevalence of asthma was not influenced by changes in sex or age ratios of the children participating in the four surveys ($p > 0.5$ for differences in male:female participation rates during the course of the study).

Table 2 shows the ratios of current physician-diagnosed asthma:current physician-diagnosed wheezing not identified as asthma in 1978, 1991, 1998 and 2003 and those of non-current physician-diagnosed asthma: non-current physician-diagnosed wheezing not identified as asthma in the last three surveys, as well as the percentage increase over consecutive measurements.

DISCUSSION

The increasing prevalence of asthma over the past three decades has been reported by several authors in various parts of the world.^{2–7} In a previously published report of three cross-sectional questionnaire surveys—1978, 1991 and 1998—we explored time trends in the prevalence of asthma in Greece.⁶ In view of recent reports that the asthma epidemic may have reached a plateau,^{8–11} in this study, we expanded our previous

analyses to investigate further trends in the prevalence of asthma during 1998–2003 as well as sex differences over the 25-year period of surveillance. We found that the prevalence of current asthma among 8–10-year-old school children in Patras, Greece, increased further by 15% (from 6% in 1998 to 6.9% in 2003); there was a greater than fourfold increase over the entire 25-year period. The lifetime prevalence of asthma increased by 29% in the 1998–2003 period and by 55% in the 1991–2003 period. Considering the continuous increase in diagnosed wheezing and the change over time of diagnosed asthma versus diagnosed wheezing, the increase in asthma can be only partially attributed to diagnostic transfer. The male:female predominance of asthma observed in all four surveys increased throughout the 25 years of surveillance.

In the 1998 and 2003 surveys, the number of children of non-Greek ethnic origin, mostly Albanian refugees, increased in Greek public schools as a result of the major sociopolitical changes that occurred in the Balkans and eastern Europe in the past decade of the 20th century. As the prevalence of childhood asthma and wheezing in Albania and eastern European countries has been found to be lower than that in Greece,¹² the prevalence of asthma in this group would most probably lead to its underestimation in the total sample.

Standardised written questionnaires are probably the method of choice for comparing prevalence in large epidemiological studies, although objective measures may improve the outcome.¹³ The four Patras surveys were conducted using identical methods. Our questionnaire is unique in that it asks parents to report only wheezing that has been confirmed by a physician on two separate occasions. It has been well established that the use of the term by parents is non-specific for childhood asthma.¹⁴ Parental responses on diagnosed asthma and diagnosed wheezing suggest that physicians in Patras rarely, if at all, make a diagnosis of asthma based on symptoms other than wheezing. In addition, there was no question on persistent or recurrent cough in our questionnaire; it has been shown that persistent or recurrent cough that is not accompanied by wheezing is rarely due to asthma.^{15,16} Finally, the last sentence of our questionnaire prompted parents, in case of doubt, to respond with a negative answer. It is reasonable to assume that these features of our study drastically limited false-positive parental responses.

To reduce the variability of changes in the prevalence of asthma and to make our findings comparable to those of other reports, we expressed the yearly increase of prevalence as a

Table 1 Prevalence of current and lifetime diagnosed asthma and/or wheezing in 1978, 1991, 1998 and 2003 in Patras, Greece.*

Parameter	1978	1991	1998	2003	Prevalence rate ratio (95% CI) (mean increase/yr/ip)†		
					1991 v 1978	1998 v 1991	2003 v 1998
Number surveyed	3003	2417	3076	2725	—	—	—
Male:female ratio	0.96:1	0.95:1	0.96:1	0.96:1			
Current diagnosed asthma and/or wheezing‡	45 (1.5)	112 (4.6)	184 (6)	189 (6.9)	3.06 (2.19 to 4.35) (0.16)	1.15 (0.91 to 1.45) (0.13)	1.15 (0.95 to 1.41) (0.12)
Male:female ratios§	1.14:1¶	1.15:1¶	1.16:1**	1.22:1**			
Lifetime diagnosed asthma and wheezing	NA††	194 (8)	296 (9.6)	338 (12.4)	NA††	1.20 (1.00 to 1.42)	1.29 (1.11 to 1.49)
Male:female ratios§	NA‡‡	1.13:1¶	1.26:1**	1.43:1**			

NA, not applicable.

Values are n (%) unless stated otherwise.

*Prevalence of non-current asthma (not shown) is the difference between lifetime and current asthma.

†Mean calculated increase per year per initial prevalence (/yr/ip) for current asthma during the respective time period.

‡p for trend <0.001 for increase in asthma prevalence in males, females and overall population during the 25-year surveillance period.

§p for trend <0.001 for increase in male:female ratio during the 25- or 12-year surveillance period, as applicable.

¶p Value <0.01 for between genders comparisons.

**p value <0.001 for between genders comparisons.

††The question was not included in 1978.

Table 2 Number of school children with "physician-diagnosed asthma": "physician-diagnosed wheezing not identified as asthma" (ratio) for current and non-current asthma in 1978, 1991, 1998 and 2003

"Physician-diagnosed asthma": "Physician-diagnosed wheezing not identified as asthma"	Percentage ratio change (p Value)						
	1978	1991	1998	2003	1991 v 1978	1998 v 1991	2003 v 1998
Current	31/14 (2.2)	77/35 (2.2)	131/53 (2.5)	146/43 (3.4)	0 (0.99)	14 (0.48)	36 (0.06)
Non-current	NA*	45/37 (1.2)	85/27 (3.1)	129/20 (6.4)	NA*	158 (0.004)	106 (0.001)

The question was not included in 1978.

percentage of the initial prevalence.⁹ Our results are in contrast with those observed in other studies.⁸⁻¹¹ For example, in the Aberdeen study,^{4, 5, 8}—an area with a much higher initial prevalence of asthma—after 30 years of continuous increase (calculated peak of asthma prevalence 0.1%/yr/ip during 1989–1994), the prevalence of asthma tended to stabilise in the 1994–1999 period (0.06%/yr/ip). Similar to some reports,¹⁷ male predominance has increased among people with asthma in Patras throughout the 25 years of surveillance. Other studies, however, support a diverging increase in favour of females.^{8, 18}

The progression of the ratio of physician-diagnosed asthma: physician-diagnosed wheezing not identified as asthma for current asthma, suggests that the proportion of 8–10-year-old school children with wheezing who are diagnosed with asthma, although initially stable (67–70% in the 1978–98 period), increased to 77% in the 2003 survey. This change suggests some diagnostic transfer between the last two surveys; however, it cannot account for the total increase in the prevalence of current asthma during this period. Our results on non-current asthma suggest that its increase has been continuous and much more pronounced among children <6–8 years of age (from 54% in 1991 to 86% in 2003), indicating significant diagnostic transfer in this age group with potentially important therapeutic implications.

It has been theorised that increases in the prevalence of asthma and other atopic allergic diseases during the past few decades, especially in westernised societies, are due to environmental risk factors; however, the epidemiology of asthma seems to be more complex than that of other atopic allergic diseases.¹⁹ An increasing body of data on family size, birth order, urban living, changes in gastrointestinal micro-organisms and immunological evidence render credibility to the concept of the "hygiene hypothesis" now in its second decade.^{19, 20} The method of the 2003 Patras survey was identical to that used in the previous surveys, and the racial, cultural, socioeconomic and family size characteristics of the target population have remained essentially unchanged during the past decade. Exposure of children to farming lifestyle in Patras is only coincidental, parasitic infections are uncommon, smoking habits of the population have not drastically changed and high immunisation rates have been established throughout the past few decades; however, traffic has dramatically increased during the period of the four surveys. Unfortunately, our study was not designed to discuss the role of these confounders in the change of the prevalence of asthma; therefore, an interpretation of our findings in this context can only be speculative.

The findings of the four surveys in Patras, Greece—a country with a much lower prevalence of asthma than other Western countries—show that there is a continuing rise in the prevalence of wheezing over the 25-year surveillance period. Although the possible increase of parental awareness regarding asthma and wheezing in childhood has not been accounted for, our data suggest that diagnostic transfer in itself cannot explain

What is already known on this topic

- During the past three decades, the prevalence of diagnosed asthma and wheezing has increased.
- In some countries the rise in asthma is reaching a plateau, and the male:female ratio has equalised.

What this study adds

- In Greece, a country with a much lower prevalence of asthma than other Western countries, the prevalence of asthma continues to rise, albeit at a decelerating rate; the male predominance has persisted.
- This rise in prevalence cannot be entirely attributed to diagnostic transfer and a continuing true increase is most probably the case.

this increase. The continuous deceleration of the rise of the prevalence of asthma implies that, similar to other Western countries, a plateau may eventually be reached in Greece also. The increase of male predominance throughout the four surveys contradicts the progressive equalisation of the male:female ratio reported by others and deserves further clarification.

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