

Is the prevalence of adult asthma and allergic rhinitis still increasing? Results of an Italian study

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Background: The prevalence of asthma and allergic rhinitis has increased worldwide during the 1970s and 1980s.

Objective: This study was aimed at evaluating whether the increasing trend in prevalence persisted during the 1990s in the young adult Italian population.

Methods: In 1998 to 2000 a screening questionnaire was sent by mail to a general population sample aged 20 to 44 years; nonresponders were contacted again first by mail and then by phone, achieving a final response rate of 78.1% (6876 of 8800). Prevalence estimates, adjusted to correct for nonresponse bias, were compared with those recorded in Italy in 1991 to 1993 during the European Community Respiratory Health Survey, when response rate had been slightly higher (87.6%). Temporal variations in symptom prevalence were analyzed by a logistic regression model, controlling for sex, age, site of residence (urban vs suburban areas), season of response, response rate, and type of contact (mail vs phone).

Results: The prevalence of asthma attacks did not vary significantly from 1991 to 1993 (3.6%) to 1998 to 2000 (3.2%) ($P = .188$). The prevalence of asthma-like symptoms (wheezing, chest tightness, shortness of breath) tended to decrease in the age classes of 32.5 to 45 years, while increasing in the youngest age class (20 to 26 years). A clear-cut increase from 15.4% to 18.3% was observed for the prevalence of allergic rhinitis ($P < .001$), whereas the proportion of people under antiasthmatic treatment increased in suburban areas but not in urban areas (interaction time-site of residence, $P < .001$).

Conclusion: Asthma prevalence has not increased during the last decade in Italy. The persistence of an increasing trend in allergic rhinitis prevalence deserves attention. (*J Allergy Clin Immunol* 2003;111:1232-8.)

Key words: Asthma, allergic rhinitis, temporal trend, epidemiology

There is accumulating evidence that the prevalence of asthma,¹⁻³ allergic rhinitis,⁴ and atopy⁵ has increased worldwide during the 1970s and 1980s. In particular, the increase in wheezing illness has been recorded in children and adolescents in many countries, but there are insufficient data to determine whether the disease is increasing also in adults.^{3,6,7} Changes in diagnostic sensitivity and in reporting attitude⁸ can only partly explain this increase, which has been attributed mainly to changes in exposure to environmental risk factors and to the so-called Western lifestyle.^{9,10}

In the 1990s there were somewhat conflicting results on changes over time in wheezing diseases and asthma prevalence among children, some studies showing a constant increase^{11,12} and some others showing a plateau,^{13,14} whereas there was a substantial agreement on the continuously increasing prevalence of atopy and allergic rhinitis.^{12,14} In adults, during the same decade, there was some evidence that the increasing trend of asthma tended to fade away or even reverse,^{15,16} whereas the prevalence of allergic rhinitis had increased¹⁷ or remained unchanged.¹⁶

Among the different research approaches to explore the trends in prevalence of chronic disorders like asthma, the epidemiologic repeated survey, by using standardized validated questionnaires, seems less affected by diagnostic and reporting bias than other observational studies on mortality or morbidity.¹⁸

In 1991 to 1993 the prevalence of self-reported respiratory symptoms was assessed in the young adult population of northern Italy in the frame of the European Community Respiratory Health Survey (ECRHS).¹⁹ Seven years later in 1998 to 2000, a new cross-sectional survey, the Italian Study on Asthma in Young Adults (ISAYA), was carried out in the same centers with the same methods. The present study is aimed at evaluating, by using a repeated survey approach, whether any significant variation in the prevalence of asthma, asthma-like symptoms, and allergic rhinitis had occurred in the adult population of northern Italy during the 1990s.

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Abbreviations used

ECRHS: European Community Respiratory Health Survey
ISAYA: Italian Study on Asthma in Young Adults
OR: Odds ratio

METHODS

Study protocol

The survey was performed in 3 centers of northern Italy, Turin, Pavia, and Verona, located in the plain of the Po river and characterized by a temperate climate. Turin is a large urban area (909,717 residents in 1998) with large manufacturing industries, Pavia is a smaller town (74,290 inhabitants) in the middle of a farming area, and Verona is a middle-size town (254,712 residents) involved in tourism and services.

In the previous survey (ECRHS, 1991 to 1993), probability samples of the general population aged 20 to 44 years (M:F = 1:1) were randomly selected from the registry of local health authority in each center (3000 in Turin and Verona, 1000 in Pavia).²⁰

Seven years later (1998 to 2000), the same procedure was applied, randomly selecting 3000 people for each center. As in the previous survey, selected individuals were sent a screening questionnaire on respiratory symptoms by mail. Nonresponders were contacted again first by mail and then by phone, achieving a final response rate of 78.1% (6876 of 8800), slightly lower than in 1991 to 1993 (87.6%).

Responders in 1998 to 2000 were slightly older than in the first survey (33.9 ± 6.8 vs 32.7 ± 7.0 years) and presented a slightly lower proportion of men (49.0% vs 50.7%). The proportion of people living in suburban areas was doubled in the second survey (2044 of 6876, 29.7%) with respect to the first survey (856 of 6031, 14.2%). This was mainly a consequence of the enlargement from 1000 to 3000 of the general population sample selected in the Pavia area, where about 60% of the population lives in small centers and in rural areas. The lag between the median time of response in the 2 surveys was 6.9 years, in particular 7.7 years in Pavia and 6.8 years in Turin and Verona.

Screening questionnaire

The questionnaire used in 1998 to 2000²¹ was the same questionnaire used in the ECRHS,²⁰ integrated with additional questions on asthma, chronic bronchitis, smoking habits, subjective perception of outdoor pollution, and direct and indirect costs of asthma.

For the purpose of case identification, asthma and allergic rhinitis were defined by a positive answer to the questions "Have you had an attack of asthma in the last 12 months?" and "Do you have any nasal allergy including hay fever?", respectively. Subjects were also asked whether they were "currently taking any medicines (including inhalers, aerosols or tablets) for asthma."

The following asthma-like symptoms were also considered: wheezing, wheezing with breathlessness, wheezing without a cold, chest tightness, and shortness of breath, defined as affirmative answer to the questions "Have you had wheezing or whistling in your chest at any time in the last 12 months?", "Have you been at all breathless when the wheezing noise was present?", "Have you had this wheezing or whistling when you did not have a cold?", "Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?", and "Have you been woken up by an attack of shortness of breath at any time in the last 12 months?", respectively.

Statistical analyses

To correct for nonresponse bias that has been shown to largely affect Italian surveys on respiratory health,²² prevalence in nonre-

sponders was assumed to be the same as in late responders (people contacted by phone).²³ Confidence intervals of adjusted estimates were computed according to Tennant and Badley.²⁴

Temporal variation (0, 1st survey; 1, 2nd survey) in symptom prevalence was analyzed through a logistic regression model, controlling for sex, age class (20 to 26.2, 26.3 to 32.4, 32.5 to 38.7 years, 38.8 years or older), site of residence (urban vs suburban areas), season of response, cumulative response rate, and type of contact (mail vs phone). Age was coded into 4 classes of the same width, so that the age range of each class (6.25 years) was close to the lag between the 2 surveys (6.9 years). Each subject was attributed the median cumulative response rate of the corresponding contact, computed for each center by averaging cumulative response rate at the start and at the end of that particular contact. The significance of the interaction between time of the survey and sex, age, or site of residence was also evaluated.

RESULTS

As shown in Fig 1, the crude prevalence of asthma attacks and asthma-like symptoms remained rather stable from the first to the second survey; more precisely, the prevalence of asthma attacks, chest tightness, and shortness of breath slightly decreased, whereas the prevalence of wheezing slightly increased. A clear-cut increase was apparent for the prevalence of allergic rhinitis during the same period.

This pattern was substantially confirmed when symptom prevalence was adjusted to compensate for selection bias (Table I). No significant change was observed in the adjusted prevalence of asthma attacks, which slightly declined from 3.6% in 1991 to 1993 to 3.2% in 1998 to 2000 ($P = .188$). The adjusted prevalence of asthma-like symptoms either remained stable, as for wheezing and wheezing without a cold, or slightly decreased, as for wheeze with breathlessness, chest tightness, and shortness of breath. The only significant variation was the decline in shortness of breath ($P < .001$) (Table I).

The temporal trend in prevalence was different in the first and subsequent age classes; the prevalence of asthma attacks, while decreasing in people aged older than 26 years from 3.8% to 3.2%, slightly increased from 3.6% to 4.3% in the first age class (Fig 2). Approximately the same pattern was observed for asthma-like symptoms; the prevalence of wheezing, wheezing with breathlessness, wheezing without a cold, chest tightness, and shortness of breath increased in people aged 20 to 26 years (from 8.4% to 11.9%, from 2.1% to 2.4%, from 5.6% to 8.4%, from 7.1% to 9.9%, and from 4.6% to 5.3%, respectively), while decreasing or remaining stable in older subjects (from 10.6% to 10.8%, from 2.9% to 2.3%, from 7.3% to 7.5%, from 8.4% to 7.1%, and from 7.9% to 5.9%, respectively). According to the logistic model, the interaction age class $\times$ time of survey was significant for wheezing ($P = .036$), wheezing without a cold ($P = .046$), chest tightness ($P = .027$), and shortness of breath ($P = .026$) but not for asthma attacks ($P = .641$) or for wheezing with breathlessness ($P = .733$). No significant interaction was detected between gender and time of survey.

The prevalence of asthma attacks and asthma-like symptoms was usually higher in urban than in suburban

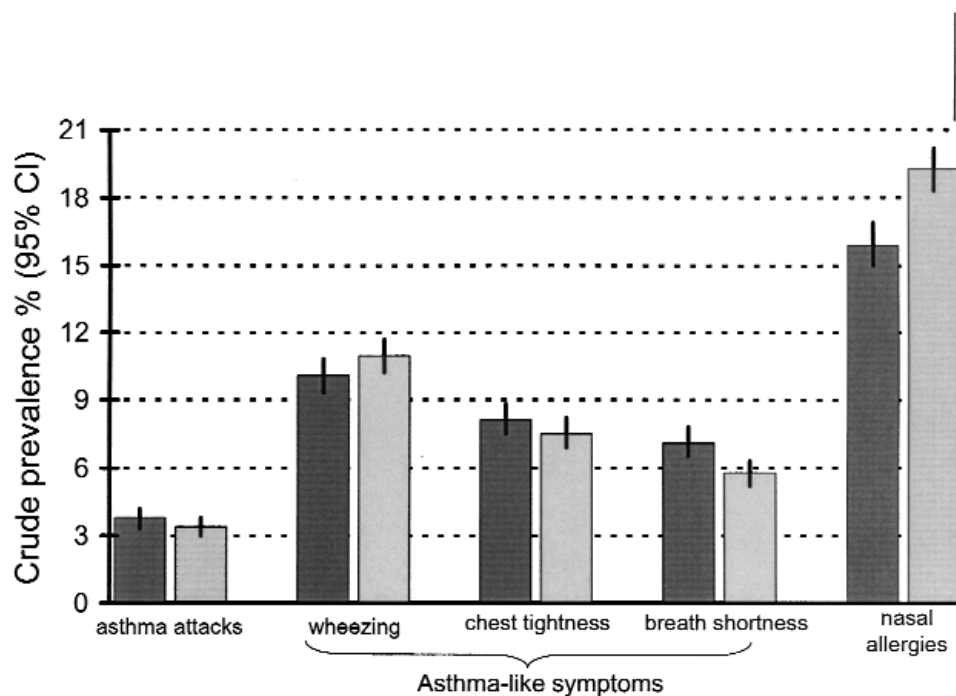


FIG 1. Crude prevalence (in percentage) of self-reported respiratory symptoms in northern Italy in 1991-1993 (dark columns) and in 1998-2000 (light columns). Bars are values; lines are 95% confidence intervals.

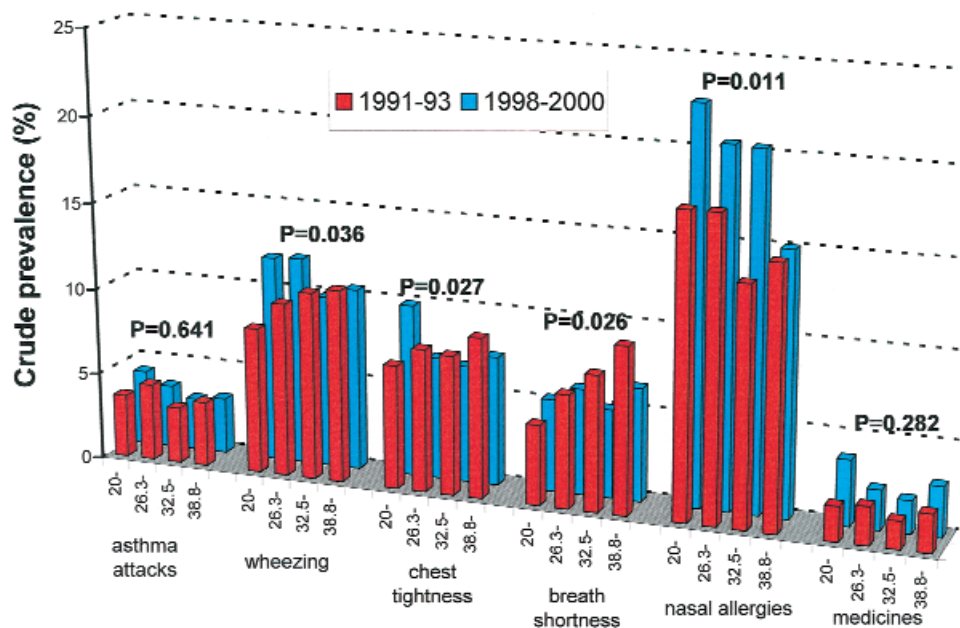


FIG 2. Crude prevalence (in percentage) of self-reported respiratory symptoms and antiasthmatic treatment in northern Italy according to age class and time of survey. Red columns refer to the first survey (1991-1993) and blue columns to the second survey (1998-2000). P values above each set of columns refer to significance of the interaction age $\times$ time of survey, which was evaluated for each symptom by a logistic regression model controlling for sex, age, site of residence (urban/suburban), season of response, type of contact (mail/phone), and cumulative response rate.

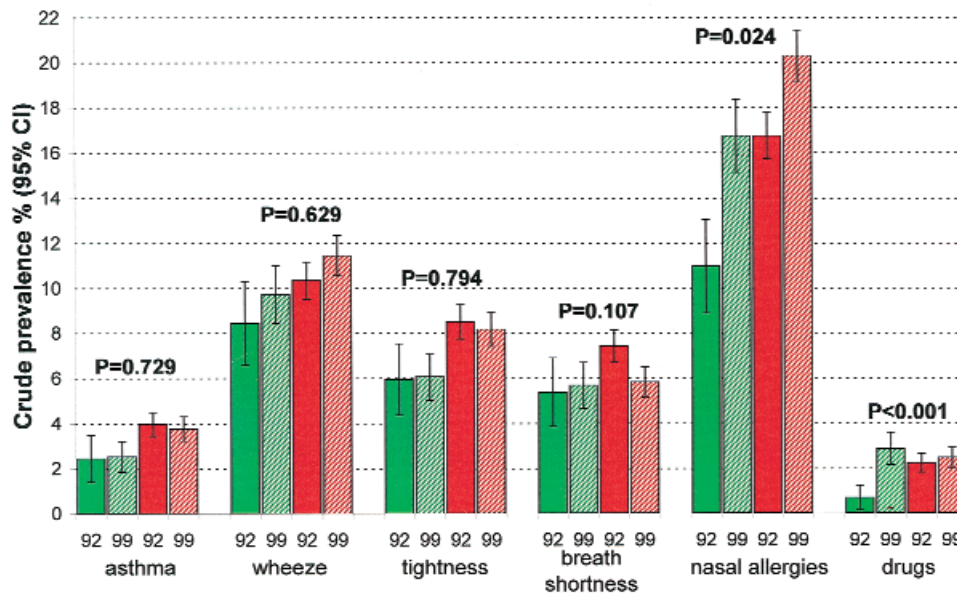


FIG 3. Crude prevalence (in percentage) of self-reported respiratory symptoms and antiasthmatic treatment in northern Italy according to site of residence and time of survey. *Green and red colors* refer to suburban and urban areas, respectively, whereas *solid and hatched areas* refer to the first (1991-1993) and second surveys (1998-2000), respectively. *Bars* are values; *lines* are 95% confidence intervals. *P* values above each set of columns refer to significance of the interaction site of residence $\times$ time of survey, which was evaluated for each symptom by a logistic regression model controlling for sex, age, site of residence (urban/suburban), season of response, type of contact (mail/phone), and cumulative response rate.

TABLE I. Adjusted prevalence (in percentage) of respiratory symptoms and antiasthmatic treatment in 1991-1993 and in 1998-2000 in the 3 Italian centers

	Adjusted prevalence (95% CI)*		OR (95% CI)† (99 versus 92)	P value‡
	1991/1993	1998/2000		
Asthma attacks	3.6 (3.0-4.2)	3.2 (2.7-3.7)	0.87 (0.71-1.07)	.188
Wheezing	9.8 (8.9-10.8)	9.6 (8.8-10.4)	1.00 (0.89-1.14)	.944
Wheeze with breathlessness	2.8 (2.2-3.3)	2.1 (1.7-2.5)	0.87 (0.68-1.11)	.249
Wheezing without a cold	6.7 (5.9-7.5)	6.5 (5.9-7.2)	1.03 (0.89-1.19)	.682
Chest tightness	7.9 (7.0-8.7)	6.5 (5.8-7.2)	0.88 (0.77-1.01)	.075
Shortness of breath	7.0 (6.2-7.9)	5.2 (4.5-5.8)	0.73 (0.63-0.85)	<.001
Nasal allergies	15.4 (14.3-16.6)	18.3 (17.2-19.5)	1.22 (1.10-1.34)	<.001
Medicines	1.9 (1.5-2.3)	2.5 (2.1-3.0)	1.22 (0.95-1.56)	.120

*Adjusted prevalence was obtained by a modified Tennant and Badley method.

†ORs and *P* values were derived from a logistic regression model, controlling for sex, age, site of residence (urban/suburban), season of response, type of contact (mail/phone), and cumulative response rate. *P* values were computed by likelihood ratio test.

areas; the difference was significant for asthma attacks ($P = .004$), wheezing without a cold ($P = .033$), and chest tightness ($P = .002$; Fig 3). However, the temporal pattern in symptom prevalence was similar in the 2 areas, with the only exception of wheezing with breathlessness, whose prevalence increased in suburban areas from 1.1% to 2.4% and decreased in urban areas from 3% to 2.3% (interaction between site of residence and time of survey, $P = .003$).

The prevalence of allergic rhinitis significantly increased during the observation period from 15.4% in 1991 to 1993 to 18.3% in 1998 to 2000 ($P < .001$). The increase in the prevalence of nasal allergies was observed in all age classes (from 16.2% to 20.9% in people aged 20 to 38.7 years) but the last one (from 15.0% to 15.1%

in people aged 38.8 years or older) (Fig 2), as denoted by the significance of the interaction term age $\times$ time of survey ($P = .011$). In suburban areas the prevalence of allergic rhinitis was lower than in urban areas ($P < .001$), but the difference tended to fade away during the observation period (interaction between site of residence and time of survey, $P = .024$) (Fig 3).

Among people with asthma attacks, the proportion of subjects reporting allergic rhinitis also did not change substantially from the first (149 of 226, 65.9%) to the second survey (161 of 234, 68.8%) ($P = .511$).

Overall, the percentage of people who self-reported to be under antiasthmatic treatment increased slightly from 1.9% to 2.5%, although not significantly ($P = .120$). This

increase was observed in suburban areas (from 0.7% to 2.9%) but not in urban areas (from 2.3% to 2.5%), as denoted by the significant interaction between site of residence and time of survey ($P < .001$) (Fig 3). The increase in treatment was substantial in people aged 20 to 26 years (from 2.0% to 3.8%) and only moderate in older age classes (from 2.0% to 2.4%), but this difference in temporal trend was not significant ($P = .282$) (Fig 2). The proportion of people free from asthma attacks increased among subjects currently taking medicines for asthma in all centers from 21.8% in 1991 to 1993 to 31.8% in 1998 to 2000 ($P = .059$).

DISCUSSION

The main results of the present survey are as follows: (1) In the overall young adult population, the prevalence of asthma attacks and asthma-like symptoms has not increased during the 1990s in Italy. (2) However, when considering age classes separately, a generational effect emerged because asthma-like symptom prevalence tended to decrease in older subjects (32.5 to 45 years) and to increase in younger subjects (20 to 26.2 years). (3) The prevalence of self-reported allergic rhinitis has increased during the same period in all age classes (20 to 38 years) but the last one (39 to 45 years). This increasing trend was more pronounced in suburban areas. (4) The proportion of people under antiasthmatic treatment has increased remarkably in suburban areas, while remaining stable in urban areas.

Our results suggest that, particularly in the younger age classes, sensitization to airborne allergens, as indirectly estimated by hay fever,²⁵ is continuously increasing; however, the absence of a parallel increase in asthma attacks and in asthma-like symptoms seems to point out a lower susceptibility of bronchial airways.

By our results we can offer a first explanation; symptoms are now better controlled and prevented than in the past because of the improvement in asthma management. During the last 10 years a number of changes in medical management, in access to health care, in awareness of the public about recognized indoor allergens and in their avoidance could have led to a lower expression of the disease.^{26,27} Recently, Kuehni et al¹¹ observed a significant increase in wheezing disorders between 1990 and 1998 in preschool children, but a declining rate of asthma symptoms in adult life, and attributed this discrepancy to the improvement in asthma care and perhaps to the early use of steroids.

In addition, a number of factors that in the past have been suggested as possible causes of the rising prevalence of asthma may have been more controlled. For instance, in the 3 Italian centers under study, pollution levels slightly decreased during the observation period: SO_2 declined from 32.7 to 16.5 $\mu\text{g}/\text{m}^3$ in Turin, from 15.5 to 5.2 $\mu\text{g}/\text{m}^3$ in Verona, and from 16.6 to 9.3 $\mu\text{g}/\text{m}^3$ in Pavia. Smaller decreases were observed also for O_3 (from 51.1 to 38.4, from 39.9 to 31.9, and from 46.8 to 33.5 $\mu\text{g}/\text{m}^3$ in Turin, Verona, and Pavia, respectively) and for NO_2 (from 86.0

to 79.0, from 63.2 to 58.3, and from 56.7 to 41.5 $\mu\text{g}/\text{m}^3$ in Turin, Verona, and Pavia, respectively) (ARPA-Agenzie Regionali per la Protezione Ambientale, Regional Agencies for Environmental Protection, personal communication, May 17, 2002). Unfortunately, changes in other risk factors, such as childhood respiratory infections, diet, occupational exposures, psychological traits, and airborne allergens, have not been well documented.

Recently, an Italian epidemiologic study has documented that the prevalence of asthma in children aged 6 to 14 years increased significantly during 1974 to 1992 and has remained stable from 1992 to 1998.¹³ Our results in young adults confirm the evidence that the increasing trend in asthma has faded away or even reversed during the same decade. Such results were not confined to Italy, a country with a rather low prevalence of self-reported respiratory symptoms,^{19,28,29} atopy,³⁰ and bronchial hyperresponsiveness,³¹ but a similar trend has been observed also in countries with a high prevalence, such as England and Australia. The English study has recorded an increase of the incidence of asthma episodes presenting to general practitioners between 1989 and 1993 and a gradual decrease since 1993.¹⁵ A recent study on young Melbourne adults compared the results of 3 cross-sectional postal surveys during the 1990s; asthma symptoms were increased from 1990 to 1992 but subsequently declined by 1998.¹⁶ This last survey has been conducted in the frame of ECRHS with a methodology similar to what we used. Besides the similar trend in symptom prevalence, the Melbourne study showed a significant increase in current use of asthma medications. The increase in the proportion of people under antiasthmatic treatment found in Australia and in suburban areas of Italy could be interpreted as the positive effect of the diffusion in the last decade of the International Guidelines of the Global Initiative for Asthma. Different from our data, in the Melbourne study there was no significant change in prevalence of nasal allergies between 1990 and 1998; otherwise, the prevalence of allergic rhinitis was already so high in 1990 (41%) that a further increase would have been unlikely.

As already reported,^{25,32} in Italian suburban areas the prevalence of asthma attacks, asthma-like symptoms, allergic rhinitis, and atopy was lower in the early 1990s. This phenomenon has been attributed to lower levels of environmental pollution and to higher levels of immunomodulating agents, such as microbial agents, in these areas. During the 1990s the prevalence of allergic rhinitis largely increased in suburban areas, maybe because of a delayed spreading of the so-called Western lifestyle in peripheral communities.^{9,10} The absence of a simultaneous increase in asthma attacks and asthma-like symptoms could be attributed to the significant increase in antiasthmatic treatment in these areas.

The trend in asthma attacks and asthma-like symptoms was different according to age class, because prevalence tended to increase in people aged 20 to 26 years and to decrease in people aged 32 to 45 years. This difference could reflect a cohort effect, because asthma

incidence is still increasing in young generations.³³ In particular, adults aged 20 to 26 years in 1998 to 2000 belonged to the same generation who underwent a peak of childhood asthma during the 1980s.

In the present study some limitations should be acknowledged. First of all, the response rate was slightly lower in the second survey with respect to the first one, producing a potential bias in the comparison of the 2 prevalence estimates; as previously demonstrated,²² symptomatic subjects are more prone to respond to self-administered mailed questionnaires, and hence a worse response rate could produce an overestimation of symptom prevalence. Thus prevalence in the second survey could have been overestimated with respect to the previous survey, masking a possible declining trend in prevalence. However, prevalence estimates were corrected to account for selection bias.²²

Second, information on respiratory symptom prevalence was derived from mailed questionnaires and phone interviews and not by more objective measurements, such as specific IgE or skin prick testing, bronchial hyperresponsiveness, or lung function.³⁴ However, self-administered questionnaires have been compared with clinical diagnosis in the first survey, and the validity of self-reported respiratory symptoms seemed adequate.³⁵ On the other hand, the clinical significance of objective measurements, as indicators of disease, disease severity, or expression, is also questioned.³⁶

Finally, because the questions administered dealt with asthma attacks and asthma-like symptoms rather than with disease diagnosis, it is possible that we observed a reduction in disease severity rather than a true decline in disease prevalence.

Even with these limitations, the present study conveys an important message, because it is one of the first investigations showing an arrest in the increasing trend in asthma prevalence among adults.

In conclusion, asthma-like symptom prevalence, after increasing dramatically and worldwide in the 1970s and 1980s, has not increased further during the 1990s in Italy, probably because the management of asthma has been improved. The persistence of an increasing trend in the prevalence of self-reported allergic rhinitis deserves attention.

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APPENDIX

List of participants in ECRHS and ISAYA in Pavia, Turin, and Verona

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