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Changes in Prevalence of Asthma and Allergies Among Children and Adolescents in Italy: 1994–2002

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ABSTRACT

BACKGROUND. Several studies conducted during the 1990s indicated an increase in the prevalence of symptoms of asthma; more recent investigations suggest that the trend is stabilizing or may even be reversing.

OBJECTIVE. We compared 2 cross-sectional surveys conducted in 1994 and 2002 in 8 areas in northern and central Italy, to evaluate prevalence changes for asthma, allergic rhinitis, and eczema.

METHODS. The International Study of Asthma and Allergies in Childhood methods and questionnaires were used to investigate 6- to 7-year-old children (16 115 and 11 287 questionnaires completed by parents in 1994–1995 and 2002, respectively) and 13- to 14-year-old adolescents (19 723 and 10 267 questionnaires completed by adolescents in 1994–1995 and 2002, respectively). In each phase, the overall response rate was >90%. Prevalence changes were calculated as the absolute difference between the prevalence recorded on the 2 occasions.

RESULTS. The prevalence of wheeze (past 12 months) increased slightly among children (change: 0.8%; 95% confidence interval [CI]: 0.0% to 1.6%) and was rather stable among adolescents. Symptoms of allergic rhinitis (children: change: 5.2%; 95% CI: 4.0% to 6.4%; adolescents: change: 4.1%; 95% CI: 1.9% to 6.3%) and symptoms of atopic eczema (children: change: 4.4%; 95% CI: 3.6% to 5.2%; adolescents: change: 2.1%; 95% CI: 1.2% to 3.0%) increased clearly in both age groups. There was some heterogeneity across the centers among adolescents, especially for allergic rhinitis, with larger increases seen in the 3 metropolitan areas. The changes observed paralleled profound family changes, ie, better parental education, higher rates of maternal employment, and lower rates of exposure

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Key Words

asthma, rhinitis, eczema, children, adolescents

Abbreviations

SIDRIA—Italian Studies of Respiratory Diseases in Childhood and the Environment
ISAAC—International Study of Asthma and Allergies in Childhood
CI—confidence interval
ECRHS—European Community Respiratory Health Survey

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to parental smoke. These factors, however, do not explain all of the observed changes in prevalence.

CONCLUSIONS. The results indicate that the epidemiologic features of asthma and allergies in Italy are changing rapidly, although the causes are still uncertain.

DURING THE 1990S, the prevalence of childhood asthma increased considerably, as observed in several countries. The general interpretation was that the phenomenon was real and not merely attributable to changes in diagnostic parameters. The increase paralleled changes in the prevalence of symptoms of allergic rhinitis and atopic eczema. Despite intensive research efforts, however, and the proposal of several hypotheses, the reasons for such changes have not been discovered. Very recently, 3 reports indicated the possibility that the epidemiologic features of childhood asthma and allergy are changing again. Braun-Fahrlander et al¹ detected no additional increases in asthma, hay fever, and atopic sensitization among adolescents living in Switzerland who were studied with the same methods in 3 cross-sectional surveys in 1992 to 2000. A study from Australia found a significant decrease in the prevalence of wheeze among a sample of 8- to 11-year-old children during the period of 1992–2002.² Finally, Anderson et al³ documented decreases in the prevalence of wheeze, symptoms of allergic rhinitis, and eczema among adolescents in 1995–2002 in the United Kingdom, one of the areas of the world with the highest rates of symptoms of asthma, allergic rhinitis, and atopic eczema, according to the worldwide International Study of Asthma and Allergies in Childhood (ISAAC), phase 1.⁴ To understand the scope of these new patterns, more investigations are needed in different areas of the world, using the same instruments, involving a large number of children, and comparing different age groups. The Italian Studies of Respiratory Diseases in Childhood and the Environment

(SIDRIA) project, part of ISAAC, was designed specifically to evaluate changes over time in the prevalence of wheezing, allergic rhinoconjunctivitis, and atopic eczema symptoms among 6- to 7-year-old and 13- to 14-year-old youths in Italy during the period of 1994 to 2002.

METHODS

Study Design

The SIDRIA studies adopted the standardized method of ISAAC.^{5,6} Phase I of SIDRIA was conducted between October 1994 and May 1995 in 8 Italian areas^{7,8} (Table 1). The surveys were performed in areas of northern and central Italy, including metropolitan areas (cities with >500 000 inhabitants, ie, Turin, Milan, and Rome) and other areas (the entire region of Emilia-Romagna, the municipality of Florence, the local health unit of Empoli, the entire province of Trento, and Siena). Phase II of SIDRIA was conducted in the same areas, with the same standardized instruments, between January and May 2002.

The study population was made up of 6- to 7-year-old children attending the first and second grades of primary school in Milan, Turin, Emilia-Romagna, Florence, Empoli, and Rome and 13- to 14-year-old adolescents attending the last grade of middle school in the aforementioned 6 areas plus Siena and Trento. Each area was required to sample at least 1000 subjects for each age group. Cluster sampling was performed separately in each area and age group; schools were selected and all students from the grades of interest were enrolled. In selection of the schools, a simple random sample would have meant that smaller schools would be over-represented. Therefore, a weight proportional to the number of students in the grades of interest was given to each school. To increase precision of the comparisons of the 2 phases, the phase II protocol required one half of the schools in each area to be extracted randomly from those

TABLE 1 Characteristics of Areas Involved in SIDRIA-1 (1994–1995) and SIDRIA-2 (2002) Among Italian Children (6–7 Years of Age) and Adolescents (13–14 Years of Age)

Area	Location	Urbanization ^a	Children				Adolescents			
			1994–1995		2002		1994–1995		2002	
			Target Population, <i>n</i>	Response Rate, %	Target Population, <i>n</i>	Response Rate, %	Target Population, <i>n</i>	Response Rate, % ^b	Target Population, <i>n</i>	Response Rate, % ^b
Turin	Northern	Metropolitan	1474	96.9	2462	95.9	1274	97.5	1198	98.5
Milan	Northern	Metropolitan	3761	96.1	2328	96.6	3486	96.8	1459	96.6
Trent	Northern	Other areas			4429		4429	94.5	1498	87.5
Emilia-Romagna	Northern	Other areas	4553	98.2	2336	97.0	4056	97.7	1420	94.9
Florence	Central	Other areas	1183	96.2	1235	83.9	1211	96.7	1564	88.4
Empoli	Central	Other areas	1575	91	1260	91.4	1071	97.8	1340	91.7
Siena	Central	Other areas					1212	97.4	1181	91.6
Rome	Central	Metropolitan	4260	94.5	2579	86.2	3528	94.2	1420	93.3

^a Metropolitan areas are cities with >500 000 inhabitants; other areas are areas with a population density <1000 inhabitants · km⁻².

^b For the adolescents, the response rate was calculated from the self-administered questionnaires.

already enrolled in phase I. Finally, the areas where the numbers of subjects to enroll were $\leq 25\%$ of the general population of the same age were divided into strata (for example, the 20 city districts of the municipality of Rome), and sampling of the schools was stratum specific.

Data Collection

Data collection was performed with the ISAAC questionnaires. For topics such as individual and family characteristics and other respiratory and allergic symptoms, SIDRIA added specific questions. Two different types of questionnaires were used, that is, (1) a questionnaire completed at home by parents of children and adolescents, with questions about asthma and allergies and about many known or suspected risk factors for these illnesses, and (2) a written questionnaire completed by adolescents at school, mainly regarding current respiratory symptoms and personal smoking habits.

Data collection was conducted thanks to staff members of the Italian National Health Service. The protocols of both phases were approved by the ethics committee of the Catholic University in Rome.

Data Analyses

Only questionnaires with ≥ 1 of the 3 main core questions of ISAAC (lifetime presence of wheezing, rhinitis, and eczema symptoms) completed were included in the analyses. We analyzed the ISAAC core questions^{5,6} regarding the frequency of wheezing, symptoms of allergic rhinitis, and atopic eczema in the 12 months before the survey (past 12 months) and the lifetime frequency of the diseases ("asthma ever," "hay fever ever," and "eczema ever"); in addition, we evaluated the severity of asthma symptoms in the 12 months before the survey with the following composite variables: (1) severe wheezing, defined as >4 attacks of wheezing, >1 nocturnal awakening per week because of wheezing, or speech-limiting wheeze, in the past 12 months; (2) severe asthma, defined as lifetime asthma with severe wheezing in the past 12 months; (3) wheezing with asthma, defined as lifetime asthma with wheezing in the past 12 months; and (4) wheezing without asthma, defined as wheezing in the past 12 months without lifetime asthma.

For the 13- to 14-year-old age group, the information about symptoms was derived from the adolescents' self-administered questionnaire, whereas the information about lifetime prevalence of illnesses was extracted from the parental questionnaire. This choice is supported by evidence that adolescents 13 to 14 years of age recognize their current symptoms of asthma and allergies more accurately than do their parents.⁸ In contrast, parents remember lifetime health history better than do their children.

To maintain comparability with the ISAAC study, all prevalence data were computed without excluding miss-

ing answers, which were counted as negative answers. For temporal comparison between the 2 phases of SIDRIA, the effect measure was the absolute difference between the prevalence rates recorded on the 2 occasions, together with 95% confidence intervals (CIs). Prevalence and prevalence changes were calculated with generalized linear models. All analyses were performed with the Huber-White sandwich estimator of variance (robust option for the Stata glm command), because students from the same school tended to be more similar to each other than to other schools' students, which caused sample variability to be generally less than it would be in a simple random sample. Finally, because the sampling proportions were different in each area, each subject was weighted for the inverse of sampling proportion in computations of the overall estimates of prevalence (and change).

Study results, size, precision, pattern of effects, and degree of heterogeneity between areas were explored visually with forest plots.⁹ A statistical test of heterogeneity between the study areas was also performed with the statistic Q (based on the χ^2 distribution).¹⁰ All analyses were performed with the Stata statistical package, version 7.0 (Stata, College Station, TX) (command glm for generalized linear models and command meta for heterogeneity testing).

RESULTS

A total of 16 115 and 11 287 children completed questionnaires in phases I and II, respectively, and a total of 19 723 and 10 267 adolescents returned completed questionnaires in phases I and II (Table 1). The response rates were generally high (Table 1), with some variation across centers. There were 19 323 phase I and 9362 phase II parent-completed questionnaires for adolescents.

Table 2 presents the characteristics of the study populations and the changes in the main features between the 2 phases of SIDRIA for the 2 age groups. In phase II, a greater proportion of children were born abroad; for both age groups, the maternal age at the time of the survey increased, the proportion of mothers with <8 years of education decreased, and the proportion of employed mothers increased significantly between 1994–1995 and 2002. A significant decrease in the proportion of mothers who smoked during pregnancy or at the time of the survey was observed for children and, to a lesser extent, for adolescents. A clear trend was observed also for fathers' education, and a greater proportion of children's fathers were employed in phase II than in phase I. In both age groups, there was a substantial increase in prevalence of parental history of asthma and hay fever. The season of data collection differed between the 2 phases (ie, primarily autumn and winter in phase I and winter and spring in phase II); however, considerable proportions of subjects completed the questionnaire dur-

TABLE 2 Characteristics of Study Population and Prevalence of Risk Factors in SIDRIA-1 (1994–1995) and SIDRIA-2 (2002) Among Italian Children (6–7 Years of Age) and Adolescents (13–14 Years of Age)

	Children			Adolescents		
	1994–1995	2002	Change ^a	1994–1995	2002	Change ^a
Male gender, %	51.8	51.3		52.2	52.5	
Age, mean, y	6.4	6.7		13.1	13.3	
Child born abroad, %	2.1	3.8	1.2 ^b	1.7	5.3	1.9 ^b
Mother						
Age at child's birth, mean, y	28.7	30.3	1.6 ^b	27.7	28.6	0.9 ^b
<8 y of education, %	10.8	4.7	−5.7 ^b	21.3	9.8	−10.7 ^b
Currently employed, %	55.9	66.5	9.8 ^b	54.0	62.5	8 ^b
Smoker, %	34.3	27.9	−6.2 ^b	34.6	30.9	−3.3 ^b
Smoked during pregnancy, %	16.5	13.0	−3.4 ^b	15.2	13.8	−1.3
Father						
<8 y of education, %	11.3	5.8	−5.5 ^b	19.2	9.4	−9.5 ^b
Currently employed, %	90.3	92.2	1.5 ^b	89.2	88.9	−0.2
Parental history of asthma, %	9.6	13.2	3.6 ^b	7.6	11.3	3.7 ^b
Parental history of hay fever, %	21.5	30.1	8.6 ^b	18.7	26.4	7.7 ^b
Active smoker, % ^c				8.7	9.3	0.5

^a Changes were adjusted for area.

^b $P < .05$.

^c Reported by adolescents.

ing winter in both surveys (23% and 62% in phases I and II, respectively, among children; 44% and 66% in phases I and II, respectively, among adolescents).

The changes in overall prevalence of asthma and allergies, adjusted for area, are summarized in Table 3. The prevalence of current wheezing increased slightly for children but not for adolescents. In contrast, the prevalence of lifetime asthma increased significantly only for adolescents. No significant trend was observed for severe wheezing, severe asthma, or wheezing with asthma. For

adolescents, the prevalence of wheezing without lifetime asthma decreased slightly.

Although the results for asthma were quite stable, allergic rhinitis showed a clear increase in prevalence. In both age groups, symptoms of allergic rhinitis and lifetime hay fever clearly increased. Similarly, the prevalence of both symptoms and diagnoses of atopic eczema increased, more so for children than for adolescents.

The prevalence changes estimates were not heterogeneous across the different areas among children (Fig 1),

TABLE 3 Changes (and 95% CIs) in Prevalence of Symptoms (Past 12 Months) and of Lifetime Asthma, Hay Fever, and Eczema Among Children (6–7 Years of Age) and Adolescents (13–14 Years of Age) in Italy

	Children				Adolescents ^a			
	Rate in 1994–1995, %	Rate in 2002, %	Change, % ^b	95% CI, %	Rate in 1994–1995, %	Rate in 2002, %	Change, % ^b	95% CI, %
Asthma								
Wheezing (past 12 mo)	7.8	8.6	0.8	0.0 to 1.6	10.5	9.7	−0.6 ^c	−1.7 to 0.5
Asthma (lifetime)	9.1	9.5	0.6	−0.4 to 1.6	9.1	10.4	1.4 ^c	0.4 to 2.3
Severe wheezing (past 12 mo)	2.3	2.3	0.1	−0.4 to 0.5	3.8	3.9	0.0	−0.6 to 0.7
Severe asthma (past 12 mo)	1.6	1.6	0.1	−0.2 to 0.4	2.1	2.3	0.1	−0.4 to 0.6
Wheezing (past 12 mo) with asthma	3.9	4.1	0.2	−0.4 to 0.8	4.0	4.5	0.5	−0.3 to 1.2
Wheezing (past 12 mo) without asthma	3.8	4.5	0.5	0.0 to 1.1	6.3	5.2	−1.1	−2.0 to −0.2
Hay fever								
Rhinitis symptoms (past 12 mo)	13.8	18.9	5.2	4.0 to 6.4	31.6	35.1	4.1 ^c	1.9 to 6.3
Rhinoconjunctivitis symptoms (past 12 mo)	5.6	6.8	1.2	0.5 to 1.9	15.9	17.4	1.6 ^c	0.0 to 3.3
Hay fever (lifetime)	6.3	9.0	2.7	1.9 to 3.6	14.4	17.2	2.8	1.5 to 4.1
Eczema								
Eczema symptoms (past 12 mo)	8.3	14.5	6.2	5.3 to 7.1	10.1	11.2	1.2	0.1 to 2.4
Eczema symptoms in flexures (past 12 mo)	6.0	10.4	4.4	3.6 to 5.2	6.5	8.5	2.1	1.2 to 3.0
Eczema (lifetime)	14.3	17	2.5	1.6 to 3.5	11.0	12.8	1.5	0.3 to 2.8

^a Symptoms were reported by adolescents; lifetime diseases were reported by parents.

^b Changes were adjusted for area.

^c Presence of heterogeneity between areas ($P < .05$).

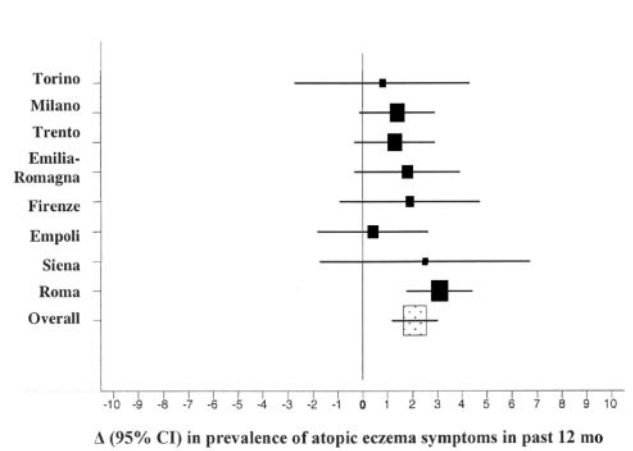
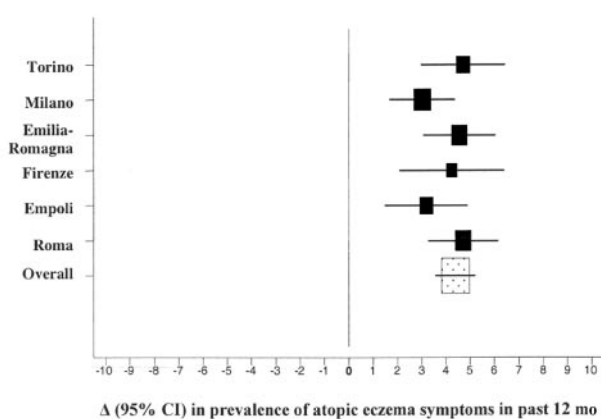
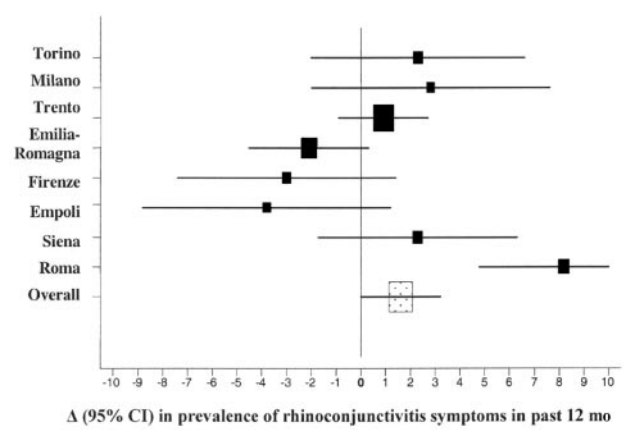
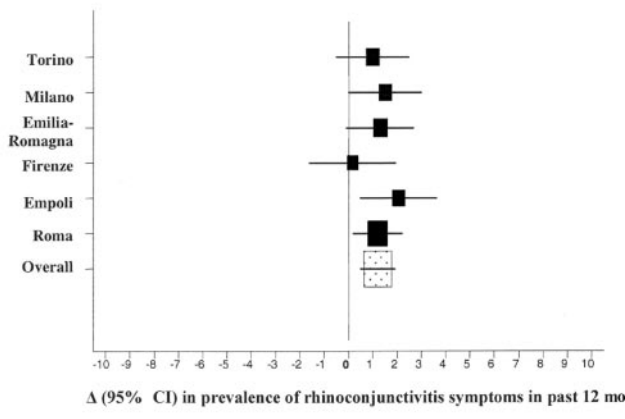
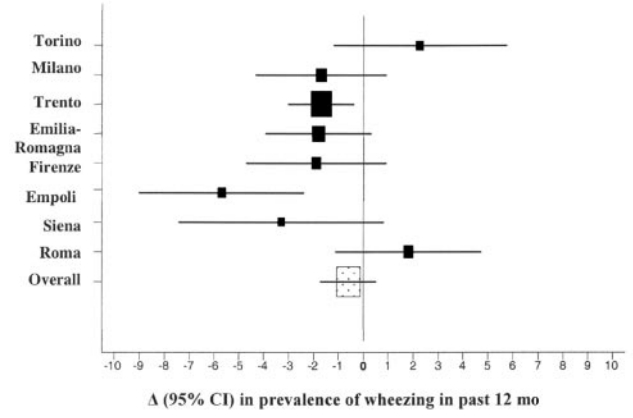
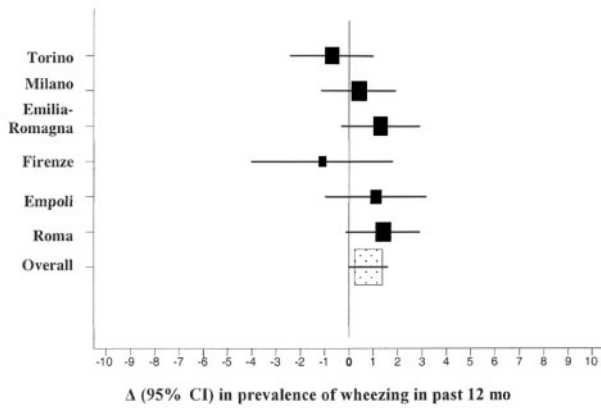


FIGURE 1
Changes (Δ) (and 95% CIs) in prevalence of wheezing, allergic rhinoconjunctivitis, and atopic eczema (past 12 months) reported by parents of children (6–7 years of age) in 6 areas in Italy.

FIGURE 2
Changes (Δ) (and 95% CIs) in prevalence of wheezing, allergic rhinoconjunctivitis, and atopic eczema (past 12 months) reported by adolescents (13–14 years of age) in 8 areas in Italy.

whereas there was a considerable degree of heterogeneity for adolescents (Fig 2). Significant heterogeneity was found for changes in wheezing in the past 12 months (P for heterogeneity = .024), in lifetime asthma (P = .001), in allergic rhinitis symptoms in the past 12 months (P = .023), and in allergic rhinoconjunctivitis symptoms in the past 12 months (P = .000). Visual inspection of the forest plots suggested that the large cities behaved differently than the other areas.

For children, there were no differences in symptoms of and lifetime asthma, as well as symptoms of and lifetime hay fever, between metropolitan areas and other areas. For adolescents, in contrast, clear increases in the prevalence of lifetime asthma (change: 3.3%), severe wheezing (change: 1.0%), and wheezing with asthma (change: 1.3%) were found only in metropolitan areas (Table 4); in the other areas, the 12-month prev-

TABLE 4 Changes (and 95% CIs) in Prevalence of Symptoms (Past 12 Months) and of Lifetime Asthma, Hay Fever, and Eczema Among Adolescents (13–14 Years of Age)^a According to Level of Urbanization in Italy

	Metropolitan Areas ^b				Other Areas ^b			
	Rate in 1994–1995, %	Rate in 2002, %	Change, % ^c	95% CI, %	Rate in 1994–1995, %	Rate in 2002, %	Change, % ^c	95% CI, %
Wheezing (past 12 mo)	10.0	11.0	1.0	−0.9 to 2.9	10.5	8.4	−2.0	−3.3 to −0.6
Asthma (lifetime)	9.5	12.6	3.3	1.9 to 4.7	8.7	8.6	0.0 ^d	−1.2 to 1.1
Severe wheezing (past 12 mo)	3.8	4.9	1.0	0.0 to 2.0	3.7	3.1	−0.7	−1.5 to 0.1
Severe asthma (past 12 mo)	2.1	2.7	0.7	−0.1 to 1.4	2.1	1.8	−0.3	−0.9 to 0.4
Wheezing (past 12 mo) with asthma	4.1	5.4	1.3	0.1 to 2.5	3.9	3.6	−0.2	−1.1 to 0.6
Wheezing (past 12 mo) without asthma	5.9	5.6	−0.3	−1.6 to 1.0	6.6	4.8	−1.8	−3.0 to −0.6
Rhinitis symptoms (past 12 mo)	30.8	37.3	6.5	3.0 to 10.1	31.1	33.0	1.9	−0.6 to 4.4
Rhinoconjunctivitis symptoms (past 12 mo)	15.4	21.1	5.8 ^d	3.3 to 8.3	15.7	13.9	−1.7	−3.5 to 0.1
Hay fever (lifetime)	14.5	18.2	3.6	2.2 to 5.0	14.3	16.3	2.1	0.2 to 4.1
Eczema symptoms (past 12 mo)	10.0	11.2	1.2	−0.3 to 2.6	10.0	11.3	1.3	−0.5 to 3.0
Eczema symptoms in flexures (past 12 mo)	6.2	8.6	2.4	1.3 to 3.5	6.7	8.4	1.7	0.3 to 3.1
Eczema (lifetime)	10.5	12.7	1.8	0.0 to 3.6	11.4	12.8	1.3	−0.3 to 2.9

^a Symptoms were reported by adolescents; lifetime diseases were reported by parents.

^b Metropolitan areas are cities with >500 000 inhabitants; other areas are areas with a population density <1000 inhabitants · km^{−2}.

^c Changes were adjusted for area.

^d Presence of heterogeneity between areas ($P < .05$).

alence of wheezing and wheezing without asthma decreased. For allergic rhinitis symptoms among adolescents, the increase in prevalence was concentrated in metropolitan areas, although lifetime hay fever prevalence increased also in the other areas (Table 4). There was no difference for children or adolescents in absolute changes in eczema prevalence between metropolitan and other areas. It should be noted that, after stratification for urbanization, residual heterogeneity was found within the other areas for lifetime asthma and within the metropolitan areas for allergic rhinoconjunctivitis symptoms in the past 12 months for adolescents (Table 4).

Some additional issues were considered in sensitivity analyses. Because the season of data collection differed in the 2 phases, all analyses were repeated with only those subjects who completed the questionnaire during winter (children: phase I, $n = 3364$; phase II, $n = 7015$; adolescents [self-report]: phase I, $n = 8598$; phase II, $n = 6723$; adolescents [parental report]: phase I, $n = 8895$; phase II, $n = 6046$). Additional analyses were also performed, adjusting in separate models for maternal or paternal education, parental occupation, maternal smoking (at present or during pregnancy), and the person who completed the questionnaire. In the final model, there were no substantial modifications in the prevalence changes reported above (results available on request). Finally, when testing the effect modification for parental asthma and hay fever, we did not find substantial and coherent differences, except for greater difference estimates for eczema among children with a history of parental asthma or hay fever.

DISCUSSION

Our study was designed to fill the gap in knowledge regarding time trends of prevalence of asthma and aller-

gic rhinitis in Italy, where asthma and allergy prevalence ranked intermediate in ISAAC.⁴ Only minor changes in prevalence of wheeze and asthma were found among children in this study. A considerable increase in the prevalence of lifetime diagnoses of asthma seems to have occurred among adolescents, especially among those living in large cities (metropolitan areas), but the prevalence of asthma symptoms remains stable. The increase in asthma diagnoses in large cities, in the absence of an increase in symptoms, is probably the result of changes in medical labeling. Overall, a stabilization of the trend in asthma seems to have occurred among Italian children and adolescents. However, clear increases in the prevalence of allergic rhinitis and eczema symptoms have occurred in both age groups. Among adolescents, the increase is more pronounced in large cities.

The results of the present study should be viewed in the context of other recent investigations on the changes in the prevalence of asthma, rhinitis, and eczema symptoms. When we considered studies that performed baseline assessments in 1990 to 1995, had an interval of ≥ 5 years between the first assessment and the second assessment, and were published through 2004, we found a total of 11 published studies on wheeze, 8 conducted in Europe and 5 using the ISAAC standardized approach (Table 5). A rather conflicting picture appears; 6 studies indicated an increase in wheeze prevalence,^{11–16} 3 studies indicated no changes,^{1,17,18} and 2 studies reported significant decreases.^{2,3} The 2 studies with striking decreases were conducted in the United Kingdom and Australia, the countries with the highest prevalence in the world, as recorded in the ISAAC study.⁴ Increases in the prevalence of allergic rhinoconjunctivitis were found in Kenya,¹⁵ Germany,¹⁶ and Hong Kong,¹⁸ but no changes or decreases were detected in Turkey,¹¹ eastern Germany,¹⁹

TABLE 5 Published Time Trend Studies on Changes in 12-Month Prevalence of Wheezing, Allergic Rhinoconjunctivitis Symptoms, and Atopic Eczema Symptoms Among School-Aged Children From Various Countries. Studies With Baseline Assessments in 1990–1995, an Interval of ≥ 5 Years Between the First and Second Assessment, and Published Through 2004

Reference	Country (Period)	No. (Baseline)	Age, y	12-mo Prevalence of Wheezing			12-mo Prevalence of Rhinoconjunctivitis Symptoms			12-mo Prevalence of Atopic Eczema Symptoms		
				Baseline Rate, %	Comparison Rate, %	Change, %	Baseline Rate, %	Comparison Rate, %	Change, %	Baseline Rate, %	Comparison Rate, %	Change, %
Kalyoncu et al ¹¹ (1999)	Ankara, Turkey (1992–1997)		6–13	11.9	13.3	1.4	15.4 ^a	14.1 ^a	–1.3	4	4.3	0.3
Downs et al ¹² (2001)	Wagga Wagga, Australia (1992–1997)	850	8–10	22.1	27.2	5.1						
Ronchetti et al ¹⁷ (2001)	Rome, Italy (1992–1998)	1229	6–14	4.0 ^b	3.7 ^b	–0.3						
Anthracopoulos et al ¹³ (2001)	Patras, Greece (1991–1998)	2417	8–10	4.6 ^c	6.0 ^c	1.4						
Ng Man Kwong et al ¹⁴ (2001)	Sheffield, United Kingdom (1991–1999)	4580	8–9	17	19.4	2.4						
Heinrich et al ¹⁹ (2002)	Eastern Germany (1992–1999)	2470	5–14				8.7 ^d	8.0 ^d	–0.7			
Esamai et al ¹⁵ (2002) ^e	Kenya (1995–2001)		13–14	10.2	13.8	3.6	25.3 ^a	31.4 ^a	6.1	14.4	21.3	6.9
Maziak et al ¹⁶ (2003) ^e	Munster, Germany (1995–2000)	3467	6–7	9.8	13.2	3.4	5.6	7	1.4	7	8.1	1.1
Maziak et al ¹⁶ (2003) ^{e,f}	Munster, Germany (1995–2000)	3757	13–14	14.1	17.4	3.3	14.5	15.1	0.6	7.2	7.8	0.6
Lee et al ¹⁸ (2004) ^e	Hong Kong, China (1995–2001)	3618	6–7	9.2	9.4	0.2	13.6	17.2	3.6	4.2	3.6	–0.6
Braun-Fahrländer et al ¹ (2004) ^d	Switzerland (1992–2000)	1324	13–14	8.8 ^g	8.3 ^g	–0.5	13.2 ^a	11.5 ^a	–1.7			
Toelle et al ² (2004)	Belmont, Australia (1992–2002)	1052	8–11	28.6	23.7	–4.9						
Anderson et al ³ (2004)	British Isles (1995–2002)	15 083	12–14	33.9	27.5	–6.4	18.4	15.1	–3.3	16.2	11.4	–4.8
Present study	Italy (1994–2002)	16 115	6–7	7.8	8.6	0.8	5.6	6.8	1.2	6	10.4	4.4
Present study [†]	Italy (1994–2002)	19 723	13–14	10.5	9.7	–0.6	15.9	17.4	1.6	6.5	8.5	2.1

^a Rhinitis without itchy watery eyes.

^b Attacks of breathlessness and audible wheezing.

^c Current asthma or wheezing.

^d Runny nose in the past 12 months.

^e ISAAC questionnaire.

^f Adolescents' report.

^g Recurrent wheeze in the past 12 months.

Switzerland,¹ and the British Isles.³ In Germany, the increase was greater for children than for adolescents.¹⁶ Finally, a similar picture was found for atopic eczema symptoms.

A controversial image of the worldwide epidemic of allergies is emerging; it seems to be changing and requires systematic periodic monitoring. The new phase of the ISAAC study⁶ will certainly provide more insights because of the standardization of protocols between countries. For the time being, it seems reasonable to conclude that the increase in asthma is leveling off, as confirmed by the present study, although it is premature to interpret the recent findings from Australia and the United Kingdom. In contrast, allergic rhinitis and eczema, at least in some parts of the world, including Italy, are on the rise.

Our results regarding the general characteristics of Italian families indicate rapid changes in society that occurred between studies. Parental education has been improving, maternal employment has been increasing, maternal age at childbirth has been increasing (by ~1 year over the 7-year period), and exposure to passive smoking and maternal smoking during pregnancy have been reduced. Although these factors tend to be associated cross-sectionally with the prevalence of the symptoms considered, they were not able to explain the amount of change observed in the prevalence of allergic illnesses.

Reports of parental history of asthma and hay fever increased dramatically in this study, and this finding itself is interesting. Although there are concerns that the changes may be attributable to some labeling bias, especially for asthma, at least a portion of the increase may be real and may be considered an indirect confirmation of the findings among children. In fact, a nationwide study in Italy on asthma and allergies among young adults (as part of the European Community Respiratory Health Survey [ECRHS] initiative), comparing cross-sectional data collected during 1991 to 1993 and 1998 to 2000, found that the prevalence of asthma-like symptoms (wheezing, chest tightness, and shortness of breath) tended to decrease in the >30-year-old age groups, whereas it increased in the youngest groups (20–26-year-old individuals).²⁰ In the whole ECRHS cohort of young adults,²¹ small increases in the prevalence of self-reported asthma attacks and asthma medication were observed, particularly among the youngest age groups (20–34-year-old individuals), whereas no significant change was observed in the prevalence of reported symptoms of asthma. In contrast, a consistent increase in nasal allergy prevalence among adults was observed by Verlatto et al²⁰ in the Italian participation in ECRHS (with a clear-cut increase from 15.4% to 18.3%), as well as in the whole ECRHS study²¹ (with a 6.9% change among adults 20–24 years of age) and in other countries.²²

There are no easy interpretations of the changes seen,

but several hypotheses will be put forward in the near future. Certainly the increase seen in our study regarding allergic rhinitis, especially in more urbanized area, should be noted. The metropolitan areas are those that best represent “the Western lifestyle package,”²³ and our observations fit well with this hypothesis. However, the possibility that air pollution (especially from diesel-powered vehicles, which are extremely widespread in Italy) could have a role cannot be dismissed.^{24,25} Our results may also indicate that wheezing, atopic dermatitis, and allergic rhinitis are different diseases with respect to not only the development of these epidemiologic trends but also probably patterns of risk factors.^{23,26} In the present study, we observed a considerable degree of heterogeneity in the changes in the prevalence of wheezing and allergic rhinoconjunctivitis symptoms among adolescents, which suggests that caution is necessary when time trends at a national level are inferred from data collected in just a few areas.

CONCLUSIONS

The results of this study indicate no changes in the prevalence rates of wheeze and increases in those of rhinitis and eczema among Italian children. The results support the view that profound modifications in the epidemiologic features of asthma and allergic diseases are occurring worldwide, requiring comprehensive, continuous, epidemiologic monitoring.

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REFERENCES

- Braun-Fahrlander C, Gassner M, Grize L, et al. No further increase in asthma, hay fever and atopic sensitization in adolescents living in Switzerland. *Eur Respir J.* 2004;23:407–413
- Toelle BG, Belousova E, Salome CM, Peat JK, Marks GB. Prevalence of asthma and allergy in schoolchildren in Belmont, Australia: three cross-sectional surveys over 20 years. *BMJ.* 2004;328:386–387
- Anderson HR, Ruggles R, Strachan DP, et al. Trends in prevalence of symptoms of asthma, hay fever, and eczema in 12–14 year olds in the British Isles, 1995–2002: questionnaire survey. *BMJ.* 2004;328:1052–1053
- International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhino-conjunctivitis, and atopic eczema. *Lancet.* 1998;351:1225–1232
- International Study of Asthma and Allergies in Childhood (ISAAC). *Phase One Manual.* 2nd ed. Auckland, New Zealand; Münster, Germany: International Study of Asthma and Allergies in Childhood; 1993
- International Study of Asthma and Allergies in Childhood (ISAAC). *Phase Three Manual.* Auckland, New Zealand: ISAAC International Data Centre; 2000
- SIDRIA Collaborative Group. Asthma and respiratory symptoms in 6–7 yr old Italian children: gender, latitude, urbanization and socio-economic factors. *Eur Respir J.* 1997;10:1780–1786
- Renzoni E, Forastiere F, Biggeri A, et al. Differences in parental- and self-report of asthma, rhinitis and eczema among Italian adolescents. *Eur Respir J.* 1999;14:597–604
- Greenland S. Meta-analysis. In: Rothman KJ, Greenland S, eds. *Modern Epidemiology.* 2nd ed. Philadelphia, PA: Lippincott-Raven; 1998:643–673
- Deeks JJ, Altman DG, Bradburn MJ. Statistical methods for examining heterogeneity and combining results from several studies in meta-analysis. In: Egger M, Davey Smith G, Altman DG, eds. *Systematic Reviews in Healthcare: Meta-Analysis in Context.* 2nd ed. London, United Kingdom: BMJ Books; 2001:285–312
- Kalyoncu AF, Selcuk ZT, Enunlu T, et al. Prevalence of asthma and allergic diseases in primary school children in Ankara, Turkey: two cross-sectional studies, five years apart. *Pediatr Allergy Immunol.* 1999;10:261–265
- Downs SH, Marks GB, Sporik R, Belousova EG, Car NG, Peat JK. Continued increase of asthma and atopy. *Arch Dis Child.* 2001;84:20–23
- Anthracopoulos M, Karatza A, Liolios E, Triga M, Triantou K, Priftis K. Prevalence of asthma among schoolchildren in Patras, Greece: three surveys over 20 years. *Thorax.* 2001;56:569–571
- Ng Man Kwong GN, Proctor A, Billings C, et al. Increasing prevalence of asthma diagnosis and symptoms in children is confined to mild symptoms. *Thorax.* 2001;56:312–314
- Esamai F, Ayaya S, Nyandiko W. Prevalence of asthma, allergic rhinitis and dermatitis in primary school children in Uasin Gishu district, Kenya. *East Afr Med J.* 2002;79:514–518
- Maziak W, Behrens T, Brasky TM, et al. Are asthma and allergies in children and adolescents increasing? Results from ISAAC phase I and phase III surveys in Münster, Germany. *Allergy.* 2003;58:572–579
- Ronchetti R, Villa MP, Barreto M, et al. Is the increase in childhood asthma coming to an end? Findings from three surveys of schoolchildren in Rome, Italy. *Eur Respir J.* 2001;17:881–886
- Lee SL, Wong W, Lau YL. Increasing prevalence of allergic rhinitis but not asthma among children in Hong Kong from 1995 to 2001 (Phase 3 International Study of Asthma and Allergies in Childhood). *Pediatr Allergy Immunol.* 2004;15:72–78
- Heinrich J, Hoelscher B, Frye C, Meyer I, Wjst M, Wichmann HE. Trends in prevalence of atopic disease and allergic sensitization in children in Eastern Germany. *Eur Respir J.* 2002;19:1040–1046
- Verlato G, Corsico A, Villani S, et al. Is the prevalence of adult asthma and allergic rhinitis still increasing? Results of an Italian study. *J Allergy Clin Immunol.* 2003;111:1232–1238
- Chinn S, Jarvis D, Burney P, et al. Increase in diagnosed asthma but not in symptoms in the European Community Respiratory Health Survey. *Thorax.* 2004;59:646–651
- Linneberg A, Nielsen NH, Frolund L, Dirksen A, Jorgensen T. Secular trends of allergic asthma in Danish adults: the Copenhagen Allergy Study. *Respir Med.* 2001;95:258–264
- Douwes J, Pearce N. Asthma and the westernization “package.” *Int J Epidemiol.* 2002;31:1098–1102
- Sunyer J, Atkinson R, Ballester F, et al. Respiratory effects of sulphur dioxide: a hierarchical multi-city analysis in the APHEA 2 study. *Occup Environ Med.* 2003;60:e2
- Behrens T, Taeger D, Maziak W, et al. Self-reported traffic density and atopic disease in children: results of the ISAAC phase III survey in Münster, Germany. *Pediatr Allergy Immunol.* 2004;15:331–339
- Douwes J, Gibson P, Pekkanen J, Pearce N. Non-eosinophilic asthma: importance and possible mechanisms. *Thorax.* 2002;57:643–648

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