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Asthma and respiratory symptoms in 6–7 yr old Italian children: gender, latitude, urbanization and socioeconomic factors

SIDRIA (Italian Studies on Respiratory Disorders in Childhood and the Environment)

Asthma and respiratory symptoms in 6–7 yr old Italian children: gender, latitude, urbanization and socioeconomic factors. SIDRIA (Italian Studies on Respiratory Disorders in Childhood and the Environment). ©ERS Journals Ltd 1997.

ABSTRACT: Little information is available on the epidemiology of childhood respiratory disorders in Southern Europe. We investigated the prevalence of asthma and respiratory symptoms in a large sample of schoolchildren, according to gender, latitude, urbanization, and socioeconomic status.

Questionnaires including the International Study of Asthma and Allergies in Childhood (ISAAC) core module on wheeze, as well as questions about other respiratory symptoms (including cough and phlegm), were completed by the parents of 18,737 schoolchildren aged 6–7 yrs, from eight centres of northern and central Italy.

Wheeze in the last 12 months was reported for 9% of males and 6% of females, and severe wheezing attacks for 1.4 and 0.8%, respectively. Asthma during lifetime was reported for 11% of males and 6.4% of females. The prevalence of physician-diagnosed asthma increased with level of urbanization, but reported wheezing did not, suggesting a labelling bias. Socioeconomic status was not associated with the prevalence of most wheezing symptoms or of physician-diagnosed asthma, but was negatively correlated with the number of hospital admissions because of asthma. Unlike wheezing symptoms, the prevalence of chronic cough and phlegm was associated with increasing urbanization and decreasing socioeconomic level.

Urbanization and socioeconomic level have little effect on the prevalence of wheezing in this area, but they might influence the diagnosis and the management of asthma, as well as the prevalence of chronic cough and chronic phlegm.
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Epidemiological studies performed in different areas of the world have shown a wide variability in the prevalence of asthma both between [1, 2] and within [3] countries, as well as an increasing incidence over time [4–6]. It seems probable that this is the result of the interaction between constitutional factors, such as gender [7] and atopic background [8], and environmental factors, such as socioeconomic level [9], urbanization [10], climate [11], family size [6], diet [12], and outdoor [13, 14] and indoor pollution [15, 16]. Recently, the International Study on Asthma and Allergies in Childhood (ISAAC) group proposed a standardized methodology for an international comparative study of the prevalence of asthma in children and adolescents [17, 18], in an attempt to identify factors associated with the prevalence and the severity of asthma.

Little information is available on the basic epidemiological aspects of asthma and of respiratory symptoms among children in the Mediterranean area, except for surveys of the general population [19], and a few studies conducted in limited regions [20–22] or on children older than those considered in the present study [23, 24]. Furthermore, to our knowledge, no large-scale survey has been conducted to evaluate the prevalence of chronic cough and phlegm, or the effect of latitude, socioeconomic status, and urbanization on respiratory symptoms in children living in this area. The Italian Studies on Respiratory Disorders in Childhood and the Environment (SIDRIA) collaborative group was assembled to provide data on the prevalence of respiratory disorders in Italian schoolchildren for comparison with other countries, and to identify possible risk factors for these conditions. In addition to an extended ISAAC protocol [17], SIDRIA included the collection of data on clinical history and on a variety of environmental, social, behavioural and familial factors. The study was

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conducted on a particularly large sample of children of two age groups (6–7 and 13–14 yrs), and in centres characterized by a wide spectrum of living conditions.

In this paper, we report the prevalence estimates of asthma and respiratory symptoms according to gender, latitude, urbanization and socioeconomic level for first and second grade schoolchildren from different areas of northern and central Italy.

Methods

Design

The study was carried out between October 1994 and March 1995, outside the main pollen season, in eight centres of northern and central Italy. These areas differ in geographic characteristics, climate and urbanization (table 1). Northern centres were located in the Po river valley and northwest of the Appennine mountains, whereas central areas included centres in Tuscany and Lazio. In the north, the winter is colder, longer, more humid and foggy than in the centre. Northern areas are also generally more industrialized.

The study population consisted of children aged 6–7 yrs attending the first and second grade of elementary school [17]. Each centre was required to sample at least 1,000 subjects. A random sample was extracted from the total number of schools in each centre, weighted for the number of children attending the school. In the sampled schools, the whole first and second grade student population was studied. If the number of subjects to enrol was equal to or less than 25% of the population, or if there was marked urban or geographic heterogeneity in the area under study, a stratification was performed before sampling. On the basis of these criteria, a random sample from the whole area was studied in Cremona, Viterbo and Milan, from two strata in Empoli and Florence, and from four strata or more in Rome, Turin, and in the Emilia region.

Questionnaire and data collection

In addition to the complete set of ISAAC modules regarding wheezing, rhinitis and eczema [17], the questionnaire contained questions on several risk factors and other respiratory symptoms: wheezing apart from colds [25]; attacks of shortness of breath with wheezing [26]; chest tightness in the morning [27]; allergenic triggers (cough and/or wheezing and/or shortness of breath with pollens, animals or house dust) (modified from [28]); physician-diagnosed asthma [25]; emergency room (ER) or hospital admissions for asthma; chronic cough and chronic phlegm apart from common colds [25]. A severity score for wheezing was constructed by assigning: 1 point for the presence of wheezing in the last 12 months; 1, 2 or 3 points for increasing frequency of wheezing attacks (less than 3, 4–12, and more than 12 episodes·yr^{-1}, respectively); 1 or 2 points for the report of night awakening with wheezing (less or more than once a week, respectively); and 1 point for the occurrence of speech limiting attacks. Based on this score, wheezing severity was graded as: absent (0 points); mild (1–3 points); and more severe (4–7 points). Current asthma was defined by a positive answer to the question as to whether the child still had asthma, or by the last asthma attack having occurred within 1 yr (a subitem of the question on asthma). Unless otherwise stated, all the questions reported in this paper refer to symptoms in the last 12 months.

Each selected school was contacted and followed by one or more trained healthcare worker(s)/physician(s). After obtaining the parents' informed consent, the teacher gave the questionnaire to the children, who took it home for their parents to complete. For those parents who, although agreeing to participate, neglected to return the completed questionnaire, a new questionnaire, together with a letter of reminder, was sent back up to a maximum of three times. The protocol of the study was approved by the Ethics Committee of the Università Cattolica in Rome.

Statistical analysis

Prevalence rates were computed with the C sample application of the Epi Into 6.0 software (Centers for Disease Control, Atlanta, Georgia), following a two-stage clustered sampling design [29]. The eight centres constituted the strata, whilst individual schools were the clusters, and they were weighted inversely to the sampling fraction of each centre. To maintain comparability with the ISAAC study, all the prevalence data were computed without excluding missing answers, which were therefore counted as negative answers.

Table 1. – Characteristics of the sampled areas

Centre	Characteristics of the sampled area					Source population		Target population		
	Latitude	Urbanization	Boundary	Area	Population density	Total schools	Children (6–7 yrs)	Target schools	Target children	Response rate
				km^2	n·km^{-2}	n	n	n	n	%
Torino	North	Metropolitan	Municipality	129	7721	162	13649	14	1474	97
Milano	North	Metropolitan	Municipality	182	7611	144	14669	30	3761	96
Cremona	North	Urban/rural	LHU	824	188	59	2149	23	1392	100
Emilia Romagna	North	Entire region	Region	22169	177	1159	48061	74	4553‡	98
Firenze Prato	Centre	Urban and urban/rural	Municipalities	853	954	112	8281	15	1183#	96
Empoli	Centre	Urban/rural	LHU	888	249	73	3150	22	1575	91
Viterbo	Centre	Urban/rural	LHU	1667	75	39	5214	13	1261	98
Roma	Centre	Metropolitan	Municipality	1499	1793	607	48340	46	4260	94

‡: 1,236 in urban and 3,317 in urban/rural areas; #: 936 in urban and 246 in urban/rural areas. LHU: local health unit.

Cross-tabulations were used to assess the relationship between respiratory symptoms, gender, geographical latitude, type of urbanization of the area of residence, and familial socioeconomic status. To evaluate the effect of level of urbanization, schools were classified as belonging to: a metropolitan area (cities with a population of more than 800,000); an urban area (cities with fewer than 800,000 and more than 100,000 residents); and a mixed urban/rural area (towns and municipalities with less than 100,000 inhabitants) (table 1). Paternal education was chosen as the closest indicator of socioeconomic status [22], and graded as: less than 8 yrs of schooling, currently the limit of mandatory school in Italy; 8 yrs of schooling; high school (13 yrs of schooling); and university degree. Maternal schooling was graded according to the same criteria.

Data are presented as the unadjusted percentage prevalence, and 95% confidence intervals (95% CIs) are given in parentheses in the text. To evaluate differences in prevalence whilst controlling for mutual confounding, a multiple logistic analysis was performed [30], which simultaneously included, in the same regression model, gender, latitude, urbanization, and paternal education. In some analyses, severity of wheezing, grouped in three levels as described above, was also included in the logistic regression model. In the regression analysis, no adjustment for cluster sampling was made to standard errors, since autocorrelation within schools appeared to be negligible. A p-value less than or equal to 0.05 was considered to be significant.

Results

Questionnaires were filled in by parents of 18,737 children (9,674 males and 9,063 females, mean age 6.4 yrs), representing 96% of the target population (table 1). The forms were completed in 50% of cases by the mother, 5% by the father, and 44% by both parents.

The prevalence of wheezing symptoms and asthma by gender, latitude, urbanization, and paternal schooling is reported in tables 2 and 3. Overall, 24% (95% CI 23.6–25.3%) of the children were reported to have wheezed at least once in their lifetime, and 8% (95% CI 7.2–8.2%) were reported to have wheezed in the last 12 months. Symptoms of more severe asthma were reported for only a minority: the prevalence of children with more than 12 attacks in the last year, of waking more than one night a week because of wheezing, and of speech-limiting attacks was 0.4% (95% CI 0.3–0.5%), 0.6% (95% CI 0.5–0.7%) and 1.1% (95% CI 0.9–1.3%), respectively. Lifetime asthma was reported in 9% (95% CI 8.4–9.5%) of the children, having been confirmed by a physician in 97% of the cases.

The prevalence of wheezing symptoms, including frequent (more than 12 in the last year) and speech-limiting attacks of wheezing, was higher in males than in females, as was reported asthma and use of hospital or emergency room admissions because of asthma. Wheezing, dry cough and/or shortness of breath provoked by house dust and pollen were also more frequent in males than in females.

The difference in the prevalence of most wheezing symptoms between northern and central areas was negligible (table 2), while the reported prevalence of asthma was significantly higher in central than in northern Italy. Unadjusted rates for 12 month hospital admission were higher in the north, whereas those for lifetime admission were identical. However, after adjusting for gender, urbanization and socioeconomic status, logistic regression analysis indicated that hospital admission because of asthma was significantly more frequent in the north (table 3). This difference was more evident when the prevalence was expressed as a percentage of the children with a diagnosis of asthma: 33% (95% CI 30–36%) of those living in the north had been admitted to hospital because of asthma during their lifetime, as compared with only 24% (95% CI 21–28%) of those living in the centre ($p< 0.0001$). Among those children with asthma, prevalence of hospital admissions relative to the last 12 months was 6% (95% CI 4–7%) in the north and 3% (95% CI 1–4%) in the centre ($p<0.001$).

Table 2. – Prevalence of wheezing symptoms by gender, latitude, urbanization and paternal schooling

	Ss	Wheezing %			Shortness of breath with wheeze %		Dry cough at night	Morning chest tightness	Wheeze with exercise	Wheeze or dry cough (%) with		
	n	Lifetime	12 months	Apart from colds	Lifetime	12 months	%	%	%	Pollens	Pets	House dust
Total	18737	24	7.7	3.7	16	5.3	18	2.4	1.7	4.7	1.3	5.7
Gender												
Female	9062	22	6.1	2.8	13	4.0	17	1.9	1.2	3.6	1.3	4.9
Male	9674	27****	9.2****	4.5****	19****	6.4****	18*	2.8****	2.2****	5.7****	1.4	6.5****
Latitude												
North	10908	24	7.5	3.5	16	5.1	17	2.4	1.6	4.4	1.2	4.7
Centre	7829	25****	8.0*	3.8	17**	5.4	18	2.4	1.8	5.1*	1.5	6.9****
Urbanization												
Urban/rural	7321	25	8.2	4.1	16	5.4	16	2.6	1.6	4.3	1.2	4.7
Urban	2345	27*	7.7	3.3	17	5.0	18**	2.7	1.5	4.7	1.4	4.6
Metropolitan	9071	23**	7.4	3.5	16	5.3	19****	2.2	1.8*	5.0*	1.4	6.6****
Paternal schooling												
<8 yrs	2293	23	7.2	3.2	16	5.7	23	2.9	2.2	4.8	1.6	6.8
8 yrs	7147	25*	7.4	3.4	17	5.0	17****	2.4	1.6*	5.2	1.2	5.4*
13 yrs	6035	24	7.9	3.8	15	4.9*	17****	2.3	1.5**	4.3	1.1	5.7*
University	2378	24	8.0	4.3*	18	6.6	16****	2.3	2.1	4.0	2.0	5.7*

Comparison was performed with multiple logistic regression, including all the variables in the table. Ss: subjects. *: $p\leq0.05$; **: $p\leq0.01$; ***: $p\leq0.001$; ****: $p\leq0.0001$, *versus* first level of each factor.

Table 3. – Prevalence of wheezing symptoms of different frequency and severity of asthma and emergency room admission for asthma by gender, latitude, urbanization and paternal schooling

	Ss	Wheezing attacks in the last 12 months %						Severity score		Asthma %				
	n	1–3	4–12	>12	Speech-limiting	<1 night·week^{-1}	>1 night·week^{-1}	1–3	4–7	Ever had asthma	Asthma diagnosed by physician	Current asthma	Hospital admission Lifetime	Hospital admission 12 months
Total	18737	4.6	1.1	0.4	1.1	1.5	0.6	6.2	1.5	9.0	8.7	4.1	2.6	0.36
Gender														
Female	9062	3.8	0.8	0.2	0.8	1.1	0.5	5.0	1.1	6.4	6.2	2.8	1.7	0.20
Male	9674	5.4****	1.3****	0.5*	1.4****	1.9****	0.7	7.3****	1.9****	11.4****	10.9****	5.3****	3.4****	0.51**
Latitude														
North	10908	4.7	1.0	0.4	1.1	1.5	0.6	6.0	1.5	7.8	7.4	3.7	2.5	0.43
Centre	7829	4.6	1.1	0.4	1.1	1.6	0.6	6.4*	1.6	10.5****	10.2****	4.6**	2.5*	0.27*
Urbanization														
Urban/rural	7321	5.1	1.0	0.4	1.1	1.4	0.7	6.8	1.4	7.6	7.3	3.7	2.1	0.29
Urban	2345	4.9	1.2	0.4	1.0	1.3	0.6	6.1	1.5	7.8	7.4	3.9	2.1	0.59*
Metropolitan	9071	4.2**	1.0	0.4	1.1	1.6	0.5	5.8**	1.5	10.2****	9.9****	4.4*	3.0****	0.35*
Paternal schooling														
<8 yrs	2293	3.6	1.0	0.2	1.4	1.4	1.0	5.6	1.6	9.4	8.9	3.8	3.3	0.47
8 yrs	7147	4.7	0.8	0.3	0.9	1.3	0.6	6.1	1.3	9.5	9.1	3.9	3.0	0.38
13 yrs	6035	4.9	1.1	0.4	1.1	1.5	0.4*	6.5	1.4	8.5	8.3	4.1	2.1*	0.29
University	2378	4.7*	1.7	0.6	1.2	2.0	0.6*	5.9	2.1	8.8	8.5	5.0*	1.6****	0.30

Comparison was performed with multiple regression, including all variables in the table. Ss: subjects. *: p≤0.05; **: p≤0.01; ***: p≤0.001; ****: p≤0.0001, *versus* first level of each factor.

Increasing levels of urbanization were not associated with an increase in the prevalence of asthma-like symptoms, with the exception of nocturnal cough and exercise-, pollen- and house dust-induced symptoms (table 2). Lifetime wheezing was even slightly less frequent in metropolitan areas. In contrast with this finding, physician-diagnosed asthma was reported more frequently in large cities (table 3). The prevalence of emergency room and hospital admissions because of asthma was also slightly increased in urbanized areas. This appears to be mostly associated with the increased diagnosis of asthma in the same areas, since the differences in the rate of hospital admissions among areas of different levels of urbanization decreased remarkably when it was expressed as a percentage of children with a diagnosis of asthma: in the latter group, the lifetime prevalence of hospital admissions was 29% (95% CI 26–33%) in metropolitan areas, 26% (95% CI 20–33%) in urban areas, and 28% (95% CI 24–33%) in mixed urban/rural areas. Despite the uniformity of these figures, however, multiple logistic regression adjusting for gender, latitude and paternal schooling still detected a significant increase in hospital admission for asthma in metropolitan areas (p<0.01), an effect which is probably underestimated by unadjusted prevalence rates because of the contrasting effect of a higher level of education in metropolitan areas, associated with reduced hospitalization (see below).

The prevalence of cumulative and 12 month wheeze was not consistently associated with socioeconomic status. However, a significant trend was observed for children of less educated fathers to have more nocturnal cough, wheeze or cough with dust (table 2), and more frequent awakenings because of wheezing, while other indicators of asthma severity, such as the occurrence of speech-limiting attacks or of frequent wheezing attacks, failed to show a similar trend (table 3). Interestingly, the percentage of children admitted to hospital because of asthma increased with a decrease in socioeconomic status, while no differences were observed in the prevalence of physician-diagnosed asthma (table 3). Among children with a diagnosis of asthma, the lifetime prevalence of hospital admission for asthma, from lowest to highest group of socioeconomic level was, respectively, 36% (95% CI 28–44%), 32% (95% CI 28–35%), 25% (95% CI 21–30%) and 18% (95% CI 12–26%). Similar results were obtained when maternal schooling was used as a measure of socioeconomic status (data not shown).

To examine the relationship between diagnosed asthma and wheezing symptoms more thoroughly, we calculated the proportion of subjects with physician-diagnosed asthma among children for whom wheezing symptoms at least once in their lifetime were or were not reported. Among children who were reported to have had wheeze, males were more likely to be reported as asthmatic (33 *versus* 23% in females; p<0.05), as were children living in central Italy (34 *versus* 25% in northern Italy; p<0.05), and in large cities (34% *versus* 24% in urban/rural areas; p<0.05). No difference was found for socioeconomic status (32% for paternal schooling <8 yrs *versus* 29% for university degree). On the other hand, physician-diagnosed asthma was reported only in 1.0% of children for whom wheezing was not reported (95% CI 0.9–1.2%). No significant differences were

observed among different strata in this latter group, except that the prevalence of physician-diagnosed asthma was slightly higher in metropolitan (1.3%) than in urban (0.6%) or urban/rural areas (0.8%).

No variations in the wheezing severity score were seen at different latitudes, or levels of urbanization, or in different socioeconomical groups, that could explain the observed variability in the rates of diagnosis and of hospitalization for asthma (table 3). To further investigate whether these differences could be related to changes in the severity of the disease, we repeated the statistical analyses relating to physician-diagnosed asthma and hospital or emergency room admission for asthma, adding the wheezing severity score in the logistic regression model. As expected, both mild and more severe wheezing were strongly and increasingly associated with the prevalence of asthma and with lifetime or 12 month hospital admissions. However, all the differences previously observed among gender, latitude, urbanization and socioeconomic level, persisted at a significant level when severity of wheezing was taken into account (data not shown).

Cough and phlegm on most days, apart from common colds, were reported in 10 and 6% of children, respectively. Chronic cough and chronic phlegm (more than 3 months in the last year), were detected in 4.6 and 4.0% of children, respectively (table 4). Cough and phlegm were reported slightly more frequently in males, although the difference was less marked than that observed for asthma or wheezing symptoms. The prevalence of these symptoms was consistently found to increase with urbanization and to decrease with socioeconomic status, and multiple logistic regression confirmed the crude comparison. Chronic cough and phlegm were markedly more frequent among children with a history of wheezing in the last 12 months (usual cough 36%, usual phlegm 20%) with respect to those who had never wheezed (6 and 4%, respectively). No significant differences in the trend of variation of these symptoms according to level of urbanization or to socioeconomic status were observed between wheezing and nonwheezing children (data not shown).

Table 4. – Prevalence of cough-related symptoms by gender, urbanization, latitude and paternal schooling

	Ss	Cough %		Phlegm %	
	n	Usually	>3 months·yr^{-1}	Usually	>3 months·yr^{-1}
Total	18737	10.0	4.6	6.2	4.0
Gender					
Female	9062	9.1	4.0	5.8	3.7
Male	9674	10.8****	5.1**	6.7**	4.3*
Latitude					
North	10908	9.3	4.2	6.2	3.9
Centre	7829	10.9	5.1	6.3*	4.2
Urbanization					
Urban/rural	7321	8.8	3.9	5.3	3.5
Urban	2345	8.5	4.5	6.1*	3.9
Metropolitan	9071	11.1****	5.0****	6.9***	4.4****
Paternal schooling					
<8 yrs	2293	13.7	5.7	7.2	4.2
8 yrs	7147	9.8****	4.3***	6.2	3.8
13 yrs	6035	9.5****	4.4***	5.8**	4.0
University	2378	8.3****	4.2**	6.1*	4.5

Comparison was performed with multiple logistic regression, including all the variables in the table. Ss: subjects. *: p≤0.05; **: p≤0.01; ***: p≤0.001; ****: p<0.0001, *versus* first level of each factor.

Discussion

This is one of the most wide-ranging surveys on respiratory disorders in children to have been completed with standardized procedures in Europe. The eight areas investigated covered a large part of the country, encompassing a variety of geographic, economic and urbanization characteristics, permitting an evaluation of the importance of these factors in the epidemiology of respiratory disorders in Italian children.

The prevalence of current asthma was 4%, whereas wheezing in the past year was more than twice as high, and the lifetime prevalence of physician-diagnosed asthma was 9%. At least 4% of the children of this age group suffered from chronic cough and phlegm. As expected from most studies in this age range [31], male children outnumbered females in the prevalence of asthma, wheezing symptoms, and all the indicators of asthma severity. Although not directly comparable because of differences in sampling, age groups or questionnaires, these prevalences are not dissimilar to those obtained in smaller studies previously performed in Italy [20–22]. When comparing rates obtained in recent international studies in children of the same age group, the prevalence of wheezing in the last 12 months is similar to that reported for Switzerland [1] and for Hong Kong [32], and lower than that reported for the UK [33–35], Australia, Chile [1], and Singapore [36].

The number of epidemiological studies on the association between level of urbanization and respiratory symptoms in children is limited. In the present study, an increased level of urbanization did not appear to be associated with an increased prevalence of wheezing symptoms, whereas it was associated with a clear increase in the prevalence of chronic cough, and phlegm, and of nocturnal cough. This observation suggests that environmental factors associated with the degree of urbanization are more likely to produce chronic airway irritation [37] than asthmatic disorders. Other studies conducted in developed countries also failed to observe differences in wheezing symptoms between urban and rural areas [35, 38].

Despite a similar prevalence of wheezing, we found an increased report of asthma in metropolitan areas. The observation that, among children with wheeze, a diagnosis of asthma was made more frequently in metropolitan than in less urbanized areas, suggests that urbanization affects diagnostic labelling more than symptoms of asthma. Hospital and emergency admissions for asthma were significantly more frequent in urbanized areas. The increase in hospital use was, at least in part, related to the increased diagnosis of asthma, but remained significantly higher in metropolitan areas even after adjustment for this factor, suggesting that other causes may also be involved. In the absence of objective clinical data, we cannot establish whether these findings reflect a different diagnostic attitude, a true difference in the prevalence of the disease, or an increased severity of symptoms in the urban environment. This last

hypothesis appears unlikely, however, since no differences were observed in the frequency or in the severity of wheezing symptoms among different levels of urbanization, and, accordingly, hospital use remained significantly increased in more urbanized areas even after the inclusion of parameters of wheezing severity in the logistic regression model. Interestingly, the diagnosis of asthma was reported more frequently in central Italy, whereas hospital admissions because of asthma were more frequent in the north, confirming that regional and cultural differences in the perception of the disease by the patients or in the diagnostic attitude of the physician [39, 40] can influence the prevalence estimates and the standards of care.

Conflicting results on the difference in asthmatic symptoms by socioeconomic status are reported in the literature. Several recent studies have found an excess of asthma or allergic diseases in higher socioeconomic classes, but others have reported no association or an association in the opposite direction (reviewed in [9]). In the present study, the prevalence of wheezing symptoms was substantially unaffected by socioeconomic status, whereas the frequency of emergency room or hospital admissions for asthma definitely increased with decreasing paternal education. A higher rate of emergency admissions in poorer communities has been described in the USA [41] and in the UK [42]. In the present population, it seems unlikely that the increased rate of hospital admissions is due to an increased severity of asthma in children of less privileged families, since, unlike others [9, 35], we did not observe an increase in the prevalence of indicators of severity, such as frequent and speech-limiting attacks, in these groups and only a small, although significant, increase was observed in frequent awakenings for wheezing. The disparity in the use of healthcare resources may be due to differences in the attention received from the physician, in the ability to comply with treatment and to cope with acute attacks, or to a combination of the above.

Unlike wheezing, nocturnal cough, chronic cough, and chronic phlegm showed a clear trend to decrease with paternal schooling and to increase with the level of urbanization. Although the association between asthma and cough is well known, a significant proportion of chronic cough is not related to asthma [43]. Limited data are available on the epidemiology of chronic cough and phlegm in children. An inverse correlation between these symptoms and socioeconomic status has been reported in the Six Cities Study in the USA [44], and in a survey of urban areas in the UK [45]. However, the results of the latter studies are not completely consistent with our findings, since a similar trend was also observed for wheezing symptoms. Interestingly, in the British study, differences in peak flow rate and in the geographical distribution between children with cough and phlegm with or without wheezing suggested that, in nonwheezing children, chronic cough represents a different syndrome from asthma [45].

Although few data are available on the effect of urbanization, it is interesting to note that the American Six Cities Study reported a positive correlation of the prevalence of bronchitis and chronic cough with exposure to particulate matter and, to a lesser extent, to environmental nitrogen dioxide (NO_2) or sulphur dioxide (SO_2) whereas no correlation was found between asthma or persistent wheezing and exposure to these pollutants [46]. Our observation of a positive correlation of urbanization with cough but not with wheezing is consistent with these findings, since we can expect city size to be correlated with environmental air pollution. Taken together, all these results suggest that chronic cough and chronic phlegm in children may have a different epidemiology from wheezing, and may be associated with different risk factors. Further analysis of the data obtained in the Italian Studies on Respiratory Disorders in Childhood and the Environment, which include monitoring of environmental air quality in a subset of the centres, should supply additional information on the importance of environmental and other risk factors for asthma and other respiratory disorders in childhood.

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