

available at www.sciencedirect.comjournal homepage: www.elsevier.com/locate/rmed

Incidence of respiratory and allergic symptoms in Italian and immigrant children

Alessandro Marcon^{a,*}, Lucia Cazzoletti^a, Marta Rava^a, Paolo Gisondi^b,
Vanda Pironi^c, Paolo Ricci^c, Roberto de Marco^a

^a Unit of Epidemiology and Medical Statistics, Department of Public Health and Community Medicine, University of Verona, Italy

^b Section of Dermatology and Venereology, Department of Biomedical and Surgical Science, University of Verona, Verona, Italy

^c Unit of Epidemiology, NHS Mantua, Mantua, Italy

Received 9 June 2010; accepted 5 September 2010

KEYWORDS

Cough;
Eczema;
Epidemiology;
Phlegm;
Rhinitis;
Wheezing

Summary

Background: Immigration usually implies a complete change of the environment where one lives. Hence, studies on immigrants may help to disentangle genetic and environmental determinants of disease. We investigated whether the incidence of allergic and respiratory symptoms differed for Italian and immigrant children living in one area of Northern Italy.

Methods: In December 2006, all the children (3–14 years) living in the Viadana district were surveyed through a parental questionnaire (response rate = 99%, $n = 3854$). Retrospective incidences of several symptoms were compared across different ethnic groups.

Results: Parental asthma, allergic rhinitis and eczema were less frequent in immigrant children than in Italian children. Wheezing and eczema incidences were lower in children born to foreign parents (especially if born abroad, incidence rate ratio (IRR) = 0.47, 95% CI: 0.26–0.82 and IRR = 0.43, 95% CI: 0.23–0.83, respectively), with respect to Italian children, while the occurrence of nasal allergies was similar among the ethnic groups. The greatest incidence of persistent cough/phlegm was observed in children born in Italy to foreign parents (IRR = 1.98, 95% CI: 1.06–3.71) and in children whose parents had chronic bronchitis (IRR = 2.57, 95% CI: 1.52–4.33).

Conclusions: Considering the distribution of parental atopic diseases and the low disease prevalence in the immigrants' countries of origin, we suggest that nasal allergies may be more sensitive than wheezing or eczema to the change in the environment related to migration. Genetic or environmental factors clustered into families seem to have a role on chronic bronchitis.

© 2010 Elsevier Ltd. All rights reserved.

Abbreviations: IRR, Incidence rate ratio.

* Corresponding author. Unit of Epidemiology and Medical Statistics, Department of Public Health and Community Medicine, University of Verona, c/o Istituti Biologici II, Strada Le Grazie 8, 37134 Verona, Italy. Tel.: +39 045 8027668; fax: +39 045 8027154.

E-mail address: alessandro.marcon@univr.it (A. Marcon).

0954-6111/\$ - see front matter © 2010 Elsevier Ltd. All rights reserved.

doi:10.1016/j.rmed.2010.09.009

Please cite this article in press as: Marcon A, et al., Incidence of respiratory and allergic symptoms in Italian and immigrant children, Respiratory Medicine (2010), doi:10.1016/j.rmed.2010.09.009

Introduction

Asthma, allergic rhinitis and eczema are the most common chronic diseases in childhood. The relative importance of hereditary and environmental factors in the inception of these diseases is not fully understood.¹ Chronic cough and phlegm are also very common in children, and they may have different possible etiologies including recurrent viral infections, asthma, and exposure to passive smoking.^{2,3} Immigration usually implies a complete change of the environment where one lives and of a person's lifestyle. Hence, studies on immigrants may help to disentangle genetic and environmental determinants of disease. Overall, immigrants are a disadvantaged group, living in an unfavorable socio-economic situation, who are often confronted with a discriminatory social atmosphere, which affects their health.⁴ In the last decade, foreign immigration to Italy has considerably increased,⁵ and it is still increasing.⁶ Nonetheless, there are few health studies on immigrants to Italy.^{7–10} The aim of this study was to investigate whether the incidence of allergic and respiratory symptoms differed for Italian and immigrant children living in one area of Northern Italy. Secondly, we described several outcomes related to the health status at birth and the early-life diseases of these children.

Methods

Study design and participants

The Viadana study (<http://biometria.univr.it/viadanastudy>) is a cross-sectional survey investigating the pediatric population of the health district of Viadana (Mantua, Northern Italy).¹¹ All the children (3–14 years) who were living in the district and who were enrolled in the district's school registers (year 2006–2007) were eligible for the study ($n = 4130$). In December 2006, the parents of the children of all the schools in the district received a questionnaire, to be filled in and given back within 20 days. Overall, 3907 questionnaires were distributed, and 3854 questionnaires were filled in and collected (response rate = 98.6%). The ethics committee of the Azienda Sanitaria Locale (National Institutes of Health) of Mantua province approved the study protocol.

The questionnaire

The questionnaire included questions on the occurrence of respiratory and allergic symptoms during lifetime that were taken from the International Study of Asthma and Allergies in Childhood (ISAAC),¹² the European Community Respiratory Health Survey (ECRHS),¹³ and the Studi Italiani sui Disturbi Respiratori nell'Infanzia e l'Ambiente (SIDRIA)¹⁴ (the Italian branch of the ISAAC study) standardized questionnaires (validated in previous international surveys), with an available Italian translation. Information on the children's and their parents' countries of birth, on potential confounders, and residential addresses were collected through the questionnaire. The questionnaire (openly available on the website) was distributed in Italian, English and French, because 15% of the children came from foreign countries. However, most

of the parents (99%) filled in the Italian questionnaire. Foreign parents could ask a cultural mediator for help if they needed it (see Table 1, last row). Back translations of the questionnaires were performed.

Children's ethnic origin

Information on the children's countries of birth (Italy vs. abroad) was crossed with the number of parents born in Italy to create a 6-level variable. The children born abroad to Italian parents, or to 1 Italian and 1 foreign parent were very few ($n = 26$ and 23 , respectively) and they were excluded from the analyses. Therefore, 4 ethnic groups were included (see Table 1). In the group of children born abroad to foreign parents, the time the child had lived in Italy was reported for 178 children (80%).

Outcomes

Lifetime retrospective incidence rates of the following symptoms were computed as described in de Marco et al.¹⁵: 1) *wheezing*: "Has your child ever had wheezing or whistling in his/her chest at any time in the past?"; 2) *nasal allergies*: "Has your child ever had any nasal allergies (including hay fever)?"; 3) *eczema*: "Has your child had an itchy rash on one or more parts of the skin, which was coming and going for at least six months, at any time in the past?"; 4) *persistent cough or phlegm*: "Does your child cough/bring up any phlegm on most days (4 or more days a week) without common colds or flu?", with the answer: "Yes, 3 or more months a year". Person-years at risk were calculated as the time from birth to the age at onset if the subject developed outcomes 1–3 (or the number of years the child had outcome 4), or the time from birth to the time of the survey if the subject did not have the condition.

Potential confounders

The potential confounders considered in the multivariable analyses (see Table 1 for coding details) were sex; age; parental educational level (maximum among parents); distance from the closest factory, i.e. chipboard industries and lower emission wood factories (based on the findings from a previous paper¹¹; traffic level (high if cars or trucks passed constantly or frequently near home); exposure to passive smoking (present if 1 person currently smoked in the house, or if 1 parent currently smoked); person who filled in the questionnaire and a score on his/her environmental concern (obtained through a factor analysis on 7 environment-related items in the questionnaire, data not shown; range 0–1, with greater values corresponding to higher concern); parental asthma, allergic rhinitis, eczema, or chronic bronchitis/emphysema (for the analysis of outcomes 1–4, respectively).

Statistical analyses

Categorical and quantitative covariates were described as percentages or medians with interquartile range, respectively. The distribution of the children's characteristics, health status at birth and early-life diseases was compared

Table 1 Distribution of socio-demographic characteristics, potential confounders, and parental diseases by ethnic group.

	Born in Italy			Born abroad	p-value
	Italian parents (n = 2980)	One foreign parent (n = 152)	Both foreign parents (n = 267)	Both foreign parents (n = 222)	
Sex (% female)	46.5	42.8	44.9	51.4	0.36
Age (year) ^a	8.6 (5.9–11.3)	7.8 (5.3–10.5)	6.2 (4.5–8.5)	10.6 (8.0–12.7)	<0.001
Parental educational level (%)					<0.001
Primary school or less	2.2	2.0	16.0	20.2	
Secondary or professional school	32.3	24.2	20.8	20.2	
High school	52.0	57.0	43.6	42.3	
University	13.5	16.8	19.6	17.3	
Maternal occupation (% house work or unemployed)	34.2	42.8	73.3	64.7	<0.001
Distance from wood factories ^b (%)					<0.001
≥2 km*	36.3	30.4	40.9	28.8	
<2 km low emission factory**	25.2	14.6	31.8	30.2	
<2 km chipboard industry***	38.5	55.0	27.3	41.0	
High traffic level (%)	58.4	63.6	52.6	62.4	0.08
Exposure to passive smoking (%)	45.6	64.6	28.7	39.1	<0.001
Person who filled in the questionnaire (%)					<0.001
Mother	53.9	45.1	41.5	37.0	
Both parents	43.0	51.4	41.8	43.1	
Father or other person	3.1	3.5	16.7	19.9	
Score on environmental concern ^a	0.89 (0.81–0.94)	0.85 (0.77–0.93)	0.74 (0.49–0.86)	0.65 (0.17–0.83)	<0.001
Parental asthma (%)	10.8	6.1	8.6	6.2	0.06
Parental allergic rhinitis (%)	21.5	18.7	7.4	5.1	<0.001
Parental eczema (%)	23.2	14.5	6.6	2.1	<0.001
Parental chronic bronchitis/emphysema (%)	6.6	9.2	5.3	6.9	0.57
Questionnaire answered with the help of a cultural mediator (%)	0.0	0.0	4.9	4.5	<0.001

* no wood factories <2 km from home and school ("unexposed" group); ** at least 1 low emission factory (but no chipboard industries) <2 km from home or school (group "at low exposure"); *** at least 1 chipboard industry <2 km from home or school (group "at high exposure").

^a median (1st quartile–3rd quartile).

^b calculated after geocoding the children's, their schools' and the factories' addresses.

across the ethnic groups with an overall test (Chi squared test, Fisher exact test, or Kruskal–Wallis test, where appropriate). For all the outcomes described above, i) crude (Table 3) and sex/age-adjusted (Fig. 1) incidence rates were computed for the children in the different ethnic groups, and ii) incidence rate ratios (Table 4), adjusted for the potential confounders were computed using Poisson regression models.

Analyses ii) were repeated: 1) stratifying the children born abroad according to the median time spent in Italy: "≤3 years" and ">3 years"; regression coefficients for these 2 subgroups (calculated vs. children born in Italy to Italian parents) were compared using Wald tests; 2) introducing an interaction term between family case history (e.g. parental asthma in the analysis of wheezing) and the children's ethnic origin, which was tested using likelihood ratio tests.

The children with the same last name, who lived at the same address, were considered to be siblings. To account for the non-independence of the observations due to siblings, the analyses were repeated allowing for intragroup

correlation in the estimate of the standard errors (Poisson regression models with cluster-robust standard error).

Results

Differences between included and excluded children

Two hundred and thirty-three (6%) children were excluded from the analyses because information on their ethnic origin was missing. The excluded children were slightly older (median age, 1st quartile–3rd quartile: 9, 6–12 vs. 8, 6–11, years, $p = 0.03$), they were more exposed to passive smoking (56 vs. 45%, $p = 0.004$), they had a lower prevalence of parental rhinitis (12 vs. 19%, $p = 0.03$), their parents had lower education (11, 39, 41, 9% vs. 4, 30, 51, 14% for primary school, secondary school, high school, and university, respectively, $p < 0.001$), and their questionnaires were more frequently filled in by their fathers or other people (11 vs. 5%, $p = 0.001$), than children who were included.

Table 2 Distribution of the health status at birth and early-life diseases by ethnic group.

	Born in Italy			Born abroad	p-value
	Italian parents (n = 2980)	One foreign parent (n = 152)	Both foreign parents (n = 267)	Both foreign parents (n = 222)	
Birth weight (%)					0.001
<2.5 kg	6.9	2.7	7.3	14.6	
2.5–4.2 kg	89.8	95.3	88.7	80.7	
>4.2 kg	3.3	2.0	4.0	4.7	
Gestational age at birth					0.02
>3 weeks before due date	9.5	7.6	5.4	9.2	
Regular	84.5	85.5	83.3	82.2	
>2 weeks after due date	6.0	6.9	11.3	8.6	
Caesarean birth (%)	31.5	21.7	28.6	20.7	0.001
Health problems at birth* (%)	15.6	14.0	11.1	14.4	0.25
Breastfeeding (exclusive or mixed) (%)					<0.001
No	21.2	17.9	11.9	14.8	
<3 months	32.7	33.8	14.7	18.2	
≥3 months	46.1	48.3	73.4	67.0	
Antibiotics, 1st year (%)	49.2	48.0	46.3	34.0	<0.001
Bronchitis ^a , first two years (%)	46.4	37.1	27.5	16.9	<0.001
Asthma-like bronchitis ^a , first two years (%)	7.2	5.8	2.8	1.8	0.004
Pneumonia or broncho-pneumonia ^a , first two years (%)	2.5	3.3	4.4	3.5	0.31
Bronchiolitis ^a , first two years (%)	5.6	5.1	1.0	0.6	0.001

* Prevalence of the children kept in hospital because of health problems after birth.

^a Disease label reported by the subject who answered the questionnaire (in answer to the question "Has a doctor ever said that your child had one or more of the following conditions during his/her first two years of life?").

Characteristics of the children included

The children born abroad came from Europe, 43% (mainly Romania, 37% of them, and Albania, 35%), Asia, 37% (India, 70%, and China, 15%), Africa, 17% (Morocco, 72%), South-America (2%), North America (0.5%) and Oceania (0.5%). The children born to foreign parents had a greater percentage of parents with the lowest, as well as with the highest education, than the children with one or both Italian parents (Table 1). The familiarity of allergic conditions was more frequent for the latter than for the children with foreign parents.

Health status at birth and early-life respiratory diseases

The children born abroad had a higher prevalence of low (<2.5 kg) birth weight (15 vs. 7% on average), and a lower prevalence of Caesarean birth than the children born in

Italy (Table 2). The children born to foreign parents were slightly less likely to be born on the due date, but they were breastfed more frequently and for a longer time than the children with one or both Italian parents. The use of antibiotics, as well as the prevalence of bronchitis, asthma-like bronchitis and bronchiolitis in very early life, tended to be lower as the number of foreign parents increased, and it was particularly low for the children born abroad.

Lifetime incidence of allergic and respiratory conditions

Table 3 reports the crude incidence rates of the outcomes considered. The sex/age-adjusted incidence rates of wheezing and eczema (Fig. 1) were maximum for the children born in Italy to Italian parents (40, 95% CI: 37–43, /1000/year, and 31, 95% CI: 29–34, /1000/year, respectively) and tended to decrease as the number of foreign parents

Table 3 Crude incidence rates (/1000/year) of wheezing, nasal allergies, eczema symptoms, and persistent cough or phlegm, with number of cases/person-years at risk in brackets.

		Wheezing	Nasal allergies	Eczema	Persistent cough/phlegm
Born in Italy	Italian parents	36.6 (746/20367)	9.8 (235/23942)	28.4 (607/21363)	5.0 (123/24476)
	One foreign parent	28.9 (29/1003)	9.9 (11/1114)	24.0 (25/1044)	9.4 (11/1170)
	Foreign parents	24.6 (38/1542)	14.2 (24/1696)	16.3 (27/1657)	16.4 (26/1587)
Born abroad	Foreign parents	7.9 (17/2161)	5.9 (13/2209)	5.5 (12/2180)	1.4 (3/2115)

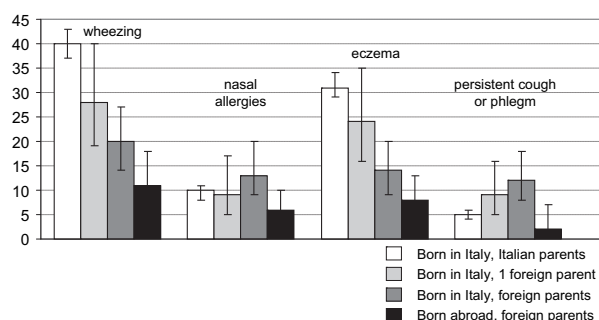


Figure 1 Sex- and age-adjusted incidence rates (/1000/year) with 95% CIs of allergic and respiratory conditions, according to the children's ethnic group.

increased, reaching the minimum for the children born abroad (11, 95% CI: 7–18, /1000/year, and 8, 95% CI: 4–13, /1000/year, respectively). The incidence of nasal allergies was 10, 95% CI: 8–11, /1000/year for the children born in Italy to Italian parents, and it was not significantly different from that of the other ethnic groups. The incidence of persistent cough or phlegm was 5, 95% CI: 4–6, /1000/year for the children born in Italy to Italian parents, and the maximum rate was observed for the children born in Italy to foreign parents (12, 95% CI: 8–18, /1000/year) (Fig. 1). The above associations were confirmed when adjusting for the potential confounders (Table 4).

The incidence rates for the children born abroad were not associated with the time spent in Italy (see Table E1 in the Supplementary material). Family case history was strongly associated with the risk of developing the studied conditions (Table 4), but there was no effect modification by the children's ethnic group.

When controlling for the presence of siblings in the analyses, the results were confirmed (data not shown).

Discussion

In this cross-sectional investigation of children aged 3–14 years living in the Viadana district in 2006, we found that

children born to foreign parents had a lower lifetime incidence of wheezing and eczema symptoms than children born to Italian parents, a lower prevalence of family history of atopic diseases, and a lower prevalence of bronchitis, asthma-like bronchitis and bronchiolitis in the first two years of life. Children born in Italy to foreign parents were at increased risk of developing persistent cough or phlegm than children in the other ethnic groups.

Family history, health status at birth and early-life respiratory diseases

Children born to foreign parents were less likely to have a family history of allergic rhinitis and eczema than children with one or both Italian parents, especially if they had been born abroad. This is inline with the fact that migrants to Italy mainly came from countries where the prevalence of atopic diseases was low.¹²

Children born abroad were more likely to have been underweight (<2.5 kg) or overweight (>4.2 kg) at birth, and were less likely to have been born at regular gestational age or delivered by Caesarean section, than children born in Italy. The reasons for this may be poor access to health care services and inadequate antenatal care in their countries of origin, as well as cultural motivations.^{4,16} Breastfeeding was much more common and prolonged for children born to foreign parents than for children with one or both Italian parents, probably due to the longer time immigrant women spent at home and to economic and cultural considerations. In fact, immigrant women were more likely to be unemployed or housewives than Italian women (Table 1). Moreover, mothers who deliver by Caesarean section are less likely to breastfeed their children.¹⁷

Inline with a previous study on migrants to Italy,¹⁰ bronchitis and asthma-like bronchitis in the first two years of life were much less frequent in children who had foreign parents than in Italian children. Bronchitis and asthma-like bronchitis are terms generally adopted by physicians for wheezing infants, as wheezing is rather frequent in very young children and it does not always turn into asthma.¹⁰ Bronchiolitis in early life was also less common for

Table 4 Mutually adjusted IRRs^a (95% CI) for the association of wheezing, nasal allergies, eczema symptoms, and persistent cough or phlegm with the children's ethnic groups (the children born in Italy to Italian parents are the reference category), and with parental-related disease^b.

		Adjusted IRRs ^a (95% CIs)			
		Wheezing (n = 2825) ^c	Nasal allergies (n = 2837) ^c	Eczema (n = 2742) ^c	Persistent cough/phlegm (n = 2763) ^c
Born in Italy	Italian parents	1	1	1	1
	One foreign parent	0.69 (0.45–1.08)	0.95 (0.47–1.94)	0.80 (0.50–1.28)	1.18 (0.51–2.72)
	Foreign parents	0.74 (0.49–1.13)	1.78 (0.97–3.24)	0.58 (0.35–0.97)*	1.98 (1.06–3.71)*
Born abroad	Foreign parents	0.47 (0.26–0.82)**	1.17 (0.61–2.24)	0.43 (0.23–0.83)*	0.50 (0.15–1.65)
Parental related disease ^b		2.14 (1.75–2.63)***	3.31 (2.51–4.35)***	1.72 (1.43–2.07)***	2.57 (1.52–4.33)***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

^a Also adjusted for sex, age, parents' educational level, distance from the closest wood factory, traffic level, exposure to passive smoking, person who filled in the questionnaire and his/her environmental concern.

^b At least one parent with asthma, allergic rhinitis, eczema, or chronic bronchitis/emphysema, respectively.

^c Number of children included in the complete case analysis.

immigrants than for Italian children. This condition is mainly caused by respiratory viruses, and it is known that severe bronchiolitis is associated with an increased risk for both recurrent wheezing and childhood asthma. It is not known if bronchiolitis contributes to asthma inception or simply identifies infants who are at increased risk for subsequent wheezing.¹⁸

Lifetime incidence of allergic and respiratory conditions

After adjusting for several potential confounders, wheezing and eczema symptoms had incidence rates that were halved in children born abroad to foreign parents, with respect to children born in Italy to Italian parents (Table 4). Children born in Italy to foreign parents seemed to be at low risk of wheezing and eczema too, but they showed the maximum occurrence of persistent cough or phlegm. Nasal allergies had similar occurrence in the studied ethnic groups.

The interpretation of these results is complicated by the ethnic admixture of immigrant children. Most of the legal immigrants who live in Italy come from low-income countries like Romania, Albania, Morocco and China.⁶ The lower incidence rates of wheezing and eczema in migrant children with respect to non-migrant children are in line with other studies^{10,19} and reflect both the prevalence of parental asthma and eczema (Table 1) and the prevalence rates in their countries of origin. In fact, the prevalence of wheezing is lower in Albania, Romania, India, Morocco and China than in Italy.¹² Similarly, Albania, China and India have low prevalences of atopic eczema.¹² On the contrary, the risk pattern for nasal allergies was completely different from that of parental allergic rhinitis (Table 1), as well as from the pattern of rhinoconjunctivitis prevalence in the countries of origin (which is lower than in Italy).¹² The different health conditions considered may in part explain this discrepancy. Indeed, rhinoconjunctivitis is likely to reflect allergic rhinitis, whereas "nasal allergies" are expected to include both allergic and non-allergic rhinitis.²⁰ Interestingly, in a study on Albanian adult immigrants to Italy, asthma was rare (1.3%), reflecting the very low prevalence observed in Albania, even if nasal allergies and sensitization to common inhalant allergens (15.8% and 19.4%, respectively) were more frequent than in Albania.⁸ Therefore, we can speculate that nasal problems are more sensitive than asthma or eczema to the radical change in the environment related to migration, and especially to the newly encountered allergens.⁸ In other words, the role of environmental factors may be greater in the inception of allergic rhinitis than in the inception of asthma or eczema, where genetic factors may be more prominent.

Inline with another study on immigrants to Italy,¹⁰ we found an excess of persistent cough or phlegm in children born in Italy to immigrant parents. This difference persisted when the analyses were adjusted for parental education (a socio-economic indicator), as well as for passive smoking,^{3,21} reported traffic level²² and proximity to chip-board industries (a proxy of industrial air pollution in the district).¹¹ A residual confounding by pollution does not seem reasonable in our view, as children born in Italy to

foreign parents were those with the lowest level of exposure to outdoor and indoor pollutants in our sample.

Several studies have shown that migrants who moved from areas of relatively low to relatively high prevalence of asthma or atopy tend to be at increased risk of developing atopic conditions, and that this increase is associated with the time spent in the country they migrated to.^{8,23,24} We could not show a similar association, may be because incidence rates were based upon small numbers.

A family history of asthma, allergic rhinitis and eczema is one of the main risk factors for the development of these diseases.^{25,26} This was confirmed in our study (Table 4). We also found that parental chronic bronchitis/emphysema was associated with a greater risk of persistent cough or phlegm in children (IRR 2.57, 95% CI: 1.52–4.33). To our knowledge, this is the first time that such an association has been reported in literature. Leeder et al. reported that the incidence of bronchitis and pneumonia in early life was associated with parental persistent cough and phlegm.²⁷

Our finding would suggest that there is some genetic basis for cough or phlegm in children. However, alternative explanations are possible. In fact, we cannot exclude that uncontrolled (e.g. environmental) factors clustered in families may be responsible for the observed association, nor that affected parents may be more prone to report similar symptoms in their children than healthy parents.

Limitations and points of strength

A parental questionnaire is the only reasonable way to collect information on symptoms in children. The use of standardized and internationally validated questions in the current study should have limited the risk of reporting bias. Other intrinsic limitations of our study are the potential for linguistic, diagnostic and cultural bias. Foreign parents could have had difficulties in understanding some questions. However, this problem has been minimized, as parents had the opportunity to fill in an English or French version of the questionnaire, as well as to ask a cultural mediator for help. Diagnoses could be less frequent in the countries of origin, with the consequence that both family history and early-life diseases may have been underestimated in immigrant children. However, symptoms instead of labels were used to calculate incidence rates. Cultural motivations could make foreign parents less prone to report symptoms in their children. However, our analyses were adjusted for a score on environmental concern. Finally, our findings may be affected by the "healthy migrant effect".²⁸ This would explain the lower prevalence of atopic conditions in migrant parents, but not the lack of a similar difference in chronic bronchitis.

The strengths of this study are that the survey investigated all the children in the area ($n = 3854$), the uncommonly high response rate (98.6%), the use of internationally validated questionnaires, and that incidence rates were calculated instead of prevalences.

In conclusion, children of immigrants to Italy seem to be at a lower risk of wheezing and eczema, but not nasal allergies, compared to Italian children. Nasal allergies may be more sensitive than wheezing or eczema to the radical

change in the environment related to migration. Parental chronic bronchitis or emphysema increases the risk of chronic bronchitis in children, suggesting a genetic basis for this condition. Children born in Italy to foreign parents are at an increased risk of persistent cough or phlegm, and the reasons for this deserve further investigation.

Conflicts of interest

All the authors have declared that they have no potential competing interests regarding the submitted article.

Sources of funding

This survey was funded by the local National Institutes of Health (Azienda Sanitaria Locale Mantova) and by the province of Mantua (Italy).

Supplementary material

Supplementary data related to this article can be found online at doi:10.1016/j.rmed.2010.09.009.

References

- Grammatikos AP. The genetic and environmental basis of atopic diseases. *Ann Med* 2008;**40**:482–95.
- de Jongste JC, Shields MD. Cough. 2: chronic cough in children. *Thorax* 2003;**58**:998–1003.
- Carter ER, Debley JS, Redding GR. Chronic productive cough in school children: prevalence and associations with asthma and environmental tobacco smoke exposure. *Cough* 2006;**2**:11.
- Bollini P, Pampallona S, Wanner P, et al. Pregnancy outcome of migrant women and integration policy: a systematic review of the international literature. *Soc Sci Med* 2009;**68**:452–61.
- Ministero dell'interno. *Primo rapporto sugli immigrati in Italia*. Roma: Ministero dell'Interno, www.interno.it/mininterno/0673_Rapporto_immigrazione_BARBAGLI.pdf; 2007.
- Istituto Nazionale di Statistica. *La popolazione straniera residente in Italia al 1 gennaio 2008*. Roma: Istituto Nazionale di Statistica, http://www.istat.it/salastampa/comunicati/non_calendario/20081009_00/; 2008.
- Lombardi C, Penagos M, Senna G, et al. The clinical characteristics of respiratory allergy in immigrants in northern Italy. *Int Arch Allergy Immunol* 2008;**147**:231–4.
- Ventura MT, Munno G, Giannoccaro F, et al. Allergy, asthma and markers of infections among Albanian migrants to Southern Italy. *Allergy* 2004;**59**:632–6.
- Tedeschi A, Barcella M, Bo GA, et al. Onset of allergy and asthma symptoms in extra-European immigrants to Milan, Italy: possible role of environmental factors. *Clin Exp Allergy* 2003;**33**:449–54.
- Migliore E, Pearce N, Bugiani M, et al. SIDRIA-2 Collaborative Group. Prevalence of respiratory symptoms in migrant children to Italy: the results of SIDRIA-2 study. *Allergy* 2007;**62**:293–300.
- de Marco R, Marcon A, Rava M, et al. Proximity to chipboard industries increases the risk of respiratory and irritation symptoms in children. The Viadana study. *Sci Total Environ* 2010;**408**:511–7.
- International Study of Asthma and Allergies in Childhood Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. *Lancet* 1998;**351**:1225–32.
- European Community Respiratory Health Survey II Steering Committee. The European community respiratory health survey II. *Eur Respir J* 2002;**20**:1071–9.
- Simoni M, Lombardi E, Berti G, et al. Mould/dampness exposure at home is associated with respiratory disorders in Italian children and adolescents: the SIDRIA-2 Study. *Occup Environ Med* 2005;**62**:616–22.
- de Marco R, Pattaro C, Locatelli F, et al. ECRHS Study Group. Influence of early life exposures on incidence and remission of asthma throughout life. *J Allergy Clin Immunol* 2004;**113**:845–52.
- Kwawukume EY. Caesarean section in developing countries. *Best Pract Res Clin Obstet Gynaecol* 2001;**15**:165–78.
- Merten S, Wyss C, Ackermann-Liebrich U. Caesarean sections and breastfeeding initiation among migrants in Switzerland. *Int J Public Health* 2007;**52**:210–22.
- Singh AM, Moore PE, Gern JE, et al. Bronchiolitis to asthma: a review and call for studies of gene-virus interactions in asthma causation. *Am J Respir Crit Care Med* 2007;**175**:108–19.
- Eldeirawi K, McConnell R, Freels S, et al. Associations of place of birth with asthma and wheezing in Mexican American children. *J Allergy Clin Immunol* 2005;**116**:42–8.
- Weinmayr G, Forastiere F, Weiland SK, et al. ISAAC Phase Two Study Group. International variation in prevalence of rhinitis and its relationship with sensitisation to perennial and seasonal allergens. *Eur Respir J* 2008;**32**:1250–61.
- Pirastu R, Bellu C, Greco P, et al. Indoor exposure to environmental tobacco smoke and dampness: respiratory symptoms in Sardinian children – DRIAS study. *Environ Res* 2009;**109**:59–65.
- Ciccone G, Forastiere F, Agabiti N, et al. Road traffic and adverse respiratory effects in children. SIDRIA Collaborative Group. *Occup Environ Med* 1998;**55**:771–8.
- Leung RC, Carlin JB, Burdon JG, et al. Asthma, allergy and atopy in Asian immigrants in Melbourne. *Med J Aust* 1994;**161**:418–25.
- Gibson PG, Henry RL, Shah S, et al. Migration to a western country increases asthma symptoms but not eosinophilic airway inflammation. *Pediatr Pulmonol* 2003;**36**:209–15.
- Burke W, Fesinmeyer M, Reed K, et al. Family history as a predictor of asthma risk. *Am J Prev Med* 2003;**24**:160–9.
- Dold S, Wjst M, von Mutius E, et al. Genetic risk for asthma, allergic rhinitis, and atopic dermatitis. *Arch Dis Child* 1992;**67**:1018–22.
- Leeder SR, Corkhill R, Irwig LM, et al. Influence of family factors on the incidence of lower respiratory illness during the first year of life. *Br J Prev Soc Med* 1976;**30**:203–12.
- Kabesch M, Schaal W, Nicolai T, et al. Lower prevalence of asthma and atopy in Turkish children living in Germany. *Eur Respir J* 1999;**13**:577–82.

Title of the manuscript: Incidence Of Respiratory And Allergic Symptoms In Italian And Immigrant Children

Author names: Alessandro Marcon^a, Lucia Cazzoletti^a, Marta Rava^a, Paolo Gisondi^b, Vanda Pironi^c, Paolo Ricci^c and Roberto de Marco^a

Author affiliations:

^a Unit of Epidemiology and Medical Statistics, Department of Public Health and Community Medicine, University of Verona, Italy

^b Section of Dermatology and Venereology, Department of Biomedical and Surgical Science, University of Verona, Verona, Italy

^c Unit of Epidemiology, NHS Mantua, Mantua, Italy

Supplementary material

Table E1: IRRs[†] (95% CI) for the association of wheezing, nasal allergies, eczema symptoms, and persistent cough or phlegm with the time spent in Italy by children born abroad to foreign parents (the children born in Italy to Italian parents are the reference category). The last row reports the p-value for the comparison of the regression coefficients for the 2 subgroups of children born abroad (≤ 3 years vs. >3 years) (Wald test). The groups of children born in Italy to one Italian and one foreign parent and to two foreign parents are omitted (see results in table 4 of the manuscript).

		IRRs [†] (95% CIs)			
	Time spent in Italy	Wheezing (n=2792) ^{‡‡}	Nasal allergies (n=2804) ^{‡‡}	Eczema (n=2710) ^{‡‡}	Persistent cough/phlegm (n=2730) ^{‡‡}
Born in Italy to Italian parents		1	1	1	1
Born abroad to foreign parents	≤ 3 years	0.48 (0.18-1.29)	1.75 (0.62-4.89)	0.25 (0.06-1.00) *	0.46 (0.06-3.40)
	>3 years	0.48 (0.21-1.08)	0.65 (0.20-2.08)	0.58 (0.25-1.31)	0.37 (0.05-2.75)
p-value		1	0.20	0.30	0.88

[†] adjusted for sex, age, parents' educational level, distance from the closest wood factory, traffic level, exposure to passive smoking, person who filled in the questionnaire and his/her environmental concern, parental related disease (at least one parent with asthma, allergic rhinitis, eczema, or chronic bronchitis/emphysema, respectively).

^{‡‡} number of children included in the complete case analysis

* $p < 0.05$