

Rhinitis in pre-school children: prevalence, association with allergic diseases and risk factors

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Summary

Background The aim of our study was to assess the prevalence of rhinitis, sneezing, runny or blocked nose apart from colds in a pre-school children population and to evaluate the risk factors and relationship with allergic diseases and sensitization.

Methods Eighteen nursery schools were randomly selected. The International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire (WQ) was distributed and filled by parents of pre-school children (3–5 years). The allergic sensitization to common aeroallergens and foods was evaluated by skin prick test (SPT). χ^2 tests were used to compare proportions between rhinitic and non-rhinitic children.

Results One thousand four hundred and two (92%) valuable questionnaires were returned. Prevalence of rhinitis in the last 12 months was 16.8%. Rhinitic children compared to non-rhinitic children presented a significant increase of diagnosed asthma (20.8% vs. 6.2%, $P < 0.001$), lifetime wheezing (43.2% vs. 21.6%, $P < 0.001$), wheezing in the last 12 months (25.0% vs. 9.4%, $P < 0.001$), atopic dermatitis (22.9% vs. 13.9%, $P < 0.001$) and allergic sensitization (29.9% vs. 13.7%, $P < 0.001$). Sensitization to grass pollen and house dust mites were significant risk factors for rhinitis ($P < 0.01$). A family history of atopy, having pets at home, male gender and greater age were significant risk factors for rhinitis, but not smoking exposure, sharing a bedroom or breastfeeding.

Conclusions In pre-school children rhinitis has a strong association with wheezing symptoms, asthma and atopic dermatitis. Allergic sensitization is a risk factor for rhinitis and should be evaluated even in pre-school children.

Keywords allergic sensitization, asthma, pre-school children, rhinitis, risk factors, wheezing

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Introduction

Allergic rhinitis is a common condition that presents a documented increase in prevalence in different areas of the world [1, 2]. Rhinitis affects a large percentage of the paediatric population, but at present, few epidemiological data with regard to its distribution according to age and natural history are available [3]. The clinical definition of allergic rhinitis is difficult to use in epidemiological settings of large populations, where it is not possible to assess disease severity in the single patient [3]. Rhinitis is possibly underestimated as many patients do not present sufficiently severe symptoms to require medical attention [4]. This is particularly evident in pre-school children, who often present nasal symptoms such as sneezing, runny or blocked nose, as well as cough and wheezing. Therefore, particularly at this age diagnosis and disease definition may be difficult. Nevertheless, factors operating very early in life are particularly

important for the acquisition of childhood allergic diseases [5, 6]. The development of allergic rhinitis is affected by familial and environmental factors occurring during infancy [5–7]. Early diagnosis may facilitate effective prevention and treatment [3, 5–8].

The aim of the present study was to investigate the prevalence and the risk factors for rhinitis, sneezing, runny or blocked nose apart from colds in a pre-school children population and to verify its relationship with asthma, wheezing symptoms and atopic dermatitis. The association between rhinitis and allergic sensitization to common allergens evaluated by skin prick tests (SPT) was also considered.

Methods

Study design, setting and subjects

This was a cross-sectional study using a validated questionnaire, the International Study of Asthma and Allergies in Childhood (ISAAC) written questionnaire (WQ) for respiratory, nasal and cutaneous symptoms [9]. Rhinitis was

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described as a problem with sneezing, or a runny or blocked nose when the child did not have a cold or flu. Questions included the presence of wheezing in the last 12 months and during their lifetime, presence of doctor-diagnosed asthma and eczema. Additional questions about parental atopy, presence of cigarette smokers and furred pets at home were asked in the WQ. Parental atopy was defined as a positive response to the question 'has the father or the mother ever suffered from allergic asthma, rhinitis or eczema'.

Eighteen nursery schools located in the urban area of Verona (North-East part of Italy) were randomly selected from the complete sampling frame of all schools of the area. All children aged 3–5 years were considered suitable for the study. Parents filled the questionnaire at home and returned it within few days during the winter of 2000–2001.

Atopic status was verified at school by SPT performed according to the EAACI guidelines [10]. Antihistamines were suspended for at least 3 days before testing and the reaction was considered as positive if there was a weal 3 mm greater than that of the negative control [10]. Standardized extracts for foods (egg, milk), pollens (Grass mix, *Parietaria judaica*), house dust mites (HDMs) (*Dermatophagoides pteronyssinus* and *farinae*), animal dander (cat, dog), alternaria (ALK-Abello, Milan, Italy) as well as a saline-negative control and a histamine control (10 mg/mL) were used.

Analysis of data

For all analyses, P -values of <0.05 were regarded as statistically significant. Prevalence rates were presented with their 95% confidence interval (95% CI). χ^2 tests were used to compare proportions between rhinitic and non-rhinitic children. The strength of association between rhinitis and asthma, lifetime wheezing, wheezing in the last 12 months, atopic dermatitis and allergic sensitization was expressed by odds ratio (OR), with their 95% confidence interval, unadjusted and adjusted by sex and age.

Logistic regression analyses were conducted to identify independent risk factors for rhinitis. All supposed risk factors were included in the initial model; the risk factors with the lowest Wald χ^2 were then excluded, one at a time, until only variables with a P -value <0.05 remained.

χ^2 were also used to compare demographic and clinical characteristics of respondents without and with SPT in order to assess the likelihood of selection bias.

All statistical analyses were performed using SAS (Version 6.12: SAS Institute, Cary, NC, USA).

Ethical approval

The study was performed with the approval of the local Ethical Committee and written informed consent was obtained from children's parents or guardians.

Results

One thousand four hundred and two valid WQ (92%) (734 males and 668 females) were returned for evaluation. 80% (1121) of parents who returned the 1402 valid WQ gave written consent for SPT. There were no statistical differences

Table 1. Prevalence (%) of rhinitis by sex and age

Age (years)	Gender	N	Prevalence in the last 12 months (%)	95% CI
3	Males	202	14.4	9.8–20.0
	Females	209	12.0	7.9–17.1
4	Males	234	18.8	14.0–24.4
	Females	238	12.2	8.3–17.0
5	Males	298	23.2	18.5–28.4
	Females	221	18.1	13.3–23.8

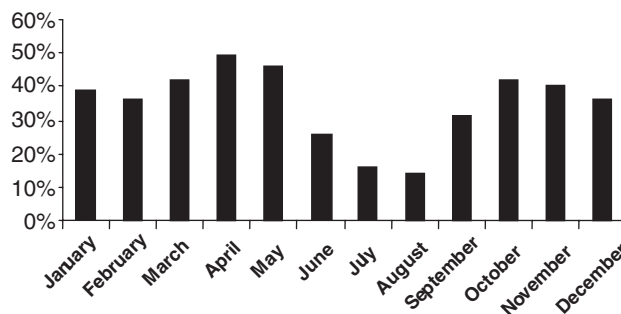


Fig. 1. Frequency of nasal symptoms according to the month of the year.

between the group with SPT and the group without SPT in sex, age, rhinitis, asthma, lifetime and in the last 12 months wheezing and atopic dermatitis. Children in the three age groups (3, 4, and 5 years) were well matched (Table 1).

The prevalence of rhinitis, defined as rhinitis, sneezing, runny or blocked nose apart from colds in the last 12 months, was 16.8% with an age-related trend (13.1% at 3 years, 15.5% at 4 years and 21.0% at 5 years). Table 1 shows the prevalence of rhinitis in the last 12 months (percentage, 95%CI) according to age and gender. Prevalence of symptoms in the last 12 months was utilized to evaluate association with allergic diseases and risk factors.

During lifetime, the 18.4% of enrolled children presented rhinitis apart from colds with the same trend (14.6% at 3 years, 17.4% at 4 years and 22.4% at 5 years). Answers to the question 'has your child ever had allergic rhinitis or hayfever?' showed a low rate of positive responses (4%) in comparison to answer to lifetime presence of rhinitis symptoms (18.4%).

The frequency of nasal symptoms according to the month of the year is shown in Fig. 1. As shown, the prevalence of rhinitis symptoms occurred more frequently from March to May and from October to December, with the lowest values in July and August.

Children with sneezing, runny or blocked nose apart from colds in the last 12 months compared to children without symptoms presented a significant increased prevalence of 'asthma ever' (20.8% vs. 6.2%, $P<0.001$), lifetime wheezing (43.2% vs. 21.6%, $P<0.001$), wheezing in the last 12 months (25.0% vs. 9.4%, $P<0.001$) and atopic dermatitis (22.9% vs. 13.9%, $P<0.001$).

Table 2 shows the strength of association between rhinitis and the following co-morbidities: asthma, lifetime wheezing, wheezing in the last 12 months, atopic dermatitis, allergic sensitization. Positive atopic status, defined as at least one

Table 2. Association between rhinitis and comorbidities

Comorbidity	Unadjusted odds ratio	95% CI	Adjusted* odds ratio	95% CI
Diagnosed asthma	3.98	2.68–5.91	3.80	2.55–5.66
Lifetime wheezing	2.76	2.06–3.70	2.63	1.96–3.54
Wheezing in the last 12 months	3.20	2.25–4.56	3.16	2.21–4.52
Atopic dermatitis	1.84	1.30–2.60	1.85	1.30–2.62
Allergic sensitization	2.68	1.88–3.84	2.46	1.71–3.54

*Adjusted by age and gender.

Table 3. Prevalence of sensitization to different allergens in children with rhinitis and healthy subjects

	Children with rhinitis (N = 197) (%)	Healthy subjects (N = 924) (%)
Grass pollen	16.8	4.3
Parietaria	5.6	1.2
Alternaria	8.6	3.7
Dog	6.6	1.4
Cat	5.6	2.2
Cockroach	1.5	0.2
Milk	3.6	0.6
Egg	2.0	1.1
House dust mite	11.7	6.1

positive SPT, was present in the 18.6% of the studied population, with an OR of 2.68 (95% CI, 1.88–3.84) for children with rhinitis. Children with a positive history of rhinitis in the last 12 months showed a significant higher rate of allergic sensitization (29.9%) in comparison to children without symptoms (13.7%) ($P < 0.001$).

The prevalence of sensitization to the different allergens in children with rhinitis and healthy subjects is shown in Table 3. The most common sensitizing allergens in children with rhinitis were grass pollen (16.8%) and HDM (11.7%). Multiple sensitivities were observed in 58.2% of sensitized children. Very few children presented positive SPT to milk and egg.

The multiple logistic regression analysis of risk factors for rhinitis is shown in Table 4. A positive familial history, pets at home, gender and age (5 yrs) were significant risk factors for rhinitis. The presence of at least one furred pet at home was associated with an increased prevalence of nasal symptoms, symptoms being present in 20.9% of the owners and 15.2% in the children without direct contact with furred pets ($P < 0.01$).

Non-significant factors were smoking exposure, bedroom sharing and not to have received breastfeeding for at least 6 months.

Discussion

Allergic rhinitis is a common chronic condition with a prevalence varying from 0.8% to 14.9% in the 6–7-year-olds and from 1.4% to 39.7% in the 13–14-year-olds as evaluated in different parts of the world by the ISAAC study [9, 11].

Table 4. Multiple logistic regression analysis of risk factors for rhinitis

Risk factor	Adjusted odds ratio	95% CI
<i>Significant risk factors (final model)</i>		
Family history*	1.82	1.36–2.44
Pets kept at home	1.44	1.06–1.94
Male†	1.44	1.08–1.92
Age	1.29	1.08–1.55
<i>Non-significant risk factors (initial model)</i>		
Parents smokers	1.19	0.89–1.59
Bedroom shared	1.08	0.74–1.56
No breastfeeding	1.02	0.75–1.54

*Familiarity for asthma, hayfever, eczema.

†Female is the reference category.

This study has shown a variation between 20- and 60-fold between centres in the rate of allergic rhinoconjunctivitis symptoms [9,11]. The interpretation of these large between-country differences is likely to be partly influenced by the validity of the WQ, despite the translation guidelines, the avoidance of diagnostic labels and the use of the symptoms of rhinoconjunctivitis. Validation study of the rhinitis WQ led to the use of symptoms of rhinoconjunctivitis rather than rhinitis alone since it was more closely related to positive skin-test reactivity [12]. To study the prevalence of the disease in younger children we used the same ISAAC WQ. It represents a low-cost, easily applicable method and has good sensitivity and specificity [13–15]. However, it has been noted that the use of the questionnaire alone may have overestimated the real prevalence of the disease. The Swiss Study on Childhood Allergy and Respiratory Symptoms with Respect to Air Pollution (SCARPOL study), comparing the core of the ISAAC WQ with SPT, demonstrated that the ISAAC core questions on rhinitis are highly specific and therefore useful in excluding atopy [12]. In addition, they have a high positive predictive value in detecting atopy among children with symptoms, but they are not helpful for detecting atopy in a general population of children (low sensitivity). The SCARPOL study conclusions suggest that to monitor the prevalence of allergic rhinitis, questions on rhinitis symptoms and on the diagnostic label 'hayfever' have to be included in a questionnaire, because they contain complementary information since underdiagnosis of allergic rhinitis is common [15]. For this reason in our study, we used the ISAAC WQ with questions on rhinitis symptoms and on 'hayfever' and we associated the WQ with SPT in order to increase the sensitivity of the research.

The relevance of allergic rhinitis among the atopic diseases is highlighted by recent studies, which have shown that adult patients with both lower and upper airway diseases tend to have the onset of rhinitis preceding the onset of asthma [16, 17]. Rhinitis is actually considered a significant independent risk factor for asthma [18] and it may appear as the first manifestation of a common allergic airway disease, leading eventually to the onset of asthma [18]. Epidemiological data, more often derived from adult populations, indicate that asthma and allergic rhinitis frequently coexist, with rhinitis symptoms reported between 19% and 94% of asthma patients and asthma reported between 19% and 38% of those with allergic rhinitis [16, 17, 19].

Children attending day-care centres often present symptoms of rhinitis, cough and wheezing. In the present study, we found a close relationship between rhinitis and diagnosed asthma, wheezing, rhinitis and allergic sensitization. It is interesting to note that there was a stronger association between rhinitis and asthma and wheezing than with allergic sensitization. However, grass pollen and HDM were significant risk factors for symptoms of rhinitis in our population. This was significant even if in pre-school age children a considerable part of symptoms may be related to viral infections and the patient group may include children with transient symptoms [20]. According to sensitization, mainly to grass pollen and mites, our patients experienced more symptoms in spring and fall as previously observed [21]. In early life allergen exposure correlates with sensitization and development of hypersensitivity and expression of atopy, rhinitis and asthma [5, 6, 22]. Therefore, epidemiological studies in the first years of life, where sensitization to allergens is more likely to start, may be particularly useful. In the Tucson Children's Respiratory Study, a high IgE level was associated with the development of rhinitis in the first years of life, supporting the fact that allergic rhinitis may be an early manifestation of an atopic status triggered by early environmental exposures [23]. However, the same study demonstrates that not only high IgE but also parental allergic disorders, early introduction of foods or formula and maternal smoking were associated with early development of rhinitis [23], leading to the consideration that different risk factors are probably involved in the development of the disease.

Our results show that sensitization to common allergens, demonstrated by SPT positivity, was significantly more frequent in children with rhinitis in comparison to children without symptoms, suggesting that exposure to allergens resulted in the development of hypersensitivity and symptoms. In addition, skin test reactivity to more than one allergen was frequent in our symptomatic children. The occurrence of multiple sensitivities in subjects with allergic rhinitis is a well-documented event [24–27]. Present data show that this could be an early event. Therefore, since allergic rhinitis usually develops during childhood, careful attention should be paid to the risk factors in early life, in particular to allergen exposure and avoidance [8, 28–31].

Among risk or protective factors, in our population breastfeeding did not reduce the risk of having rhinitis. The issue of protective effect of breastfeeding against atopic diseases is controversial [32]. There are reports documenting a protective effect [33, 34] and other disclosing no protection [35–37] and some documenting an increased risk of atopic diseases associated with breastfeeding [38, 39]. This may in part be explained by the fact that breastfeeding mothers do not constitute a uniform group. The composition of breast milk shows marked individual variation and so, consequently, does the success of breastfeeding in reducing the risk of disease [40, 41].

Parental smoking did not act as a risk factor for rhinitis in our population; this is consistent with previous data in asthma that were unable to demonstrate that cigarette smoke exposure has a direct effect on the prevalence of asthma, but only on the severity of the disease [42].

The findings of our study do not support the protective effects of early pet exposure on allergic sensitization [43–45].

Of course our observation has all the bias of a retrospective analysis. However, this issue is also controversial. The inverse association between pet ownership and sensitization and hayfever symptoms was demonstrated to be partially due to removal of the pets in families with sensitized and/or symptomatic children [46]. Furthermore, pet ownership is less likely in families at high risk of sensitization [47] and this of course may be another selection bias in epidemiological studies. When a protective effect of early life cat exposure was documented, this was clearly associated with very high levels of allergen exposure [43, 44], requiring the presence of more than one animal [45]. It is unlikely that such a high level of allergen can be reached in Italian homes, where the use of smooth floor is common and the use of carpets is relatively rare.

Our epidemiological data add further knowledge about rhinitis distribution in this age group, where diagnosis and treatment of allergic diseases are commonly underestimated. This is clearly the case in our study population since nasal symptoms apart from cold in the last 12 months were reported in 16.8% of children, while the diagnosis of allergic rhinitis was present only in the 4% of our study population. This was observed in another epidemiological study in children aged 5–8 years, where a prevalence of 9% of physician-diagnosed hayfever and a 24% prevalence of subjects with nasal symptoms was found, but without a physician diagnosis of hayfever [48]. Thus, the most common allergic condition, allergic rhinitis, presents several diagnostic challenges [21], since the symptoms may prompt physicians to think first of a viral cause and not an allergic reaction. Of course, the combination of a careful history with SPT may facilitate an earlier diagnosis with consequent earlier and more appropriate treatment.

In conclusion, data from our study demonstrate an early onset of allergic rhinitis, a strict correlation between the prevalence of rhinitis apart from flu and cold and the prevalence of wheezing and asthma. Even at an early age, rhinitis should be considered as a potential clinical manifestation of atopy and a risk factor for the development of asthma. Rhinitis may appear as the first manifestation of a common allergic airway disease, leading eventually to the onset of asthma [18]. This should be considered in order to offer an early diagnosis and consequent appropriate treatment to the patient.

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