

Prevalence and Associated Risk Factors of Allergic Rhinitis in Preschool Children in Beijing

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Objectives/Hypothesis: To investigate the prevalence of allergic rhinitis (AR) and its associated risk factors in preschool children in Beijing.

Study design: Two-stage, clustered, stratified random sample study.

Methods: Parents of 4,075 children aged 3, 4, and 5 years in urban and suburban areas were surveyed using a questionnaire. A random subgroup of 1,067 children was examined by otolaryngologists with skin prick test (SPT).

Results: The survey response rate was 98.3%. Based on the criteria published by ARIA document, the prevalence of epidemiologic AR was 48% (53.2% in urban areas; 43.4% in suburban areas). Among 795 children with epidemiologic AR, sensitization to common inhalant allergens was confirmed by a positive SPT in 248 children (31.2%). Thus, the adjusted prevalence of clinical AR was 14.9% (19.5% in urban areas; 10.8% in suburban areas). In these AR children, 166 (67.1%) were intermittent and 82 (32.9%) persistent, with moderate/severe symptoms in 103 (41.5%). The most common inhalant allergens were *Alternaria tenuis* (55.7%), followed by *Dermatophagoides farina* (39.4%), and *Dermatophagoides pteronyssinus* (38.6%). Both asthma (adjusted OR 4.88, 95% CI: 3.48–6.86) and eczema (adjusted OR: 1.49, 95% CI: 1.15–1.94) appear to be significant concomitant risk factors for AR.

Conclusions: The prevalence of AR in young children can be overestimated using epidemiologic criteria. AR is a common disease in Asian preschool children, with an increasing trend as children get older, and is higher in urban than suburban areas—suggesting an important role for environmental risk factors in AR.

Key Words: Asian, prevalence, preschool children aged 3, 4, and 5 years, allergic rhinitis, risk factors.

Level of Evidence: 1b

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INTRODUCTION

Allergic rhinitis (AR) is a common disease in both children and adults. It affects social life, sleep, school, and work, and its economic impact is substantial.^{1–3} Although the prevalence of rhinitis increases later in life, the exact prevalence in preschool children is still a

matter of discussion.¹ By 6 years of age, doctor-diagnosed allergic rhinitis may occur in more than 40% of children.⁴ Risk factors for rhinitis in this age group are unclear.

It was found in the International Study of Asthma and Allergies in Childhood (ISAAC) III study that in children aged 6 to 7 years, there was a global increase in rhinitis prevalence across most countries.⁵ In 1974, Broder et al. reported that the prevalence of seasonal AR was 10.2% in 4- to 7-year-old children in the United States.⁶ In 1992, Grize et al. reported a prevalence of 5.0% for seasonal AR in 5- to 7-year-old children in Switzerland.⁷ In Mexico during 2002–2003, in children aged between 6 to 7 years old, the prevalence of rhinitis (ever), current rhinitis, rhinoconjunctivitis, and the diagnosis of allergic rhinitis were reported to be 27.9%, 24.2%, 9.2%, 5.5%, respectively.⁸ Kong WJ et al. (2009) reported a prevalence of 10.8% of AR in 3- to 6-year-old children in central China (Wuhan city).⁹ There is no population-based random sample study of the prevalence of AR and related risk factors in preschool children in China.

The diagnosis of AR is based upon a typical history of allergic symptoms and diagnostic tests.^{1,10} To date, however, most reported prevalence studies of AR in young children are almost exclusively based on surveys

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using a questionnaire (epidemiological AR) that may attribute to an overestimation of AR prevalence.¹⁰ In the literature, however, data on the prevalence of clinically diagnosed AR in preschool children is lacking. The skin prick test (SPT) represents a major diagnostic tool in the field of allergy. It can be performed and interpreted reliably early in life.¹¹ The aim of this study was to investigate the prevalence and associated risk factors of AR in preschool children (3, 4, and 5 years of age) in a randomly selected sample drawn from urban and suburban areas of Beijing. Meanwhile, we attempted to compare the prevalence of AR made by epidemiological criteria (using a questionnaire), and by clinical examination, SPT, and associated risk factors.

MATERIALS AND METHODS

Approval to conduct this study was granted by the institutional review board of the Capital Medical University, and Beijing Children's Hospital, Beijing, P. R China.

STUDY DESIGN

This is a two-stage, clustered, and stratified random sample study of children aged 3, 4, and 5 years of age. Based on Beijing's administrative boundary, there are a total of eight districts in urban areas and 10 districts in suburban areas. One urban district (Dongcheng, with a population of 536,000) and one suburban district (Daxing, with a population of 672,000) were selected using a random sampling list. Based on the estimated prevalence of 15% (p) and the pre-specification of a precision of 3% ($\pm \delta$) at a 95% confidence level, the sample size (n) can be calculated by $n \geq (1.96)^2 \frac{p(1-p)}{\delta^2}$.¹² Therefore, the minimum sample size for each age group was estimated to be 544 ($n=544$).

A minimal required total sample size was 3,264 and a total targeted sample size was 4,000. An equal sex ratio (1:1) was considered following the report of the "Beijing Statistical Yearbook 2006," where the male:female ratio was 1.02:1 in Beijing.¹³

Study Subjects

In both selected district areas, a list of all registered kindergarten children was obtained from the district government. The study group was selected using a random sampling list to obtain enough children aged 3 (≥ 3 years and < 4 years), 4 (≥ 4 years and < 5 years), to 5 (≥ 4 years and < 6 years) years old for this study.

Working Definitions

1. Allergic rhinitis (AR). The diagnosis of AR was made using the criteria published in the ARIA document.^{1,10} Children with at least two of the four common symptoms of AR: itchy nose, sneezing, runny and blocked nose, for at least 1 hour on most days during the past year were diagnosed as **epidemiological AR**. If allergic sensitization was confirmed by medical history, clinical examination and SPT tests, a diagnosis of **clinical AR** was made.

2. Classification of AR. Intermittent AR (IRA) means that the AR symptoms are present < 4 days a week or for < 4 consecutive weeks. **Persistent AR (PER)** means that the symptoms are present more than 4 days a week, and for more than 4 consecutive weeks during the past year.¹⁰

3. Severity of AR. Mild means that none of the following items are present: sleep disturbance, impairment of daily activities, leisure and/or sport activity impairment, school or work symptoms that were troublesome. **Moderate/severe** means that one or more of the above items are present.¹⁰

4. Common cold/upper respiratory tract infection (URTI). This was defined as the sudden occurrence of a respiratory illness for at least 2 days with: a) at least one respiratory tract symptom such as a blocked or runny nose, sore throat, unusual cough, or hoarseness of voice; and b) at least one systemic symptom of fever, chills, muscle ache, or headache. We specifically asked the patients to differentiate allergic rhinitis symptoms from the symptoms of a "common cold/URTI".

Survey Questionnaire

A survey questionnaire was developed based on the reports of the ISAAC I and III, with modifications following the ARIA's recommendations.^{3,10,14} It includes 1) general information: age, gender, medical history, family history, allergies, eating habits, outdoor activities, and common cold/upper respiratory tract infection (URTI) symptoms in the past year; 2) associated diseases or conditions: asthma (previously diagnosed by physician), eczema, otitis media, mouth breathing with and without snoring during sleep, etc.; 3) typical symptoms of AR: itchy nose, sneezing, nasal blockage, runny nose, itchy eye, tearing, and etc.; 4) environmental factors: house type, keeping a pet at home, carpets on the floor, room embellishments; and 5) medical history including treatments (e.g., antihistamines, nasal steroids, herbal medicine, and etc.) received during the past year and symptom improvement after treatment.

Completion of Questionnaire

A 1-day pre-survey meeting and training course was organized by the principal investigator who explained clearly the aim and details of study arrangements and completion of the questionnaire to the directors and physicians from all selected kindergartens. An introduction letter was sent to the parents of all children between 3, 4, and 5 years of age, together with the informed consent form and questionnaire from the director of each kindergarten. The signed informed consent form, together with completed questionnaires by parents, were collected within 1 week, and checked by the physician in each kindergarten. If necessary, further explanations of how to complete the questionnaire were provided to the parents by the physician in each kindergarten.

Medical Examinations and SPT

The survey data were entered into a computer-based data system in SPSS (SPSS Inc., Chicago, IL).

	Daxing (Suburban) N=2133 (%)	Dongcheng (Urban) N=1874 (%)	p value
Gender			0.93
Male	1122 (52.6)	983 (52.5)	
Female	1011 (47.4)	891 (47.5)	
Age (year)			0.04
3	476 (22.3)	475 (25.3)	
4	805 (37.7)	648 (34.6)	
5	852 (39.9)	751 (40.1)	
Family History			
Allergic rhinitis	289 (13.5)	377 (20.1)	<0.01
Asthma	29 (1.4)	30 (1.6)	0.53
Eczema	90 (4.2)	135 (7.2)	<0.01
House Type			<0.01
Land house	241 (11.3)	403 (21.5)	
Multi-story apartment	1892 (88.7)	147 (78.5)	
Breastfeeding (for >3 months)	1537 (72.1)	1308 (69.8)	0.12
Keeping Pets			0.02
Cat	33 (1.5)	42 (2.2)	
Dog	152 (7.1)	51 (2.7)	
Vaccination (measles/ poliomyelitis/ epidemic encephalitis/BCG vaccine, etc.)	2114 (99.1)	1858 (99.1)	0.90
Lifestyle			
Eating fast food (>2 times per week)	1698 (79.6)	1699 (90.7)	<0.01
Eating sea food (>2 times per week)	737 (34.6)	605 (32.3)	0.13
Outdoor activity (>2times per week)	1619	1248	<0.01
Frequency of Common cold/URTI (during the past year, with fever above 38°C)			0.02
0	454 (21.3)	385 (20.5)	
1	680 (31.9)	567 (30.3)	
2	425 (19.9)	452 (24.1)	
3	301 (14.1)	263 (14.0)	
>3	273 (12.8)	207 (11.0)	
Usage of antibiotics (during the past year)			0.06
0	509 (23.9)	479 (25.6)	
1	410 (19.2)	372 (19.9)	
2	388 (18.2)	379 (20.2)	
3	373 (17.5)	301 (16.1)	
>3	453 (21.2)	343 (18.3)	
Medical history			
Asthma	62 (2.9)	75 (4.0)	0.06
Eczema	222 (10.4)	239 (12.8)	0.02
Acute Otitis Media (AOM)	119 (5.6)	172 (9.2)	<0.01

(Continues)

	Daxing (Suburban) N=2133 (%)	Dongcheng (Urban) N=1874 (%)	p value
Mouth breath (during sleep)	310 (14.5)	293 (15.6)	0.33
Snoring	469 (22.0)	389 (20.8)	0.34
AR Symptoms			
Itchy nose	426 (20.0)	495 (26.4)	<0.01
Sneezing	899 (42.1)	891 (47.5)	<0.01
Nasal blockage	912 (42.8)	949 (50.6)	<0.01
Runny nose	830 (38.9)	890 (47.5)	<0.01
Itchy eye	328 (15.4)	431 (23.0)	<0.01
Tearing	254 (11.9)	257 (13.7)	0.27

Based on medical history, children were classified by epidemiological AR based on the criteria published in the ARIA document.^{1,10} Fifty percent (50%) of the AR and non-AR children were randomly selected and invited to participate in a routine ENT examination and SPT for common inhalant allergens. These were performed in the medical office of the kindergarten by a group of ENT specialists who had been specially trained for the clinical diagnosis and management of AR in pediatric patients. All tests were completed free of charge.

All children were informed not to take antihistamines 7 days before the SPT examination. SPT was performed throughout the entire study using a lancet (Allergopharma, Reinbek/Hamburg, Germany) and panel of standardized allergen extracts from Allergopharma (Allergopharma, Reinbek/Hamburg, Germany), including 12 common allergens or mixtures, such as *Alternaria tenuis*, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, animal hairs (including cat epithelia, dog epithelia, rabbit epithelia, golden hamster, and guinea pig epithelia), molds (including *Aspergillus funigatus*, *Mucor mucedo*, *Penicillium notatum*, *Pullularia pullulans*, *Rhizopus nigricans*, *Serpula lacrymans*), early blossoming (including alder, hazel, poplar, willow tree, and elm), lamb's quarters, midblossoming (including birch, beech, oak, and plane tree), weed mixtures (including mugwort, dandelion, English plantain, and nettle), hay dust, grasses/cereals (including barley, oat, rye, rye grass, timothy grass, velvet grass, vernal grass, and wheat), and ragweed. Saline and histamine were always used as negative and positive controls. A positive immunological reaction was defined when the saline control site is completely negative, and small wheals of a mean diameter greater than or equal to 3 mm of the negative control (excluding children with dermatographism).¹⁰ Allergic sensitization was confirmed if a positive result was found to at least one allergen tested. A diagnosis of clinical AR was made by a combined assessment of a typical history of allergic symptoms, ENT examination, and SPT test by the ENT specialists.

TABLE II.
Prevalence of Epidemiologic and Clinical AR in the Urban and Suburb Areas.

	Prevalence			
	Total N° (%)	Dongcheng (Urban) N° (%)	Daxing (Suburban) N° (%)	p-value Odds Ratio (95%CI) †
Epidemiologic AR	1922 (48.0)	997 (53.2)	925 (43.4)	<0.01 1.49 (1.31–1.68)
Clinical AR*	596 (14.9)	366 (19.5)	230 (10.8)	<0.01 2.01 (1.68–2.40)

*Adjusted by positive rate of SPT.

†Reference of suburban.

Statistical Analysis

All statistical analyses were performed by a professional statistician using SPSS 18.0 statistical software (SPSS Inc., Chicago, IL). A *P*-value of 0.05 or less was regarded as statistically significant. The prevalence of epidemiological AR was calculated based on the criteria in each age group, and presented with their odds ratio and 95% confidence interval (95% CI). The prevalence of clinical AR was adjusted by using the percentage of the positive SPT in the subgroup of AR (with SPT test only), and presented with their odds ratio and their 95% CI. Bivariate analyses using the Chi-square and logistic regression methods were carried out to examine the association between AR and potential risk factors.

RESULTS

The questionnaire survey was conducted in the months of April and September 2007 as they reflect the peak concentration of pollens for spring and autumn respectively. The survey was completed in a 2-week time period during each sampling period (with almost equal number of children in different kindergartens). A total of 4,075 questionnaires were dispensed with 4,007 (98.3%) being completed and valid for analysis. The demographic

profiles and general information in both the Dongcheng (urban) and Daxing (suburban) are shown in Table I.

Table II shows the prevalence of AR based on epidemiologic criteria (epidemiological AR) and by clinical diagnosis (Clinical AR). In general, the prevalence of epidemiological AR was 48%, which was statistically ($p<0.01$) higher in Dongcheng (urban) (53.2%) than in Daxing (suburban) (43.4%) areas. Among the children with epidemiological AR, SPT was carried out in 795 (41.4%, participation rate of 82.8%) children, but only 248 (31.2%) were SPT positive. The adjusted prevalence of clinical AR was 14.9% overall, 19.5% for Dongcheng (urban) and 10.8% for Daxing (suburban) ($p<0.01$). There is an increasing trend for the incidence of clinical AR (10.2%, 12.6%, and 19.4% in the age groups of 3, 4, and 5 years, respectively) but not epidemiological AR (43.1%, 51.6%, and 47.5%, respectively) as the children get older.

In children with nonepidemiological AR ($n=2087$), only 272 children (13%, participation rate of 26%) came for a clinical examination and SPT. Among this group, 55 children (20.2%) had allergic sensitization (SPT positive) to the common allergens tested.

Table III shows the allergic sensitization (positive SPT results) to common inhalant allergens in both epidemiological and clinical AR children. It shows that the three most common inhalant allergens in all children ($n=1067$) who were tested by SPT were *Alternaria tenuis*, followed by *Dermatophagoides farina* and *dermatophagoides pteronyssinus*. The same pattern of allergen sensitization was confirmed in clinically diagnosed AR with *Alternaria tenuis* (55.7%), the most frequent, followed by *Dermatophagoides farina* (39.4%) and *Dermatophagoides pteronyssinus* (38.6%) (Table III).

In children with clinically confirmed AR ($n=248$), 166 had intermittent (66.9%) and 82 persistent (33.1%) AR. One hundred and three (41.5%) had moderate/severe symptoms (Table IV).

The risk factors associated for epidemiological and clinical AR are shown in Table V. For statistical analysis, these potential risk factors have been included and adjusted ($p<0.05$, by logistic regression test) in this table. One can see that some factors are confirmed in both epidemiological and clinical AR, such as a higher prevalence of AR in Dongcheng (urban) than Daxing (suburban), in older age groups, in children with a family history of allergic rhinitis, and in children who suffered from more frequent common cold/URTIs during the past year. However, other factors such as a higher prevalence of AR in males, children with asthma and

TABLE III.
Common Sensitized Allergens Evidenced by Skin Prick Test.

	AR* n=795(%)	Non AR* n=272(%)
<i>Alternaria tenuis</i>	138 (17.3)	23 (8.5)
<i>Dermatophagoides farinae</i>	97 (12.2)	26 (9.6)
<i>Dermatophagoides pteronyssinus</i>	95 (11.9)	26 (9.6)
Animal hair 1	50 (6.3)	7 (2.6)
Moulds II	49 (6.2)	3 (1.1)
Early blossoming	42 (5.3)	10 (3.7)
Lamb's Quarters	36 (4.5)	3 (1.1)
Mid blossoming	33 (4.2)	10 (3.7)
Weed mix	32 (4.0)	10 (3.7)
Hay dust	22 (2.8)	3 (1.1)
Grasses/Cereals	22 (2.8)	4 (1.5)
Ragweed	15 (1.9)	3 (1.1)
Positive SPT to at least one of the allergens:	248 (31.2)	55 (20.2)
• To one allergen only	88	19
• To two allergens	65	4
• To three or more allergens	95	32

*Epidemiologic AR

TABLE IV.
The Type and Severity of Clinically AR, and their Sensitization to Common Allergens in Two Different Areas (n=248).

		Severity Mild N° (%)	Moderate/severe N° (%)	Common allergens (top three): N°		
				<i>Alternaria tenuis</i>	<i>Der.f</i>	<i>Der.p</i>
Total Clinical AR (n=248)	145 (58.5)	103 (41.5)	138	97	95	
Dongcheng (Urban, n=156)	Intermittent (n=99)	63 (63.6)	36 (36.4)	54	38	38
	Persistent (n=57)	29 (50.9)	28 (49.1)	34	21	22
Daxing (Suburban, n=92)	Intermittent (n=67)	38 (56.7)	29 (43.3)	39	25	20
	Persistent (n=25)	15 (60.0)	10 (40.0)	11	13	15

eczema, living in a multi-story apartment, and a lower prevalence in children with breastfeeding (for more than 3 months) in clinically diagnosed AR.

There was no significant difference between AR and non-AR children with regard to history of vaccination, eating fast food, or usage of antibiotics during the past year (Table V). Pets present in the home and eating seafood were found to have a positive relationship with epidemiological AR but not clinical AR. Doing more outdoor activity was found to be significantly associated with epidemiological AR only.

In children with Clinical AR (n=248), 33 children (13.3% vs. 2.6% in non-AR children) have reported a physician-diagnosed asthma, eczema in 45 children (18.1% vs. 11.8% in non-AR children), otitis media in 27 children (10.9%), snoring in 89 children (35.9%), and open-mouth breathing in 77 children (31.0%). The results of statistical analysis (by χ^2 test) show that asthma ($p<0.01$, OR=5.92, 95% CI: 4.31–8.13) and eczema ($p<0.01$, OR=1.67, 95% CI: 1.33–2.11) were strongly linked with clinical AR. Other comorbidities and medical conditions such as acute otitis media ($p=0.03$, OR=1.38, 95% CI: 1.04–1.84), snoring ($p<0.01$, OR=2.04, 95% CI: 1.69–2.46) and mouth breathing ($p<0.01$, adjusted OR=2.32, 95% CI: 1.91–2.83) were all significantly associated with AR.

DISCUSSION

The prevalence of AR is increasing worldwide as evidenced by many literature reports during the past decades. However, most of the studies were based on questionnaire surveys only, which may result in an overestimation of the prevalence (up to 50%) of AR [15–17]. Our data confirms that the prevalence of epidemiological AR is 3.2-fold (48% vs. 14.9%, Table II) greater than the actual AR diagnosed by a standard procedure of combining a typical history of AR symptoms and allergy diagnostic tests (SPT). SPT is a high-efficient method when it is performed using a high-quality allergen extracts, and a battery that includes all relevant allergens of patient's geographic area. However, both false-positive and false-negative skin tests may occur due to a number of variables such as the quality of the allergen extract, age, seasonal variation, and drugs (e.g., oral H1-antihistamines).¹ The reason for overestimation of the true prevalence of AR using questionnaire is not fully understood. It may due to the fact that many subjects suffer

from non-AR, such as infectious rhinitis caused by viruses, which is common in preschool children.¹ Recently, a study showed that the proportion of children with AR increased from 5% to 14% from age 4 to 8 years, whereas the proportion of children with non-AR decreased slightly over the same period of development, from 8% to 6%.¹⁸ In addition, in this study, some allergens tested are in a mixture solution that may potentially reduce their sensitivity, and therefore cause a lower rate of positive skin test. However, data from our study is important as it combines a questionnaire survey, and clinical diagnosis with SPT in a large number and randomly selected preschool children with AR, both in Dongcheng (urban) and Daxing (suburban) areas in Beijing.

In addition to AR, viral rhinitis (common cold/URTI) is a common disease that may occur up to six to eight times a year in children.¹⁹ Our study found that only 17.1% of preschool children did not have common cold/URTI symptoms during the past year, and most of them (54.5%) had at least one or two episodes of a common cold/URTI, which is significantly correlated with the prevalence of AR (Table V). Therefore, understanding the differential diagnostic criteria between AR and infectious rhinitis is important in doing an epidemiological study, as well as in management of children with rhinitis complaints in clinic practice.

In this study, *Alternaria tenuis* and two house-dust mite species (*Dermatophagoides farina* and *Dermatophagoides pteronyssinus*) were found to be the most common cause of allergic sensitization, particularly in children with AR. Indeed, exposure to indoor allergens in our home environment is a common cause of perennial allergic rhinitis, especially in young children who spend most of their time inside the house. House-dust mites are commonly found in association with bedding products, carpets, curtains, and fabric products. There is an increasing incidence of clinical AR in children from 3 to 5 years of age in our study. This is probably due to an increased allergic sensitization in older children. Whether this phenomenon is due to the maturation of the immune system or due to a longer period of indoor allergen exposure is not fully understood. Therefore, in children with allergic sensitization to house dust mite allergens, avoidance of house dust mites is always an integral part of a management strategy for allergic rhinitis in children.^{1,10}

The children of farmers have less allergic rhinitis than other children, suggesting that a countryside

TABLE V.
The Risk Factors Associated with Epidemiologic AR and Clinical AR.

	Epidemiologic AR		Clinical AR	
	<i>p</i> value	OR (95% C.I.)	<i>p</i> value	OR (95% C.I.) (Adjusted)
Area				
Daxing (suburban)		1		1
Dongcheng (urban)	<0.01	1.51 (1.32,1.72)	<0.01	2.01 (1.66,2.42)
Age	<0.01		<0.01	
3		1		1
4		1.48 (1.25,1.76)		1.41 (1.07,1.87)
5		1.27 (1.07,1.50)		2.44 (1.87,3.17)
Gender	NS			
Male				1
Female			<0.01	0.69 (0.57,0.83)
Family History	NS			
AR				
No		1		1
Yes	<0.01	1.90 (1.59,2.27)	<0.01	1.68 (1.35,2.08)
Eczema				
No		1		
Yes	0.01	1.59 (1.19,2.13)		
House Type				
Land house		1		1
Multi-story apartment	<0.01	1.63 (1.36,1.96)	<0.01	1.53 (1.17,2.01)
Breastfeeding (for >3 months)	NS			
No				1
Yes			<0.01	0.75 (0.62,0.91)
Keeping Pet (cat, dog)			NS	
No		1		
Yes	<0.01	1.49 (1.28,1.74)		
Lifestyle				
Eating seafood			NS	
No		1		
Yes	0.01	1.26 (1.05,1.51)		
Outdoor activity			NS	
No		1		
Yes	<0.01	1.27 (1.10,1.46)		
Frequency of Common Cold/URTI (during the past year)	<0.01		<0.01	
None		1		
1		1.21 (0.99,1.48)		1.46 (1.05, 2.04)
2		1.58 (1.29,1.94)		1.96 (1.40, 2.73)
3		2.72 (2.15,3.43)		2.71 (1.92, 3.83)
4		1.99 (1.57,2.52)		2.07 (1.44, 2.97)
Medical History				
Asthma history	NS			
No				1
Yes			<0.01	4.88 (3.48,6.86)
Eczema history	NS			
No				1
Yes			<0.01	1.49 (1.15,1.94)

The analysis was performed based on logistic regression.
NS: not significant.

lifestyle could possibly protect children from the development of allergies.^{20–25} In agreement with the literature, our data confirmed a significant (almost 2-fold) higher prevalence of AR for children living in Dongcheng (urban) (19.5%) versus Daxing (suburban) (10.8%). Although Daxing is not completely a farming area, these findings are evidence that in addition to genetic predisposing factors, lifestyle or environmental factors must play an important role in the development or clinical manifestation of AR. Unfortunately, our study was not able to identify a particularly important risk factor by comparing the difference between Dongcheng (urban) and Daxing (suburban). The overall levels of air pollutants (e.g., sulfur dioxide, nitrogen dioxide, suspended particles, and ozone) have shown no major difference over the past several years between these two areas, based on the reports from the Agency of Air Quality Control in Beijing. The water supply to both areas is of equal standard, originating from the same source. Therefore, more work is needed in the area of longitudinal epidemiologic studies to identify key environmental factors and, if possible, to find strategies to modify the environment without causing harm to susceptible individuals.

In the literature, pet ownership was found to markedly increase the risk of sensitization to pets.²⁶ The prevalence of asthma, rhinitis, and skin allergy was significantly more common in families with pets in the home than in those without pets.²⁷ The prevalence of owning pets was low (1.9% cat and 5.1% dog) in Beijing. However, our data shows that when there are pets in the home there is a higher incidence ($p < 0.01$, OR = 1.49; 95% CI: 1.29–1.74) of rhinitis symptoms (epidemiological AR). Therefore, children allergic to pets may benefit from allergen avoidance at home.¹⁰ Other factors, such as eating seafood (>2 time a week) is associated with a higher incidence of epidemiological AR (OR = 1.26; CI: 1.05–1.51) but not clinical AR, suggesting a need of more longitudinal studies in order to assess the impact of lifestyle and foods on AR prevalence.

Vaccination for common infectious diseases was carried out in almost all preschool children (99.1%), but this did not seem to influence the prevalence of AR in our study. Breastfeeding (for more than 3 months) was found to be common (69.8% in urban; 72.1% in suburban) in Beijing and had a protective effect against atopic diseases.¹ Our data would support the common idea that breastfeeding should be recommended as both primary and secondary prevention measures for allergic diseases.^{1,10}

More interestingly, our study demonstrated a close link between AR and asthma in children with a history of asthma ($p < 0.01$, OR = 4.88; 95% CI: 3.48–6.86), as well as of eczema ($p < 0.01$, OR = 1.49; 95% CI: 1.15–1.94). It confirms the concept that AR is an independent risk factor for the development of asthma.¹ For other comorbidities, AR is significantly associated with otitis media, snoring, and mouth breathing, which are common diseases/disorders in children and have a significant impact on hearing and airway/breathing functions. Therefore, an appropriate treatment of AR is

important in the prevention and management of these common diseases and conditions in young children.

CONCLUSION

In conclusion, this is the first population-based random sample study that reports the prevalence of AR in preschool children in urban and suburban areas in Beijing in Asian. The results of this study demonstrate that the prevalence of AR in preschool children can be overestimated by using epidemiologic criteria. AR is a common disease in young children, which increases as the child gets older and is higher in urban than in suburban areas, suggesting an important role of lifestyle and environmental risk factors for AR in children.

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