

ORIGINAL ARTICLE

Prevalence of allergic rhinitis in 3–6-year-old children in Wuhan of China

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Summary

Background Only a few prevalence studies of allergic rhinitis (AR) have been reported in China. This study aimed to evaluate the prevalence of AR in a population of 3–6-year-old children in Wuhan, China.

Methods Sixteen kindergartens in Wuhan City were randomly selected; for each kindergarten, there were three classes from three grades (top, middle and bottom grade, 3–6 years old, respectively). Questionnaires generated by the authors were distributed and filled out by parents of the selected children, with a telephone interview subsequently. Skin prick test (SPT) was carried out on the children after a written consent was signed by the parents.

Results A total of 1211 (89.5%) valid questionnaires were returned for evaluation. The adjusted current prevalence of AR in 3–6-year-old children was 10.8% with the diagnostic criterion of nasal symptoms(+) and SPTs(+). In the SPTs(+) children, the most common inhalant allergen was house dust mites (94.7%), followed by moulds (28.4%). The prevalence of AR was higher in males than that in females (13.0% vs. 7.7%, $P < 0.05$). 15.8% and 23.2% of AR children were sensitive to egg and milk, respectively. The percentage of children sensitive to both inhalant and food allergens was 27.4%.

Conclusions We found an unexpectedly high prevalence of diagnosed AR in 3–6-year-old children within the investigated population. Dust mite was the most important allergen source for 3–6-year-old children in Wuhan.

Keywords allergic rhinitis, children, epidemiology, prevalence

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Introduction

Allergic rhinitis (AR) is a common disease with a documented increase in prevalence in different areas of the world [1]. AR affects a large percentage of the paediatric population. However, only a few epidemiological studies of AR in 3–6-year-old children have been reported [2]. Children aged 3–6 years usually behave actively, but have limited ability to express themselves verbally. Many young parents receive inadequate education about AR, and its nasal symptoms are often confused with flu or other infective rhinitis. Therefore, the condition may not be recognized by the parents, and is sometimes ignored even by physicians. Frequently, AR is associated with bothersome symptoms and the quality of life is significantly impaired in children [3]. Early detection and optimal treatment are emphasized in ARIA guidelines [2].

Data on the prevalence of AR in China mainland are sparse. The aim of our study was to investigate the prevalence of AR in a pre-school population in Wuhan, which is the centre of industry, finance, commerce, science and research, culture and education in the central region of China. As the capital of Hubei Province, Wuhan has eight million residents and covers an area of 8494 km². Some of China's metropolises such as Beijing, Shanghai, Guangzhou, Chengdu and Xi'an are all within a circle around the centre of Wuhan within a radius of 1000 km. Wuhan's climate is sub-tropical monsoon with abundant rainfall and four distinctive seasons.

Material and methods

Subject

Sixteen kindergartens located in the urban area of Wuhan were randomly selected from the complete sampling

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frame of all kindergartens in the area. In each kindergarten, three classes were randomly selected from the three grades (top, middle and bottom grade), respectively. Each class included about 30 3–6-year-old children. A questionnaire was sent to the parents of selected children, filled out by the parent, and then returned within a few days in November 2005.

Parental questionnaire

The questionnaire was generated by the authors, and checked by a group of experts of rhinology and epidemiology. Because there were no standard questionnaires of AR for 3–6-year-old children in published articles, the International Study of Asthma and Allergies in Childhood (ISAAC) of the rhinitis module for 6–7 years was referenced [4], similar to Peroni's research [5]. To increase the reliability, a third choice was added in question 1 in addition to those described by ISAAC, for the nasal symptoms of 3–6-year-old children were sometimes atypical and some parents could not determine whether the nasal symptoms were caused by cold/flu or not, although suggestions were given already. The core questions included:

1. In the past 12 months, has your child had a problem with sneezing, or a runny, or a blocked nose when he/she DID NOT have a cold or the flu? Yes [] No [] Not Sure []
(Characters of cold or flu: the nasal symptoms caused by definitive reasons (cold or flu) and often disappeared about 1 week, the accompanied symptoms included coughing and pharyngalgia. Systemic symptoms such as headache, myalgia, hypodynamia and fever might be comparably serious with flu.)
2. Has your child ever had hay fever? Yes [] No []
3. Severity of each symptom when nasal problem occurs:
 - (1) blocked nose: absence[] mild[] moderate[] severe[]
 - (2) itch nose: absence[] mild[] moderate[] severe[]
 - (3) runny nose: absence[] mild[] moderate[] severe[]
 - (4) sneezing: absence[] mild[] moderate[] severe[]

Telephone interviews were conducted for all families after the questionnaire sheets were returned. The telephone interview was carried out by a member of the research group, and two consultants in a specific consulting company after education. The purpose of the telephone interview was: (1) To verify the validity of the answer written in the questionnaire. (2) To clarify the condition of the children who chose the option 'not sure' in question 1. The consultants were required to describe the nature of cold/flu and rhinitis symptoms for the parents, but not to make the decision instead of the parents. (3) To

establish a rapport with the parents, for later observation in the future. The children who chose the option 'Not Sure' in question 1 were determined positive or negative finally after the telephone interview. Finally, the children who selected 'No' in the first two questions were considered to be negative for nasal symptoms [symptoms(–)] and classified in the non-rhinitis group; the others were considered to be positive for nasal symptoms [symptoms(+)] and classified in the rhinitis group.

Historical information was also gathered in the questionnaire, including: seasons (spring, summer, autumn, winter, during seasonal changing, perennial), keeping pets at home (no pets, cat, dog, others), triggers [when sleep at bed, dust, pollen, animals, damp (mould), cold air, tobacco fumes, strong smelling scents, others], the place in which symptoms usually occur (indoor, outdoor, both).

Skin prick tests

Skin prick tests (SPTs) were performed on all children after a written consent for SPTs was signed by the parents. The tested allergens were selected according to the common allergens of the local geographical area for 3–6-year-old children [6]. Standardized extracts for SPTs were from Allergopharma (Hamburg, Germany), including house dust mites (HDMs) (*Dermatophagoides pteronyssinus*), a mixture of moulds (*Alternaria tenuis*, *Botrytis cinerea*, *Cladosporium herbarum*, *Curvularia lunata*, *Fusarium moniliforme* and *Helminthosporium halodes*), ragweed and a trees mixture (*Betula alba*, *Fagus silvatica*, *Quercus robur* and *Platanus orientalis*). To explore the influence of food allergen in AR children, egg and milk allergens were also examined. Saline and histamine (10 mg/mL) were used as negative and positive controls. Antihistamines were suspended for at least 3 days before testing. The reaction was considered positive with a mean weal size equal to or greater than histamine (given a negative reaction to saline). The SPTs were considered positive [SPTs(+)] when any inhalant allergen was positive. The SPTs was thought negative [SPTs(–)] when no inhalant allergen was positive.

Statistical analysis

For all analyses, *P*-values of <0.05 were regarded as statistically significant. Prevalence rates were presented with their 95% confidence interval (95% CI). The χ^2 -test was also used to compare the sex, age and clinical characteristics of respondents without and with SPTs in order to assess the likelihood of selection bias.

The statistical analysis was performed using SPSS 13.0 for Microsoft Windows (SPSS Inc., Chicago, IL, USA).

The study was approved by the Ethics Committee of Huazhong University of Science & Technology.

Results

A total of 1211 (89.5%) valid questionnaires were returned for evaluation. Children in the three age groups were well matched (Table 1).

The study flow chart is shown in Fig. 1. Two hundred and ninety-two children were considered positive by the questionnaire, 859 children were considered negative, and 60 children were considered 'not sure'. The answers of the key questions in the questionnaire were highly coincident with that of the telephone interviews. After the telephone interview, 36 children who selected 'not sure' were considered to have 'rhinitis' and were classified in the rhinitis group; others were classified in the non-rhinitis group. Altogether 328 children were considered to have rhinitis.

Parents of 239 children (72.9%) among the 328 rhinitis children signed the written consent for SPTs. Seventy-two of 883 children (8.2%) agreed to attend the SPTs in non-rhinitis group. The children who attended the SPTs or not are compared in Table 2. There were no significant differences in the sex, age and severity of nasal symptoms between the children given or not given the SPTs in both groups.

Table 1. The age and sex distribution of the selected children

Age (years)	Male number (%)	Female number (%)	Total number (%)
5–6	244 (54.3)	205 (45.7)	449 (100)
4–5	219 (53)	194 (47)	413 (100)
3–4	193 (55.3)	156 (44.7)	349 (100)

The results of SPTs are shown in Table 3. The positive rate of SPTs in the rhinitis group was 39.8% (95/239), with 3–4 years 36.1%, 4–5 years 38.5% and 5–6 years 45.3% of different ages. In the SPTs(+) children, the most common inhalant allergen was HDMs (94.7%), followed by moulds (28.4%). The data demonstrated that some diagnosed AR children were sensitive to egg (15.8%) and milk (23.2%). 27.4% (26 of 95) of the children were sensitive to both inhalant and food allergens. The positive rate in the non-rhinitis group was 9.7% (7/72); the allergen distribution was similar to the children in the rhinitis group.

The adjusted prevalence rate was calculated in Table 4. The prevalence rate of nasal symptoms in children aged 3–6 years was about 27.1%. There was no significant

Table 2. Comparison of children attended skin prick tests (SPTs) or not

	Children attended SPTs	Children not attended	P-value
Rhinitis group			
Male : female	140 : 99	46 : 43	NS
(3–4 years) :	78 : 74 : 87	30 : 25 : 34	NS
(4–5 years) :			
(5–6 years)			
Symptom score	4.5(3.1–5.9)	4.5(3.1–6.1)	NS
Non-rhinitis group			
Male : female	46 : 26	610 : 529	NS
(3–4 years) :	15 : 21 : 36	337 : 390 : 412	NS
(4–5 years) :			
(5–6 years)			

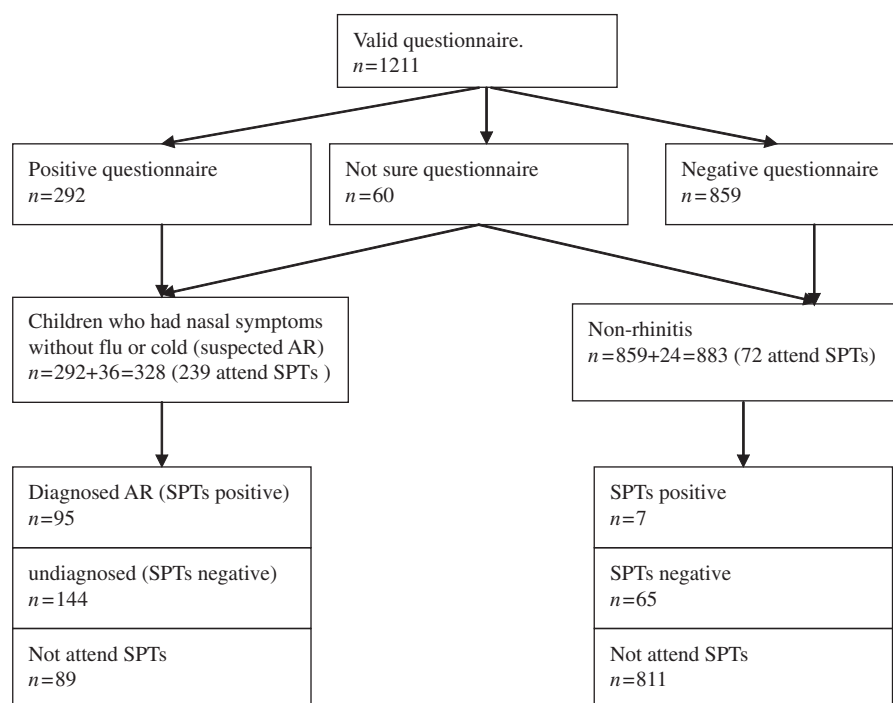


Fig. 1. Study flow chart.

Table 3. The results of SPTs

Allergen	Numbers of positive children in rhinitis group (positive rate %)	Numbers of positive children in non-rhinitis group (positive rate %)
HDMs	90/95 (94.7)	7/7 (100)
Moulds mixture	27/95 (28.4)	2/7 (28.6)
Ragweed	6/95 (6.3)	1/7 (14.3)
Trees mixture	6/95 (6.3)	0/7 (0)
Egg	15/95 (15.8)	2/7 (28.6)
Milk	22/95 (23.2)	1/7 (14.3)

HDM, house dust mite; SPT, skin prick test.

Table 5. Average scores of nasal symptoms of symptoms(+)SPTs(−) and symptoms(+)SPTs(+) children

Symptoms	Symptoms(+) SPTs(−) (95% CI)	Symptoms(+) SPTs(+) (95% CI)	P-value
Blocked nose	1.3 (0.4–2.1)	1.5 (0.7–2.2)	0.06
Runny nose	1.6 (0.6–2.8)	1.4 (0.5–2.3)	0.18
Sneezing	0.5 (0.1–1.04)	1.01 (0.4–1.6)	<0.01
Itchy nose	1.0 (0.3–1.7)	1.3 (0.6–2.1)	<0.01
Total scores	4.3 (2.5–6.2)	5.2 (3.6–6.8)	<0.01

SPT, skin prick test; CI, confidence interval.

Table 4. Current prevalence of AR in 3–6-year-old children

Evaluation criterion	Age (years)	Male prevalence, % (95% CI)	Female prevalence, % (95% CI)	Total prevalence, % (95% CI)
Nasal symptoms	5–6	28.3 (22.6–33.9)	25.4 (19.4–31.3)	26.7 (22.8–31.1)
	4–5	27.9 (21.9–33.8)	19.6 (14.0–25.2)	24.0 (19.9–28.1)
	3–4	29.0 (22.6–35.4)	33.3 (25.9–40.7)	31.0 (26.1–35.8)
	3–6	28.4 (24.9–31.8)	25.6 (22.0–29.2)	27.1 (24.6–29.6)
Nasal symptoms+ skin test	5–6	15.5 (10.9–20.0)	8.5 (4.6–12.3)	12.2 (9.2–15.2)
	4–5	11.3 (7.1–15.4)	6.8 (3.2–10.3)	9.2 (6.4–12.0)
	3–4	12.8 (8.1–17.6)	7.8 (3.6–12.1)	11.2 (7.9–14.5)
	3–6	13.0 (10.4–15.6)	7.7 (5.5–9.9)	10.8 (9.0–12.5)

AR, allergic rhinitis; CI, confidence interval.

difference in the nasal symptoms between males and females (male 28.4% vs. female 25.6%, $P > 0.05$).

In this research, nasal symptoms(+) and SPTs(+) were used as the diagnostic criteria of AR. The adjusted current prevalence of AR was 10.8% in 3–6-year-old children with the above diagnostic criteria. There was no statistical difference between each age groups ($P > 0.05$). The prevalence of AR in males was higher than that in females (male 13.0% vs. female 7.7%, $P < 0.05$). The average symptom scores of symptoms(+)SPTs(−) children compared with symptoms(+)SPTs(+) children are shown in Table 5. There were significant differences of sneezing, itchy nose and total scores between the two groups ($P < 0.000$). Historical information associated with the nasal symptoms is shown in Table 6. It was found that the occurrence of most symptoms(+) in SPTs(+) children was perennial, indoor. Keeping pets was not popular in Wuhan. Animals and pollens were not significant triggers in 3–6-year-old children in Wuhan. It was also found that there were significant differences of the allergic comorbidity between symptoms(+)SPTs(+) and symptoms(+)SPTs(−) children. The occurrence of asthma, atopic dermatitis and self-reported food allergy was much higher in symptoms(+)SPTs(+) children.

Discussion

The current work is the first study to evaluate the prevalence of AR in pre-schoolchildren in Wuhan, a

populous city in central China. Our results showed that the current prevalence of AR was 10.8% in 3–6-year-old children [diagnostic criteria: nasal symptoms(+)SPTs(+)].

The ISAAC questionnaire of 6–7-year-old children was referenced in this study as Peroni [5]. The ISAAC questionnaire is most often used in different countries or areas [7, 8]. It is a low-cost, easily applicable method and has good sensitivity and specificity [9]. However, some false-positive cases might be included, and the prevalence percentage may be influenced by different medical care experiences and patient education in different areas of the world [10]. Some methods were used (the added choice, telephone interview and SPTs) to reduce potential error. The prevalence of nasal symptoms(+) in 3–6-year-old children in Wuhan was 27.1%. In the study of Peroni [5], it was found that the prevalence of nasal symptoms(+) in 3–6-year-old children was about 16.8%, which was much lower than that in this study. This might reflect the real difference in the prevalence of nasal symptoms between Italy and Wuhan, China.

SPTs were performed after the questionnaire to investigate the allergic factors in the population studied. Standard reagents for SPTs were from Allergopharma. The species were selected according to the popular allergen of the local area. The positive rates of animal danders (cat or dog epithelia) and cockroach were comparably low for 3–6-year-old children in our clinic data [6], although they were important indoor allergens in other areas [11–13]. The reason might be feeding pets was not popular in

Table 6. Related historical information of symptoms(+)SPTs(+) and symptoms(+)SPTs(-) children

	Symptoms(+) SPTs(+) <i>n</i> = 95, number (%)	Symptoms(+) SPTs(-) <i>n</i> = 144, number (%)	<i>P</i> -value
Seasonality			
Perennial	90 (94.7)	136 (94.4)	0.23
Seasonal	5 (5.3)	8 (5.6)	
Keeping pets	2 cats, 0 dog	3 cats, 2 dogs	
Triggers			
Cold air	62 (65.3)	89 (61.8)	0.09
Dust	19 (20.0)	10 (6.9)	<0.01
Cigarette or Strong smell	21 (22.1)	31 (21.5)	0.13
Old cotton wool	30 (31.6)	22 (15.3)	<0.01
Animals	4 (4.2)	2 (1.4)	0.13
Temperature change	53 (55.8)	52 (36.1)	<0.01
Pollens	5 (5.3)	2 (1.4)	0.07
The place symptoms always occur			
Indoor	86 (90.5)	75 (52.1)	<0.01
Outdoor	2 (2.1)	18 (12.5)	
Both	7 (7.4)	51 (35.4)	
Allergic comorbidity			
Asthma	19 (20)	8 (5.6)	<0.01
Atopic dermatitis	54 (56.8)	32 (22.2)	<0.01
Self reported food allergy	12 (12.6)	7 (4.9)	0.02

SPT, skin prick test.

Wuhan, which was also shown in this study. Cockroaches have seldom seen in young families due to good living condition. Therefore, HDMs, moulds, ragweed and trees mixture were selected as the major allergens for SPT.

There were 72.9% (239/328) in the rhinitis group and only 8.2% (72/883) in the non-rhinitis group who underwent SPTs. There may be two reasons: firstly, such an investigation had seldom been conducted before, the parents did not understand the scientific research very clearly. Although SPT was explained very carefully, the parents were still not sure whether the test would be safe and not painful, especially parents of children without rhinitis symptoms. Secondly, almost all families had only one child because of the family planning policy of China. Most parents would not 'take a risk' of subjecting the child to an *in vivo* test if not necessary.

The results showed that the positive rate was 9.7% (7/72) in the children without rhinitis symptoms. Although only 8.15% children underwent SPTs, we postulated that the positive rate in general population was not high, and the positive rate in children without nasal symptoms was much lower than that with symptoms (9.7% vs. 39.8%). Eighty-nine (27.1%) suspected AR children had not been administered SPTs. There was no significant difference in the sex, age and severity of nasal symptoms between the children given or not given the SPTs. The hypothetical

prevalence should be 7.8% if all these children were SPTs(-), and 15.2% if SPTs(+).

There are some factors that might influence the prevalence of AR in children in China. Firstly, the family plan had been enforced for nearly 30 years [14]; only one child could be born in a family in urban areas. Secondly, the child was usually nursed very carefully and clean, for most families had only one child and six guardians (father, mother, grandpa, grandma, maternal grandfather and grandmother). Thirdly, most 3–6-year-old children lived in a new house in urban area, as due to the rapid economic development recently, most couples would have bought a new house before marriage. All the above factors might have decreased the possibility of exposure to respiratory infections, microbacteria and endotoxin. The prevalence of AR might increase according to the hygiene hypothesis [15].

In this study, it was demonstrated that the prevalence of AR for males was significantly higher than that for females (males 13.0% vs. females 7.7%, $P < 0.05$). These results were consistent with the previous studies [5, 16]. A report had implicated that differential expression of atopic diseases between boys and girls in early childhood was accompanied by sex-specific differences in immune response profiles [17], which might partly agree with the sexual differences of atopy.

HDMs was the major allergen among 3–6-year-old children in Wuhan both in the clinic and in this investigation. The historical information also showed that most symptoms(+)SPTs(+) children were perennial, and often occurred indoors. This might be because of the climate and geographic location of Wuhan. HDMs was also a major allergen in some other cities in mainland China [18–20]. Moreover, many symptoms(+)SPTs(+) children were sensitive to egg and milk allergen as well (27.4%), even though most of them did not show symptoms when eating such food. It had been proved that food and inhalant allergy often co-exist in very young children, and food allergies in early life are a risk factor of future inhalant allergy [21]. No one showing positive response to egg or milk when he/she demonstrated negative response to inhalant allergens in symptom(+) children. It might be postulated that children without food sensitivity in early life had a lower risk of having an inhalant allergy later.

There were some differences in the symptom scores between symptoms(+)SPTs(+) and symptoms(+)SPTs(-) children; the former had more severe sneezing, itchy nose and general symptoms. The occurrence of asthma, atopic dermatitis and self-reported food allergy was also found to be much higher in symptoms(+)SPTs(+) children, which indicates the influence of allergy. Symptoms(+)-SPTs(-) children might have other kinds of rhinitis, such as chronic rhinitis, sinusitis, non-infectious, non-AR, etc. [22]. There were few children who might be AR could be omitted because most important allergens had been

included according to our clinical data [6]. In conclusion, our study showed a high prevalence (10.8%) of diagnosed AR in 3–6-year-old children in Wuhan. More attention should be paid to AR in this age group. HDMs are the most important allergen source among 3–6-year-old children, which should also receive more attention.

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References

- 1 Phipatanakul W. Allergic rhinoconjunctivitis: epidemiology. *Immunol Allergy Clin North Am* 2005; 25:263–81.
- 2 Bousquet J, van Cauwenberge P, Khaltaev N. Allergic rhinitis and its impact on asthma. ARIA workshop report. *J Allergy Clin Immunol* 2001; 108:S147–276.
- 3 Bousquet J, Bullinger M, Fayol C, Marquis P, Valentin B, Burtin B. Assessment of quality of life in patients with perennial allergic rhinitis with the French version of the SF-36 Health Status Questionnaire. *J Allergy Clin Immunol* 1994; 94:182–8.
- 4 Asher MI, Keil U, Anderson HR *et al.* International study of asthma and allergies in childhood (ISAAC): rationale and methods. *Eur Respir J* 1995; 8:483–91.
- 5 Peroni DG, Piacentini GL, Alfonsi L *et al.* Rhinitis in pre-school children: prevalence, association with allergic diseases and risk factors. *Clin Exp Allergy* 2003; 33:1349–546.
- 6 Chen J, Kong W, Xiang J *et al.* Age features of the allergens in allergic rhinitis patients of different age in Hubei area. *Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi* 2008; 22:683–5 (in Chinese).
- 7 Strachan D, Sibbald B, Weiland S *et al.* Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Allergy Immunol* 1997; 8:161–76.
- 8 Mallol J, Clayton T, Asher I. ISAAC findings in children aged 13–14 years – an overview. *Allergy Clin Immunol Int* 1999; 11:176–82.
- 9 Asher MI, Keil U, Anderson HR *et al.* International study of asthma and allergies in childhood (ISAAC): rationale and methods. *Eur Respir J* 1995; 8:483–91.
- 10 Sen A. The morbidity of rich and poor. *Br Med J* 1998; 316:0.
- 11 Arruda LK, Ferriani VP, Vailes LD, Pomés A, Chapman MD. Cockroach allergens: environmental distribution and relationship to disease. *Curr Allergy Asthma Rep* 2001; 1:466–73.
- 12 Sarpong SB, Wood RA, Karrison T *et al.* Cockroach allergen (Bla g 1) in school dust. *J Allergy Clin Immunol* 1997; 99:486–92.
- 13 Roost HP, Künzli N, Schindler C *et al.* Role of current and childhood exposure to cat and atopic sensitization. European community respiratory health survey. *J Allergy Clin Immunol* 1999; 104:941–7.
- 14 Zhang JJ, Fu BJ. Discussion on Chinese population control. *J North China Inst Water Conservancy Hydroelectr. Power (Soc Sci)* 2007; 23:42–4.
- 15 Fuleihan RL. The hygiene hypothesis and atopic disease. *Curr Opin Pediatr* 2002; 14:676–7.
- 16 Kulig M, Klettke U, Wahn V, Forster J, Bauer CP, Wahn U. Development of seasonal allergic rhinitis during the first 7 years of life. *J Allergy Clin Immunol* 2000; 106:832–9.
- 17 Uekert SJ, Akan G, Evans MD *et al.* Sex-related differences in immune development and the expression of atopy in early childhood. *J Allergy Clin Immunol* 2006; 118:1375–81.
- 18 Wang CS, Zhang L, Han DM, Zhou B, Zhao Y, Wang XD. Prevalence of sensitization to aeroallergens in Beijing patients with allergic rhinitis. *J Clin Otorhinolaryngol* 2006; 20:204–7 (in Chinese).
- 19 Zhang QG, He HY. Allergens in patients with allergic rhinitis in Qingdao area. *J Otolaryngol Ophthal Shandong Univ* 2006; 20:520–1 (in Chinese).
- 20 Bao YS, Yin M, Cheng L *et al.* Atopic sensitization to perennial allergens among schoolchildren in Yixing City. *Acta Universitatis Med Nanjing (Nat Sci)* 2005; 11:847–50 (in Chinese).
- 21 Wickman M, Lilja G, Soderstrom L, van Hage-Hamsten M, Ahlstedt S. Quantitative analysis of IgE antibodies to food and inhalant allergens in 4-year-old children reflects their likelihood of allergic disease. *Allergy* 2005; 60:650–7.
- 22 Bachert C. Persistent rhinitis – allergic or nonallergic? *Allergy* 2004; 59:11–5.