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The Changing Epidemiology of Asthma in Shanghai, China

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Abstract

Objectives—To investigate the prevalence of bronchial asthma in Putuo district in Shanghai, China.

Methods—Cross-sectional, community-based study with random sampling of a district with a population of one million. These subjects were residents of the district and 6 or more years of age. Questionnaire and spirometry were completed in all subjects. Asthma was defined as physician-diagnosed asthma.

Results—We surveyed 27,042 participants, of which 46.3% were male, and 53.7% were female. The prevalence of asthma was 1.80% (488/27,042). Asthma prevalence in males was 2.11%, which was significantly higher than 1.54% in females. The prevalence of allergic rhinitis, chronic urticaria or eczema in asthmatic population was 35.45%, 9.02% and 3.48%, respectively. However, the proportions of these allergic diseases in total population were 4.49%, 0.86% and 0.73%. 39.34% asthmatic subjects had a family history of asthma. The most prominent causes of asthma attack were cold air, respiratory infection, dust inhalation and exercise. Pulmonary function of 428 asthma patients was analyzed: 228 (53.27%) patients had FEV1%pred lower than 80%. Patients older than 65 year had lower FEV1%pred than other age groups ($P < 0.01$).

Conclusions—The prevalence of physician-diagnosed asthma in urban of Shanghai has increased in recent years. The most important causes of asthma attack were cold air, respiratory infection and dust exposure. The proportion of individual with decreased percent predicted FEV1 increased with age. Strengthening the prevention and treatment of asthma, especially in children with asthma, may decrease the population burden of asthma.

Keywords

bronchial asthma; epidemiology; China

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Introduction

Asthma is one of the most prevalent chronic respiratory diseases, affecting almost three hundred million people in the world [1]. The prevalence of asthma has increased in many countries and areas. Asthma prevalence has increased from 7.4% in 2001 to 8.2% in 2009 in USA [2]. In Australia, the prevalence increased from 6% in 1996 to 19% during 2005-2007 [3]. The International Study of Asthma and Allergies in Children (ISAAC) investigated the prevalence of asthma in many countries for years showing an increase in the prevalence of asthma and wheezing in the most recent Phase III survey when compared with Phase I [4].

Previously, we conducted an asthma study in Pudong Area of Shanghai in 1997. The prevalence of asthma was 0.41% [5]. The current survey was done to assess whether the prevalence of asthma increased after a decade. We completed a cohort study in Putuo District in Shanghai during the period of August, 2007- January, 2010. Our aim was to evaluate the epidemiology of chronic diseases in Shanghai, China. Asthma, allergic rhinitis, and eczema were also investigated in this study.

Methods

Study design and data collection

The Shanghai Putuo study, collaboration between Harvard School of Public Health and Shanghai Putuo District People's Hospital, recruited subjects from August 2007 to January 2010 from Putuo District in Shanghai, China. The Institutional Review Board of the Harvard School of Public Health and Putuo District People's Hospital approved this study. Study subjects were recruited based on random selection from census track data with following eligible criteria: age 6 years and older with no restrictions with regard to prior health history. All subjects provided informed consent to participate in this study.

Putuo District is located northwest of the central area of Shanghai, China. In 2010, the region's total registered population was about 1.17 million [6].

All subjects were interviewed face-to-face in person by trained personnel using structured questionnaires. The questionnaires include socio-demographic factors (age, gender, education, marital status and household income), smoking history (smoking status, pack-years of smoking, and second-hand smoke), occupational history and medical history. Respiratory disease history, allergic history, family history and St's George questionnaire was used if the subject reported respiratory symptoms in the prevalence survey. The definition of asthma was physician- diagnosed asthma.

Blood pressure, height, weight, waist circumference were measured during the physical examination. Pulmonary function was tested using the Micro Plus hand held spirometer (Micro Medical Limited, U. K.) The forced expiratory volume of first second (FEV1) and forced vital capacity (FVC) were recorded. All subjects were tested at least three times and the best acceptable values were recorded.

Statistical analysis

All data were entered using Epidata. Statistical analyses were performed using SPSS version 16.0. Data were presented as mean±standard deviation (SD) or percent of total number. The main analysis was ANOVA. $P < 0.05$ was considered to be statistically significant. For FEV1, to avoid over adjustment, age and height were not included because of it was described as the percent of predicted lung function.

Results

Demographic characteristic of survey population

Demographic characteristics of the survey population are shown Table 1. The total number of respondents was 27,042. Of whom 12,519 (46.3%) were male, and 14,523 (53.7%) were female. The range of age was 6-102 yr. Mean age was 46.97 ± 18.85 yr. 16.5% subjects were received university education. Subjects graduated from the junior high school, senior high school and junior college were 25.5%, 28.7% and 13.8%, respectively. The common current occupations were professional, office and retired person (20.2%, 11.6% and 37.9%, respectively). Current smokers and ex-smokers were 21.3% and 3.8%, respectively.

Asthma prevalence

A physician-diagnosis of asthma was reported by 488 subjects, yielding a prevalence of 1.80%. The prevalence in males was 2.11% (264/12,519), higher than the prevalence in females which was 1.54% (224/14,523). The ratio of asthma prevalence in male and female was 1.37:1.

The prevalence of asthma in males under 18 was 5.22%, and 2.37% in females of same age ($\chi^2=10.505$, $P<0.01$). The prevalence in males and females was 1.80% and 1.52% respectively between 19-64 year of age ($\chi^2=2.366$, $P>0.05$). The prevalence of asthma was 2.10% and 1.31% in male and female in subjects older than 65 year of age ($\chi^2=4.191$, $P<0.05$). The change of asthma prevalence with gender and asthma is shown figure 1.

Asthma accompanied with other allergic diseases

Patient data revealed the following proportions: 35.45% allergic rhinitis, 9.02% eczema and 3.48% chronic urticaria, respectively, among the 488 asthma patients. The proportions of allergic rhinitis, eczema and chronic urticaria in the total population were 4.49% (1214/27042), 0.86% (232/27042) and 0.73% (197/27042), which were significantly lower than in asthma patients ($P<0.01$).

Family history of asthma in asthmatics

39.34% of asthma patients reported a family history of asthma. Maternal asthma was reported at a prevalence of 11.68% which was the highest among other family members. Next most common was father, which was 10.45%. The percentages of asthma in relatives are showed in table 2.

Causes of asthma exacerbations

In this study the most common causes of asthma exacerbations were cold air inhalation, respiratory infection, dust inhalation and exercise. The percentages of each reported were 67.6%, 55.6%, 30.9% and 16.5%, respectively.

Pulmonary function

Because children under 12 years old have no reference value of pulmonary function, the pulmonary functions of these subjects were not analyzed. Excluding those with poor test performance and refusing subjects, 428 subjects with pulmonary functions were analyzed. 228 (53.27%) of subjects had a FEV1%pred lower than 80% predicted. We stratified these asthma patients into three groups according to age: 12-18 yrs, 19-64 yrs and older than 65 yrs. In these three groups, the average FEV1%pred predicted was $84.6 \pm 11.43\%$, $77.50 \pm 20.13\%$ and $55.01 \pm 24.00\%$, respectively. FEV1%pred of the elder group was significantly lower than other two groups ($P < 0.01$). The percentage of subjects in these three groups with abnormal FEV1%pred was 27.27% (9/33), 50.15% (167/333) and 83.87% (52/62), respectively (see Table 3).

Functionally, the subjects were divided into four groups according to FEV1%pred, group I: FEV1%pred $\geq 80\%$, II: FEV1%pred $< 80\%$ and FEV1%pred $\geq 60\%$, III: FEV1%pred $< 60\%$ and FEV1 $\geq 40\%$, IV: FEV1%pred $< 40\%$. The mean age and asthma duration of each group are shown in table 4. The lower FEV1%pred, the older mean age. The correlation coefficient between FEV1%pred and age was -0.479 , while it was -0.148 between FEV1%pred and asthma duration.

Quality of life

The average SGRQ score of these asthma patients was 13.95 ± 1.88 . With aging the mean SGRQ score increased. SGRQ score in subjects in the tails of age groups, i.e. those over 65, was significantly higher than in subjects under 18, as well as in the younger age group of 19-64 years. The mean SGRQ scores of these three groups were 34.55 ± 22.94 , 6.73 ± 7.17 and 11.00 ± 16.46 , respectively. Pulmonary function had a positive relation with quality of life ($r = 0.405$, $P < 0.001$).

Discussion

Asthma prevalence varies between and among countries and areas. The results of surveys in different provinces in China are also not uniform. The surveys in Liaoning province in 1999 and in Henan province in 2000 showed that the asthma prevalence was 1.25% and 1.05 %, respectively [7-8]. Our survey showed the asthma prevalence was 1.80%. Of note, our result was 4.4 times higher than a previous Pudong Jinqiao survey in Shanghai in 1997 that reported at 0.41% [5]. These two areas are both in the downtown area of Shanghai with similar population characteristics. These two surveys were done by the same team and used same methods. The results of these two investigations showed that asthma prevalence in urban Shanghai has increased markedly since 1997.

In this survey, asthma prevalence was highest in children under 18 yr, then declined with age, then increased in males over 65 yr. We conducted another survey of asthmatics in primary and middle school students in 2007, in which we found that 28.8% (81/281) children had disease remission at different ages, most commonly ages 6-8 and 12-13 [9]. Some asthma patients had remission in adolescence, which may be one of reasons that asthma prevalence in adults was lower than in children.

Asthma prevalence differs with gender, with males higher than females. An asthma survey in Henan Province of China in 2000 showed a similar result, with the prevalence ratio in males and females of 1.23:1 [7].

Asthma is usually accompanied by other allergic diseases, and our results are consistent with other studies. Epidemiologic studies showed that about 30-80% asthma patients also have allergic rhinitis [8-10], supporting the hypothesis that asthma and allergic rhinitis are 'one airway, one disease' [11]. Effective AR control is one of method of asthma control.

The most popular triggers of asthma attacks in our survey were cold air, respiratory infection and dust. Asthma is also often an allergic disease. Cold exposure may cause airway contraction and asthma attack [12]. Respiratory infection, especially viral infection, is also the most popular precipitant of an asthma attack [13]. There are large concentrations of dust mites in the Shanghai area, which is one of main allergens of asthma attack. We did skin tests in asthma patients in the Pudong Jinqiao survey in Shanghai in 1997, and showed that 73.1% patients had a positive reaction to mites, significantly higher than other allergens [5]. Hence, respiratory infection prevention and treatment, reducing cold air and dust exposures are effective methods to reduce asthma attacks.

The Global Initiative for Asthma (GINA) proposes one of the goals of asthma control is to maintain pulmonary functions near normal. The results of PFTs in our study showed over 50% subjects had impaired lung function, especially in patients older than 65 years. However, asthma duration was not associated with FEV1%pred. In the survey in primary and middle school students in 2007 we found that the percentage of patients with standard treatment of asthma was very low. There were only 22.2% asthma patients using an inhaled corticosteroid in patients with ACT score under 19 [9]. Hence, an important goal is to achieve asthma control earlier can maintain pulmonary function normal or near normal, and improve life quality of asthma patients.

The study of Pereira [14] showed the SGRQ score in moderate and severe asthma was 31.9 ± 20.2 . The SGRQ score in our survey was 13.95 ± 1.88 . The SGRQ score was increased in patients older than 65 year, and most of these patients had an abnormal FEV1%pred.

According to the results of this survey, the prevalence of asthma in urban of Shanghai has increased substantially over the past decade. Strengthening the prevention and treatment of asthma, improving asthma symptoms, maintaining pulmonary function near normal, especially in children with asthma, may decrease the burden of asthma in urban Shanghai.

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Figure 1.
Asthma prevalence at different ages by gender

Table 1

Demographic characteristics of the population

Variable	Results
Number	27042
Gender (%)	
Male	46.3
Female	53.7
Age (years), mean $\pm$ SD	46.97 $\pm$ 18.85
Education level (%)	
illiteracy	4.4
Primary school	11.1
Junior high school	25.5
Senior high school	28.7
Junior college	13.8
University or graduate school	16.5
Occupation (%)	
Agriculture	0.5
Worker	5.6
Professional	20.2
Office	11.6
Service	6.0
Housework	2.2
Retired	37.9
Others	15.8
Smoking status (%)	
Current smokers	21.3
Ex-smokers	3.8
Non-smokers	74.9

Table 2

Characteristics of asthmatic subjects

	n	Percentage (%)
Subjects diagnosed asthma		
male	264	2.11 (264/12,519)
female	224	1.54 (224/14,523)
Smoking status of asthmatic subjects		
Current smokers	76	15.6 (76/488)
Ex-smokers	37	7.6 (37/488)
Asthma with other allergic disease		
Allergic Rhinitis	173	35.45 (173/488)
eczema	44	9.02 (44/488)
urticaria	17	3.48 (17/488)
Asthma in family members		
father	51	10.45 (51/488)
mother	57	11.68 (57/488)
grandparents	38	7.79 (38/488)
Maternal grandparents	21	4.30 (21/488)
sibling	28	5.74 (28/488)
children	30	9.5 (30/488)
grandchildren	11	8.6 (11/488)

Table 3

Predicted FEV1 by age

Age (yr)	n	Mean FEV1%pred	Subjects with FEV1%pred<80% N (%)
12-18	33	84.61±11.43	9 (27.27%)
19-64	333	77.50±20.13	167 (50.15%)
65	62	55.01±24.00	52 (83.87%)

Table 4

Mean age and asthma duration by FEV1

FEV1%pred	Mean age (yr)	Asthma duration (yr)
FEV1%pred ≥80%	41.34±16.01	25.57±14.99
60% FEV1%pred<80%	47.16±16.38	30.26±17.04 *
40% FEV1%pred<60%	58.05±15.48	32.73±17.76 *
FEV1%pred<40%	65.92±13.93	29.82±20.01

* Asthma duration was significantly different compared with patients of FEV1%pred ≥80% (p<0.05).