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An epidemiology study of bronchial asthma in the Li ethnic group in China

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ABSTRACT

Objective: To investigate the prevalence and risk factors of bronchial asthma in the Li ethnic group in Hainan, China. **Methods:** This study employed a stratified random sample design using custom-designed questionnaires. Subjects with asthma-like symptoms were first identified by two rounds of surveys and then confirmed by respiratory physicians using pulmonary function test, bronchial dilation test and challenge test. Demographic data, information on family history of asthma, history of allergies, smoking habits, domestic cooking fuel and other potential risk factors were collected. Logistic regression was performed to evaluate risk factors for asthma. **Results:** The prevalence of asthma in the Li ethnic group was 3.38%, much higher than the national average level in China. Aging, agriculture industry (the rubber industry in particular), rural residence, family history of asthma, history of allergies, cold air, inhalation of dust and irritant gases, smoking, domestic cooking fuel and living environment were associated with increased risk of asthma. **Conclusions:** The high prevalence of asthma in the Li ethnic group highlights the importance of asthma prevention and treatment in this population. Risk factors indentified in this study warrant special attention. Elevating public awareness about asthma in local communities will benefit the prevention of the disease.

1. Introduction

Bronchial asthma is a common chronic respiratory disease, one of the major chronic diseases threatening the world's population. The prevalence of asthma in many countries has risen steadily in recent years to levels between 0.3% and 17.0%[1-3]. The prevalence of asthma in China is about 1.5% or higher[4]. The Global Initiative for Asthma divides risk factors for asthma into host factors and environmental factors. Host factors include genetic predisposition, gender, race and obesity[5-8]. Environmental factors include allergen exposure, infection, air pollution, occupational influence, smoking, living environment, family size, diet and socioeconomic status[9-13]. Hainan, the southernmost province of China, has high risk factors of asthma due to its natural environment, weather condition, and the inhabitants' diet and lifestyle. However, epidemiological studies of the asthma status in Hainan are still inadequate. The Li ethnic group has lived in the tropical regions for many generations with little intermarriage with the outside world. The current study investigated the prevalence and risk factors of asthma in this group and provided crucial epidemic data for the prevention and treatment of the disease.

2. Materials and methods

2.1. Subjects

This study used a stratified (urban/rural) clustered sample design. Subjects were Li ethnic people randomly selected

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from various regions in Hainan that are heavily inhabited by these people, including southern regions such as Sanya (n=2 637) and Lingshui (n=2 449), central regions such as Five-Finger Mountain (n=786), Baisha (n=929), Qiongzhong (n=803) and Baoting (n=971), and western regions such as Dongfang (n=4 475), Danzhou (n=1 186), Ledong (n=1 325) and Changjiang (n=1 003). A total of 130 502 long-term residents of the Li people in Hainan, aged from 2 to 90, participated in this study, accounting for 1.05% of the total Li population in Hainan. Descendents of intermarriages in the past three generations were excluded from this study.

2.2. Asthma survey and physical examination

The questionnaires employed were custom-designed for this study. Survey contents included demographic information such as gender, age, education, income, occupation and employment history; potential risk factors such as personal and family medical history, smoking habits, cold stimulation and living environment; and information on asthma diagnosis and medication history. Community workers were recruited and trained in basic knowledge of asthma. They then interviewed residents in their respective community using a questionnaire on asthma symptoms. Interview respondents who described asthma-like symptoms in this questionnaire were selected by physicians to complete a second in-depth questionnaire of 81 questions. The results obtained from the second questionnaires were screened based on diagnostic standards of asthma and chronic obstructive pulmonary disease. Then subjects with asthma-like symptoms were examined by respiratory physicians using pulmonary function test, bronchial dilation test and challenge test. The administration of survey and follow-up physical examinations was standardized and strictly monitored by trained medical staff to ensure consistency among different test locations. A total of 441 asthmatic patients were identified in this study. The control group comprised 1 296 age-matched healthy subjects randomly selected from the same test locations. Questionnaire recovery rate and valid rate were both over 99%.

2.3. Diagnostic criteria of asthma

The following diagnostic criteria of bronchial asthma were used in both questionnaires and lung function tests. (1) Subjects were diagnosed with asthma in the respiratory department of 3A-grade hospitals and had received asthma treatment. (2) Subjects had seasonal or periodic breathing difficulties with self-reported or doctor-diagnosed wheezes in the lungs. Subjects recovered by themselves or after medication. Potential causes of symptoms included allergen exposure, cold air, physical and chemical stimulation, viral upper respiratory infection and exercise. (3) Subjects showed no typical symptoms of asthma nonetheless showed positive results in the bronchial dilation test. If subjects fit any of these three criteria and diseases other than asthma could be excluded from causes of wheezing, these subjects were recognized as bronchial asthma patients.

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2.4. Statistical analysis

Data were double entered using the Epidata 3.01 software. Statistical analyses included descriptive statistics, chi-square test and logistic regression, and were performed using the SPSS 13.0 software. $P < 0.05$ was considered statistically significant.

3. Results

3.1. The prevalence of asthma in the Li ethnic group in Hainan

The current study investigated 13 050 Li people in Hainan and identified 441 cases of asthma patients with the prevalence of 3.38% (Table 1). A total of 421 adult patients were recorded in 11 698 adult subjects with the prevalence of 3.6%, compared with the prevalence of 1.48% in children (20 children patients out of 1 352 children subjects).

3.2. Gender and age difference in the prevalence of asthma in Li people

The prevalence of asthma in male and female subjects was not significantly different from each other ($x^2 = 0.928$, $P = 0.336$) (Table 1). The prevalence of asthma increased with age for both genders (male: $x^2 = 31.992$, $P < 0.01$; female: $x^2 = 27.294$, $P < 0.01$) (Table 1).

3.3. Occupational difference in the prevalence of asthma in Li people

The prevalence of asthma was highest among people in agriculture (4.08%), and was lowest among business people (1.97%) (Table 2). Within agriculture industry, people in the rubber industry had the highest prevalence of asthma (4.62%), significantly higher than in the planting industry ($P < 0.01$) (Table 2).

3.4. Region difference and urban/rural difference in the prevalence of asthma in Li people

The central regions in Hainan had the highest prevalence

of asthma (4.90%), followed by the western regions (3.42%) and the southern regions (2.30%) (Table 3). The prevalence of asthma in the rural population (3.85%) was significantly higher than that in the urban population (2.63%, $P<0.01$) (Table 3).

3.5. Risk factors for asthma

Table 4 summarizes risks factors for asthma. A total of 29.01% of asthma patients reported a family history of asthma, significantly higher than the control group (8.64%; $x^2 = 114.80$, $P < 0.01$). Maternal history of asthma was particularly important since it was reported by 15.65% of asthma patients. History of allergies was also more common in asthma patients (31.07%) than in the control group (5.48%; $x^2 = 204.37$, $P<0.01$). Common causes included allergic rhinitis, urticaria, food allergy, drug allergy, dust and dust mite allergy, pollen allergy and irritating gases. Smoking was another important risk factor: smoking rate in the asthma group (30.39%) was much higher than that in the control group (22.61%, $x^2 = 10.74$, $P < 0.01$). Other risk factors for asthma included cold air, inhalation of dust or irritant gases, strenuous exercise or exertion, excitement or other emotions, using straw or wood as domestic cooking fuel, living in thatched cottages and living together with livestock.

Table 1
Gender and age difference in the prevalence of asthma in the Li people.

Age (year)	Male		Female		Total	
	Sample size	Prevalence (*n*, %)	Sample size	Prevalence (*n*, %)	Sample size	Prevalence (*n*, %)
2–10	452	6 (1.33)	582	9 (1.55)	1 034	15 (1.45)
11–20	1 068	21 (1.97)	985	17 (1.73)	2 053	38 (1.85)
21–30	1 152	28 (2.43)	1 161	26 (2.24)	2 313	54 (2.33)
31–40	1 025	39 (3.80)	984	35 (3.56)	2 009	74 (3.68)
41–50	653	27 (4.13)	604	25 (4.14)	1 257	52 (4.14)
51–60	669	30 (4.48)	649	29 (4.47)	1 318	59 (4.48)
> 60	1 641	84 (5.12)	1 425	65 (4.56)	3 066	149 (4.86)
Total	6 660	235 (3.53)	6 390	206 (3.22)	13 050	441 (3.38)

Table 2
Occupational difference in the prevalence of asthma in the Li people.

Occupation	Sample size	Prevalence (*n*, %)	x^2	*P*
Agriculture	6 808	278 (4.08)	–	–
Planting	1 296	37 (2.85)	–	–
Rubber	3 115	144 (4.62)	7.269	0.007
Tea	1 423	56 (3.94)	2.397	0.122
Rice processing	974	41 (4.20)	3.075	0.080
Industry	1 403	41 (2.92)	4.200	0.040
Aquaculture	1 228	31 (2.52)	6.839	0.009
Business	1 117	22 (1.97)	11.772	0.001
Public officials	1 425	42 (2.95)	4.071	0.044
Others	1 069	27 (2.53)	6.023	0.140

Occupational differences within the agriculture industry were significant ($x^2 = 7.427$, $P = 0.059$). Planting served as the reference group for comparisons with other agriculture industries with corrected significance level of 0.017. Occupational differences between different industries were also significant ($x^2=23.982$, $P=0.000$). Agriculture served as the reference group for comparisons with other industries with corrected significance level of 0.01.

Table 3
Region difference and urban/rural difference in the prevalence of asthma in the Li people.

Regions	Sample size	Prevalence (*n*, %)	x^2	*P*
Regional distribution			42.90	0.000
Southern	5 086	117 (2.30)	43.12[a]	0.000
Central	3 489	171 (4.90)	10.85[b]	0.001
Western	4 475	153 (3.42)	11.04[c]	0.001
Urban and rural areas				
Urban	5 014	132 (2.63)	13.90	0.000
Rural	8 036	309 (3.85)		

a: comparison between the southern and central regions; b: comparison between the central and western regions; c: comparison between the western and southern regions. The corrected significance value is 0.016.

Table 4
Risk factors for asthma in the Li people.

Risk factors	Asthma group (*n*, %)	Control group (*n*, %)	x^2	*P*	*OR* (95% *CI*)
Family history of asthma					
Total	128 (29.01)	112 (8.64)	114.800	0.000	4.323 (3.259–5.735)
Father	44 (9.98)	32 (2.47)	44.330	0.000	4.378 (2.739–6.998)
Mother	69 (15.65)	59 (4.55)	59.330	0.000	3.889 (2.696–5.610)
Both sides	29 (6.58)	15 (1.16)	39.130	0.000	6.011 (3.191–11.322)
Siblings	21 (4.76)	13 (1.01)	24.220	0.000	4.935 (2.449–9.941)
Other	26 (5.89)	21 (1.62)	22.850	0.000	3.804 (2.118–6.832)
No	272 (61.69)	968 (74.69)	27.280	0.000	0.545 (0.434–0.686)
Unclear	41 (9.29)	216 (16.67)	14.180	0.000	0.513 (0.360–0.729)
History of allergies					
Allergic rhinitis	66 (14.97)	28 (21.6)	105.400	0.000	7.970 (5.048–12.585)
Urticaria	62 (14.06)	21 (1.62)	111.890	0.000	9.932 (5.976–16.506)
Food allergy	21 (4.76)	5 (0.39)	42.740	0.000	12.910 (4.838–34.450)
Drug allergy	33 (7.48)	3 (0.23)	85.250	0.000	34.860 (10.636–114.260)
Dust and dust mite allergy, pollen allergy	36 (8.16)	16 (1.23)	54.390	0.000	7.111 (3.905–12.950)
Irritating gases	29 (6.58)	9 (0.69)	53.190	0.000	10.066 (4.726–21.438)
Smoking					
Yes	134 (30.39)	293 (22.61)	10.740	0.001	1.494 (1.174–1.902)
House area (m^2)					
< 50	321 (72.79)	919 (70.91)	0.569	0.451	1.097 (0.862–1.397)
50–99	84 (19.05)	249 (19.21)	0.006	0.939	0.989 (0.752–1.302)
100–149	31 (7.03)	93 (7.18)	0.011	0.918	0.978 (0.642–1.491)
⩾ 150	5 (1.13)	35 (2.70)	3.372	0.066	0.413 (0.161–1.061)
Number of home residents					
< 5	99 (22.45)	332 (25.62)	1.770	0.183	0.841 (0.651–1.086)
5–9	289 (65.53)	848 (65.43)	0.001	0.969	1.004 (0.800–1.261)
⩾ 10	53 (12.02)	116 (8.95)	3.530	0.060	1.390 (0.984–1.961)
Causes of cough/wheezing					
Cold air	194 (43.99)	426 (32.87)	17.730	0.000	1.604 (1.286–2.001)
Inhalation of dust or irritant gases	213 (48.30)	396 (30.56)	45.500	0.000	2.123 (1.702–2.648)
Strenuous exercise or exertttion	129 (29.25)	288 (22.22)	8.910	0.003	1.447 (1.134–1.846)
Excitement or other emotions	46 (10.43)	95 (7.33)	4.240	0.039	1.472 (1.017–2.131)
Education					
Primary school and below	253 (57.37)	759 (58.56)	0.193	0.660	0.952 (0.765–1.185)
Middle school	171 (38.78)	492 (37.96)	0.090	0.762	1.035 (0.829–1.292)
College and above	17 (3.85)	45 (3.47)	0.140	0.708	1.115 (0.631–1.968)
Domestic cooking fuel					
Fuel	67 (15.19)	184 (14.20)	0.264	0.608	1.083 (0.799–1.466)
Straw or wood	328 (74.38)	743 (57.33)	39.418	0.000	2.160 (1.699–2.748)
Others	46 (10.43)	369 (28.47)	53.837	0.000	0.293 (0.211–30.41)
Living environment					
Bungalow	69 (15.65)	303 (23.38)	11.690	0.001	0.608 (0.456–0.810)
Thatched cottages	134 (30.39)	319 (24.61)	5.690	0.017	1.337 (1.053–1.698)
Humans and livestock living together	185 (41.95)	461 (35.57)	5.730	0.017	1.309 (1.050–1.632)
Other	53 (12.02)	213 (16.44)	4.910	0.027	0.695 (0.503–0.959)

4. Discussion

Hainan, located in the tropical region with high levels of pollen, has high prevalence of allergic diseases. The Li ethnic group, an indigenous people of Hainan, is a main ethnic minority there with a population of 120 million. Having lived in mountains for generations, Li people are frequently exposed to pollen and other allergens. In addition, many of them live in poor environmental conditions, cooking in damp and low-ceiling kitchens with poor ventilation. Most Li people still use straw and leaves as fuel, causing serious air pollution. As a consequence, Li people suffer high prevalence of respiratory diseases, making it imperative to conduct epidemiology studies on bronchial asthma among Li people for asthma prevention and teatment.

This study showed an overall asthma prevalence of 3.38% in Li people in Hainan. The highest prevalence was found in the central regions, which are located in remote mountains and have worse living environment compared with other regions. Interestingly, inconsistent with other studies[1], our study showed that asthma was more prevalent in rural areas than in urban areas, possibly because rural Li people suffer from poor living conditions and unsanitary environment and also have more exposure to pollen and other allergens.

The effects of gender and age on asthma prevalence were investigated in our study. We did not find any gender-specific difference. On the other hand, aging is associated with increased risk of asthma. Although often manifested during childhood, the onset of asthma can occur in all age groups. As a life-long disease, the cumulative prevalence of asthma generally increases with age.

Occupation has a major impact on the prevalence of asthma. Our study showed that people engaged in agriculture had the highest prevalence of asthma, probably due to regular contact with pollen and irritating substances. In particular, people in the rubber industry faced higher risk of asthma than people in other agricultural industries. Activities in rubber-related industries such as cultivation and processing result in heavy contact with pollen, dust and harmful gases. Special attention is required on the prevention and treatment of asthma in the rubber industry, one of the most important local industries.

Other risk factors include family history of asthma, history of allergies, exposure to allergens, smoking, domestic cooking fuel and living environment. Our study found that people with a family history of asthma had 4.323-fold risk of asthma compared with people without a family history, consistent with 3 to 4-fold risk reported previously[14]. History of allergies conferred a 6.78-fold increase in the risk of asthma. Smoking led to 1.49-fold risk, further indicating that smoking is an important risk factor. People living in poor and less hygienic environment were also more susceptible to asthma. Consistent with previous reports, indoor air pollution and allergens increased the risk of developing asthma[15,16].

The current study investigated the prevalence and risk factors of asthma in the Li ethnic group in Hainan. The Li people are at a higher risk of asthma than the national level in China, probably due to long-term exposure to pollen and other allergens as well as poor living environment. We recommend the following measures to improve the prevention and treatment of asthma among Li people: (1) Improve living environment and hygiene conditions; (2) Strengthen labor protection and reduce occupational exposure to allergens and hazardous substances; (3) Promote smoking cessation and reduce the usage of straw or wood as domestic cooking fuel; (4) Disseminate basic knowledge about asthma, its prevention and treatment in the Li ethnic group. In addition, the high prevalence of asthma, a polygenic disease, in the Li people may be affected by the fact that Li people have little intermarriage with the outside world. Therefore, future studies on the genetic analysis of the Li ethnic group will make significant contributions to the diagnosis and treatment of asthma as well as other diseases.

Conflict of interest statement

We declare that we have no conflict of interest.

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