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Analysis of the Prevalence of and the Factors Influencing Springtime Childhood Respiratory Tract Diseases in Urban Chongqing, China

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Abstract

Objective: To investigate the prevalence rate and impact factors of springtime respiratory tract diseases in children in urban area of Chongqing.

Methods: From March to May 2019, this study selected 2509 children in 5th and 6th graders from 4 elementary schools in an urban district of Chongqing City Proper. An epidemiological survey and pediatric pulmonologists inquiry were conducted to explore the prevalence rate of children's respiratory diseases during one month.

Results: The results showed that 756 (31.82%) children in total contracted respiratory system diseases. The prevalence rates of pneumonia and bronchitis in children exposed to smoking by family members at home was higher than the rate in children of the counterparts (P<0.05). The prevalence rate of asthma in children who had experienced relocation or home renovation more than 3 times was higher than the rate in children who had not experienced any relocation or home renovation (P<0.05). After adjustment for age and sex, the risk of asthma in children who had experienced relocation or home renovation more than 3 times was 8.934 (95% CI=1.973, 40.448) times greater than the risk in children who had not experienced relocation or home renovation (P<0.05). The risk of pneumonia or bronchitis in children exposed to smoking by family members at home was 1.890 (95% CI=1.012, 3.530) times the risk for children of the counterparts (P<0.05, Table 4).

Conclusion: The prevalence rate of children's respiratory diseases was high in spring in urban area of Chongqing. In order to improve the health of children, we should pay more attention to community health services and lifestyles intervention.

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Introduction

Childhood respiratory tract diseases are a global problem and a severe challenge faced by pediatricians [1]. Among common pediatric diseases, childhood respiratory tract diseases dominate pediatric clinics in China, exert severe impacts on children's health, and place a heavy burden of disease on the society and on patients' families. As a common childhood respiratory tract infection with great harmful impacts on children's health, pneumonia is an important cause of death in children under 5 years old in developing countries [2,3]. Furthermore, asthma, the most common chronic childhood respiratory tract disease, affects numerous families globally in both developed and developing countries [4]. Currently, large-scale epidemiological surveys on the prevalence of childhood respiratory tract diseases, systematic studies on the prevalence of respiratory tract diseases during peak seasons, and research on factors that influence the incidence of respiratory tract diseases are lacking in China and worldwide. The present study has great clinical impact as it collected a relatively large sample of healthy children in a community to analyze the prevalence of and the factors influencing respiratory diseases. Since springtime is the peak season for respiratory tract diseases, its selection as the study season is of great significance, and the results have important significance for the creation of preventative public health strategies by health departments that aim to reduce the incidence rate of springtime childhood respiratory tract diseases.

To achieve this goal, this study performed epidemiological surveys of 5th and 6th graders in a district of Chongqing City Proper in China between March and May 2019 and explored the effects of exposure to smoking at home and relocation on the prevalence of childhood respiratory system diseases.

Methods

From March to May 2019, this study selected 2509 children in 5th and 6th graders from 4 elementary schools in an urban district of Chongqing City Proper as study subjects from an established cohort [5,6]. One hundred thirty-three children with missing data on sex or age were excluded, and 2376 children in total were included in this study, including 1244 males (52.36%) and 1132 females (47.64%). And the inclusion and exclusion criteria were as follows: the inclusion criteria including: ① fifth or 6th graders in elementary schools;② long-term resident of the selected district; ③ informed consent form completed and signed by the guardian, and the exclusion criteria including: ① duration of enrollment at the selected school less than 6 months; ② unwillingness of the guardian or child to participate; ③ severe cardiovascular or pulmonary diseases, such as bronchopulmonary dysplasia or congenital heart disease.

Materials collection

The information was collected by the questionnaires. The questionnaires were based on relevant literatures and designed by respiratory pediatricians and epidemiologists using uniform programs and survey steps. Uniformly training was carried out for interviewers, and informed consent forms were signed both by the parents and the children. The contents of the questionnaire were as follows: demographic variables (such as parents' education level and household income), history of respiratory system diseases (such as whether the subject had contracted respiratory tract diseases in the past month and the types of respiratory tract disease contracted, including upper respiratory tract infection, bronchitis, pneumonia, or asthma), and major risk factors related to respiratory system diseases (such as the living environment and the presence of a smoker in the family). Professionally trained interviewers provided detailed instructions for the questionnaire to the homeroom teachers and parents of the children, and all of the children completed the questionnaire with assistance from parents or guardians. During the physical exams, pediatric pulmonologists asked the children about their recent history of respiratory tract diseases and verified the accuracy of the completed questionnaire.

Statistical methods

Double data entry was performed by two people using Microsoft Access, and the consistency was verified. Measurement data were described as mean ± standard deviation. Count data were described in percentages. Comparisons among groups were performed using the chi-squared test or Fisher's exact test for the prevalence of respiratory tract diseases, and pairwise comparisons were further performed using the Bonferroni test to adjust P values. The multivariate logistic regression model was used to explore the risk factors for respiratory system diseases. The data analysis was conducted using SAS 9.4 software (Copyright© 2020 SAS Institute Inc. Cary, NC, USA). A significant difference was defined by an α level of 0.05.

Results

A total of 2496 children in 5th and 6th graders in 4 elementary schools in 2 subdistricts of an urban district in Chongqing City Proper were included in the study; they comprised 775, 624, 513 and 584 children from the 4 elementary schools and included 1107 children in 5th graders and 1389 children in 6th graders. A total of 2376 children completed the questionnaires and included in the analyses; their average age was 11.63 ± 0.60 years, and they included 1144 males and 1132 females.

The prevalence of springtime respiratory system diseases were described in Table 1. During the survey conducted between April and May 2019, 756 (31.82%) children in total contracted respiratory system diseases, including 727 (30.60%) with upper respiratory tract infection, 47 (1.98%) with bronchitis, 4 (0.17%) with pneumonia, and 17 (0.72%) with asthma (Table 1).

The relationship between demographic characteristics and respiratory system diseases in 10- to 13-year-olds was shown in Table 2. There was no statistically significant difference in the prevalence of springtime respiratory system diseases among the children based on differences in sex, age, cesarean section, intake of vitamin A and vitamin D, father's education level, mother's education level, or annual household income (all P>0.05, Table 2).

Relationship between environmental factors and respiratory system diseases in 10- to 13-year-olds was reported in Table 3. The prevalence rates of pneumonia and bronchitis in children exposed to smoking by family members at home was higher than the rate in children not exposed to smoking at home (P<0.05). The prevalence rate of asthma in children who had experienced relocation or home renovation more than 3 times was higher than the rate in children who had not experienced any relocation or home renovation (P<0.05). The presence of sources of pollution within 500 meters of the residence and the size of the residence had no statistically significant effect on the prevalence rate of childhood respiratory system diseases (all P>0.05, Table 3).

The impact factors of childhood respiratory system diseases were analyzed in Table 4. After adjustment for age and sex, the risk of asthma in children who had experienced relocation or home renovation more than 3 times was 8.934 (95% CI=1.973, 40.448) times greater than the risk in children who had not experienced relocation or home renovation (P<0.05). The risk of pneumonia or bronchitis in children exposed to smoking by family members at home was 1.890 (95% CI=1.012, 3.530) times the risk for children who were not exposed to smoking at home (P<0.05, Table 4).

Table 1: The prevalence of respiratory tract diseases in children aged 10 to 13 years in an urban area of Chongqing in spring (n=2376).

Disease	N	Prevalence (%)	95%CI
Upper respiratory tract infection	727	30.60	28.75~32.49
Bronchitis	47	1.98	1.46~2.26
Pneumonia	4	0.17	0.10~0.43
Asthma	17	0.72	0.42~1.14
Including any type of the above disease	756	31.82	29.95~33.73

CI: Confidence Interval

Table 2: The relationship between demographic characteristics and respiratory diseases in children aged 11 to 13 years.

Variables	N	Respiratory diseases	χ^2	P	Upper respiratory tract infection	χ^2	P	Bronchitis or pneumonia	χ^2	P	Asthma	χ^2	P
Sex													
Male	1244	394 (31.67)	0.026	0.873	377 (30.31)	0.105	0.746	23 (1.85)	0.387	0.534	11 (0.88)	1.047	0.306
female	1132	362 (31.98)			350 (30.92)			25 (2.21)			6 (0.53)		
Age, years													
11	1044	334 (31.99)	0.512	0.774	325 (31.13)	0.942	0.624	22 (2.11)	0.438	0.803	9 (0.86)	0.569	0.752
12	1178	377 (32.00)			360 (30.56)			22 (1.87)			7 (0.59)		
13	154	45 (29.22)			42 (27.27)			4 (2.60)			1 (0.65)		
Caesarean section [a]													
No	721	236 (32.73)	0.020	0.887	229 (31.76)	0.142	0.706	19 (2.64)	1.166	0.280	8 (1.11)	1.679	0.195
Yes	1360	441 (32.43)			421 (30.96)			26 (1.91)			8 (0.59)		
Taking VA supplements in the past six months													
No	2288	727 (31.77)	0.054	0.816	698 (30.51)	0.239	0.625	48 (2.10)	1.884	0.170	17 (0.74)	0.659	0.417
Yes	88	29 (32.95)			29 (32.95)			0 (0.00)			0 (0.00)		
Taking VD supplements in the past six months													
No	2266	718 (31.69)	0.395	0.529	689 (30.41)	0.847	0.358	46 (2.03)	0.024	0.877	17 (0.75)	0.831	0.362
Yes	110	38 (34.55)			38 (34.55)			2 (1.82)			0 (0.00)		
Father's education [b], years													
≤9	444	150 (33.78)	1.059	0.589	146 (32.88)	1.513	0.469	10 (2.25)	1.217	0.544	3 (0.68)	0.770	0.680
~12	739	229 (30.99)			218 (29.50)			12 (1.62)			4 (0.54)		
>12	881	287 (32.58)			274 (31.10)			21 (2.38)			8 (0.91)		

Mother's education[c], years													
≤9	558	177 (31.72)	0.240	0.887	172 (30.82)	0.029	0.986	13 (2.33)	1.061	0.588	3 (0.54)	2.823	0.244
~12	747	246 (32.93)			230 (30.79)			12 (1.61)			8 (1.07)		
>12	767	246 (32.07)			239 (31.16)			17 (2.22)			3 (0.39)		
Annual income [d], thousand yuan													
0~25	280	86 (30.71)	1.091	0.955	82 (29.29)	1.131	0.951	2 (0.71)	8.121	0.150	0 (0.00)	–	0.633[e]
26~50	332	112 (33.73)			106 (31.93)			9 (2.71)			3 (0.90)		
51~100	497	158 (31.79)			154 (30.99)			5 (1.01)			4 (0.80)		
101~150	320	106 (33.13)			101 (31.56)			6 (1.88)			2 (0.63)		
151~200	188	60 (31.91)			57 (30.32)			5 (2.66)			1 (0.53)		
≥201	258	79 (30.62)			74 (28.68)			8 (3.10)			3 (1.16)		

[a] 295 of missing data; [b] 312 of missing data; [c] 304 of missing data; [d] 501 of missing data; [e] Fisher's exact test.

Table 3: The relationship between environmental factors and respiratory tract diseases in children aged 11 to 13 years.

Variables	N	Respiratory diseases	χ^2	P	Upper respiratory tract infection	χ^2	P	Bronchitis or pneumonia	χ^2	P	Asthma	χ^2	P
Times of moving/ renovating houses [a]													
None	861	265 (30.78)	1.190	0.755	255(29.62)	0.813	0.846	13 (1.51)	2.260	0.520	3(0.35)	–	0.023[f]
Once	697	225 (32.28)			217(31.13)			15 (2.15)			5 (0.72)		
Twice	271	91 (33.58)			85(31.37)			7 (2.58)			2 (0.74)		
≥ Three times	135	46 (34.07)			44(32.59)			4 (2.96)			4 (2.96)[e]		
Pollution sources [b]													
No	1925	621 (32.26)	1.436	0.231	594(30.86)	2.339	0.126	38 (1.97)	–	0.724[f]	15 (0.78)	–	>0.999[f]
Yes	117	44 (37.61)			44(37.61)			1 (0.85)			0 (0.00)		
Exposure to passive smoking [c]													
No	1092	349 (31.96)	0.381	0.537	332(30.40)	0.787	0.375	16 (1.47)	4.214	0.040	5 (0.46)	2.970	0.085
Yes	981	326 (33.23)			316(32.21)			27 (2.75)			11 (1.12)		
Size of house (m^2)[d]													
≤70	552	169 (30.62)	2.259	0.323	163 (29.53)	1.630	0.443	10 (1.81)	0.997	0.607	4 (0.72)	/	>0.999[f]
71~100	891	306 (34.34)			291 (32.66)			18 (2.02)			8 (0.90)		
≥101	529	170 (32.14)			163 (30.81)			14 (2.65)			4 (0.76)		

[a]412 of missing data; [b]There are polluting companies or pollution sources 500 meters around the residential house and 334 of missing data; [c]303 of missing data; [d]404 of missing data; [e]Compared with 0 times moving or renovating residential houses after pregnancy, P<0.05; [f]Fisher's exact test.

Table 4: The multivariate logistic model analysis the impact factors of children's respiratory tract diseases.

Dependent variables	Independent variables	β	Standard error	Wald χ^2	P[a]	OR (95% CI)
Bronchitis or pneumonia (n=2073)						
	Exposure to passive smoking					
	No					1.0 (reference)
	Yes	0.636	0.319	3.984	0.046	1.890 (1.012,3.530)

Asthma (n=1964)						
	Times of moving/ renovating houses					
	None					1.0 (reference)
	Once	0.721	0.732	0.970	0.325	2.057 (0.490,8.638)
	Twice	0.748	0.916	0.666	0.414	2.112 (0.351,12.709)
	≥ Three times	2.190	0.770	8.078	0.004	8.934 (1.973,40.448)

[a] adjusted age and sex.

Discussion

The results of this study showed that the prevalence rate of springtime pneumonia in 11- to 13-year-olds is relatively high in urban district of Chongqing, China and the frequency of recent relocation or moving residential was positively correlated with the prevalence of asthma. Moreover, exposure to passive smoking by family members have significant effects on bronchitis or pneumonia in children. As acute respiratory tract infection is the most common childhood respiratory tract disease in China, accounting for over 60% of the cases seen in pediatric clinics. Acute respiratory tract infections are classified into upper respiratory tract infections and lower respiratory tract infections. Upper respiratory tract infections are more common and are mostly caused by viral infections. According to the literature, viral infection is closely related to community-acquired pneumonia and severe respiratory tract infection in children. Studies have shown that while the majority of viral infections are self-limiting to a certain degree, they are still among the main causes of human morbidity and mortality [7,8], especially in children.

A previous analysis of the classification of childhood respiratory system diseases in the China revealed that the most common viral infections of the respiratory tract were caused by respiratory syncytial virus, followed by human parainfluenza virus, rhinovirus, influenza virus, and human bocavirusm [9]. Consistent with the pattern of childhood respiratory tract diseases, the prevalence rate of respiratory tract diseases in the past month among children enrolled in this study was 31.82%; 31.10% of the children exhibited respiratory tract infections, and upper respiratory tract infections, accounted for 30.60% of the cases.

This study showed that sex is not an independent risk factor for childhood respiratory tract infections, which was inconsistent with the study by Julia Bakir et al. [10] that showed that the male sex was susceptible to acute lower respiratory tract infection. It was previously suggested that per capita household income and family history of allergy are independent risk factors for respiratory tract infections in adult [11] and in children; in contrast, this study suggested that the parents' education level and annual household income were not risk factors for childhood respiratory system diseases in the springtime. The main reasons for this finding are as follows: firstly, with improvements in the standard of living, the desire for good health and knowledge of disease prevention have significantly increased across households with various levels of education and income, and therefore, the difference in the awareness of disease prevention among parents with different backgrounds is less pronounced, weakening the connection between respiratory tract infections and family conditions; secondly, the sample size of the current study was bigger than that of the aforementioned study, and the population was selected from a cohort study and was more representative, while the other study sampled 320 cases in total from 4 administrative districts using nonspecified sampling methods and unrepresentative subjects, which could affect the accuracy of the results. Hence, the reported prevalence could not represent the average prevalence within the population. Studies have suggested that recurrent respiratory tract infections in children were significantly correlated with decreases in serum levels of vitamin A or vitamin D [12-14]. However, the current study suggested that there was no significant correlation between respiratory tract infections in children and the intake of vitamin A or vitamin D, possibly because children in this region usually consume foods rich in vitamin A and participate relatively frequently in outdoor activities. Moreover, the absence of regular supplement of vitamin A or vitamin D does not necessarily indicate a reduced serum level of vitamin A or vitamin D in the child. We will include analyses of serum levels of vitamin A and vitamin D in future studies to verify whether these factors are related to respiratory tract infections.

Passive smoking is closely related to respiratory tract infections in children [15] including both upper respiratory tract infections (such as otitis media, sinusitis, pharyngitis, and tonsillitis) and lower respiratory tract infections [16]. Many studies have found that passive smoking significantly increased the risk of contracting lower respiratory tract infections in children [3,17]. Smoke contains large quantities of chemical and carcinogenic substances, all of which may affect the developing respiratory system [18]. Passive smoking damages the respiratory mucosal cilia in children, slows down the speed of ciliary movement, and damages the mucociliary barrier of the respiratory tract, leading to lowered non-specific immunity function in children. Smoke particles can lower the immunoglobulin content in the saliva of children, resulting in damage to the specific defense mechanisms of the nasal cavity and subsequently causing respiratory tract infections [19]. Among children who were hospitalized due to community-acquired pneumonia, passive smoking increased the duration of hospitalization and the severity of pneumonia [20]. This study suggested that the probability of contracting pneumonia or bronchitis among children was markedly increased if family members smoked when the children were at home. The results of this study further confirmed the influence of smoking by family members on respiratory tract infections in children.

The main factors that induce bronchial asthma exacerbation are respiratory tract infections, weather changes, exercises, and contact with allergens, with respiratory tract infections playing the most significant role [21]. A previous study reported that home remodeling, especially with wood flooring and wallpaper, could significantly increase the incidence rate of asthma in children [22]. Another study revealed that having wood floors and painting the walls during house remodeling markedly elevated

the incidence of asthma in children [23], possibly because the PM 2.5 particles generated during remodeling resulted in the occurrence of allergic diseases such as asthma [24]. This study revealed for the first time that asthma exacerbation in children in this region had a significant positive correlation with the frequency of relocation or home remodeling, suggesting that these factors may induce asthma exacerbations. This induction of exacerbations and may be mainly related to the pollution caused by recent remodeling, which increases exposure to toxic and harmful particles and irritating odors.

Childhood respiratory tract diseases severely impact the physical and mental health of children, place a heavy burden of disease on society and families, and represent an important social public health issue. The results of this study revealed that the prevalence rate of childhood respiratory system diseases is relatively high in the springtime. Therefore, pediatric pulmonology services may need to adjust seasonally and increase the number of health care personnel to satisfy patient needs. Moreover, the results of this study showed that passive smoking is an important risk factor for bronchitis or pneumonia in children; therefore, the promotion of smoking cessation may help reduce the contraction of childhood respiratory tract infections. Relocation and home renovations are factors that induce bronchial asthma exacerbations in children. Therefore, providing timely, relevant health education to the families of asthma patients may reduce the induction of bronchial asthma exacerbations as a result of relocation or home renovations. Moreover, the results of this study increase the scientific evidence of the prevalence of springtime children's respiratory diseases and their risk factors.

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