The effect of residential environment on respiratory diseases and pulmonary function in children from a community in Jilin Province of China

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Abstract

Background Respiratory disease is a major and increasingly global epidemic that has a great impact on humans, especially children. The purpose of this study was to identify environmental risk factors for respiratory diseases and changes in pulmonary function in the different living environments. Methods A population-based, cross-sectional survey of respiratory diseases and related environmental risk factors was conducted in Jilin Province of Northeast China. The study population included students from grade third to fifth enrolled in the four schools in October 2016. Complete questionnaire information was available for 2419 children. We assess the impact of environmental factors on respiratory health in children. Results The results of multivariate logistic regression showed that a garbage station, noise or heating company around the home, purchase furniture, passive smoking and utilization of anophelifuge and disinfectant are risk factors of respiratory diseases. There is a significant difference in the measurement of lung function between the different classifications of the garbage station, noise, window opening in winter, passive smoking and the main fuel for cooking in winter et al. Conclusions We found that the environment in Changchun and Yanji cities, China, reported a garbage station, purchase furniture within a year, passive smoking, and utilization of anophelifuge and disinfectant et al may be the risk factors for respiratory diseases among school-aged children. A garbage station or noise around the home, close to the main traffic road, low frequency of opening windows in winter, passive smoking and using liquid gas may be also associated with decreased lung function.

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Results

The results of multivariate logistic regression showed that a garbage station, noise or heating company around the home, purchase furniture, passive smoking and utilization of anophelifuge and disinfectant are risk factors of respiratory diseases. There is a significant difference in the measurement of lung function between the different classifications of the garbage station, noise, window opening in winter, passive smoking and the main fuel for cooking in winter et al.

Conclusions

We found that the environment in Changchun and Yanji cities, China, reported a garbage station, purchase furniture within a year, passive smoking, and utilization of anophelifuge and disinfectant et al may be the risk factors for respiratory diseases among school-aged children. A garbage station or noise around the home, close to the main traffic road, low frequency of opening windows in winter, passive smoking and using liquid gas may be also associated with decreased lung function.

Keywords

Environmental Lung Disease,Epidemiology,Pulmonology(general)

1. Introduction

Environmental conditions play an important role in the pathogenesis and deterioration of chronic diseases[1]. Respiratory diseases is a major and increasingly global epidemic and has a great impact on humans, especially children[2]. Respiratory disease is the leading cause of death in children[3], and its prevalence rate is still increasing[4]. The lung of children are still growing, the development and function of lung are easily altered by early exposure to environmental risk factors. It is easier to inhale more environmental risk factors through breathing, because children have more physical activities than adults[5]. Environmental risk factors may have adverse effects on children's respiratory system and lead to a decline in lung function[6]. Exposure to traffic pollutants may cause children coughing, sneezing, asthma, and decreased lung function[7-9]. Phthalates, pesticides, and bisphenol-A (BPA) have been known as important risk factors for development and exacerbation of asthma[10]. In addition, environ ental tobacco smoke (ETS), air pollution and family environment may be associated with respiratory infection[11-13]. In particular, ETS exposure may cause an increase in symptoms of respiratory disease[14,15]. Most people spend most of their time at home, exposed to the risk factors in their living environment[16,17]. However, there is still less research on the impact of environmental risk factors in living environment on respiratory diseases. We examined associations between environmental risk factors in living environment and children's respiratory health, as assessed by questionnaire and Pulmonary function measurements, in a cross-sectional study of a predominantly Chinese community in Jilin Province of China.

2. Materials and methods

2.1. Study population

Changchun and Yanji city of Jilin province (China) are selected as the research cities. Two primary schools are randomly selected from each city. The study population consisted of students from grade third to fifth enrolled in the four schools in October 2016, at least 200 students are selected for each grade, and the sampling method is cluster random sampling. We assess the impact of environmental factors on respiratory health in children (n =2419).

2.2. Exposure assessment

The environmental impact factors were assessed through the parental Questionnaire. Whether there is a stinky ditch, garbage station, heating company or noise in 100 meters around home; The distance from home to main traffic road; Whether decorated house within three years; Whether bought furniture within a year; Window opening in winter; Passive smoking (smoke inhaled every day for more than 15 minutes); Main heating mode; Main fuel for cooking; The presence or absence of pets; The use of fume exhauster, insecticide, anophelifuge, moth repellant, air freshener, disinfectant, and air cleaner were queried.

2.3. Health outcome assessment

Children's health outcomes included recurrent respiratory tract infection, pneumonia, asthma, tracheitis/ bronchitis and rhinallergosis, also ascertained by the parental questionnaire. All diseases are clinically confirmed and have a clear diagnosis report. A subset of the study population underwent analysis of pulmonary function at designated hospital or medical examination center after children's weight and standing height were obtained(n = 627). The contents of pulmonary function analysis included forced vital capacity(FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow velocity (PEF), forced expiratory flow at 25%FVC (V_{25}) and forced expiratory flow at 75%FVC(V_{75}).

2.4. Ethical Standards

The Ethics Committee of Jilin Provincial Center for Disease Control and Prevention approved this study. Written informed consent was obtained from each participant signed by their parents.

2.5. Quality Control

All investigators were trained before the investigation. In the survey, a questionnaire was set up to verify the questionable questionnaire on the day. If necessary, a reinvestigation was needed to correct the mistakes and leak out the vacancy. The data were parallel double entered and corrected according to the consistency test report. The measurement instruments used were calibrated according to the same standard.

2.6. Statistical analysis

The database was established by EPIDATA 3.1, and statistical analysis was carried out by SPSS 17.0 statistical software. The categorical variables were described as numbers and frequency and the continuous variables were described as $x \pm$ s (mean $\pm$ standard deviation). The χ^2 test and t-test and were adopted on comparison between two groups. The least significant difference (LSD) procedure and the One-Way ANOVA were used to compare the means of three groups. To Analyze the environmental impact factors of respiratory diseases, we use multivariate logistics regression analysis. A P -value < 0.05 (two-tailed) was considered to be statistically significant.

3. Result

3.1 Characteristics of study population

A total of 2419 samples included in the study and the characteristics of study population listed in Table 1. The sex ratio of study population is close to 1. The educational background of most of children's parents are junior high school or above. The prevalence of respiratory diseases is 14.8%. In outdoor environmental factors, the noise is the most serious. Almost all families use fume exhauster during cooking, nearly half of households use natural gas, and other environmental factors are exposed in some families (Table 1). There were few differences between the pulmonary function testing subset and larger study sample in selected demographics, health outcome, and environmental exposures. So that the subset can represented the study population reasonably.

3.2 Monofactor analysis of the environmental risk factors of respiratory diseases

Significant differences were found in variables stinky ditch, garbage station, noise, heating company, purchase furniture, passive smoking, insecticide, anophelifuge, moth repellant and disinfectant between the population with respiratory diseases and no respiratory diseases (P <0.05). (Table 2)

3.3 Multivariable analysis of the environmental risk factors of respiratory diseases

Taking the respiratory diseases and no respiratory diseases as the dependent variable, the significant factors in the results of univariate analysis (stinky ditch, garbage station, noise, heating company, purchase furniture, passive smoking, insecticide, anophelifuge, moth repellant and disinfectant) as the independent variables, and the multivariate logistic regression was conducted to analyze the environmental risk factors of respiratory diseases. The Valuation of Variables was listed in Table 3.

As shown in Table 4, we found that garbage station, noise,heating company, purchase furniture, passive smoking, anophelifuge and disinfectant are risk factors of respiratory diseases (P <0.05).

3.4. Pulmonary function under different environmental conditions

As shown in Table 5, there was significant difference in V_{75} between garbage station and no garbage station, and the V_{75} of garbage station was lower than no garbage station (P <0.05); The PEF of noise was significantly lower than no noise (P <0.05); The FVC of children whose home is >150m from the main traffic road was significantly higher than <20m (P <0.05);The $V_{25}$of children whose window opening in winter >3 times/week was significantly higher than 1-3 times/week (P <0.05);FVC were all significantly different between passive smoking <1 day/week or passive smoking 1-2 day/week and no passive smoking (P <0.05); $FEV_1$of passive smoking 1-2 day/week was higher than no passive smoking (P <0.05); The FVC, FEV_1 and V_{75} of electric power, liquid gas and pipe-line gas were all higher than natural gas (P <0.05).

4. Discussion

We found that a garbage station, noise or heating company in 100m around the home is the risk factor of respiratory diseases in primary school students. Additionally, lung function measures decreased among children who lived in homes with a garbage station and noise within 100 meters. The respiratory tract irritant gases can be produced by the fermentation of garbage[18-20], the combustion of the garbage can cause a higher mutagenicity and polycyclic aromatic hydrocarbons (PAH) contents in the air[21]. PAH compromises the normal developmental process of respiratory airways and mutagenicity can activates the activity of PAH, they are associated with depressed lung function in children[22,23]. Similarly, The inhalable particulate matter (IPM) produced by the burning fuel of the heating company is stronger associated with respiratory diseases[24-26]. Exposure to noise facilitates diseases, children who have been exposed to traffic noise and air pollution for a long time may have more adverse health effects than exposure to air pollution alone[27]. In our study, noise is a risk factor for respiratory diseases, and the reason may be that stress is a co-factor.

The analysis of the family environment showed that purchase furniture within a year, passive smoking, anophelifuge and disinfectant may also cause respiratory diseases in primary school students, and passive smoking was associated with lower FVC and FEV_1. Hazardous respiratory effects can be produced in the furniture production, the cough and short breath of the furniture decoration students were obviously higher than that of the control group[28]. In the short period of purchase of furniture hazardous respiratory effects still exist, the incidence of respiratory diseases was increased while buying new furniture [29]. Passive smoking is known as a risk factor for lung cancer[30,31]. The results of our study suggested that passive smoking also changes lung function. Many studies have reported that humidifier disinfectants(HDs) independently increased the risk of acute lobar pneumonia and asthma in children[32-34], our study added to the evidence that disinfectants are harmful to the respiratory system. People rarely think of anophelifuge when it comes to respiratory disease, which may be caused by the lack of direct study of anophelifuge. Our research made up for this and showed that anophelifuge is a risk factor for respiratory diseases.

Although the distance from home to main traffic road, the frequency of opening windows in winter and the main fuel for cooking in winter are not the factors affecting the respiratory disease in our study, they may cause changes in the lung function. Close to the main traffic road may cause FVC decline and low frequency of opening windows in winter may cause decline in V_{25}. Other studies have also reported the effect of distance from home to main traffic road on lung function[35-37]. Additionally, we found that comparing with the use of electric power, liquefied gas and pipeline gas, children in families with liquid gas have decreased lung function measures.

Overall, our study suggested that the environmental risk factor can be assessed by questionnaire to determine their impact on the respiratory system. Appropriate reduction or elimination of these environmental risk factors could help reduce the effect of this risk[38,39]. Therefore, closely attention should be paid to these environmental risk factors to protect the health of respiratory system. Some limitations still in our study: (1) Environmental risk factors are determined by questionnaire rather than on-site exposure assessment. (2) This is a cross-sectional study with the limitations of cross-sectional study. (3) There may be some residual miscellaneous factors that have not been obtained through the questionnaire. Further studies for these additional risk factor with detailed exposure assessment are needed.

5. Conclusions

We found that environment in Changchun and Yanji cities, China, reported a garbage station, noise or heating company in 100m around the home, purchase furniture within a year, passive smoking, and utilization of anophelifuge and disinfectant may be the risk factors for respiratory diseases among school-aged children. A garbage station or noise around the home, close to the main traffic road, low frequency of opening windows in winter, passive smoking and using liquid gas as the main cooking fuel may be also associated with decreased lung function.

Conflict of interest

None

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