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Home environment, lifestyles behaviors, and rhinitis in childhood

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ABSTRACT

The prevalence of children allergic rhinitis has been increasing in China and associated factors still are not clear. In the present paper, we selected 13,335 parent-reported questionnaires of 4–6 years-old children, in a cross-sectional study from April 2011 to April 2012 in Shanghai city, and investigated associations of various factors with parent-reported allergic rhinitis (doctor-diagnosed) and rhinitis symptoms in childhood. After adjusted by age, sex, family history of atopy, and respondent of questionnaire, we find that no siblings, mother in older age during pregnancy, shorter breastfeeding, using antibiotics in the first year, and home dampness-related exposures, had significant associations with increased prevalence of the studied diseases. Location, type, building area, decoration materials and construction period of the residence, also had significant associations with these diseases. Current parental smoking and pet-keeping had no significant associations with the studied diseases. Incense-burning and using mosquito coils had significant associations with reduced risk of allergic rhinitis and with increased risk of rhinitis symptoms. Using air cleaner and cleaning the residence in high frequency had associations with increased risk, but eating fast food and ice cream often had associations with the reduced risk, of the studied diseases. Families with children being diagnosed allergic rhinitis likely change their lifestyle behaviors. In conclusion, childhood rhinitis could be influenced by heredity and many "environmental exposures". Avoidance behaviors and reverse causation in parental smoking, pet-keeping, and dietary habits for childhood rhinitis should be carefully considered.

1. Introduction

Allergic rhinitis is a common airway disorder among children and had great influence on the patients' quality of life and study at school (Greiner et al., 2011). In China, more preschool children were diagnosed allergic rhinitis by a doctor than earlier periods (Zhang et al., 2013a). International Study of Asthma and Allergies in Childhood (ISAAC) phrase one (1994–1995) and phrase three (2001), which was conducted both in Beijing and Guangzhou, found that the prevalence of hay fever (ever) in 13–14 year old children increased from 6% to 7.6% in Beijing and 2.9% to 4.1% in Guangzhou (Asher et al., 2006). A cross-sectional study on childhood allergic diseases in 2009 found that the prevalence of childhood among 0–14 year old children were 20.42% in Chongqing, 14.46% in Beijing, and 7.83% in Guangzhou of China (Zhao et al., 2010). National-averaged prevalence of allergic rhinitis for these children increased to higher than the worldwide-averaged level in the past 20 years (Greiner et al., 2011). Meanwhile, dwelling characteristics, home environment, family lifestyles, and dietary habits in China have been largely changed, along with the rapid development of building industry and the improvement of economic status (Weschler, 2009; Zhang et al., 2013b).

Therefore, there may be some associations between increasing of allergic rhinitis prevalence and changing of these environmental factors and lifestyle behaviors. Many related studies have been conducted and found that environmental exposures are notably associated with childhood allergic rhinitis among children in different countries or regions (Brunekreef, 1992; Brunekreef et al., 2012; Spengler et al., 1994, 2004; Bornehag et al., 2005; Dong et al., 2008; Naydenov et al., 2008a,b; Sun and Sundell, 2013; Dalibalta et al., 2015; Keet et al., 2015; Wang et al., 2015). The substantial differences in home environment and lifestyles among the families in various areas and in different socioeconomic status provided a

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fantastic chance for us to reveal these associations of environmental factors and lifestyles and childhood airway diseases in China. However, the related studies in China were still limited (Zhang et al., 2013a; Liu et al., 2014a).

From 2011 to 2012, we conducted a large-scale questionnaire study in Shanghai (Huang et al., 2013, 2015), which was a part of the national study (CCHH: China, Children, Homes, Health) in more than ten large cities of China (Zhang et al., 2013a). In our previous articles, we have analyzed part of the data and found that furred pet-keeping in the current residence or in the early residence at the child's birth (Huang et al., 2013), parental smoking (Liu et al., 2013b), dwelling characteristics and family natural ventilation habits (Liu et al., 2014b; Zhao et al., 2013), and dampness-related exposures (Hu et al., 2014; Wang et al., 2013a,b, 2015; Zhao et al., 2013) had significant associations with childhood asthma and related symptoms. Although some of these articles have included allergic rhinitis and rhinitis symptoms (Wang et al., 2013a,b, 2015; Zhao et al., 2013; Hu et al., 2014), there were no compassion for the factors with childhood diseases by data in our entire questionnaire. Therefore, in the present paper, we focused on childhood allergic rhinitis and related symptoms and investigated their associations with all factors we had collected in the questionnaire and which involved individual and maternal characteristics, early nursing, dwelling characteristics, environmental exposures, family lifestyle behaviors, and children's dietary habits. We also investigated dose–response relationships of several selected factors, which had been revealed in the previous studies (Huang et al., 2013; Liu et al., 2013a, 2014b; Hu et al., 2014; Liu et al., 2015), with childhood allergic rhinitis and related symptoms. We also tried to find the interaction effect of these selected factors on the studied diseases.

2. Methods

2.1. The CCHH study in Shanghai

From April 2011 to April 2012, we sampled 17,898 parents or guardians of 1–8-year-old preschool children in 72 kindergartens from five districts of Shanghai city, by a multistage hierarchical approach. Method for the selection of the surveyed kindergartens were as follows: firstly, three urban districts (Hong-Kou, Jing-An, and Zha-Bei) and two suburban districts (Bao-Shan and Feng-Xian) were selected from 18 districts (10 urban districts and 8 suburbs) of Shanghai city; secondly, all kindergartens in the selected districts were numbered and about 15 kindergartens were randomly chose in each district. More detailed distributions of these chose kindergartens in each district were shown in our previous article (Huang et al., 2015). Questionnaire was performed by two methods: (1) on-site distributed to parents or guardians of children at teacher–parent meetings at the kindergartens by our members; (2) posted to the children's teachers, who then distributed the questionnaires with an explanatory handout and guidance *via* the children to parents.

Questions about diseases and symptoms were the same as in the International Study of Asthma and Allergies in Childhood (ISAAC). Questions for children's individual and maternal characteristics, early nursing of the children, dwelling characteristics, early and current home environmental exposures, family lifestyle behaviors, and children's dietary habits, were similar to the DBH (Dampness in Buildings and Health) study in Sweden (Bornehag et al., 2005), the ALLHOME study in Bulgaria (Naydenov et al., 2008a,b), and the study in Northeast Texas, USA (Sun and Sundell, 2013). More information about the CCHH study in Shanghai were provided in our previous articles (Huang et al., 2013; Hu et al., 2014; Liu et al., 2013a, 2014b). The entire questionnaire was presented in the supplemental materials of a previous paper (Zhang et al., 2013a). All participants verbally consented for themselves and for the preschool children for whom they responded to questionnaires. The questionnaire and proposal for the CCHH study in Shanghai were approved by the ethical committee in the School of Public Health, Fudan University in Shanghai, China.

2.2. Definitions of exposures and diseases

All information which involved in this paper was provided by parents or guardians of the children. Questions about the studied "exposures" were provided in the previous article (Zhang et al., 2013a). Children were defined as having the "exposure" when their questionnaires were answered "Yes" to these questions. Herein the early residence or early indicators were defined as refer to the household at the child's birth; and the current residence or current indicators were defined as the home the surveyed child currently live in. Questions about allergic rhinitis and related symptoms were as follows: (1) Doctor-diagnosed allergic rhinitis, ever: Has your child been diagnosed with hay fever or allergic rhinitis by a doctor?; (2) Rhinitis symptoms, ever: Has your child ever had sneezing, or a runny nose or a blocked nose without a cold or flu at any time in the past?; 3) Rhinitis symptoms, during last year: Has your child ever had sneezing, or a runny nose or a blocked nose without a cold or flu in the last 12 months?. Children were defined as having the disease or symptom when their questionnaires were answered "Yes" to these questions. Family history of atopy (FHA) was defined as that at least one of the child's sibling, parent or grandparent having had at least one of the following: asthma, and/or eczema, and/or allergic nose or eye problems.

2.3. Statistical analysis

Statistical analyses were performed with using Statistical Product and Service Solutions (SPSS) (version 17.0, SPSS Ltd., USA). Pearson's chi-squared test was applied to compare prevalence of allergic rhinitis and rhinitis symptoms for different factors. Bivariate and multiple logistic regression models were used to investigate associations and dose–response relationships between "exposures" and childhood allergic rhinitis and rhinitis symptoms, and results were presented by crude odds ratio and adjusted odds ratio, respectively. Confidence intervals of 95% are also shown, with the criterion for significance in statistical analysis set at $p < 0.05$. Multiple regression models were constructed by one studied disease (as dependent variable, Yes *vs.* No), one target factor (as independent variable, Yes *vs.* No) and potential confounders, which included respondent of questionnaire, the child's sex and age, and FHA. If the target factor had more than two categories, one of the categories was selected as permanent reference (equivalently "No") and another category as corresponding variable (equivalently "Yes") in each regression model. Multiple regression models, which were constructed by setting the two variables we want to test interaction effect and their multiplicative item as independent variables, were also used to reveal the multiplicative interaction effect of the selected factors on studied diseases.

3. Results

3.1. Demographic data and basic prevalence

We selected 13,335 questionnaires of 4–6 year-olds children from the finally returned 15,266 questionnaires of 1–8 year-olds children (response rate: 85.3%), since the amount of children in 1–3 and 7–8 year-olds were very small (Huang et al., 2013, 2015; Liu et al., 2014b). Most (94.2%) of these questionnaires were filled out by the children's parents. Boys and girls had similar sample