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Early-life exposure to home dampness associated with health effects among children in Chongqing, China

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ABSTRACT

Associations between early-life exposure to perinatal dampness problems and health effects among 2917 children (3–6 years) were evaluated in this study. After adjusted for gender, age, family history of asthma or allergies, environmental tobacco smoke exposure, gestation age and house location in the logistic regression models, perinatal exposure to dampness indicators was observed to be strongly associated with some respiratory and allergic symptoms in the last 12 months, including wheezing, cough at night, rhinitis and eczema. The prevalence of theses respiratory and allergic symptoms in the last 12 months was significantly increased with perinatal-only exposure to most dampness indicators and was further increased with continuous exposure (perinatal plus current exposure). There was almost no such significant increase with current-only exposure. This study found less association between perinatal-only exposure and doctor-diagnosed diseases, and these associations may be explained by recall bias. Early-life exposure to perinatal dampness reported by parents was significantly associated with some current respiratory and allergic symptoms among children in Chongqing, China. Hence, it is necessary to pay attention to early living environment, especially home dampness, although the mechanisms are still unclear.

1. Introduction

In recent years, more and more studies have observed that self-reported dampness in buildings is associated with an increase of respiratory illness, including cough, wheezing, airway infections and respiratory symptoms [1–7]. Multidisciplinary reviews have concluded that there are adverse health effects of dampness and mold in buildings, especially on asthma and allergies. In particular, dampness and odor at home might result in an increased risk of childhood asthma [8–11]. Building dampness, as an important public health issue, contributes to asthma and allergies among children in many geographical regions [12,13]. However, there are few studies and reports on the health effects of early-life exposure to home dampness, and the understanding about the influence of early-life exposure to dampness problems on health is insufficient, especially among children [14,15].

China is a developing country under continued urbanization, and its morbidity rate of asthma among children under the age of 15 has increased sharply in recent years [16,17]. Rapid urbanization has caused much pressure on the indoor environment, which may contribute to the increase of asthma and related health problems. Studies in China have indicated that indoor environmental factors, including home dampness, may influence the prevalence of asthma and allergies among college students, school children and pre-school children [18–21]. Chongqing is a city with high indoor relative humidity, low indoor wind speed and large rainfall all over the year which can increase the risk for pronounced dampness problems, and the higher asthma morbidity as compared to other cities in China [17,22–24]. Associations between exposure to dampness in residential buildings and health have already been studied in Chongqing recently [21]. However, there are no studies that have reported on exposure in early life and preschool children's health in Chongqing or other cities that have the same climate feature in China. Hence, the objective of this study is to assess whether early-life exposure to indoor dampness in homes is associated with the development of asthma, allergies and related symptoms among pre-school children in Chongqing, China.

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2. Material and methods

This study is based on a cross-sectional questionnaire research in Chongqing, and carried out as the first phase of the study "China, Child, Homes, Health" (CCHH) [25]. Questionnaires were distributed to the parents of all 7177 children in randomly selected pre-schools in three different districts in Chongqing and were collected one week later by the teachers. The questionnaire survey has been carried out from December 2010 to April 2011.

2.1. Questionnaire

The questionnaire was adopted from a Swedish study on pre-school children and was slightly modified for the consideration of Chinese conditions [1,18]. The questionnaire includes about 80 questions on demographic data, family conditions, dwelling characteristics, home dampness and health conditions of the child and the parent who answered the questionnaire [21,25]. This paper mainly focus on two parts: home dampness and health conditions of the child. The questionnaire asked some dampness problems of the entire resident environment in the perinatal period, and all questions on home dampness are as follows:

"Current visible mold": Have you noticed any visible mold on the floor, walls or ceiling in the child's room? (yes vs. no)

"Current damp stains": Have you noticed any visible damp stains on the floor, walls or ceiling in the child's room? (yes vs. no)

"Current condensation on windows": In the winter, did condensation or moisture occur on the inside or at the bottom of windows (windowpanes) in the child's room? (more than 25cm / 5-25cm / less than 5cm / no)

"Current moldy odor": Have you been bothered by moldy smell in your residence during the last 3 months? (frequently/ sometimes/ never)

"Perinatal visible mold or damp stains": When the child was born, have you noticed visible mold or damp stains on the floor, walls or ceiling? (frequently/ sometimes/ never)

"Perinatal condensation on windows": When the child was born, did condensation or moisture occur on the inside, at the bottom, of windows (windows) in the winter period? (frequently/ sometimes/ never)

"Perinatal moldy odor": When the child was born, have you been bothered by moldy smell in your residence? (frequently/ sometimes/ never)

The questions on children's health covered respiratory and allergic symptoms in the last 12 months and doctor-diagnosed diseases, as follows:

"Wheezing in the last 12months": In the last 12 months, has your child had wheezing or whistling in the chest? (yes vs. no)

"Cough at night in the last 12 months": In the last 12 months, has your child had a dry cough at night for more than two weeks, apart from cough associated with a cold or chest infection? (yes vs. no)

"Rhinitis in the last 12 months": In the last 12 months, has your child had a problem with sneezing, or a runny, or a blocked nose when he / she did not have a cold or the flu? (yes vs. no)

"Eczema in the last 12 months": Has your child had eczema at any time in the last 12 months? (yes vs. no)

"Doctor-diagnosed asthma": Has your child been diagnosed with asthma by a doctor? (yes vs. no)

"Doctor-diagnosed rhinitis": Has your child been diagnosed with hay fever or allergic rhinitis by a doctor? (yes vs. no)

"Family history of asthma and allergies": Does asthma or allergic diseases exist in the family? (yes vs. no)

The answers were categorized into two groups: "Yes" (when the answer is "Frequently" or "Sometimes") and "No" (when the answer is "Never"). The indicator "Condensation on windows" was classified in two categories: "Yes" (when the answer is "More than 25 cm", "5–25 cm" and "less than 5 cm") and "No" (when the answer is "no"). The answer "Don't know" was excluded from the analyses. A combined dampness indicator "Current visible mold or damp stains" was defined as "Yes" if visible mold or damp stains was noticed in the child's room, otherwise it was classified as "No". Finally, home dampness includes three indicators: visible mold or damp stains, condensation on windows and moldy odor. Family history of asthma and allergies was classified as "Yes" if father, mother or siblings living in this house had asthma or allergic diseases and as "No" if none of them had these diseases.

Exposure duration depends on the time when the exposure occurred. Perinatal exposure was defined as exposure occurred when the child was born, and current exposure is referring to the situation in the child's room when the questionnaire was answered. In order to evaluate the independent influence of perinatal-only exposure to dampness, all dampness indicators were classified into four categories according to the time when the dampness indicators were found by parents: "no exposure" (if neither perinatal nor current dampness indicators were reported), "perinatal-only exposure" (if only perinatal dampness indicators were reported), "current-only exposure" (if only current dampness indicators were reported) and "continuous exposure" (if both perinatal and current dampness indicators were reported).

2.2. Data analysis

Statistical analysis was performed using the Statistical Package for Social Science (SPSS 18.0). Initially, associations were analyzed by chi-squared test for contingency tables. Then associations between home dampness indicators and health effects were calculated by multiple logistic regression, adjusting for gender of the child (boy vs. girl), age of the child (3 years vs. 4 years vs. 5 years vs. 6 years), family history of asthma or allergies (yes vs. no), environmental tobacco smoke exposure in uterus or during the first year of life (ETS exposure) (yes vs. no), gestation age ($\leq$36 weeks vs. 37–40 weeks vs. $\geq$41 weeks) and house location (urban vs. rural or suburban). Adjusted odd ratio (AOR) with 95% confidence interval (CI) was calculated. P-value less than 0.05 indicated a statistically significant level.

2.3. Ethics statement

The study complies with the Helsinki Declaration. The study and the consent procedure were approved by the Medical Research Ethics Committee of the School of Public Health, Fudan University. A written informed consent was obtained from the participants.

3. Results

Among the selected 7117 children, 5299 children participated, and the response rate is 74.5%. One parent of each child answered the questionnaire. The study was limited to the child who has lived