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Associations between home dampness-related indicators and eczema among preschool children in Shanghai, China

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Abstract

In recent years, prevalence of eczema has been increasing among preschool children in China. It's urgent to find associated factors. On basis of 13,335 questionnaires from parents or guardians for 4-6 year-old children (response rate 85.3%) in a cross-sectional study from April 2011 to April 2012 in Shanghai, the associations between home dampness related indicators and the prevalence of childhood eczema was investigated. There were 7.8%, 15.3%, 42.1%, 55.7%, and 30.7% of the surveyed residences who had visible mold spots, visible damp stains, damp clothing and/or bedding, water damage, condensation on window in winter, and moldy odor (six home dampness-related indicators), respectively. The prevalence of eczema (ever) and eczema (in the past 12 months) was 22.9% and 13.2%, respectively. These home dampness indicators had significant and strong associations with the increased risk of childhood eczema. With regard to the same indicators, the increased risk of eczema in girls was higher than in boys. Total numbers of home dampness-related indicators had notable dose-response relationships with the prevalence of childhood eczema. In conclusion, home dampness-related exposures are strong risk factors for childhood eczema.

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1. Introduction

In recent years, the prevalence of atopic eczema children in many countries had a rapid growth trend [1, 2]. As to the children, aged from 1~14 years old, the National Child Health Collaborative Group [3] carried out a national survey about allergic diseases in 1990 and 2000. Both the survey and other similar survey revealed that the prevalence of

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allergic diseases in China have been increasing [4]. In 2002, Gu et al. conducted a survey about the prevalence of childhood eczema in ten cities in China [5] and found that the prevalence among preschool children in Beijing (4.75%) was the highest, followed by Shanghai (2.78%), and Shenyang (1.10%) was the lowest. An early survey in Sweden revealed that the number of home dampness-related indicators had significant associations with home concentration of dust mites and with eczema prevalence [6]. Tham K.W. et al. surveyed 6794 preschool children in Singapore and found that 5.0% of the surveyed family had dampness-related indicators, which was strongly associated with the prevalence of childhood eczema [7]. However, related researches on home environment and childhood eczema were rare in China. Based on the China, Children, Homes, Health (CCHH) study in Shanghai, we investigated the associations of six home dampness-related indicators with the eczema prevalence.

2. Methods

2.1. The CCHH study in Shanghai

From April 2011 to April 2012, we conducted a large-scale cross-sectional Questionnaire study (CCHH phase one) in the 72 kindergartens from 5 districts (urban area: Jing-An district, Hong-Kou district and Zha-Bei district; suburban area: Bao-Shan district and Feng-Xian district) of Shanghai, and surveyed 17898 parents or guardians of 1-8 year-old preschool children. Questionnaires were distributed by two methods: 1) delivered to parents and recovered on-site by us in kindergartens at the teacher-parents meetings, and 2) posted to kindergartens where teachers delivered them to parents, and then recovered them and mailed them back to us. All the data for the present study are from the questionnaire. Early published articles provided more information about this study [1, 8, 9, 10, 11]. The CCHH study was approved by the ethical committee in the School of Public Health, Fudan University in Shanghai, China.

2.2. Questionnaire and statistical analysis

Questions on children's respiratory symptoms were the same as in the International Study of Asthma and Allergies in Childhood (ISAAC) [12]. The questions about childhood eczema were as follows: 1) eczema (ever): Has your child ever had an itchy rash (eczema), which was coming and going for the last 6 months; 2) eczema (in the last 12 months): Has your child had this itchy rash at any time in the last 12 months. Table 1 summarized the questions for home dampness-related indicators.

Table 1. Questions for home dampness-related indicators in the questionnaire.

Dampness-related indicators	Corresponding question in questionnaire
1. Residence at the child's birth	
(1) mold spots or damp stains	Did you notice there is visible mold or damp stains on the floor, walls or ceiling in the child's residence at birth?
(2) condensation on windows	Did you notice there is condensation or moisture occur on the inside, at the bottom, of windows in winter in the child's residence at birth?
(3) moldy odor	Have you been bothered by the moldy odor in the child's residence at birth?
2. Current residence	
(1) visible mold spots	Have you noticed any visible mold on the floor, walls or ceiling in the child's room?
(2) visible damp stains	Have you noticed any visible damp stains on the floor, walls or ceiling in the child's room?
(3) damp clothing and/or bedding	Have you noticed your clothing and/or bedding are damp in the last year?
(4) water damage	Have there been any flooding or other kinds of water damages in your residence?
(5) condensation on windows	In the winter, does condensation or moisture occur on the inside, at the bottom, of windows in the child's room?
(6) moldy odor	Have you during the last 3 months been bothered by the moldy odor in your residence?

The data was input and analyzed by SPSS (Version 17.0, SPSS Ltd., USA). Pearson's Chi-square test was used to compare the difference of prevalence between different sex and different groups of home dampness-related exposure. Bivariate and multivariate logistic regression models were applied to reveal associations and dose-response relationships of the home dampness-related indicators with eczema. Crude and adjusted associations were indicated

by odds ratio (OR) and adjusted odds ratio (AOR) with 95% confidence interval (CI). A $p < 0.05$ indicated significance in all statistical analyses.

3. Results

A total of 15266 questionnaires for 1-8 year-old preschool children were returned (response rate: 85.3%). We selected 13335 four to six year-old children to be analyze since the number of children in other ages are small [10]. The prevalence of eczema (ever) and eczema (in the past 12 months) of the 4-6 year-old children was 22.9% and 13.2%, respectively. The prevalence of eczema (ever) in girls was close to in boys, whereas the prevalence of eczema (in the past 12 months) in girls was a little higher than in boys (Table 2).

The prevalence of eczema in children with exposures in each home dampness-related indicator either at the child's birth home or in the current residence was higher than other children without these exposures. When the sampled children were stratified by sex, among those children live in the residence with dampness-related indicators, the prevalence of eczema in girls is significantly higher than in boys (Table 2).

Table 2. The prevalence of childhood eczema under different dampness-related indicators.

Items	Category	Total sample N(%)	Eczema (ever)			Eczema (in the past 12 months)		
			Total, n (%)	Boy, n (%)	Girl, n (%)	Total, n (%)	Boy, n (%)	Girl, n (%)
Total		13335 (100.0)	2856 (22.9)	1447 (23.0)	1396 (22.8)	1695 (13.2)	832 (12.8)	856 (13.6)
1. Residence at the child's birth								
(1) mold spots or damp stains	yes	1773 (13.6)	479 (29.2)***	238 (27.6)***	237 (30.7)***	271 (16.0)***	123 (13.9)	146 (18.2)***
	no	11222 (86.4)	2310 (21.9)	1175 (22.2)	1128 (21.6)	1390 (12.8)	691 (12.7)	694 (12.9)
(2) condensation on windows	yes	6892 (53.3)	1655 (25.4)***	831 (25.0)***	815 (25.8)***	999 (14.9)***	483 (14.1)**	511 (15.8)***
	no	6043 (46.7)	1119 (19.9)	572 (20.3)	545 (19.4)	653 (11.2)	329 (11.4)	322 (11.1)
3) moldy odor	yes	975 (8.0)	260 (28.8)***	147 (31.1)***	111 (26.0)	148 (16.1)***	76 (15.8)*	71 (16.4)
	no	11201 (92.0)	2343 (22.2)	1166 (21.9)	1169 (22.4)	1416 (13.0)	692 (12.6)	718 (13.4)
2. Current residence								
(1) mold spots	yes	987 (7.8)	264 (28.9)***	126 (26.8)*	137 (31.1)	145 (15.4)*	66 (13.6)	79 (17.5)*
	no	11603 (92.2)	2442 (22.4)	1243 (22.7)	1189 (22.1)	1474 (13.1)	724 (12.9)	743 (13.4)
(2) damp stains	yes	1939 (15.3)	529 (29.2)***	272 (28.9)***	254 (29.5)***	303 (16.3)***	149 (15.3)*	151 (17.1)**
	no	10728 (84.7)	2205 (21.9)	1116 (22.1)	1081 (21.6)	1336 (12.9)	653 (12.6)	679 (13.2)
(3) damp clothing	yes	5428 (42.1)	1277 (25.2)***	647 (25.3)***	626 (25.1)***	768 (14.7)***	372 (14.1)*	392 (15.3)**
	no	7453 (57.9)	1479 (21.1)	752 (21.3)	720 (20.9)	873 (12.1)	434 (11.9)	436 (12.3)
(4) water damage	yes	2185 (18.2)	583 (28.4)***	285 (27.2)***	295 (29.6)***	347 (16.5)***	165 (15.3)*	179 (17.5)***
	no	9820 (81.8)	1994 (21.6)	1018 (21.9)	970 (21.2)	1204 (12.7)	595 (12.4)	605 (12.9)
(5) condensation on windows	yes	5631 (55.7)	722 (28.1)***	374 (28.9)***	346 (27.3)***	468 (17.8)***	238 (17.9)***	230 (17.8)***
	no	4474 (44.3)	1464 (21.1)	729 (20.6)	728 (21.6)	856 (12.0)	411 (11.3)	439 (12.6)
(6) moldy odor	yes	3705 (30.7)	373 (28.9)***	192 (28.9)***	178 (28.8)***	214 (15.9)**	107 (15.3)*	105 (16.4)*
	no	8377 (69.3)	2200 (22.0)	1106 (21.8)	1087 (22.2)	1327 (12.9)	650 (12.5)	672 (13.3)

*0.01 ≤ $p < 0.05$; **0.001 ≤ $p < 0.01$; *** $p < 0.001$.

Besides, in the logistic regression analysis both without and with adjustment for the potential confounders, all home dampness-related indicators had significant and notable associations with the increased risk of childhood eczema. For the same dampness-related indicators, girls had a substantial higher increased risk of eczema than boys (Table 3).

When the number of the dampness-related indicators in each surveyed residence was cumulated by different methods (Table 4), the more the total number of these indicators, the higher the prevalence of eczema (both ever and in the last 12 months); Both before and after adjusted for the potential confounders, the dose-response relationships were significant and strong, especially associations between the total number of home dampness-related indicators in the current residence and eczema.

Table 3. Logistic regression analysis for association of different home dampness-related indicators and childhood eczema.

Wet description	AOR ^a , 95%CI					
	Eczema (ever)			Eczema (in the past 12 months)		
	Total	Boy	Girl	Total	Boy	Girl
1. Residence at the child's birth (yes vs. no; no = 1.00)						
(1) mold spots	1.46, 1.29-1.66***	1.32, 1.11-1.57**	1.63, 1.36-1.92***	1.31, 1.12-1.52***	1.13, 0.91-1.40	1.50, 1.22-1.85***
(2) condensation	1.25, 1.14-1.37***	1.18, 1.04-1.35**	1.33, 1.17-1.52***	1.26, 1.12-1.41***	1.15, 0.98-1.35	1.38, 1.18-1.62***
(3) moldy odor	1.46, 1.24-1.72***	1.63, 1.31-2.04***	1.30, 1.02-1.65*	1.32, 1.08-1.61***	1.31, 1.00-1.73	1.35, 1.02-1.80*
2. Current residence (yes vs. no; no = 1.00)						
(1) mold spots	1.34, 1.14-1.58***	1.19, 0.95-1.50	1.52, 1.21-1.92***	1.16, 0.95-1.41	1.01, 0.75-1.34	1.34, 1.02-1.77*
(2) damp stains	1.38, 1.22-1.56***	1.32, 1.11-1.56**	1.46, 1.22-1.73***	1.23, 1.06-1.42***	1.17, 0.96-1.44	1.30, 1.06-1.60**
(3) damp clothe	1.27, 1.15-1.39***	1.28, 1.13-1.46***	1.25, 1.09-1.42**	1.24, 1.11-1.39***	1.23, 1.05-1.44*	1.26, 1.07-1.47**
(4) water damage	1.36, 1.21-1.53***	1.25, 1.06-1.47**	1.49, 1.26-1.75***	1.27, 1.11-1.46***	1.22, 1.00-1.48	1.33, 1.10-1.62**
(5) condensation	1.35, 1.21-1.51***	1.42, 1.22-1.65***	1.28, 1.10-1.50**	1.46, 1.28-1.66***	1.53, 1.27-1.84***	1.39, 1.16-1.67***
(6) moldy odor	1.40, 1.21-1.61***	1.43, 1.18-1.73***	1.37, 1.12-1.68**	1.24, 1.05-1.47***	1.25, 0.99-1.58	1.24, 0.97-1.58

^aAdjusted confounders are like these: administrative area (urban vs. suburban), sex (boy vs. girl), age (≤ 4 year-old vs. > 4 year-old), breastfeeding (≤ 6 months vs. > 6 months), family history of asthma or allergies (yes vs. no), the ownership of the house (owner vs. rent), furred animals / pets in the child's residence at birth (yes vs. no), parental smoking (yes vs. no). * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$.

Table 4. Dose-relationships between home dampness-related indicators and childhood eczema

Amount of dampness-related indicators	Total sample N(%)	Eczema (ever)			Eczema (in the past 12 months)		
		n (%)	OR, 95%CI	AOR, 95%CI	n (%)	OR, 95%CI	AOR, 95%CI
The total number of dampness-related indicators in child's birth room (n)							
n=0	5006 (42.0)	892 (19.0)***	1.00	1.00	531 (11.0)***	1.00	1.00
n=1	5364 (45.0)	1228 (24.1)**	1.35, 1.23-1.49***	1.15, 0.96-1.36	746 (14.3)**	1.35, 1.20-1.52***	1.25, 1.10-1.42**
n=2	1187 (10.0)	320 (28.7)***	1.72, 1.48-1.99***	1.55, 1.32-1.82***	195 (17.0)***	1.67, 1.40-1.99***	1.52, 1.25-1.84***
n=3	354 (3.0)	110 (33.5)***	2.15, 1.69-2.74***	2.14, 1.65-2.77***	59 (17.7)*	1.75, 1.30-2.34***	1.70, 1.24-2.32**
The total number of dampness-related indicators in child's current residence (n)							
n=0	1638 (20.1)	266 (17.2)***	1.00	1.00	144 (9.0)***	1.00	1.00
n=1	2653 (32.6)	516 (20.5)**	1.24, 1.06-1.46**	1.15, 0.96-1.36	322 (12.4)	1.43, 1.17-1.76***	1.23, 0.99-1.53
n=2	2034 (25.0)	466 (24.1)	1.53, 1.29-1.81***	1.38, 1.15-1.65**	302 (15.2)*	1.81, 1.46-2.23***	1.58, 1.26-1.97***
n=3	1064 (13.1)	275 (27.1)***	1.80, 1.49-2.18***	1.64, 1.33-2.03***	169 (16.2)**	1.95, 1.64-2.47***	1.67, 1.29-2.16***
n=4	454 (5.6)	131 (30.0)***	2.07, 1.62-2.64***	1.98, 1.52-2.59***	82 (18.4)**	2.28, 1.70-3.06***	2.01, 1.46-2.78***
n=5	222 (2.7)	73 (34.9)***	2.59, 1.89-3.54***	2.39, 1.69-3.38***	41 (19.2)*	2.40, 1.64-3.52***	1.89, 1.23-2.91**
n=6	67 (0.8)	21 (35.0)*	2.60, 1.51-4.49***	2.57, 1.40-4.69**	12 (19.0)	2.37, 1.24-4.55**	2.33, 1.13-4.81*
Whether there were dampness-related indicators in child's birth room or current residence?							
Both no	1284 (16.4)	199 (16.3)***	1.00	1.00	114 (9.1)***	1.00	1.00
Birth ^a	300 (3.8)	53 (19.0)	1.20, 0.86-1.68	1.16, 0.80-1.66	24 (8.3)	0.91, 0.57-1.44	0.85, 0.52-1.40
Present ^b	1881 (24.0)	337 (19.0)	1.20, 0.99-1.46	1.18, 0.96-1.45	208 (11.4)*	1.28, 1.01-1.63*	1.22, 0.95-1.57
Both yes	4363 (55.8)	1091 (26.1)***	1.82, 1.54-2.15***	1.55, 1.30-1.85***	688 (16.1)***	1.92, 1.56-2.37***	1.59, 1.28-1.98***

^adampness-related indicators only existed in child's birth room; ^bdampness-related indicators only existed in child's current residence. * $0.01 \leq p < 0.05$; ** $0.001 \leq p < 0.01$; *** $p < 0.001$.

4. Discussion

This survey covered 5 administrative regions of Shanghai with large sample sizes and high response rate, thus our results in the present study is likely to have a perfect representation of situation of home dampness-related indicators and childhood eczema in Shanghai and their associations. The prevalence of childhood eczema (ever) in Shanghai was 22.9%, which was still low when it was compared to the similar CCHH surveys in other cities at the same period [1], but was equal to in Sweden (23%) [13] and was higher than in USA (20%) [14]. This result suggested that children's atopic eczema should be an important issue to be concerned in the field of public health in Shanghai, China.

Although researches on environmental factors and childhood eczema was still limited, our findings that dampness-related indicators in the early and/or current residence could significantly increase the risk of prevalence of eczema

among preschool children were consistent with previous studies in Sweden [6, 13], Singapore [7], and USA [14] for children in the similar ages. We also found that the increased risk of eczema due to dampness-related exposures in girls was higher than in boys (Tables 2 and 3). These results suggested that the home dampness-related problems perhaps had a different impact on the prevalence of eczema in boys and in girl. Our findings, that the dampness-related indicators in the residence at the child's birth also had strong associations and dose-relationships with the prevalence of childhood eczema in the past 12 months, suggested early dampness-related exposures could have notable influence on later childhood allergic diseases [9]. Children who lived in the residence which have dampness-related indicators at the child's birth room had the highest prevalence and increased risk of childhood eczema. This suggested that home dampness-related exposures in different periods may have additive effects to some extent. Besides, when condensation or moisture occurs on inside and windows, it's a sign of poor ventilation [8, 15] and high indoor humidity, which could create a comfortable environment for breeding of a number of micro-organisms (e.g. dust mites). The previous researches both in Germany [16] and in Japan [17] found that high level of indoor dust mites were significantly associated with the increased risk of childhood eczema.

There are some limitations in this study. All data were from a cross-sectional survey, and the judgment about dampness-related indicators (yes or no) was from the subjective response of parents, thus the results might be influenced by retrospective bias. Besides, we only had qualitative analyses (yes or no) about home dampness-related indicators, and had no quantitative analyses. In the home inspection of CCHH phase 2, we could validate some of these problems.

5. Conclusions

Home dampness-related exposures are strong risk factors for childhood eczema. Specifically, under the same indicators, the increased risk of eczema in girls was higher than in boys. Total numbers of home dampness-related indicators had notable dose-response relationships with the prevalence of childhood eczema.

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