

Dampness in dwellings and its associations with asthma and allergies among children in Chongqing: A cross-sectional study

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The city of Chongqing has high outdoor temperatures and humidity throughout the year and consequently a high risk of dampness and mold problems in dwellings. As part of the China, Children, Homes, Health (CCHH), associations between home characteristics and children's asthma, allergies, and related symptoms were investigated in Chongqing, China. A cross-sectional questionnaire survey on home characteristics including dampness and symptoms of asthma and allergies in 5299 children was performed. Data for 4754 children (3–6 years) and their homes were analyzed. Results showed that 35.1% of homes were reported to have “damp bedding”, 14.3% “condensation on window panes (higher than 5 cm)”, 11.6% “mouldy odor”, 9.3% “water leakage”, 8.3% “damp stains” and 5.3% “visible mould”. Wheezing and rhinitis ever were reported for 27.0% and 51.1% children respectively, and rhinitis, wheezing, cough at night and eczema in the last 12 months were reported for 38.1%, 20.5%, 18.9% and 13.2% respectively. Doctor-diagnosed asthma was reported for 8.3% of children, and doctor-diagnosed rhinitis for 6.2%. Dampness in homes was generally strongly associated with asthma and allergies among Chongqing children. The strongest association was found between “visible mould” and doctor-diagnosed rhinitis, and the adjusted Odds Ratio (OR^A) was 2.27 (95% CI: 1.48, 3.49). “Damp bedding” was significantly associated with all asthma and allergic symptoms, but doctor-diagnosed asthma and rhinitis. The behavior of “putting bedding to sunshine” could effectively reduce the prevalence of asthma and allergic symptoms, and the risk of bedding affected with damp was reduced significantly when bedding was put to sunshine frequently.

dampness, children, asthma, allergies, indoor environment

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A large number of studies in various geographical regions have identified moisture-related problems in buildings as a health-risk exposure. Such studies began to appear in the literature in the late 1980's [1–3], continued into the 1990's [4–12], and have extended into the 21st century [13–15]. These studies [16–21] indicate that living or working in buildings with reported dampness or mould problems is associated with respiratory or allergic health effects. Most of the studies on the association between indoor dampness problems and respiratory or allergic health effects have been cross-sectional studies [11–15,22–26]. Some have been

case-control studies [5–7,9,27], while others have been cohort studies [28–30]. Causative agents in damp buildings have been tentatively identified and include microbial growth, mold, house dust mites (HDM) or chemicals [16,17].

In China, there are relatively few reports about damp buildings. In cross-sectional studies at Tianjin University on the association between dampness in dorms and allergy and airways infections among college students, dampness was a significant risk factor for common cold and allergies [31,32]. Dampness in the home was a strong predictor of, and risk factor for, respiratory symptoms in children, 6–12 years of age in Kaohsiung [33]. It was also reported that house

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dampness was a significant risk factors for “current wheezing” (wheezing last 12 months) of schoolchildren with an average age of 10.0–10.4 in Hong Kong, Beijing and Guangzhou [34]. However, there are still few studies [33–35], focusing on associations between dampness problems and asthma and allergies among pre-school children in China, especially in the mainland. In Chongqing, with rainfall throughout the year (the annual average rainfall is 1000–1350 millimeters, and the annual average sunshine hours is 1000–1400 h), the outdoor temperature and humidity (the annual average relative humidity is between 70%–80%) are so high that it may easily lead to leakage of rain into the building construction, humidity in indoor air and other dampness and mould problems, so the risk of dampness problems could be pronounced. Damp home environments induce mould, damp bedding, and the growth of house dust mites [16]. The aim of this article is to evaluate the associations between dampness problems and the symptoms of asthma and allergies in young children in homes in the humid climate in Chongqing.

1 Methods

1.1 Questionnaire

A cross-sectional study was carried out via questionnaire. Questions pertaining to health were those developed for the ISAAC study [36,37]. Questions pertaining to the home environment were adopted from DBH (Dampness in Buildings and Health) and ALLHOME studies for Chinese home characteristics [13,15,24]. The questionnaire was distributed to parents of children in 55 randomly selected Chongqing kindergartens. Teachers were instructed to distribute questionnaires to children, and to recollect completed questionnaires. The questionnaire included about 80 questions on demographic data (e.g. child’s age, gender), family information (e.g. family size), dwelling characteristics (e.g. dwelling type), dampness problems (e.g. visible mould) and health conditions of the child and the family, and the questions on dampness problems and health condition of the child are shown in the Appendix.

1.2 Dampness

There are mainly four sources (outdoor source, indoor source, building source and accident) for moisture in a building structure and high relative humidity in indoor air [16]. The questionnaire included different indicators to assess dampness problems: “visible mould” and “condensation on window panes” as indications of a high relative humidity in indoor air, “damp stains”, “water leakage” and “mouldy odor” as indications of moisture in the construction. The present study is the first time to ask about “damp bedding” as indications of dampness and the behavior of “putting bedding to sunshine”. Exposure to dampness was

defined as affirmative responses to any of these questions which can be found in Appendix.

1.3 Statistical analyses

Statistical analyses were performed with the Statistical Package for Social Science (SPSS 18.0). Associations between dampness indicators and building characteristics were estimated using the *Chi-squared* test and *P*-value less than 0.05 indicated a statistically significant level. Associations between dampness and asthma and allergies were evaluated in logistic regression models and expressed by odds ratios (OR) with 95% confidence interval (95% CI). Odds ratios were adjusted for house site, gender, age, family allergic history and exposure to environmental tobacco smoke (ETS). The response “Not known” was treated as missing data such that the questionnaire was excluded from analyses.

2 Results

Parents or guardians of 5299 children in three randomly selected districts (Shapingba District, Jiulongpo District and Yubei District) in Chongqing responded to the survey, giving a response rate of 74.5%. Questionnaires with missing information on gender, age and dampness were excluded from analyses. The analyses were performed for children from 3 to 6 years old, for a total of 4754 children. Boys accounted for 51.3% and girls for 48.7%.

2.1 Self-reported asthma and allergies

The prevalence of asthma and allergic symptoms is shown in Table 1. In total, 51.1% of children were reported to have rhinitis ever, and 27.0% wheezing ever. The most reported allergic symptom in the past 12 months was rhinitis (38.1%) followed by wheezing (20.5%). The prevalence of doctor-diagnosed asthma was 8.3% and rhinitis 6.2%. Eleven point three percent of respondents reported symptoms of asthma and allergies among family members and 51.4% of respondents reported exposure to ETS during pregnancy or the child’s first year of life. There was significantly difference in the prevalence of rhinitis reported by children from rural, suburban and urban. Asthma and allergies, especially doctor-diagnosed asthma, were reported to be less common among girls ($P < 0.05$). The prevalence of wheezing and cough at night decreased with age ($P < 0.001$), and the 6-year-old children had fewer symptoms, except for rhinitis, than any other age group. Asthma and allergies among family members increased the risk of symptoms for children ($P < 0.001$). A higher prevalence of wheezing and rhinitis in the past 12 months was observed for exposure to ETS.

2.2 Self-reported dampness

Six dampness indicators were used. Table 2 shows the asso-

Table 1 Prevalence of self-reported asthma and allergies and associations with different house site, age, gender, family allergic symptoms and exposure to ETS^{a)}

	Total		Wheezing ever		Rhinitis ever		Wheezing last 12 months		Cough at night last 12 months		Rhinitis last 12 months		Eczema last 12 months		Doctor-diagnosed Asthma		Doctor-diagnosed Rhinitis	
	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P
Overall	27.0		51.1		20.5		18.9		38.1		13.2		8.3		6.2			
House site																		
Rural	18.8	0.958	43.4	<0.001	22.9	0.438	16.1	0.071	30.6	<0.001	14.0	0.801	5.0	0.004	2.2	0.001		
Suburban	71.0		48.2		20.2		17.1		35.4		12.7		7.4		6.1			
Urban	10.2	27.3	53.0		20.4		19.7		40.0		13.2		9.2		6.8			
Age																		
3-year-old	21.2	0.036	51.5	0.249	25.2	<0.001	24.9	<0.001	40.0	0.270	16.1	<0.001	8.6	0.834	5.6	0.551		
4-year-old	33.8	27.1	50.7		20.5		19.5		38.2		14.6		8.6		6.1			
5-year-old	30.5	27.0	49.7		19.4		16.9		36.2		10.8		7.9		6.1			
6-year-old	14.5	23.0	54.3		15.5		12.7		38.9		10.7		7.9		7.3			
Gender																		
Boy	51.3	29.0	52.5	0.046	21.5	0.070	18.5	0.502	39.1	0.139	13.7	0.259	9.9	<0.001	7.0	0.014		
Girl	48.7	24.9	49.6		19.3		19.3		37.0		12.6		6.5		5.3			
Family allergic history																		
No	88.7	24.7	49.3	<0.001	18.6	<0.001	17.7	<0.001	36.0	<0.001	12.5	<0.001	6.5	<0.001	4.9	<0.001		
Yes	11.3	43.3	64.1		34.2		28.9		54.0		18.9		23.3		16.2			
Exposure to ETS																		
No	48.6	26.0	49.9	0.165	19.2	0.037	18.2	0.228	36.3	0.019	12.9	0.648	8.1	0.624	5.9	0.327		
Yes	51.4	27.9	52.0		21.7		19.6		39.7		13.4		8.5		6.6			

a) Associations were evaluated by *Chi*-square test and expressed with *P*-value using Cross-Tab.

Table 2 Prevalence of different dampness problems reported in different building characteristics

	Total		Visible mould		Damp stains		Water leakage		Condensation on window panes		Mouldy odor		Damp bedding	
	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P	(%)	P
Overall ^{a)}	5.3		8.3		9.3		14.3		11.6		35.1			
House site														
Rural	10.2	0.004	16.4	<0.001	8.8	0.628	5.9	<0.001	18.8	<0.001	43.9	<0.001		
Suburban	18.8	5.7	8.8		10.1		12.9		14.2		34.7			
Urban	71.0	4.8	7.0		9.0		16.0		9.9		33.9			
Construction period														
Before 2000 ^{b)}	35.9	0.004	12.2	<0.001	11.9	<0.001	9.9	<0.001	14.5	<0.001	38.5	<0.001		
After 2000	64.1	4.5	6.0		8.0		16.8		9.9		32.9			
Home position ^{c)}														
First floor ^{d)}	68.1	12.6	24.4	<0.001	12.6	0.133	8.9	0.006	23.8	<0.001	58.4	<0.001		
Above first floor	13.9	4.3	5.2		8.6		18.9		8.3		31.0			

a) The prevalence of dampness problems excluded the missing data; b) "before 2000" means the construction time is before 2000 (including 2000); c) the distribution of "Home position" includes apartments only; d) "first floor" means the subject lived in the bottom of the apartment building, with no residents living below.

ciation of different indicators with different building characteristics. The most commonly observed dampness indicator is “damp bedding” (bedding affected with damp) reported by 35.1% of parents, followed by “condensation on window panes” (condensation of more than 5 cm occurring on windows during winter) at 14.3%. Dampness problems were more common in rural areas. More dampness problems except for “condensation on window panes” were reported from homes built before 2000 compared to those built later. Living at the first floor of the building had a higher risk of dampness and mould. As shown in Table 3, the reports of “damp bedding” were significantly less after frequently putting the bedding to sunshine (*Chi-square test, P*<0.001).

2.3 Association between dampness problems and asthma and allergies

Logistic regression models were built to analyze the associations. Crude Odds Ratios (OR^C) without adjustment for associations between dampness indices and asthma and allergies are shown in Table 4, and adjusted Odds Ratios (OR^A) are shown in Table 5. All the dampness indices were associated with wheezing and rhinitis ever in the past after adjustments for confounders, except for “condensation on window panes” (condensation or moisture on window more than 5 centimeters), which was only associated with rhinitis ever in the past (OR^A : 1.27; 95% CI: 1.06, 1.53). “Visible mould” was significantly associated with increased risk of wheezing, cough at night and rhinitis in the past 12 months. There were strong associations between “damp stains” and all symptoms of asthma and allergies. Exposure to “water leakage” was significantly associated with increased risk of asthma and allergic symptoms in the past 12 months, such as wheezing, cough at night, and eczema. “Condensation on window panes” was associated with cough at night and rhinitis in the past 12 months, and “mouldy odor” was associated with increased risk for all symptoms in the past 12 months. The association between “water leakage” and doctor-diagnosed asthma (OR^A : 1.69; 95% CI: 1.22, 2.35) remained significant after adjustment, and self-reported “visible mould”, “water leakage”, “condensation on window panes” and “mouldy odor” were significantly associated with rhinitis diagnosed by a doctor.

“Damp bedding”, a new index, was significantly associated with all symptoms except doctor-diagnosed asthma and rhinitis. “Putting bedding to sunshine” was strongly associ-

ated and protective against all symptoms after control for confounding factors. In all, dampness problems in homes were strongly associated with asthma and allergies among Chongqing children, and the strongest association was between “visible mould” and doctor-diagnosed rhinitis (OR^A : 2.27; 95% CI: 1.48, 3.49).

2.4 Respondent and non-respondent

To evaluate the representativeness of this cross-sectional study, 300 children were randomly selected from those who did not respond in the cross-sectional study. The parents of 206 responded to a short questionnaire consisting of four questions: house site, gender, wheezing last 12 months and damp stains. The results are shown in Table 6. More damp stains were reported by the non-respondents and the prevalence of wheezing last 12 months among non-respondent was also higher. However, there were no statistically significant differences in responses to any questions between respondent and non-respondent (*Chi-square test, P*>0.05).

3 Discussion

3.1 Bias and confounders

Information bias or selection bias could confound associations between dampness and health. Information/reporting bias may occur when people with dampness problems intend to report more health outcomes or vice versa, leading to a systematic over-reporting of dampness problems or symptoms of children in the cross-sectional questionnaire study [16,38]. We evaluated the possibility of selection bias in this study by reinviting initial non-responders to complete a short questionnaire. There were no significant differences in the prevalence of wheezing last 12 months and damp stains between responders and the 206 non-responders, suggesting there was no information bias.

Three districts in Chongqing were randomly selected for cluster random sampling. Five thousand two hundred and ninety nine out of 7117 participants answered questionnaires with a response rate of 74.5%. The high response rate and non-differences between respondents and non-respondents indicate that the impact of selection bias on the results was also limited.

Confounders must also be adjusted [39]. In this study, the associations of dampness exposure with symptoms of asthma and allergies were calculated by logistic regression and adjusted for house site, gender, age, family allergic history and smoking during pregnancy and/or the child’s first year of life. Thus, the distortion of an exposure-outcome association caused by confounders was minimized.

3.2 Dampness

In this study, six indices of dampness were used. “Visible

Table 3 Associations between dampness problems and asthma and allergic symptoms by Crude Odds Ratio (OR^C) with 95% CI

	Total (%)	Damp bedding		
		(%)	OR^C (95% CI)	<i>P</i>
Putting bedding to sunshine				
Never/rarely	58.9	37.2	1.00	0.001
Frequently	41.1	32.3	0.81(0.71,0.91)	

Table 4 Associations between dampness problems and allergic symptoms by Crude Odds Ratio (OR^c) with 95% CI

	Wheezing ever	Rhinitis ever	Wheezing last 12 months	Cough at night last 12 months	Rhinitis last 12 months	Eczema last 12 months	Doctor-diagnosed Asthma	Doctor-diagnosed Rhinitis
Visible mould	1.86 (1.41,2.44)	1.34 (1.03,1.75)	1.90 (1.43,2.54)	1.46 (1.07,2.00)	1.48 (1.14,1.94)	1.25 (0.87,1.81)	1.40 (0.91,2.16)	2.26 (1.49,3.43)
Damp stains	1.67 (1.33,2.09)	1.40 (1.13,1.74)	1.61 (1.26,2.06)	1.39 (1.07,1.79)	1.33 (1.07,1.66)	1.86 (1.42,2.44)	1.44 (1.02,2.04)	1.36 (0.91,2.05)
Water leakage	1.91 (1.53,2.37)	1.45 (1.17,1.79)	1.65 (1.30,2.09)	1.48 (1.16,1.89)	1.32 (1.07,1.63)	1.48 (1.12,1.96)	1.96 (1.44,2.68)	1.78 (1.23,2.57)
Condensation on window panes ^{a)}	1.10 (0.90,1.33)	1.32 (1.11,1.58)	1.12 (0.90,1.38)	1.43 (1.16,1.77)	1.36 (1.14,1.63)	1.31 (1.03,1.68)	1.38 (1.03,1.85)	1.73 (1.26,2.37)
Mouldy odor	1.68 (1.37,2.06)	1.53 (1.26,1.86)	1.83 (1.48,2.27)	1.54 (1.23,1.93)	1.44 (1.19,1.75)	1.33 (1.02,1.74)	1.45 (1.05,1.99)	1.43 (0.99,2.07)
Damp bedding	1.29 (1.13,1.48)	1.31 (1.16,1.48)	1.41 (1.22,1.63)	1.32 (1.14,1.54)	1.37 (1.21,1.55)	1.27 (1.07,1.52)	1.23 (0.99,1.52)	1.28 (0.99,1.63)
Putting bedding to sunshine ^{b)}	0.80 (0.70,0.91)	0.79 (0.71,0.89)	0.76 (0.65,0.88)	0.76 (0.66,0.89)	0.81 (0.72,0.91)	0.72 (0.60,0.86)	0.90 (0.72,1.11)	0.76 (0.59,0.98)

a) "Condensation on window panes" means more than 5 cm of condensation on the inside of the windowpane during winter; b) "putting bedding to sunshine" means taking beddings out during sunshine days frequently.

Table 5 Associations between dampness problems and allergic symptoms by adjusted Odds Ratio (OR^d) with 95% CI (adjusted for house site, gender, age, family allergic history and exposure to environmental tobacco smoke (ETS))

	Wheezing ever	Rhinitis ever	Wheezing last 12 months	Cough at night last 12 months	Rhinitis last 12 months	Eczema last 12 months	Doctor-diagnosed Asthma	Doctor-diagnosed Rhinitis
Visible mould	1.81 (1.36,2.40)	1.38 (1.04,1.83)	1.88 (1.40,2.54)	1.41 (1.02,1.96)	1.52 (1.15,2.00)	1.18 (0.80,1.72)	1.32 (0.84,2.06)	2.27 (1.48,3.49)
Damp stains	1.54 (1.21,1.95)	1.42 (1.13,1.78)	1.52 (1.18,1.96)	1.33 (1.02,1.75)	1.35 (1.08,1.69)	1.76 (1.33,2.33)	1.30 (0.89,1.88)	1.38 (0.90,2.09)
Water leakage	1.75 (1.40,2.20)	1.29 (1.04,1.61)	1.57 (1.23,2.01)	1.33 (1.03,1.73)	1.18 (0.95,1.47)	1.45 (1.08,1.93)	1.69 (1.22,2.35)	1.55 (1.05,2.27)
Condensation on window panes ^{a)}	1.05 (0.85,1.28)	1.27 (1.06,1.53)	1.07 (0.86,0.34)	1.31 (1.06,1.64)	1.29 (1.07,1.55)	1.28 (0.99,1.64)	1.19 (0.88,1.62)	1.53 (1.10,2.13)
Mouldy odor	1.60 (1.29,1.98)	1.55 (1.27,1.90)	1.72 (1.37,2.16)	1.58 (1.25,2.00)	1.50 (1.22,1.84)	1.36 (1.03,1.79)	1.36 (0.97,1.90)	1.47 (1.00,2.15)
Damp bedding	1.25 (1.09,1.44)	1.33 (1.17,1.51)	1.37 (1.18,1.60)	1.27 (1.09,1.49)	1.38 (1.21,1.57)	1.24 (1.03,1.48)	1.13 (0.91,1.42)	1.28 (0.99,1.65)
Putting bedding to sunshine ^{b)}	0.82 (0.72,0.95)	0.82 (0.73,0.93)	0.78 (0.67,0.91)	0.76 (0.65,0.89)	0.84 (0.74,0.95)	0.74 (0.62,0.89)	0.99 (0.79,1.23)	0.82 (0.63,1.06)

a) "Condensation on window panes" means more than 5 cm of condensation on the inside of the windowpane during winter; b) "putting bedding to sunshine" means taking bedding out during sunshine days frequently.

Table 6 Comparison of several key questions between respondent and non-respondent^{a)}

	Respondent (%)	Non-respondent (%)	P
House site			
Rural	10.4	11.2	0.070
Suburban	18.7	24.7	
Urban	70.9	64.1	
Gender			
Boy	51.3	53.9	0.478
Girl	48.7	46.1	
Wheezing last 12 months			
Yes	20.6	26.3	0.054
Damp stains			
Yes	8.1	10.8	0.181

a) Comparisons were made for each question excluding the missing data; the respondent group includes all responses (5299 responses) to the cross-sectional study; the non-respondent group includes 206 responses.

mould” and “condensation on window panes” indicate high indoor air humidity. “Water leakage”, “damp stains” and “mouldy odor” are often indicators of dampness problems due to poor construction. The most frequently reported index of dampness was “damp bedding” (35.1%).

In our study, buildings constructed before 2000 were associated with an increased frequency of the dampness indicators: “visible mould”, “damp stains”, “water leakage”, “mouldy odor” and “damp bedding”. This is consistent with previous studies in Sweden [40] and Tianjin, China [32]. “Condensation (more than 5 centimeters) on window panes” was reported more in buildings constructed after 2000 and in buildings located in urban area ($P < 0.05$). “Condensation on window panes” may be a proxy for low ventilation rate [16,31,41]. Thus, new buildings constructed with modern technologies and materials in urban areas may be more air tight. Homes located on the ground floor had more dampness problems than those on higher floors. Chongqing is a rainy city all year around, especially from May to September, and the leakage of rain and snow into the building construction or moisture from the ground may account for damper ground floors [16].

3.3 Association between asthma and allergies and dampness

Many studies have investigated the association between symptoms of asthma and allergies in children 0–6 years old and dampness and mould exposures in the home. Most have found an association between exposure to dampness and health effects (1–6 years, Finland [8]; 2, 3, 5 and 7 years, Bulgaria [15]; 1.5–6 years, Singapore [25]; 3–4 years, Canada [42]; 4 years, UK [43]), even though the definition of dampness varied and climates differed. Our study found self-reported dampness indices in residences to be strongly

associated with self-reported symptoms of asthma and allergies in Chongqing, consistent with the findings of other cross-sectional studies [13,15,25]. Although indoor dampness has been widely observed to be associated with increased risk for asthma and allergic symptoms, whether the dampness problems may lead to development of asthma and allergies in children remains uncertain.

The association between “visible mould” and allergic symptoms was shown for rhinitis in the past 12 months, with OR^A of 1.52 (95% CI: 1.15, 2.00), consistent with a study in Singapore [25]. A “mouldy odor” was a significant risk factor for all asthma and allergic symptoms among children in Chongqing, consistent with some cohort studies [28,30]. “Condensation on window panes” was significantly associated with cough at night and rhinitis, consistent with the findings of a case-control study in Stockholm [44]. In Sweden, for doctor-diagnosed asthma and allergies, the significant risk dampness indices were floor moisture, damp stains and condensation [13]. It was found that “water leakage” was associated with a higher prevalence of doctor-diagnosed asthma and rhinitis, and “condensation on window panes” was associated with doctor-diagnosed rhinitis among children in Chongqing, but “damp stains” was not. Different climate and building characteristics may explain these disparities. In total, common dampness problems were risk factors for asthma and allergies.

“Damp bedding” was frequently reported and was strongly associated with all the symptoms of asthma and allergies. The behavior of putting bedding to sunshine was significantly associated with lower risk of all symptoms. House dust mites may explain some associations as described in reviews of the scientific literature [16,17,24]. Children can spend nearly half a day in bedding which is highly infested with mites [45], which need a high humidity and temperature to survive and reproduce. The conditions that mites need to grow are easily met in bedding affected with damp, and sunshine can keep the bedding dry and prevent growth of mites and microbes due to the effect of UV-radiation.

4 Conclusions

Dampness problems in Chongqing homes are serious, and associated with asthma and allergies. Among the dampness indices, “damp bedding” was the most reported. Other dampness indicators were also reported with high frequencies. As for building characteristics related to dampness problems, building construction period, house site and home position are related to dampness problems. The reasons for indoor dampness problems in Chongqing include the high humidity in the outdoor air and the rainfall all the year around. “Damp bedding”, firstly considered in this study, had serious health effects for children in Chongqing, possibly because of dust mites. The risk of bedding affected with

damp was reduced significantly when bedding was put to sunshine, and the behavior of putting bedding to sunshine was effectively protective against all symptoms. However, whether exposure to dampness will cause the development of asthma and allergy or not cannot be deduced from this cross-sectional study.

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Appendix

Questionnaire

Questions about dampness problems and health condition of the child mainly used for the present analysis in questionnaires were as follows:

(1) Dampness

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

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

"Water leakage": Have there been any flooding or other kinds of water damages in the rooms? (yes vs. no)

"Condensation on window panes": In the winter, does condensation or moisture occur on the inside or at the bottom of windows (windowpanes) in the child's room? (>5 cm vs. < 5 cm)

"Mouldy odor": Have you been bothered by mouldy smell in your residence during the last 3 months? (yes vs. no)

"Damp bedding": Have you found your beddings or clothes are affected with damp during the last year? (yes vs. no)

(2) Health

"Wheezing ever": Has your child had wheezing or whistling in the chest at any time in the past? (yes vs. no)

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

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

"Rhinitis ever": 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)

"Rhinitis 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 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)