Self-Reported Moisture or Mildew in the Homes of Head Start Children with Asthma is Associated with Greater Asthma Morbidity

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ABSTRACT *This study used results from a cross-sectional survey of parents of 3- to 5-year-old children with asthma to assess the frequency of self-reported home environmental conditions that could contribute to worsening asthma and examined the relationship between these factors and the child's asthma morbidity. Participants were 149 parents drawn from the two largest agencies that provide subsidized preschool childcare services in East and Central Harlem, inner-city communities with high prevalence of asthma. The sample represented 77% of eligibles determined by a validated case-identification instrument. Data were collected on demographics, symptoms, medication use, Emergency Department visits and hospitalization, and environmental conditions in the home. One or more of these home environmental conditions were reported by 92% of participants. Controlling for other environmental conditions and demographics, associations were found between self-reported presence of moisture or mildew on ceilings, walls, or windows and higher frequency of hospitalizations for breathing-related problems (OR = 3.31; 95% CI 1.62–6.75), frequent episodes of wheezing (OR = 3.25; 95% CI 1.8–6.0), and higher frequency of night symptoms due to asthma (OR = 2.19; 95% CI 1.4–3.41). Having a carpet or rug in the child's bedroom or the living room was also associated with hospitalizations (OR = 3.23; 95% CI 1.53–6.8), and male gender was marginally associated with the frequency of night symptoms (OR = 1.51; 95% CI .95–2.4). Asthma is prevalent in the Head Start population, and exposure to home environmental conditions that may worsen asthma is common in the socially disadvantaged populations served by Head Start programs.*

KEYWORDS *Asthma, Disadvantaged, Environment, Head Start, Inner City, Mildew, Moisture, Morbidity, Pediatric.*

Abbreviations: BRQ – Brief Respiratory Questionnaire, a case identification tool used to determine inclusion; OR – Odds ratio

INTRODUCTION

The highest rates of asthma hospitalization and Emergency Department care are among young children and in low-income, minority populations.¹ In socially

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disadvantaged communities such as East and Central Harlem in New York City, pediatric asthma is a leading cause of hospitalizations, Emergency Department visits, and school absence.² The Head Start program serves approximately 900,000 children nationwide, primarily from low-income families.³ Parents in these communities rely on Head Start and other subsidized preschool childcare programs, so it is not surprising that high asthma prevalence and associated morbidity have been reported in Head Start populations.^{4–6} Several studies have documented the link between asthma and environmental factors such as a smoker living in the residence, pets, cockroaches, rats or mice, and mold.^{7–12} Limited data suggest that homes of Head Start children hold environmental factors that may worsen asthma.^{13,14} In a study to assess an asthma education intervention—a study not expressly designed to demonstrate the impact of home environmental factors on asthma severity—our instruments included self-report items on home environmental conditions. We administered these instruments to a Head Start population in East and Central Harlem. In this paper, we report on our examination of the relationship between these home environmental factors and asthma morbidity within a Head Start sample.

METHODS

Participants

We drew our sample from parents/guardians of children enrolled in 10 Head Start and subsidized preschool centers in East and Central Harlem, whose total enrollment averaged approximately 650 during our study period of 1999–2000. These two communities are heavily affected by asthma,^{15,16} with a hospitalization rate of 1.7% in East Harlem and 1.3% in Central Harlem for pediatric asthma (ages 0–14) in the year 2000, compared with 0.06% for New York City as a whole, and 0.03% nationwide.² Participants in this study included both biological and foster parents and legal guardians because they were the adult responsible for the health and welfare of the child.

Instruments

Brief Respiratory Questionnaire (BRQ) Staff of the preschool agencies secured informed consent and administered a 15-item Brief Respiratory Questionnaire (BRQ) that identified children as having probable asthma based on physician's diagnosis, recurrent symptoms, history of hospitalization, and medication use. In a related validation study, we found the BRQ to have a positive predictive value of 97% for probable asthma using physician review of a structured medical history as the gold standard.¹⁷

We used two scoring methods to classify children as case positives (i.e., children with asthma or probable asthma identified by the BRQ) or negatives. Because parents and physicians use various terms to refer to pediatric respiratory problems, one of our scoring methods required a diagnosis of either asthma or an alternative term (reactive airway disease, asthmatic or wheezy bronchitis, or wheezing), plus parent-reported signs or symptoms of asthma in the prior 12 months: either taking any prescribed medication for respiratory problems or having three or more episodes of day or night symptoms or three or more absences from Head Start due

to respiratory problems. We also needed to account for parents who might report signs or symptoms of asthma but no diagnosis, so our second scoring method required no diagnosis but either symptom episodes at a higher threshold (six instead of three) or indications of medical care (ever requiring emergency care or hospitalization for respiratory problems or, in the prior 12 months, having received a prescription for medication to treat asthma or the alternative diagnostic terms).

Baseline Interview We recruited parents/guardians of case positive children for a longitudinal study to assess an asthma education program and administered baseline interviews covering demographics, symptoms (prior 14 days), medication use (prior 4 weeks), ED visits and hospitalization (prior 12 months), and environmental factors. The measures of morbidity included (1) the number of respiratory hospitalizations or Emergency Department visits, attacks treated with oral steroids, school days missed per month enrolled, and episodes of wheezing (without a cold) during the prior 12 months, and (2) days with any asthma symptoms and nights awakened because of symptoms during the prior 14 days. Daytime respiratory symptoms more than twice a week, use of bronchodilators more than twice a week, and nights awakened due to respiratory symptoms more than twice a month are three indicators that can classify children as having persistent asthma according to national guidelines.¹⁸ We assessed common indoor environmental factors that have been consistently associated with asthma among children and young adults: whether the stove had outside vented exhaust, the number of smokers in the household, problems with roaches, mice or rats during the prior 3 months, whether there were carpets or rugs in the living room or child's bedroom, the presence of pets in the home, and the presence of any moisture or mildew on ceilings, walls, or windows.

We completed baseline interviews for parents/guardians of 149 children with probable asthma (77% of those eligible) and assessed the frequency of self-reported home environmental conditions and their potential contribution to worsening asthma symptoms and morbidity among this group. The institutional review boards of The New York Academy of Medicine, Columbia University, and the Centers for Disease Control and Prevention approved our study protocol, and we obtained written informed consent from participants.

Statistical Analyses We calculated estimates of prevalence of individual and of multiple environmental conditions. To test the hypothesis that environmental conditions would be associated with asthma severity, we assessed bivariate associations between the environmental conditions and the measures of severity using the Wilcoxon two-sample test. We then modeled the significant outcomes by including other environmental conditions and demographic measures in multivariable analyses with Poisson distribution (since our dependent variables were discrete and not normally distributed) to test whether the significant associations held and to determine if other predictors showed significance. We set the level of statistical significance at $\alpha = 0.05$.

RESULTS

The children that we report on were primarily African-American (42%), Hispanic (38%), and mixed ethnicity of African-American and Hispanic (16%) and were about evenly distributed across genders (51% male; Table 1). Respondents were

TABLE 1. Demographic characteristics of sample

	N (%)
Child's ethnicity	
Black	63 (42.3)
Hispanic	57 (38.3)
Mixed	24 (16.1)
Other/refused	5 (3.4)
Child's gender	
Boys	77 (51.7)
Girls	72 (48.3)
Respondent's relationship to child	
Mother	131 (88)
Father	6 (4)
Other family member	9 (6)
Missing	3 (2)
Language of administration	
English	135 (90.6)
Spanish	14 (9.4)
Household income (monthly)	
<\$1000	43 (28.9)
\$1000–\$1999	40 (26.8)
\$2000–\$2999	14 (9.4)
≥\$3000	22 (14.8)
Missing/refused	30 (20.1)

most often the biologic mother (89%), were primarily interviewed in English (91%), and 29% of them reported an income under \$1000 per month.

On the baseline interview, most parents (79%) reported that they had been told by a physician that their child had asthma (Table 2). Parents reported a high lifetime prevalence of cough that lasted more than a week (78%) and wheezing (84%). With regard to the three indicators that classify children as having persistent asthma,¹⁸ about 26% of parents reported that their children had respiratory symptoms more than twice a week, 30% reported use of bronchodilators more than twice a week, and 30% reported nights awakened due to respiratory symptoms more than twice a month. At least one of these indicators was reported for 48% of the children in our sample. About 54% of children were reported to take some form of prescribed medication in the past 4 weeks for asthma. In terms of healthcare utilization during the prior 12 months for a respiratory illness, 47% reported at least one emergency medical visit and 17% reported at least one hospitalization. Despite the high reported prevalence of asthma and asthma-like diagnoses and respiratory symptoms, only 39% reported that their child was under the care of a physician for asthma.

The prevalence of self-reported home environmental conditions that could impact asthma severity ranged from 17 to 57% (Table 3). At least one self-reported home environment condition that could worsen asthma was reported for 92% of the children with asthma, and 49% of homes had three or more environmental conditions present.

Moisture or mildew on ceilings, walls, or windows were reported present in homes of 27 children (18%). Compared to children with asthma that lived in homes where moisture or mildew were not reported, the group of children living in these

TABLE 2. Parent-reported diagnosis, morbidity, and medical treatment among preschool children

	N (%)
Diagnosis	
Asthma	113 (78.9)
Wheezing	111 (74.5)
Asthmatic or wheezy bronchitis	62 (41.6)
Signs and symptoms	
Prior 2 weeks symptom frequency (cough, wheeze, other breathing problem)	
0 times	51 (34.0%)
1–2 times	24 (16.1%)
3–5 times	35 (23.5%)
6+	39 (26.1%)
Prior 2 weeks nights awakened with respiratory problems	
0 times	74 (49.3)
1–2 times	31 (20.8)
3–5 times	31 (20.8)
6+	13 (8.72)
Medical treatment	
Prior 12 months Emergency Department visits	
1 time	32 (21.4)
>1 time	38 (25.5)
Prior 12 months hospitalization	26 (17.4)
Use of any medication for asthma in prior 4 weeks	81 (54.0)
Use of bronchodilator in prior 4 weeks	64 (43.0)
>2 days/week use of bronchodilator in prior 4 weeks	44 (29.5)
Currently under care of MD for asthma	58 (38.9)

homes had on average significantly more hospitalizations for respiratory conditions and episodes of wheezing during the prior 12 months and significantly more nights awakened with respiratory problems in the prior 2 weeks than expected for this group (Figure 1). This group of children also had more school absences, Emergency Department visits for respiratory conditions, and courses of oral corticosteroids

TABLE 3. Parent-reported environmental conditions in children’s homes

	Percent/mean
Gas stove without outside vented exhaust*	57
One or more smokers live in household*	47
Problems with cockroaches, prior 3 months	38
Carpet or rugs in living room or child’s bedroom	36
Problems with mice or rats, prior 3 months	26
Moisture or mildew on ceilings, walls, or windows	18
Cat in home	17
Number of conditions reported	
0	8
1–2	44
3–4	44
5 or more	5

*Missing data for one child.

FIGURE 1. Results of Wilcoxon two-sample test showing significant associations between moisture or mildew and three measures of morbidity.

related to respiratory illness in the prior 12 months, but the associations were not statistically significant. Moisture and mildew problems were not associated with prior asthma diagnosis by a physician, race, income, or sex, indicating that these factors do not explain the associations between moisture problems and asthma severity. No other environmental condition that was reported had statistically significant associations with the asthma severity measures, nor was the total number of environmental conditions reported associated with measures of asthma severity.

In multivariable analyses of the relationships identified in Figure 1, after controlling for other environmental conditions reported by parents and demo-

TABLE 4. Results of univariate/multivariable models predicting health outcomes associated with environmental conditions

	OR	95% CI
Model #1: no. of hospitalizations in prior 12 months		
Unadjusted		
Moisture or mildew	2.79	(1.40–5.58)
Adjusted		
Moisture or mildew	3.31	(1.62–6.75)
Carpet	3.23	(1.53–6.80)
Model #2: no. of times wheezing in prior 12 months		
Unadjusted		
Moisture or mildew	3.11	(1.65–5.85)
Adjusted		
Moisture or mildew	3.25	(1.8–6.0)
Model #3: no. of nights awake in prior 2 weeks		
Unadjusted		
Moisture or mildew	2.32	(1.50–3.62)
Adjusted		
Moisture or mildew	2.19	(1.40–3.41)
Gender (male)	1.51	(0.95–2.40)

graphics, children whose parents reported the presence of moisture or mildew on ceilings, walls, window walls, or windows had, on average, 3.31 times more hospitalization visits for breathing-related problems than the those that did not report mold or mildew at home (Table 4). In addition to moisture or mildew, carpeting or rugs in the living room or child's bedroom predicted hospitalizations in the prior 12 months. The expected frequency of episodes of wheezing was 3.25 times greater for children with mold or mildew at home after controlling for other environmental factors. Moisture or mildew was the only environmental condition that predicted the number of times of wheezing due to respiratory conditions in the prior 12 months. Similarly, the expected frequency of night symptoms due to asthma was 2.19 times higher for children whose parents reported mold or mildew at home adjusted for other environmental factors. Male gender was marginally associated with the expected number of nights awakened due to asthma-related symptoms, showing a slight risk after controlling for other factors.

DISCUSSION

The result from our unadjusted model associating moisture or mildew with wheeze was $OR = 3.11$, 95% CI 1.65–5.85, and our adjusted result was $OR = 3.25$, 95% CI 1.8–6.0. These results show a stronger relationship than in a study of children enrolled at Head Start centers in Chicago,⁴ where self-reported exposure to dampness or mold were significantly associated with self-reported wheeze ($OR = 2.01$; 95% CI 1.38–2.93). Controlling for other variables (family history of asthma, low and very low birth weight, gender, and African-American ethnicity) in a logistic regression model, self-reported exposure to dampness or mold was significantly associated with self-reported asthma diagnosis and wheeze ($OR = 1.95$; 95% CI 1.27–3.04). In that study in Chicago, an unadjusted association was also found between self-reported exposure to dampness or mold and asthma diagnosis ($OR = 1.94$; 95% CI 1.23–3.04).

The study is limited by a lack of objective assessment of home conditions and a lack of information on individual allergy status and exposures of children to common triggers outside of home. One possible problem with self-report data concerns the possibility that the presence of asthma symptoms may have resulted in increased recognition of exposure. We assume that increased recognition would have been distributed randomly across all the environmental factors that we assessed and conclude that the relationship we found between measures of severity and moisture or mildew was therefore unlikely to be artifactual. Another potential problem with self-report is bias, but as there was no intervention being tested, this is not an issue that should compromise our findings. As this study was not designed to focus on the relationship between indoor moisture and asthma, we are not able to compare the relationships we found with healthy controls. Nor are we able to report whether it mattered where the mold or mildew was present because in our instrument, we did not ask that detail. Nor did we assess whether or not the classroom buildings also had moisture or mildew; however, our analyses found no learning center effect across children sampled from different centers.

Head Start programs offer home visits for assessment and education of participating families,¹⁹ suggesting that approaches be explored for incorporating services such as asthma trigger assessment, family education, and referrals for housing remediation into home visit activities already a part of the Head Start

program. The frequent presence of multiple problems in most homes suggests that efforts to reduce home environmental triggers in this population should be multifaceted including, for example, assistance with smoking cessation, and implementation of integrated pest management. The causes of moisture problems can include defects in building structure, plumbing, or ventilation beyond the ability of most tenants to correct on their own, suggesting that assistance with repairs to address moisture problems are services that would greatly benefit families of children with asthma.

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